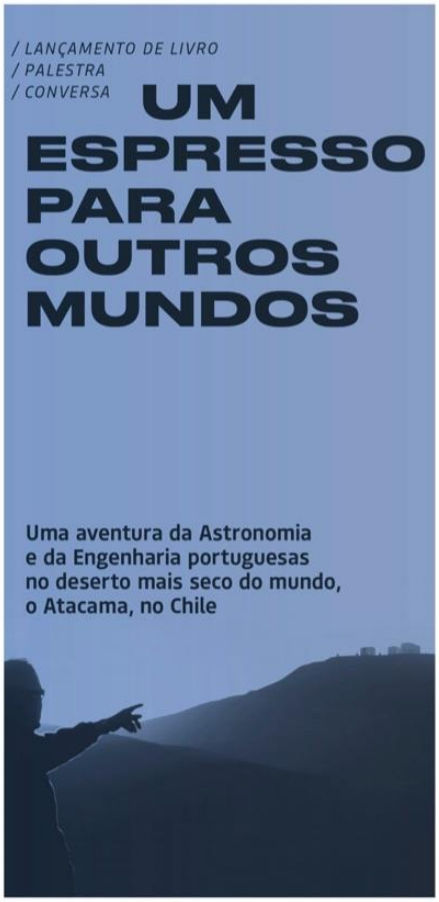
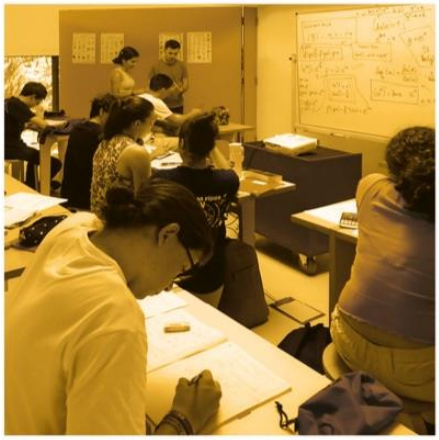
CENTRO DE ASTROFÍSICA UNIVERSIDADE DO PORTO

RELATÓRIO DE GESTÃO E CONTAS





Centro de Astrofísica da Universidade do Porto

U.PORTO

ANO 2022

Relatório de Gestão

Versão aprovada pela Assembleia Geral em 2023/04/19

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CARATERIZAÇÃO DA ASSOCIAÇÃO

O Centro de Astrofísica da Universidade do Porto (CAUP) é uma associação científica com personalidade jurídica, tendo sido constituída em 4 de Maio de 1989 como instituição privada sem fins lucrativos, pela Universidade do Porto (U.Porto). Tem o estatuto de utilidade pública desde setembro de 1991.

A Associação tem por objetivo apoiar e promover a formação e investigação na área de Astronomia/Astrofísica e da instrumentação associada, quer através de iniciativas próprias, quer colaborando de forma independente com entidades públicas e/ou privadas, nomeadamente através do estabelecimento de parcerias, protocolos e intercâmbios nacionais e/ou internacionais, bem como desenvolver infraestruturas laboratoriais relacionadas com a área de atividade do CAUP.

Constituem fins do CAUP apoiar e promover, designadamente:

- A atividade de investigação científica fundamental e aplicada em Astronomia/Astrofísica através de projetos nele desenvolvidos, bem como a aquisição de conhecimentos básicos de caráter interdisciplinar, que abram novas perspetivas à investigação aplicada;
- A Astronomia/Astrofísica no país através da organização de conferências, cursos de curta duração, seminários e outras atividades similares;
- A formação de pessoal científico e técnico, podendo conduzir à elaboração de dissertações de mestrado ou teses de doutoramento;
- O ensino em Astronomia/Astrofísica, nomeadamente a nível de licenciatura e pós-graduação;
- A divulgação científica na área de Astronomia/Astrofísica.

Órgãos Sociais

Os elementos que estiveram em funções em 2022 foram:

- **Mesa da Assembleia Geral:**

  Presidente – Universidade do Porto (Prof. João Correia da Silva, Prof. Pedro Rodrigues após 5/12/2022)

  Vice-Presidente – Mário J. P. F. G. Monteiro

  Secretário – Margarida S. Cunha
- **Direção:**

  Presidente – Jarle Brinchmann

  Vogal – Catarina G. G. Lobo

  Vogal – Daniel F. M. Folha
- **Conselho Fiscal:**

  Presidente – Filipe A. L. Pires

  Relator – Universidade do Porto (Marlene Susana Amorim Teixeira Rebelo)

  Vogal – Jorge Filipe S. Gameiro

Os membros do Conselho Consultivo em 2022 foram:

- **Conselho Consultivo:**

  Vogal – Moira Jardine (University of St Andrews)

  Vogal – Mark McCaughrean (European Space Agency)

  Vogal – Yannick Mellier (Institut d'Astrophysique de Paris)

  Vogal – Francesco Pepe (Observatoire de l'Université de Genève)

Os Associados do CAUP a 31 de dezembro de 2022 eram:

- Associados Fundadores (1): Universidade do Porto
- Associados Efetivos (22): Pedro P. Avelino, Jarle Brinchmann, Vitor M. M. Costa, Margarida M. S. Cunha, António J. C. da Silva, J. Paulo Maurício de Carvalho, Pedro R. L. Figueira, Daniel F. M. Folha, Jorge Filipe S. Gameiro, M. S. Nanda Kumar, Maria Teresa V. T. Lago, João J. F. G. A. Lima, Catarina G. G. Lobo, Carlos J. A. P. Martins, Manuel A. S. Monteiro, Mário J. P. F. G. Monteiro, Polychronis Papaderos, Filipe A. L. Pires, Ricardo S. S. Reis, Nuno M. C. Santos, Sérgio A. G. Sousa, Pedro T. P. Viana.

Instalações

O CAUP partilha o edifício com o Planetário do Porto, propriedade da U.Porto após a extinção da *Fundação para a Ciência e o Desenvolvimento* (FCD) em 2013, com uma área total útil de 3580 m^2. O espaço atribuído ao CAUP resulta do financiamento atribuído pelo Ministério da Ciência e Tecnologia para a construção do edifício planeado de raíz para albergar o CAUP e o Planetário do Porto.

O espaço dedicado para uso do CAUP é de 915 m^2, correspondendo a gabinetes, salas de seminários e reuniões, armazéns, sala de rede, biblioteca, observatório e Astroteca. A área restante é ocupada pelo Planetário, sendo uma parte desta partilhada, como o átrio e o auditório (60 lugares).

O CAUP é responsável pela gestão científica, educacional e administrativa do Planetário do Porto, de acordo com o contrato sobre o exercício de poderes públicos assinado com a U.Porto em julho de 2013.

Recursos Humanos

O CAUP tem recursos humanos próprios que, no final de 2022, correspondiam a um total de 33 colaboradores com contrato de trabalho. Estes podem ser agrupados por tipo de contrato e área de trabalho da seguinte forma (a 31 de dezembro de 2022):

Contratos sem termo (total de 10):

Divulgação:

(1) Filipe A. L. Pires – *especialista*

(2) Paulo J. T. Pereira – *assessor gráfico*

(3) Ricardo S. S. C. Reis – *técnico*

(4) Elsa M. P. S. Moreira – *técnico*

Informática:

(5) Manuel A. S. Monteiro – *especialista*

Administração e Serviços:

(6) Carlos A. G. Gonçalves – *porteiro*

(7) Argentina M. T. Pereira – *técnico*

(8) Elsa M. P. P. Silva – *técnico*

(9) Ernesto J. Silva – *porteiro*

(10) Fernando M. S. Soares – *porteiro*

Contratos a termo (total de 23):

Investigação:

(1) Vardan Zh. Adibekyan – *investigador auxiliar*

(2) Susana C. C. Barros – *investigador júnior*

(3) Diego Bossini – *investigador júnior*

(4) Jarle Brinchmann – *investigador principal*
(5) Tiago J. L. C. E. Campante – *investigador auxiliar*
(6) Margarida M. S. Cunha – *investigador principal*
(7) Elisa Delgado Mena – *investigador auxiliar*
(8) Olivier D. S. Demangeon – *investigador júnior*
(9) João Faria – *investigador júnior*
(10) José C. Fonseca – *investigador auxiliar*
(11) Jean Michel Gomes – *investigador júnior*
(12) Patricio Lagos – *investigador júnior*
(13) Carlos J. A. P. Martins – *investigador principal*
(14) Jorge H. C. Martins – *investigador júnior*
(15) Ana S. Paulino Afonso – *investigador júnior*
(16) L. Filipe Pereira – *investigador júnior*
(17) Ângela R. G. Santos – *investigador júnior*
(18) Tom C. Scott – *investigador júnior*
(19) Lara G. Sousa – *investigador júnior*
(20) Sérgio A. G. Sousa – *investigador principal*

Divulgação :
(21) Adriana Silva – *técnico*

Administração e Serviços:
(22) Sara Ramos – *técnico*
(23) Joana Bateira – *técnico*

Além de contratos de trabalho, o CAUP acolhe igualmente bolseiros, quer através de contratos de bolsa próprios quer sendo instituição de acolhimento de bolseiros da FCT (ver relatório de atividades).

Síntese da Atividade em 2022

A atividade do CAUP é estruturada em torno das iniciativas desenvolvidas no âmbito das unidades, estando atribuída uma missão específica a cada uma destas unidades:

- **Unidade de Investigação** (UnI): coordena todas as iniciativas e atividades que estão associadas à investigação, nomeadamente seminários, conferências, reuniões de trabalho, participação em projetos científicos e/ou de instrumentação, participação em consórcios nacionais e internacionais nas áreas de investigação relevantes, participação em comités científicos, etc. Com a criação da unidade de investigação Instituto de Astrofísica e Ciência do Espaço (IA), financiada pela FCT a partir de 2015 e com inicialmente duas instituições de Gestão CAUP e a FCiências.ID – Associação para a Investigação e Desenvolvimento de Ciências, as competências da UnI do CAUP passaram a ser delegadas na Coordenação do IA, onde têm assento dois elementos do CAUP em paridade com dois elementos do pólo de Lisboa. Em 2021 um novo pólo da IA foi constituído na Universidade de Coimbra, sendo que em 2022 foi consolidada a sua integração.
- **Unidade de Formação** (UnF): coordena/apoia todas as atividades de formação organizadas pelo CAUP ou que têm a sua participação/colaboração, nomeadamente formação universitária (licenciatura, mestrado e doutoramento), formação contínua, cursos avançados e organização de eventos que visam reforçar a qualidade da formação oferecida pelo CAUP.
- **Núcleo de Divulgação** (ND): organiza todas as atividades de divulgação e promoção da cultura científica, incluindo as do Planetário do Porto – Centro Ciência Viva, e outras iniciativas para o público e escolas que são oferecidas pelo CAUP regularmente. Também coordena a participação do CAUP em projetos nacionais e internacionais de divulgação científica e assegura ainda a componente de imagem/grafismo e de comunicação do CAUP. Esta unidade integra e co-coordena o Grupo de Comunicação de Ciência do IA.

- **Unidade de Administração e Serviços** (UnAS): assegura todas as funções e tarefas de apoio administrativo às atividades do CAUP e sua gestão. Garante o bom funcionamento das instalações e equipamentos, incluindo os serviços de *Tecnologias da Informação e Comunicação* (TIC), e dá apoio à gestão das atividades, projetos e eventos na componente de contabilidade e administração. Esta unidade trabalha em proximidade com a Coordenação do IA por forma a garantir uma boa gestão desta unidade de investigação.

A descrição detalhada da atividade desenvolvida em 2022 no âmbito de cada uma destas unidades é apresentada na componente de relatório de atividades.

Situação Económico-Financeira

A situação económico-financeira no final de 2022 apresenta uma recuperação após dois anos da pandemia causada pela COVID-19. O fim das restrições permitiu retomar as atividades da Associação para valores perto dos registados pré-pandemia, nomeadamente, no Planetário do Porto. Em consequência, obteve-se um resultado líquido do exercício positivo.

O montante global de gastos aumentou em relação a 2021, situando-se acima de um milhão e setecentos mil euros. Os rendimentos também cresceram, voltando a ser superiores aos gastos, como se ilustra na Figura 1. O capital próprio manteve-se ao nível de 2021, enquanto as disponibilidades no final do ano aumentaram significativamente, consequência do início de uma ERC Advanced Grant, situando-se acima de dois milhões de euro

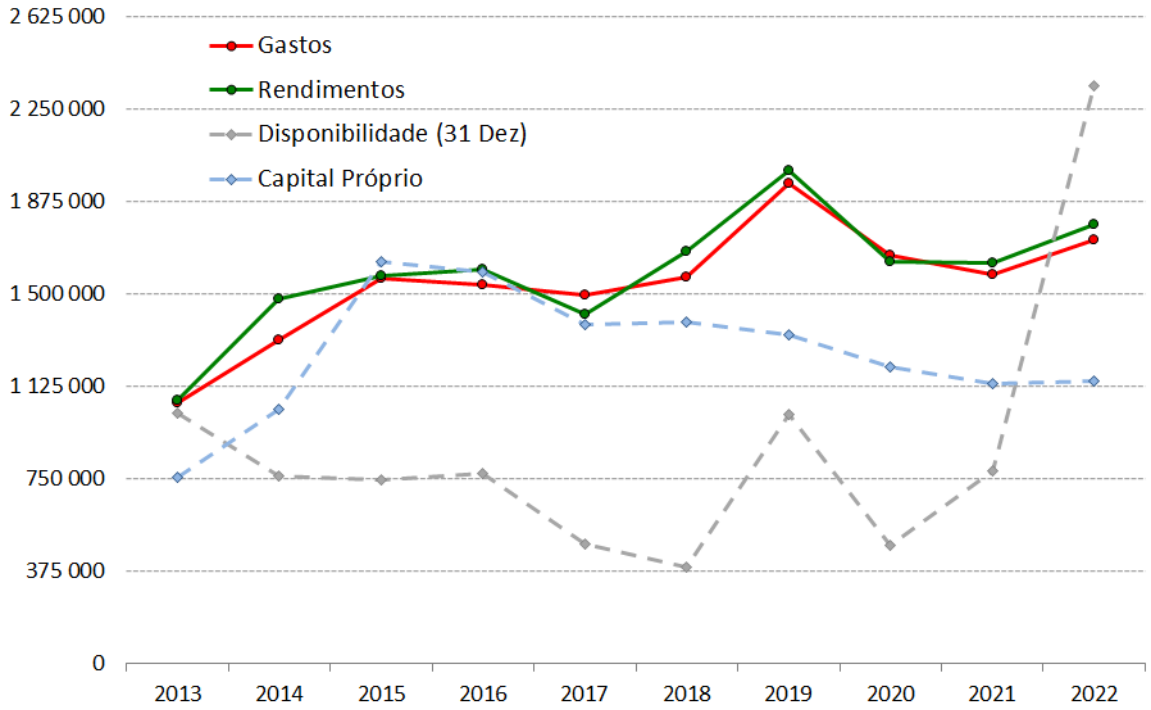


Figura 1: Evolução dos Gastos (linha vermelha) e dos Rendimentos (linha verde), para o exercício por ano fiscal, desde 2013. Os valores dados estão em euros. Também se indica as disponibilidades (linha cinzenta) existentes a 31 de Dezembro de cada ano e o capital próprio (linha azul).

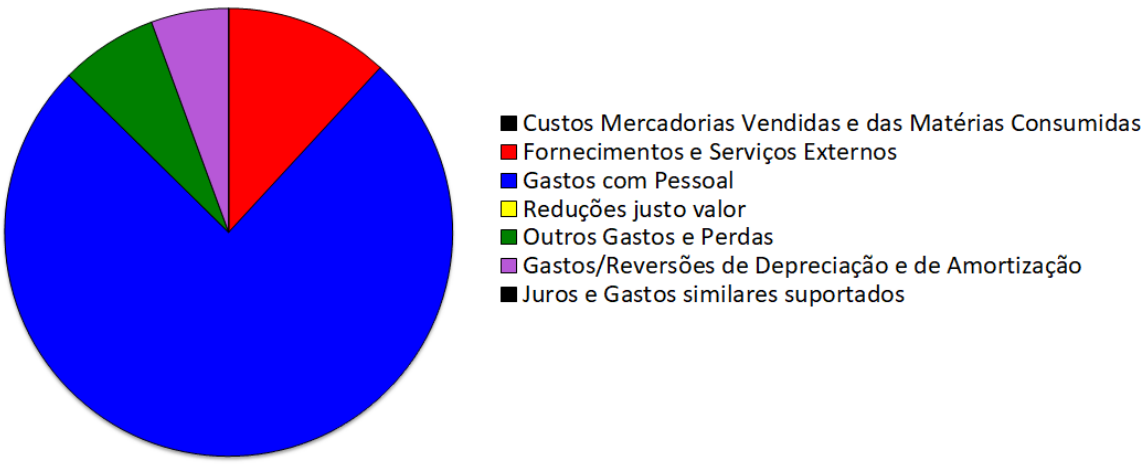


Figura 2: Distribuição dos Gastos do exercício de 2022, correspondendo a um total de 1 722 724,80 euros.

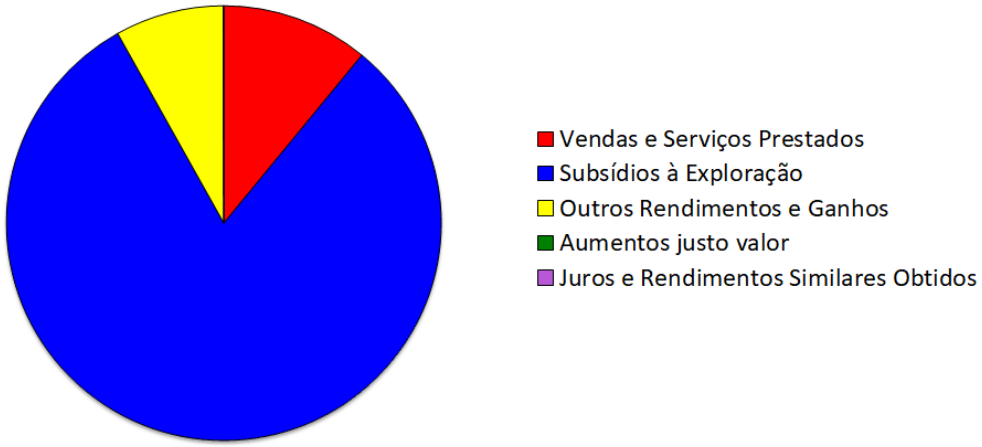


Figura 3: Distribuição dos Rendimentos do exercício de 2022, correspondendo a um total de 1 784 399,93 euros.

A fração dos custos com recursos humanos, quer através de despesas com o pessoal, quer através da contratação de bolseiros, teve uma ligeira descida face aos dois últimos anos, consequência da retoma das atividades. A Figura 2 ilustra o peso relativo das diferentes componentes de Gastos nas contas em 2022. A maior componente das despesas do CAUP continua a ter lugar por via de financiamento assegurado através de projetos (Figura 3), pelo que tais despesas não representam um custo continuado além do contrato de financiamento aprovado.

O CAUP depende maioritariamente de financiamentos externos provenientes da Fundação para a Ciência e a Tecnologia (FCT), da Comissão Europeia (CE) e de outras entidades (ver a Figura 4).

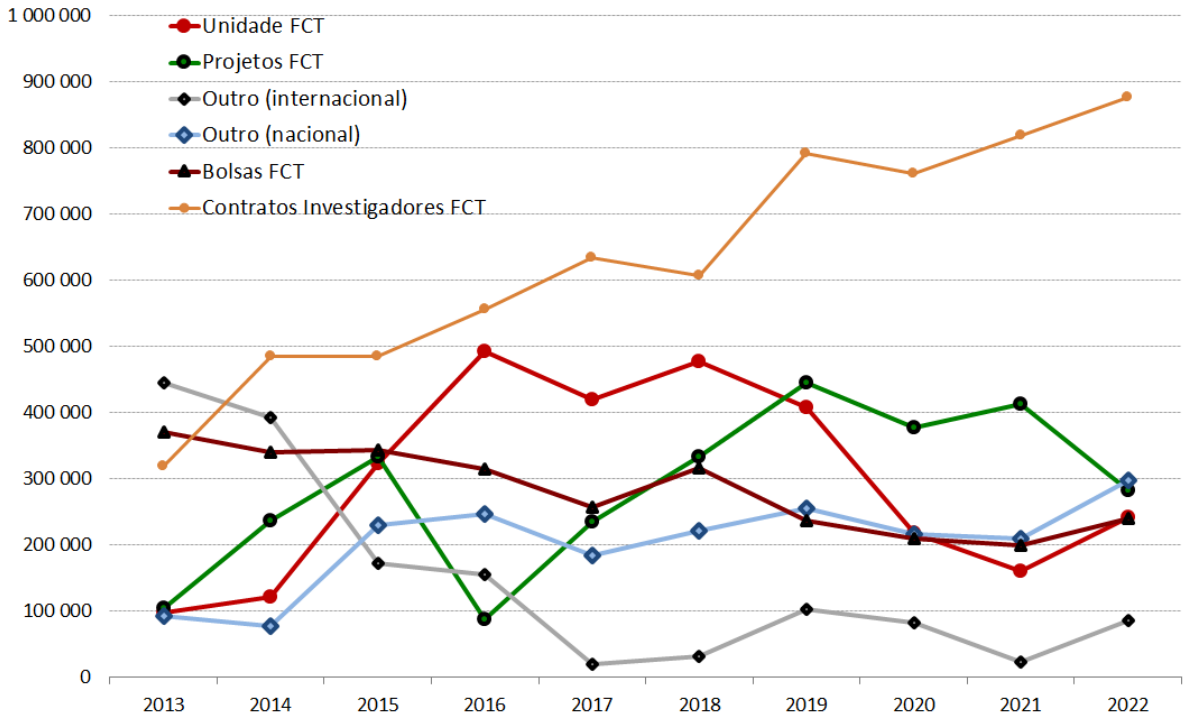


Figura 4: Distribuição das fontes de financiamento para o exercício por ano fiscal, desde 2013.

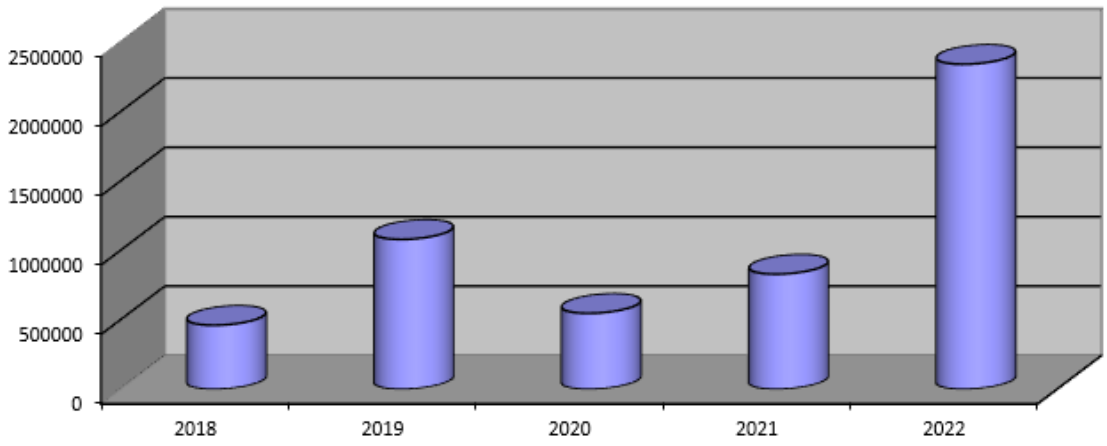
O financiamento da Unidade I&D, proveniente da FCT, subiu em 2022 sobretudo devido ao aumento do número de missões realizadas - ficando, no entanto, estes valores abaixo dos verificados antes da pandemia. O financiamento de projetos FCT registou uma descida significativa consequência do término de vários projetos. O financiamento nacional proveniente de outras fontes subiu relativamente aos anos anteriores, consequência da retoma da atividade do Planetário e do financiamento NORTE 2020 para capacitação dos Centros de Ciência Viva da Região Norte. No que respeita a outros fundos internacionais verificou-se também uma ligeira subida, em grande parte devido à execução de financiamento PRODEX.

O financiamento correspondente aos contratos FCT registou uma ligeira subida devido aos aumentos dos vencimentos. No ano de 2022, esta componente correspondeu a um total de 876 324 euros (20 investigadores envolvidos). Uma outra fonte de financiamento indireto provém das bolsas de investigação atribuídas diretamente pela FCT cujo valor global aumentou relativamente a 2021. Estas, embora não sendo executadas através do CAUP, representam um financiamento importante das atividades de investigação e formação, cuja obtenção é apenas possível através do apoio do CAUP. Em 2022, esta componente correspondeu a um total de 240 012 euros (1 investigador, 15 alunos de doutoramento e 1 BGCT na área da divulgação e promoção da cultura científica). O peso das duas componentes (contratos de investigador FCT e bolsas FCT) é também indicado na Figura 4. À semelhança do que acontece com os salários dos docentes, os montantes das bolsas FCT não são incluídos nas contas do CAUP.

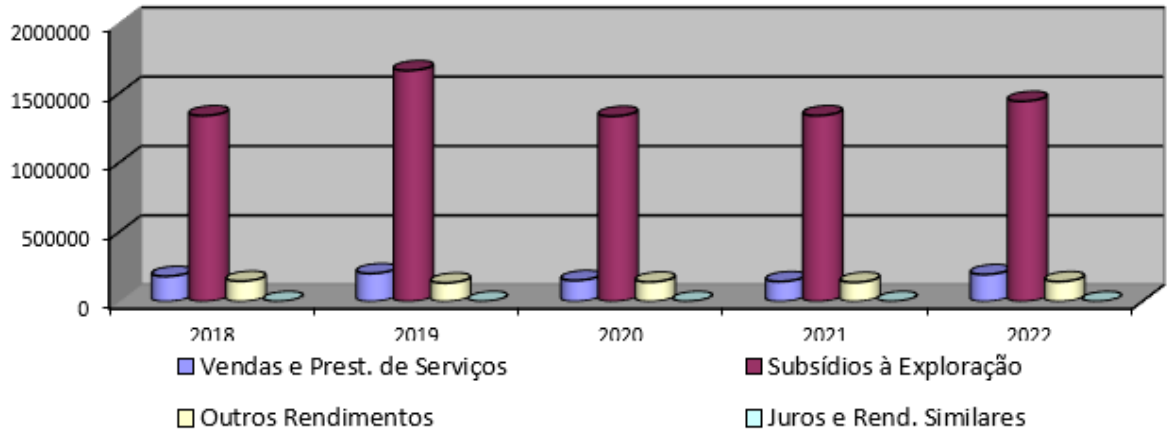
Indicadores Económico-Financeiros

Nesta seção fornecem-se alguns dos indicadores económico-financeiros das contas de 2022, em comparação com os 4 anos anteriores.

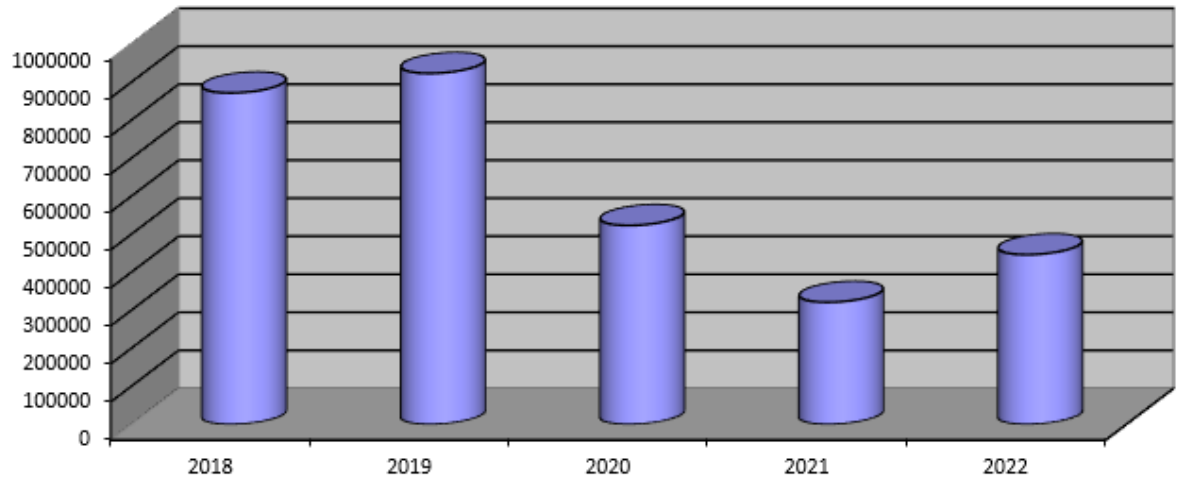
Meios Financeiros Liquidos	2018	2019	2020	2021	2022
Caixa	35	35	35	35	35
Depósitos Bancários	389606	1009156	477264	781028	2343397
Outros Instrumentos Financ.	72435	71803	70824	49381	0
TOTAIS	462076	1080994	548123	830444	2343432



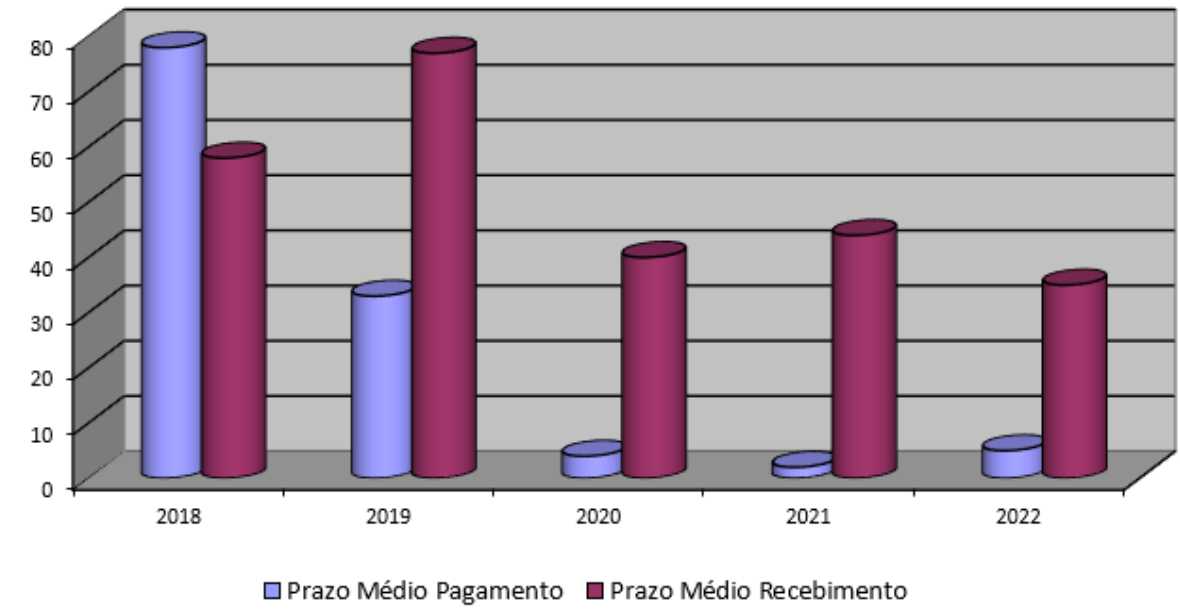
Evolução dos Rendimentos	2018	2019	2020	2021	2022
Vendas e Prest. de Serviços	182041	202436	152362	144550	195424
Subsídios à Exploração	1340581	1665765	1336622	1340789	1444064
Outros Rendimentos	147359	134182	141325	138792	144239
Juros e Rend. Similares	1271	1271	1275	1271	673
TOTAIS	1671252	2003654	1631584	1625402	1784400



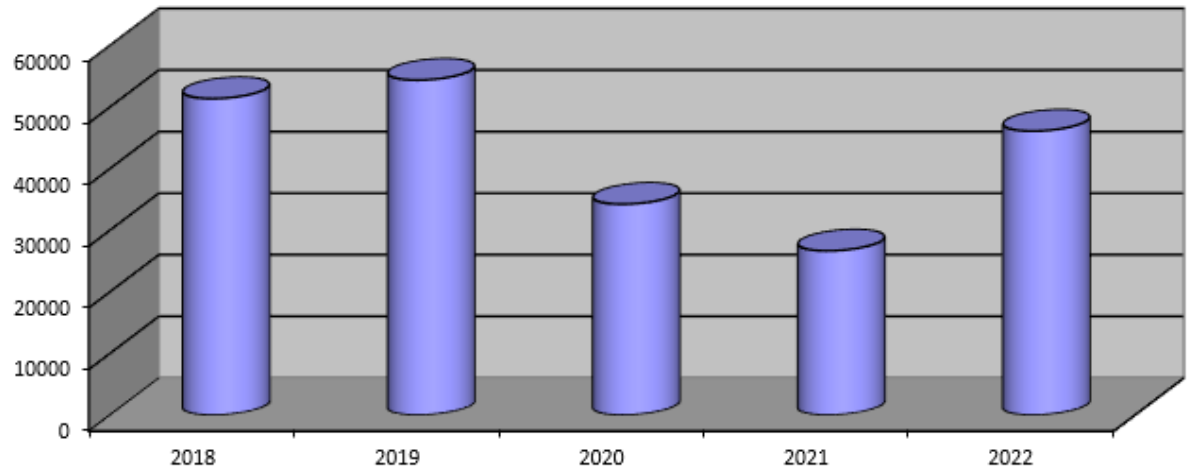
Fornecedores e Outros Passivos Correntes					
	2018	2019	2020	2021	2022
Fornecedores	64888	18351	886	375	2663
Outros Passivos Correntes	807441	905431	522785	321333	444147
TOTAIS	872329	923782	523671	321708	446810



Tesouraria					
	2018	2019	2020	2021	2022
Prazo Médio Pagamento	78	33	4	2	5
Prazo Médio Recebimento	58	77	40	44	35



Activo Fixo					
	2018	2019	2020	2021	2022
Aquisições	51380	54382	34248	26668	46110
TOTAIS	51380	54382	34248	26668	46110



Obrigações Fiscais

A Direção informa que a situação perante a Segurança Social e as Finanças se encontra regularizada, pelo que não existe qualquer dívida vencida.

Perspetivas

Ao longo dos últimos anos o CAUP tem contado com uma baixa percentagem de financiamento proveniente da Comissão Europeia. A atribuição duma ERC Advanced Grant ao Prof. Nuno Santos em 2022 tem, por isso, particular relevância. Porém, é fundamental assegurar que este não é um caso isolado procurando ativamente taxas de sucesso mais elevadas neste importante instrumento de financiamento.

O financiamento da Unidade de Investigação (IA) atribuído para o período 2020-2023 teve uma diminuição superior a 37% quando comparada com o período anterior, apesar da avaliação da unidade continuar a ser "Excelente", o que tem tido um impacto significativo no desenrolar das atividades do CAUP. No final de 2023 terá início a próxima avaliação das unidades de investigação, sendo fundamental para o CAUP que o IA continue a ser classificado como "Excelente". Felizmente, a investigação permanece num nível elevado e a componente de divulgação continua a ter um excelente desempenho. A visita do "Advisory Board" do IA em janeiro de 2023 foi particularmente construtiva, tendo resultado num relatório muito positivo, favorável e de claro apoio à estratégia da instituição, com algumas sugestões de melhorias. Assim, estamos confiantes de que conseguiremos um bom resultado na próxima avaliação.

Após dois anos gravemente afetados pela pandemia, as atividades do Planetário retomaram rapidamente no início de 2022, contribuindo para um resultado financeiro melhor do que nos dois anos anteriores. O apoio do NORTE 2020 para capacitação dos Centros de Ciência Viva da Região Norte permitiu a produção de uma nova sessão de planetário, intitulada "O Céu d'Os Lusíadas", que ajudou a consolidar os processos de criação e produção da equipa. Esta era uma ambição de longa data sendo natural a continuação deste tipo de trabalho e investimento para o futuro.

Dos projetos financiados pela FCT destaca-se, para além da continuação de um projeto, a conclusão dos projetos exploratórios "Characterizing the smallest planet hosts" e "Zoom In ON high-mass Star forMation" e de sete projetos regulares (GWStrings, P-TUGA, IdEas with ALMA, G.EANES, CosmoESPRESSO, EPIC e BreakStarS). Em contrapartida, apenas dois novos projetos exploratórios tiveram início em 2022: SAM e FLAEMING. Embora prevista, trata-se de uma diminuição significativa do número de projetos em execução.

Esta é uma situação preocupante sobretudo por causa da atual política de financiamento de projetos de I&D da FCT.

Em 2022, para além da continuação da COST action "Revealing the Milky Way with Gaia", iniciado em 2019, tivemos a conclusão do projeto "SKilled, Innovative & Entrepreneurial Scientists", ambos financiados pela União Europeia. Ao nível de outro tipo de financiamento internacional destaca-se a continuação do contrato com a ESA, no âmbito do programa PRODEX, referente à participação no instrumento PLATO, iniciado em 2018.

O CAUP, no âmbito do IA, continuará a tentar atrair, nacional e internacionalmente, excelentes candidatos, capazes de obter bolsas individuais de doutoramento e contratos de trabalho para investigação ao nível de pós-doutoramento.

Para fortalecer a capacidade de participação em grandes projetos internacionais, iremos criar um grupo de computação científica, que integrará a estrutura de unidades do CAUP, e para o qual pretendemos começar a recrutar pessoas em 2023. Embora transversal, este grupo trabalhará em estreita proximidade com o grupo de instrumentação, alavancando a sua capacidade de resposta a compromissos internacionais.

Desde 2013 que o CAUP é responsável pela gestão administrativa do Planetário do Porto, acumulando-a com a gestão educativa e científica, como especificado no contrato assinado com a U.Porto. Esta gestão garante uma forte sinergia entre a investigação científica e a divulgação, que se constitui como uma mais valia no cumprimento do seu objetivo estatutário de contribuir para a divulgação científica em Astronomia e Astrofísica, proporcionando a possibilidade de continuar a atrair o interesse de jovens para esta área do conhecimento em particular, bem como em geral para as áreas STEM, e a contribuir para a literacia científica da população.
Em 2022 o CAUP teve também seis projetos financiados na área da divulgação, com contribuições significativas da Ciência Viva – Agência Nacional para a Cultura Científica e Tecnológica, uma imagem da importância dada a esta área de atuação.

Aplicação dos Resultados

É convicção da Direção que o Relatório de Gestão e os demais documentos de prestação de contas retratam de forma clara e apropriada, nos aspetos materialmente relevantes, a posição financeira e o resultado das operações da entidade contabilística do CAUP.

Pelo referido, e tendo em conta que no exercício findo em 31 de dezembro de 2022 se apurou um Resultado Líquido do Exercício positivo, no montante de 61 675,80 euros (sessenta e um mil seiscentos e setenta e cinco euros e oitenta cêntimos), a Direção propõe:

- que seja aprovado o Relatório de Gestão e os demais documentos de prestação de contas;
- que a totalidade do 'Resultado Líquido do Exercício' seja transferida para 'Resultados Transitados'.

[redacted]

Doutor Jarle Brinchmann

(Presidente)

[redacted]

Prof. Doutora Catarina G. G. Lobo

(Vogal)

[redacted]

Prof. Doutor Daniel F. M. Folha

(Vogal)

Porto, 14 de abril de 2023.

REPORT OF ACTIVITIES

This component of the report describes the main initiatives and results obtained during the year of 2022.

The activity of CAUP is structured around Units: these are Research, Training, Outreach and Administration and Services. Each Unit has a Head, and a clearly defined mission.

The activities within each Unit are described in the sections below. The appendices list some of the major indicators of the activity.

Human Resources

By the end of 2022 the team included:

- **32 Researchers** – corresponding to
- *11 Lecturers* (4.95 FTE): Ilídio André P. M. Costa (AE Santa Bárbara[1]), J. Paulo Maurício de Carvalho (FCUP), Pedro P. Avelino (FCUP), Daniel F. M. Folha (IUCS-CESPU), Jorge F. Gameiro (FCUP), Maria Teresa V. T. Lago (FCUP, Retired), João J. G. Lima (FCUP), Catarina G. G. Lobo (FCUP), Mário J. P. F. G. Monteiro (FCUP), Nuno C. Santos (FCUP), Pedro T. P. Viana (FCUP)
- *21 Research Positions* (19.20 FTE): Vardan Zh. Adibekyan, Susana C. C. Barros, Diego Bossini, Jarle Brinchmann, Tiago J. L. C. E. Campante, Margarida S. Cunha, Elisa Delgado Mena, Olivier D. S. Demangeon, João P. S. Faria, Pedro Figueira (ESO), José C. Fonseca, Jean Michel Gomes, Patricio Lagos, Carlos J. A. P. Martins, Jorge H. C. Martins, Ana S. Paulino Afonso, L. Filipe Pereira, Ângela R. G. Santos, Tom C. Scott, Lara G. Sousa, Sérgio A. G. Sousa

- **23 PhD students**
- Alexandros Antoniadis Karnavas, Ana F. S. Barros, Thibault Boulet, Abhishek Chougule, Miguel Clara, Ana Rita Costa Silva, Eduardo Cristo, Pedro Alexandre Cunha, Tomás de Azevedo Silva, João D. F. Dias, David Grüber, Mara Jacinto, Catarina M. J. Marques, Nuno A. M. Moedas, Sandy G. Morais, Sergei Mukovnikov, Andreas W. Neitzel, José Rodrigues, Nuno M. Rosário, André Miguel Silva, Bárbara M. T. B. Soares, Paulina M. Zaworska, Daniel A. D. Vaz

- **8 Outreach staff** (7,8 FTE)
- Ilídio André P. M. Costa, Tania F. S. Cunha, José M. C. Dantas, Elsa M. P. S. Moreira, Paulo J. T. Pereira, Filipe A. L. Pires, Ricardo S. S. C. Reis, Adriana Silva

- **8 Supporting staff** (6,3 FTE)
- Joana Bateira, Carlos A. G. Gonçalves, Manuel A. S. Monteiro, Argentina M. T. Pereira, Sara Ramos, Elsa M. P. P. Silva, Ernesto J. Silva, Fernando M. S. Soares

CAUP also had 1 external supporting staff (legal adviser, corresponding to a total of 0.1 FTE).

CAUP also provides support to students enrolled in the 1st Ciclo (Licenciatura em Física and others), 2nd Ciclo (Mestrado em Astronomia & Astrofísica) at the Faculdade de Ciências da U.Porto (FCUP) and students from other universities/institutes.

Several CAUP researchers collaborate in some courses of the 2nd Ciclo (Mestrado em Astronomia & Astrofísica) and of the 3rd Ciclo (Programa Doutoral em Astronomia).

The major changes in the team (researchers with a PhD) during 2022 were:

L. Filipe Pereira	-	started his contract in February
M. S. Nanda Kumar	-	ended his contract in March
João N. T. Gomes da Silva	-	ended his contract in April
Andrew J. Humphrey	-	ended his contract in July

[1] Middle and high school teacher deployed at CAUP: Planetário do Porto – Centro Ciência Viva

Morgan Deal	-	ended his contract in August
Ivan Rybak	-	ended his contract in October
Pedro Palmeirim	-	ended his fellowship in November

UnI – Research Unit

Research in CAUP is structured according to the organization of the research unit Instituto de Astrofísica e Ciências do Espaço, into five research groups. The description below focuses on activity done by CAUP members but the general description is relative to IA.

Report from the Group
Towards the detection and characterisation of other Earths

Activities of the team focused around the two major areas: Exoplanets and Solar System research. Exoplanet research has been mostly centred in the Porto node, while Solar System research is divided in planet atmospheres (centred in Lisbon) and the study of minor bodies Solar System and planetary surfaces (centred in Coimbra). Active collaborations exist between the three nodes, namely in the study of planetary atmospheres (Porto-Lisbon) and the study of solar system exospheres (Lisbon-Coimbra).

On the **exoplanet side**, the team is focused on tackling high impact questions such as: are there other Earths orbiting other Suns and how can we detect them? What is the composition of exoplanets and of their atmospheres, and what is their internal structure? How diverse are planetary systems? How can we tackle the challenges of stellar "noise" in exoplanet research? How do their properties (composition, architecture, …) relate with those from their host stars and what clues do these provide about the planet formation and evolution process?

To answer these questions, the team focuses its activities on:

1) the search and characterization of exoplanets using state-of-the-art radial velocity data, including the detection and mass measurement of planets previously detected by the transit method (e.g. with missions such as TESS);

2) the study of exoplanet atmospheres using broad-band photometry, high-resolution spectroscopy and model atmospheres.

3) the study of astrophysical sources of noise for the detection and characterization of planets as well as methods to correct/model them and obtain more precise radial velocities;

4) the study of planet-host stars as a way to characterise planets as well as their properties and formation processes, as well as the statistical study of planet properties as well as the relation with the properties of the host stars;

A significant part of this research was done in the context of our top-level participation as consortium members in ESO's ESPRESSO project (started operations in 2018) and ESA's CHEOPS mission (launched in late 2019, with operations recently extended up to the end of 2026). Given our key roles and contributions in the project phase, we have been exploiting our privileged access to the definition of the science programs of ESPRESSO and CHEOPS, as well as the analysis of the obtained data. Several high impact results were published based on these data (see below), and several others are in preparation.

Furthermore, making use of the know-how that was (and is) built from these projects, we are now preparing for the exploitation of data from the new NIRPS spectrograph (@ESO's 3.6m), that will start the operations in April 2023. Our high-level participation in these projects reinforces the existing strategy and allows the team to be in the forefront of exoplanet detection and characterization.

In this context, we are already preparing for the science opportunities raised by future projects and missions such as the HIRES@ESO's ELT spectrograph (2030, approved for construction by ESO in December 2021) as well as the PLATO and ARIEL missions (ESA – 2026 and 2029, respectively). For all of those, we are responsible for scientific tasks as well as part of the data reduction/analysis pipelines.

A final highlight to mention the ERC Advanced Grant that was offered to one of the team members. The approved project proposes to build a new telescope (PoET – http://poet.iastro.pt) to tackle the problems of stellar

signals (or "noise") in the detection and characterization of other Earths. This project is fully in line with (and will potentiate) the science goals mentioned above.

On the Solar System side, most research focused on the exploration of new avenues in the study of Solar System atmospheres, namely to tackle questions such as: what do we know about the dynamics and chemistry of solar system planet atmospheres? This aspect has clear links with the study of exoplanet atmospheres that are also being exploited. Of relevance here is the leadership in the WG responsible for the study of these synergies within the ARIEL consortium

Within this context, the team continued different studies of the atmospheres of Venus, Mars, Saturn, and Jupiter. We can highlight here the use of both ground and space-based observations to perform dynamical studies based on cloud tracking techniques (UV and IR) and the detection and characterization of atmospheric waves.

Synergies with the study of Minor bodies and the Solar System history are also being explored addressing questions like: what does the dynamics and composition of minor bodies tell us about the formation of the Solar System? And what about the cratering history?

Scientific Highlights for 2022

In 2022, a total of 7 IA Press-releases were published announcing scientific or science-related results with a leading participation of the team. Of these, 2 were also ESO Press Releases and 1 was an ESA Press Release. Most of them were done in an international context. The list of highlights below is based on some of these.

Detection of Barium in exoplanet atmospheres: the heaviest element ever detected

A team, led by Instituto de Astrofísica e Ciências do Espaço researcher and PhD student Tomás Azevedo Silva, discovered barium in the atmosphere of ultra-hot gas giants WASP-76 b and WASP-121 b. This discovery represents the detection of the heaviest element ever detected in the atmosphere of an exoplanet.

For this result, the team used the ESPRESSO instrument on ESO's VLT to analyse and study the transmission spectrum of WASP-76 b and WASP-121 b. These measurements are done during the transit of the planet in front of its star, allowing us to analyze the light that crosses the planet's atmosphere. This made it possible to clearly detect several elements, including barium.

WASP-76 b and WASP-121 b are no ordinary exoplanets: both are ultra-hot Jupiters as they are comparable in size to Jupiter. Being very close to their host stars, they have extremely high surface temperatures above 1000°C.

The puzzling and counterintuitive aspect of this discovery is: why is there such a heavy element in the upper layers of the atmosphere of these planets? The team was surprised to find barium, which is 2.5 times heavier than iron, in the upper atmospheres of these planets. Given the high gravity of the planets, we would expect heavy elements like barium to quickly fall into the lower layers of the atmosphere.

This result thus defies the models of planet atmospheres, bringing new light into the physical processes happening on them.

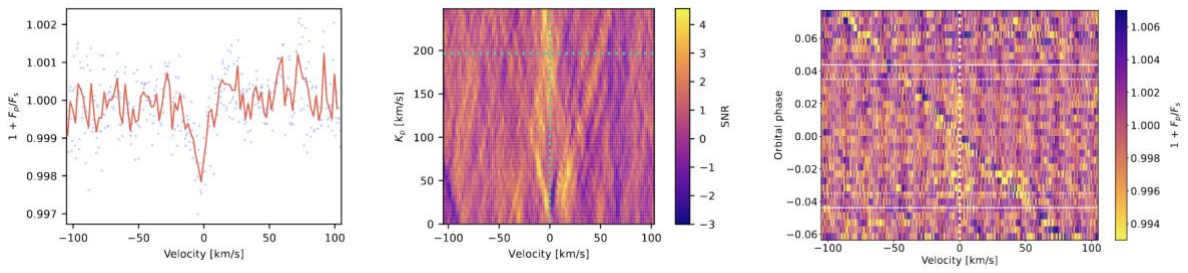


Figure: Plots illustrating the detection of Barium in the atmosphere of WASP-76b. From Azevedo Silva et al. 2022 (A&A 666, L10).

Unveiling a new population of super-Mercuries

In two different papers published in 2022, the team unveiled the presence of three new members of a new population of "super-Mercury" like planets.

The planet Mercury, in the Solar System, has a relatively larger core and relatively smaller mantle than the other planets, but we don't know why. Some possible explanations involve a giant impact which removed part of the planet's mantle or, because of its high temperature, part of Mercury's mantle could have evaporated. Surprisingly, other exoplanets with similar characteristics, called super-mercuries, were only recently found around other stars.

In a first study, led by Tomás Azevedo Silva (PhD student of IA – Azevedo Silva et al. 2022, A&A 657, A68), the team announced the discovery of a super-mercury orbiting the star HD137496 b. With an interior modeling analysis, and based on the known radius and mass of the planet, they found that the planet is composed mainly of iron, with the core representing over 70% of the planet's mass (M_{core} / M_{total} = $0.73_{-0.12}^{+0.11}$). The system also has a second planet in a longer period orbit: an eccentric long period gas giant.

In a second study, using data from the ESPRESSO spectrograph, a team led by IA researcher Susana Barros discovered a system with two super-Mercuries orbiting the star HD23472. This allowed us to obtain clues about how these planets were formed, which could help us exclude some possibilities. For example, if an impact large enough to create a Super-Mercury is already very unlikely, two giant impacts in the same system seems very improbable. We still don't know how these planets are formed but it appears to be connected to the composition of the parent star.

The star HD23472 was also found to host 3 other planets: this system is composed of three super-Earths with a significant atmosphere and surprisingly two Super-Mercuries, which are the closest planets to the star. Three of the planets have masses lower than that of the Earth.

This result is actually consistent with previous findings, also led by the IA team, suggesting that there is a compositional link between the planet and stellar composition (Adibekyan et al. 2021).

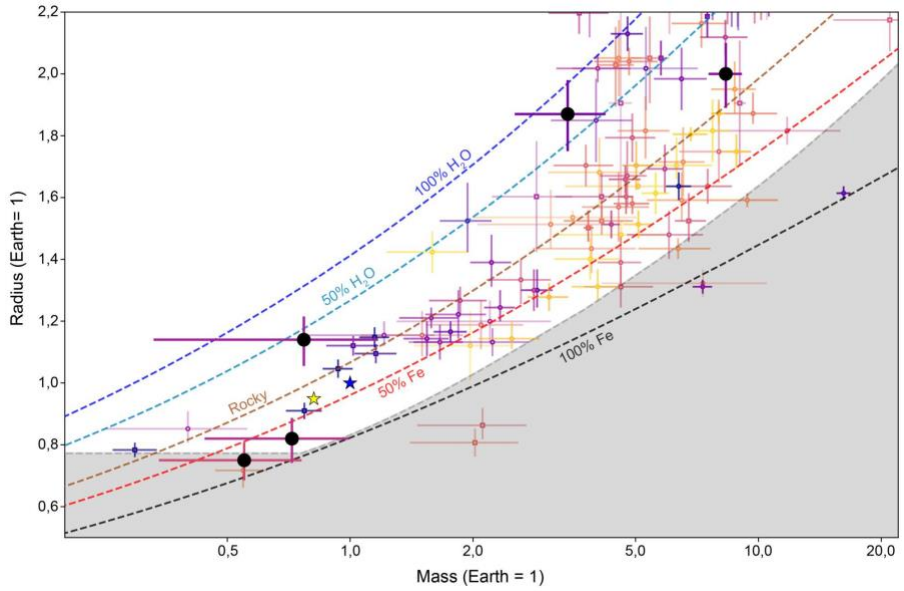


Figure: Position of the 5 planets in the HD23472 system in the mass-radius diagram. Different curves denote the locus of planets with different internal compositions (according to models). The grey area below shows the maximum collision stripping of the mantle region. From Barros et al. 2022 (A&A 665, A154).

A sub-Earth like planet detected around the closest star to the Sun

A team led by IA researcher João Faria found evidence of a new planet orbiting the star Proxima Centauri, the closest star to our Solar System. This candidate planet is the third detected in the system and the lightest yet discovered orbiting this star. It is actually the lightest exoplanet ever measured using the radial velocity technique.

More importantly, this planet has only 0.25 times the mass of the Earth, being the lowest mass planet in the system detected so far. The discovery shows that our closest stellar neighbour seems to be packed with interesting new worlds, within reach of further study and future exploration.

The newly discovered planet, named Proxima d, orbits Proxima Centauri at less than a tenth of Mercury's distance from the Sun. It takes just five days to complete one orbit around Proxima Centauri.

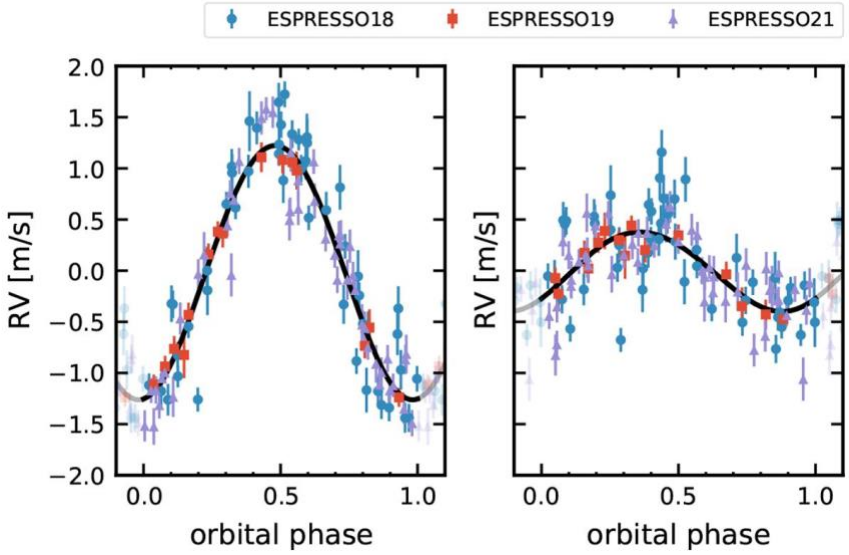


Figure: Radial velocities from ESPRESSO, phase-folded to the orbital periods of Proxima b (left) and Proxima d (right). From Faria et al. 2022 (A&A 658, A115).

The discovery was possible thanks to the ESPRESSO spectrograph (ESO, VLT), and illustrates our strong involvement in this project as well as the relevant scientific leadership results it is bringing to the IA team.

A rugby-ball shaped planet

Using data from the ESA mission CHEOPS, a team led by IA's researcher Susana Barros measured the shape of the short period giant planet called WASP-103b. Results revealed that it has a deformed shape more like that of a rugby ball than a sphere. This is the first time that the deformation of an exoplanet has been detected, offering new insights into the internal structure of these star-hugging planets.

The planet has been deformed by the strong tidal forces between the planet and its host star WASP-103. For WASP-103b, a planet almost twice the size of Jupiter with 1.5 times its mass and orbiting its host star in less than a day, Astronomers have suspected that such close proximity would cause monumental tides, but up until now they haven't been able to measure them.

The resistance of a material to being deformed depends on its composition. For example, here on Earth we have tides due to the Moon and the Sun but we can only see tides in the oceans. The rocky part doesn't move that much. By measuring how much the planet is deformed we can tell how much of it is rocky, gaseous or water.

This is the first time such analysis has been made, providing a better knowledge of the planet's internal structure and composition.

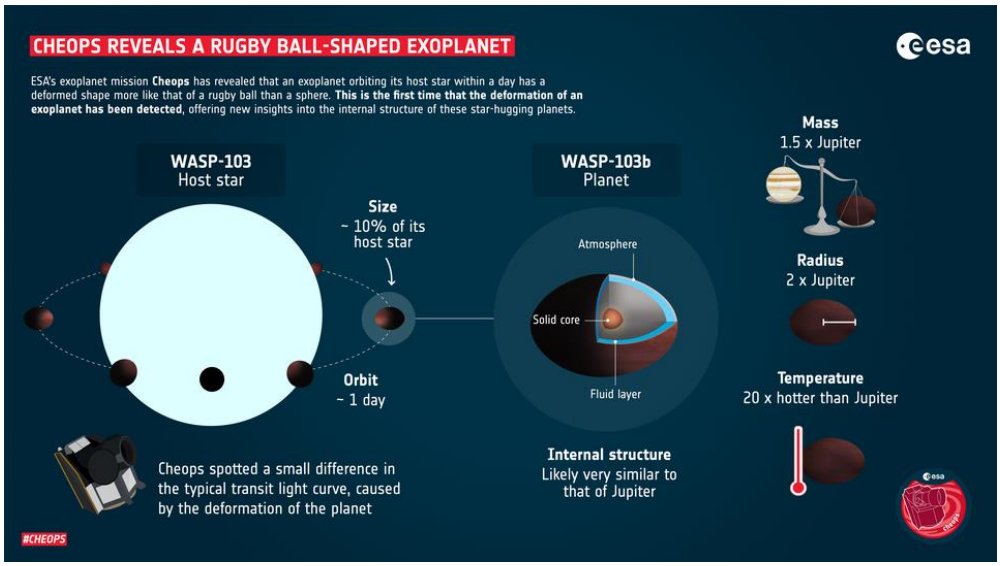


Figure: Schematics of the rugby ball shaped planet WASP-103b. Courtesy ESA and Barros et al. 2022, A&A 657, A52.

Thematic line meetings, Journal Clubs and other activities

In 2022, as for the previous years, the IA-planet line maintained a regular journal club and team meeting agenda. Team meetings and journal clubs are organised every two weeks. Meetings include a presentation of "general information", as well as a short presentation of the work being carried out by one PhD student, followed by discussion. This format helps the whole team to be acquainted with the research that is being carried out and helps the students to develop presentation skills and identify potential problems and solutions in his/her research project. Journal clubs include the presentation of recent research papers, followed by discussions.

All this information is kept up-to-date in the new team web pages (http://planetas.iastro.pt).

All regular team meetings and journal clubs were performed remotely via Zoom, to assure a smooth participation from team members in all 3 nodes (Porto, Coimbra, and Lisboa).

We also organised our annual team meeting (called "2-DEMOC"), where the team strategy and plans (both scientific and organisational) were discussed. This year's event took place in Aveiro.

A large international conference (Towards Other Earths III) also started its organisation in 2022; it will take place in Porto, in July 2023.

Team members actively participated in different public outreach activities, including public talks and debates in schools and online, as well as other outreach events. In this context, the team has also kept updating a public outreach page on Planetary Systems (https://outrosmundos.iastro.pt), where information in Portuguese is provided about planetary system's science as well as the discoveries where the team is involved.

In 2022, 1 PhD thesis was successfully finished (several others ongoing):

- "Advanced Statistical Data Analysis Methods for the detection of Other Earths", João Camacho (PhD)

A number of undergraduate students also worked with the IA team in different projects:

- "Exoplanet composition and stellar abundances", Barbara Silva Oliveira
- "Measuring the size of exoplanets with CHEOPS", Yuri Carrilho Damasceno
- "Characterization of hot solar-type stars with exoplanets", Cheila Bhuralal and Yuri Damasceno
- "Characterization of hot solar-type stars with exoplanets", Yuri Damasceno
- "Measuring the size of exoplanets with CHEOPS", António Miguel Correia and Bárbara Oliveira

- “The impact of stellar C/O ratios on planet formation“, Bernardo Campilho
- “The enigma of Li-rich giants and its relation with stellar activity”, Inês Rolo Martins
- "Can the Ti I 5713.9 and Fe II 6149.2 A spectral lines be used to follow RV activity noise?”, Telmo Monteiro and Carlos António
- "A new activity proxy for finding other Earths", Pedro Afonso
- "Studying the atmospheres of other worlds within and outside the Solar System, Margarida Barros de Oliveira, Moussam Maity
- "Spectral fingerprints of planetary contents", Henrique Eira
- "What are the terrestrial exoplanets made of?", Redyan Ahmed and Naman Joshi
- "Do the chemical mixtures of rocky planets reflect the initial composition of the planet-forming disk?", Matilde Abreu, Mariana Navia and Duarte Branco
- "On the origins of super-Mercuries", Aniket Prasad and Tomás Moura

In 2022, team funding came mostly from IA "strategic funding" as well as from 4 running FCT projects (3 "normal" ones, that ended mid-2022, and one PEX, still running). Two more PeX projects were funded in the 2022 call, but only start in 2023. To these, we add the ERC Advanced Grant that was mentioned above, that started activities in October 2022.

Furthermore, funding for our participation in the PLATO and ARIEL missions was already secured through PRODEX for the year 2022. We note, however, the PRODEX funding covers only the "project level activities". A continuation of this funding for the period 2023-2025 has been also secured, also adding CHEOPS to the list of space missions presently supported by PRODEX.

We would further like to highlight the strong collaborative work done in 2022 to foster collaborations of IA-Planet team members with other groups in the institute. This particularly concerns collaborations with the Stellar and Instrumentation groups. Collaborations with the stellar group include the characterisation of planet host stars, stellar spectroscopy, and asteroseismology, the study of solar and stellar activity, and Galactic chemical evolution. Instrumentation group collaborations touch several aspects related with the development of new instruments and related software, such as PoET, NIRPS, PLATO, and ANDES. Collaborations with other groups, namely cosmology and science communication, has also been done, respectively, through common instrumentation interests and through the communication of science results.

Nuno Santos

Group Leader

Report from the Group
Towards a comprehensive study of stars

Our activity during 2022 was distributed across three main research lines: Sun and Heliosphere, Stellar Physics, and Stellar Populations.

Sun and Heliosphere research line. We have continued our participation and collaboration in several national and international projects. Group members are leading the Portuguese participation in the SWATNet MSCA Innovative Training Network, are contributing actively to the European Solar Telescope (EST) Preparatory Phase, and are developing the first detailed regional model of the ionosphere. We have also been collaborating in the context of the SUNRISE and Solar Orbiter missions. Our participation in EST is of particular strategic importance. The Portuguese contribution to the project focuses on developing the Integral Field Spectropolarimeter, of which one of the Group members is Co-PI. This group is predominantly based at Coimbra.

Stellar Physics research line. In the context of asteroseismology, we continue to be actively engaged in international consortia related to the NASA space missions Kepler/K2 and TESS. The exploitation of asteroseismic data from TESS is being carried out in the context of the TESS Asteroseismic Science Consortium (TASC), in which our team is strongly involved, with representation on the Steering Committee and co-leadership of one of its working groups. Furthermore, our team continues to be strongly involved in the preparation of the stellar science component of PLATO (ESA), with responsibilities in the design, implementation, and validation of sections of the Stellar Analysis System (SAS) pipeline, leading work packages in the framework of both the PLATO Science Management (PSM) and the PLATO Data Center (PDC). The team has also been contributing to the Ariel (ESA) consortium, in the context of which we coordinate working groups responsible for determining the surface chemical abundances as well as the fundamental properties of the mission's target stars.

The characterization of pre-main-sequence stars and their environments and, in particular, T Tauri stars (TTSs), is being achieved using several strategies, namely, photometric analysis of circumstellar disks around Classical T Tauri stars (cTTSs), spectroscopic studies (UV and visible) of signatures of outflows and accretion rates, and spectropolarimetric observations using SPIRou@CFHT of the complex magnetic field structures permeating TTSs. The team's involvement in SPIRou is of particular significance, with one of its members being part of the consortium's Steering Committee.

Stellar Populations research line. We continue to be actively engaged in several international consortia, including ANDES@ELT, the Maunakea Spectroscopic Explorer (MSE), ESPRESSO@VLT, NIRPS@ESO 3.6-m Telescope, and the Gaia-ESO Survey (concluded), among others. Of particular note, the ANDES project has started pre-Phase B in September 2022. Our team has a strong involvement in this project, playing a role in the development of its scientific priorities and the definition of top level requirements for the instrumentation. Furthermore, HAYDN has been selected by ESA in November 2022 for a Phase-0 study (on which more below).

Scientific highlights for 2022

Probing the cores of red-giant stars

In Vrard et al. (2022, Nature Communications, 13, 7553), the authors used asteroseismic data from the NASA Kepler mission to diagnose structural discontinuities in the cores of red-giant clump stars. They found evidence for large core structural discontinuities in about 6.7% of the stars in the sample (sample size: 359 stars; see Figure below), implying that the region of mixing beyond the convective core boundary has a radiative thermal stratification. These stars are otherwise similar to the remaining stars in the sample, which may indicate that the building of the discontinuities is an intermittent phenomenon. This work sets important constraints on state-of-the-art models for this particular type of star, reinforcing their use as Galactic probes, and is an output of the BreakStarS FCT R&D project (PI: Cunha), completed in April 2022. A press release was issued by IA announcing this result.

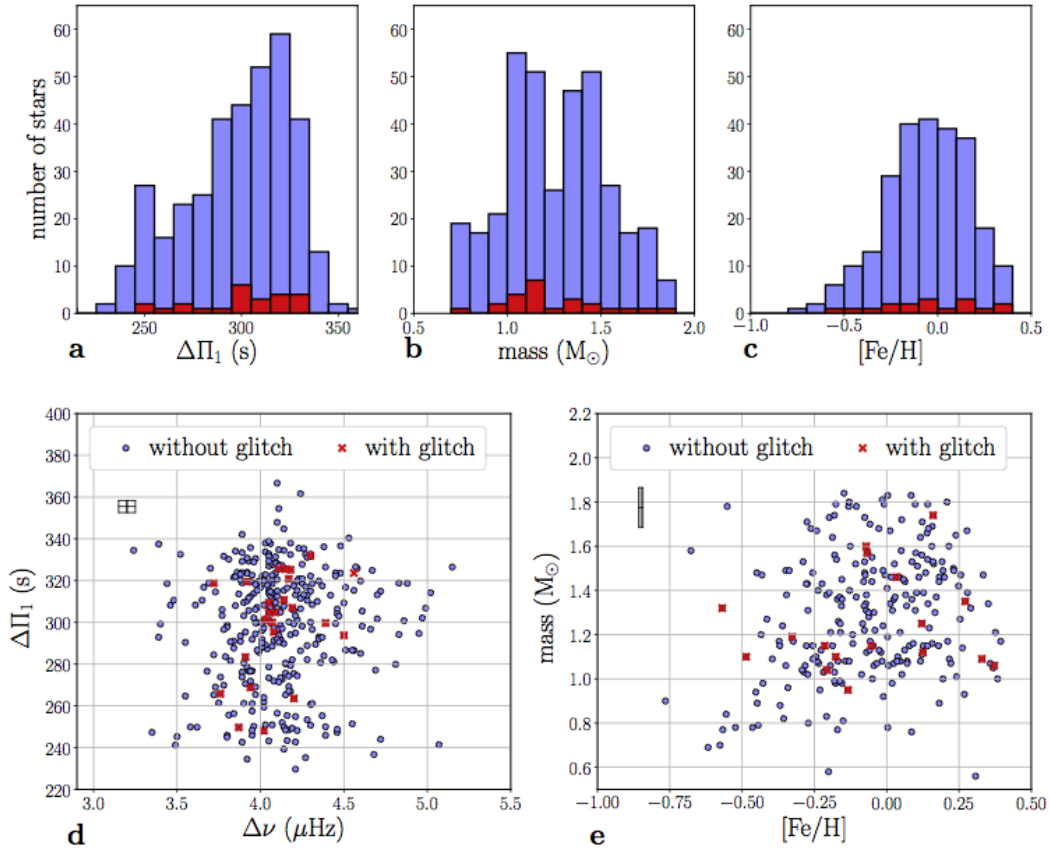


Figure 1: Histograms representing the number of stars as a function of the period spacing (panel a), mass (panel b), and metallicity (panel c) present in the full sample (in blue) and for which a discontinuity was found (in red). Period spacing as a function of the large frequency separation (panel d) and stellar mass as a function of metallicity (panel e) for the total analyzed sample (blue circles) and the stars for which a discontinuity was found (red crosses). From Vrard et al. (2022).

Atomic diffusion and turbulent mixing in solar-like stars

In Moedas et al. (2022, Astronomy & Astrophysics, 666, A43), the authors implemented turbulent mixing in stellar models and assessed the possibility of reproducing the effect of radiative accelerations (with turbulent mixing) for elements like iron in order to make the calculation of large grids of stellar models less computationally demanding. They found that, for iron, a parameterization of turbulent mixing that simulates the effect of radiative accelerations is possible. This leads to an increase in the efficiency of the turbulent mixing to counteract the effect of gravitational settling. Moreover, this approximation does not significantly affect the surface abundances of other elements investigated by the authors, with the exception of oxygen and calcium (see Figure below).

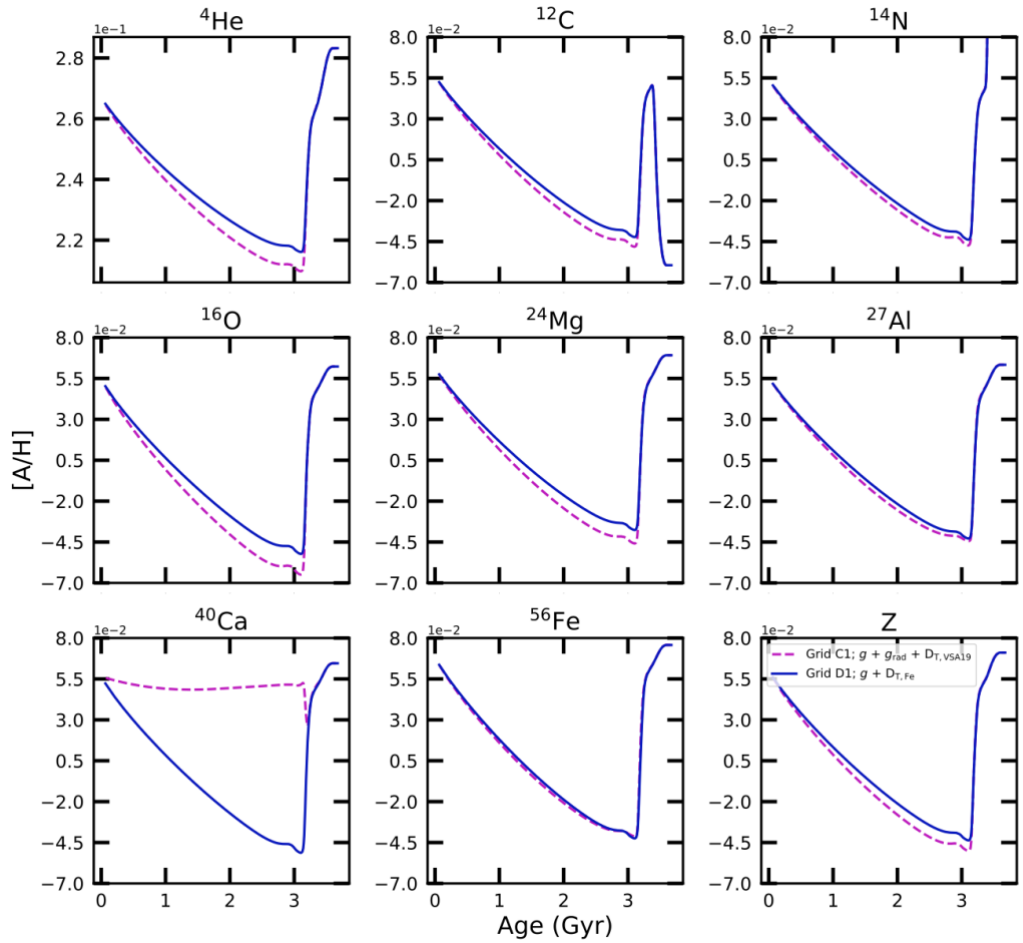


Figure 3: Evolution of the surface abundances of several chemical elements for a 1.4 solar-mass model. Purple dashed lines represent a model including atomic diffusion with radiative accelerations and the turbulent mixing calibrated by Verma & Silva Aguirre (2019, MNRAS, 489, 1850), whereas blue solid lines represent a model including atomic diffusion without radiative accelerations and the parameterization of turbulent mixing derived by the authors. From Moedas et al. (2022).

COSPAR ISWAT2022

The 3rd Working Meeting of the COSPAR International Space Weather Action Teams (ISWAT) was held between the 26th and the 30th of September 2022 at the University of Coimbra. The meeting was organised locally by Group members and welcomed nearly 70 participants. The ISWAT initiative is a global hub addressing challenges in the field of space weather. This meeting brought together the ISWAT community in order to finalise the preparation of the community-driven Space Weather Roadmap, to review the status of ongoing ISWAT projects, and to plan new actions and collaborations based on the Roadmap guidelines.

Figure 4: Poster of COSPAR ISWAT2022.

HAYDN selected for a Phase-0 study

HAYDN (High-precision AsteroseismologY of DeNse stellar fields), which had been proposed as a mission concept in response to ESA's call for an M-class mission (Voyage 2050 long-term plan), was selected for a Phase-0 study in November 2022. Group members are involved in both the science and payload consortia. HAYDN is meant to collect high-cadence, long photometric time series of dense stellar fields. If selected, it will lead to breakthroughs in stellar astrophysics, especially in the metal-poor regime, shed light on the evolution of open and globular clusters, and help us understand the assembly history and chemodynamics of the Milky Way bulge and of a few nearby dwarf galaxies.

Other activities

We start by providing an overview of the Group's internal procedures and meetings. Next, we highlight a number of indicators for the year 2022, namely, funded projects, completed theses, organisation of conferences and workshops, and outreach.

Regular meetings and activities

We hold biweekly Group meetings, a forum for discussing Group-related issues and strategy. These are held together with the Journal Club. Moreover, we hold science meetings on a biweekly basis (alternating them with the Group meetings), a forum for presenting and discussing ongoing work conducted by Group members. In 2022, we had two more instalments of Stars Day (one in May and the other one in December), a biannual in-person meeting with a strong social component. Stars Day events are fully organised by our students. Finally, we also held the annual 'SOAR analysis' meeting.

Communication

The Group website is regularly updated, containing news as well as information on our research and other activities. This past year, we have also created a Slack workspace for file sharing and everyday communication among Group members.

Funded projects (starting, finishing, or ongoing in 2022)

FCT R&D projects:

- 1 regular project.
- 1 exploratory project.

- 3 exploratory projects awarded (all starting in 2023).

Estímulo ao Emprego Científico Individual:

- 2 Principal Investigator contracts.
- 2 Assistant Researcher contracts.
- 1 Junior Researcher contract.
- 1 Principal Investigator contract awarded (starting in 2023).

European funding:

- Revealing the Milky Way with Gaia (MW-GAIA) — COST Action.
- Space Weather Awareness Training Network (SWATNet) — MSCA Innovative Training Network.
- SSA P3-SWE-XXXVII SWE Products for Southern Europe — Phase 1 (PROSE).

Completed theses

MSc:

- Andreas Neitzel. Title: Determination of age and mass for seismic stars in the Ariel input catalog. Supervisors: Diego Bossini and Tiago Campante.
- Margarida Santiago. Title: Evolution and dynamics of solar H-alpha filaments and their relation with Space Weather events. Supervisors: Ricardo Gafeira.
- Pedro Martins. Title: O ambiente de novos enxames estelares jovens na Galáxia exterior: um estudo no milímetro e no infravermelho. Supervisors: João Yun.

Organization of conferences/meetings/workshops

- Solar and Stellar Coronal Mass Ejections — Splinter Session at Cool Stars 21.
- COSPAR International Space Weather Action Teams (ISWAT) 3rd Working Meeting.

Outreach

- 5 Group-related press releases/news articles published by the Science Communication Group.
- Partnership with National Geographic Portugal: 1 article by Group members.
- IAstro Summer Internship program: 1 project led by Group members.
- 3 courses in Astronomy and Astrophysics currently being offered by Group members.

Tiago Campante

Group Leader

Report from the Group
The assembly history of galaxies resolved in space and time

In 2022, the Group continued to implement its strategic plan, gradually returning to face-to-face communications thanks to the decline of the COVID19 pandemic, and by intensifying its efforts toward the exploration of the formation history of galaxies and their structural components, of the genesis and growth of super-massive black holes (SMBHs) in galactic nuclei and their influence on the assembly history of galaxies, the mechanisms triggering and regulating starburst activity and its role on the galaxy stellar mass growth, and the influence of the environment on galaxy evolution.

These science goals which are being pursued by a team of 13 researchers, 12 collaborators and 12 students, are served by the participation of IA with leadership roles in the instrument consortia of MOONS@VLT, BlueMUSE@VLT, MOSAIC@ELT of ESO, and ESA missions with key relevance to the strategy of the Group (Euclid, Athena), as well as by the parallel development of highly optimised computational tools for the scientific exploitation of multi-wavelength data for galaxies near and far.

The growth of SMBHs and their observational manifestations as Active Galactic Nuclei (AGN) is being investigated by the Group both at highest redshifts and in the nearby universe. The emergence of the very first powerful AGN in the Universe, and how they shaped the earliest galaxy evolution is being studied through sub-mm observations with IRAM and the revolutionary ALMA, and by post-processing cosmological simulations to obtain quantitative predictions on the number and detectability of early SMBHs at X-rays and radio wavelengths. Building upon its expertise on the analysis and interpretation of multi-wavelength data, and as part of a coherent strategic roadmap, the Group is developing new observational discriminators for the detection of proto-AGN at the Epoch of Reionization (EoR). It also acts as a strong driver in the development of the future ASKAP's Evolutionary Map of the Universe survey, through the IA-lead Key Science Project "Radio AGN in the EoR" and is represented at the Board and Science team level in ESA's future X-ray mission, Athena.

At low and intermediate redshift (z), the AGN phenomenon is being studied using the currently most powerful telescopes and instruments, most notably the Multi Unit Spectroscopic Explorer (MUSE) at ESO-VLT. Special emphasis is being laid on the study of quasars surrounded by gigantic Lyman-α halos and the definition of new diagnostics for constraining the physical conditions and excitation mechanisms in the nebular component of these extreme environments. This line of research is further supported by a comparative analysis of gas kinematics and excitation properties obtained from integral field spectroscopy (IFS) with predictions from cosmological simulations incorporating AGN feedback, and through IA's spectral synthesis code FADO. The latter, together with other IA-developed tools, are being used to prepare the scientific exploitation of MOONS (the Multi Object Optical and Near-infrared Spectrograph for the VLT), an instrument the IA co-leads and which is expected to start its operation in 2024.

During 2022, the team continued having a key involvement in the preparation of guaranteed time observations with MOONS and in the definition of strategies for the reduction and analysis of data from it. IA researchers assume major roles in several MOONS Science and Technical Working Groups (WGs), including the co-leadership of the AGN WG and the technical WG-1, and have an active role in the scientific WGs on Physics of the ISM, Passive galaxies and stellar continuum, Galaxy environment, Large-Scale Structures, High-z Universe and the EoR, Clusters/Protoclusters, and in the technical WGs on Mock Catalogues from Simulations, Determination of Redshift and Physical Parameters from Spectra, and on the Determination of Environmental Parameters.

Another important field of the activities of the Group centres on spatially resolved investigations of galaxies with IFS and deep multi-band photometry. Using MUSE and the CALIFA and MaNGA IFS galaxy surveys, team members are investigating a wide range of fundamental issues in extragalactic research, including the build-up history of galaxy bulges and the physical drivers of their inside-out star formation quenching, age and metallicity patterns in spiral and elliptical galaxies, cooling flows and ram pressure stripping effects in galaxy clusters, gas kinematics and excitation mechanisms in elliptical galaxies, the evolution of the ionising photon efficiency across cosmic time, massive Wolf-Rayet stars and the diffuse ionised gas in star-forming galaxies, and the nature of ultra-faint galaxies. Furthermore, using ALMA, MUSE and FADO the team is studying the action of starbursts on the molecular gas phase in extremely metal-poor dwarf galaxies, which may be considered the best local analogs of the first proto-galactic units that emerged at the EoR. The activities of the team also encompass

the development of Machine Learning tools for the identification of high-z AGN and the characterization of galaxies from the Euclid Galaxy Legacy Survey, which is co-led by IA.

Scientific Highlights for 2022

Studies of high-redshift galaxies with the James Webb Space Telescope (JWST)

The advent of JWST has stimulated a number of parallel research projects by our team and collaborators. In particular, Brinchmann (2022, A&A, submitted) has carried out a critical examination of 14 galaxies with available JWST NIRSpec data at a redshift $1.2 < z < 8.5$. He devised a modification of the direct abundance determination method that reduces the dependence of metallicity determinations on the flux calibration uncertainties by a factor ∼3. Two of the most important results from this study were that shocks provide a substantial contribution to the gas excitation in galaxies at $z \lesssim 3$. This IA researcher has additionally demonstrated that studies of the mass-metallicity relation at those redshifts using galaxy samples with detected auroral [OIII]4363 line emission can introduce serious biases, given that such galaxies form a special subclass of low-metallicity, high-excitation sources. This study has shown instead that Bayesian photoionization modeling of strong lines is preferable to using temperature-sensitive emission lines.

Parallel efforts by the team in the context of JWST focus on spectral modelling of star-forming galaxies with the goal of exploring their early star formation history (SFH), as well as simulations of the morphology and colour patterns of high-redshift galaxies in the JWST filters (Sect. 7).

Physical characterization of galaxies with Machine Learning (ML) tools

a) One line of ML-supported research by the IA-Galaxies team centres on Lyman-α-emitting (LAE) galaxies. Paulino-Afonso has initiated the FLAEMING project, which is a new effort that leverages data-rich surveys such as COSMOS to train ML models for identifying LAE candidates. She has successfully trained a model that can classify LAEs with approximately 90% accuracy using only optical and near-infrared fluxes. An application of this model to the COSMOS field has permitted the prediction of the existence of ∼3500 new LAE candidates not detected by the SC4K survey, effectively doubling the existing sample.

Two parallel projects in this context use a) gradient-boosting algorithms trained from COSMOS2015 and SC4K to improve LAE identifications, and b) Convolutional Neural Networks for the search of LAEs from broadband data. These three aforementioned projects strongly benefit from GPUs awarded to Dr. Ana Paulino-Afonso in the framework of the NVIDIA Academic Hardware Grant Program.

b) Another set of projects carried out by the IA Galaxies Group centers on the scientific exploitation of data with the upcoming Euclid space observatory. Following the development and validation of a ML technique for the classification of astronomical sources (Humphrey et al. 2022a, MNRAS, 517, L1), and their photometric redshift-aided classification using ensemble learning with particular focus on the efficient discrimination between high-z quasars and foreground Galactic stars (Cunha & Humphrey 2022, A&A 666, 87), our team has extended ML techniques toward estimating galaxy redshifts and physical properties of galaxies using unlabelled observations (Humphrey et al. 2022b, A&A, submitted) and the selection of quiescent galaxies from mock photometry in the Euclid Galaxy Legacy Survey (Humphrey et al. 2022c, A&A, submitted).

The influence of the environment on galaxy evolution

The team has continued its studies of the action of the environment on galaxy evolution, both in galaxy clusters and compact galaxy groups. New insights into this fundamental subject could be gained through interferometric studies of the hydrogen 21cm line of selected galaxies in the cluster Abell 1367. In this regard, extending a previous study of selected sources, in particular on the enigmatic galaxy triplet FGC 1287 in the outskirts of the galaxy (Scott … Lagos et al. 2022, MNRAS, 511, 9), T. Scott has participated in a study of the field around that cluster with the Arecibo Galaxy Environment Survey (Deshev … Scott et al. 2022, A&A 665, 155).

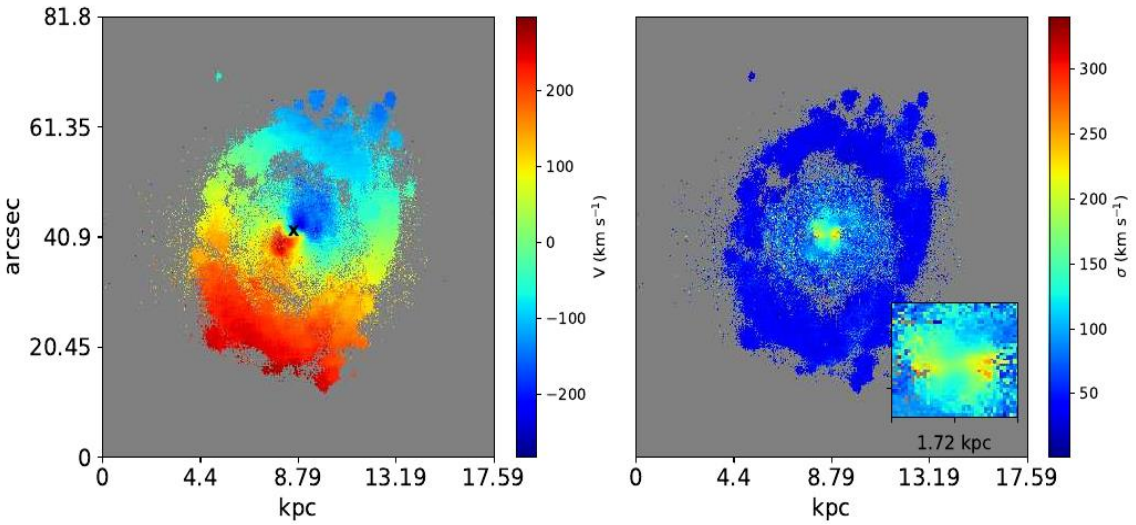


Figure: Example of the analysis of group-dominant galaxies by Lagos … Scott et al. (2022). Gas velocity (left panel) and gas velocity dispersion (right panel) obtained for the galaxy ESO0507-G025 from fitting the [NII]6583 emission line. The position the continuum maximum is indicated by the X symbol

Another study centers on gas excitation mechanisms in massive (>10^{12} $M_\odot$) galaxies in the densest known galaxy clusters. Lagos … Scott et al. (2022, MNRAS, 516, 54) by applying the IA-developed spectral synthesis code FADO (Gomes & Papaderos 2017) to deep MUSE IFS data for 18 group-dominant galaxies (all of those classified as Ellipticals and S0) were able to accurately subtract the underlying stellar continuum and perform a thorough analysis of gas-phase metallicity patterns and excitation diagnostics. An insight gained from this study is that the nuclei of group-dominant galaxies typically show LINER-like emission-line ratios that hint at an AGN, and that extranuclear star-forming regions in some S0s are chemically homogeneous. Various lines of evidence presented by these authors suggest that group-dominant galaxies likely acquired their cold gas through accretion and/or cooling flows.

This large-scale program is supplemented by studies focusing on further physical and evolutionary characteristics of the galaxy sample, such as the morphology and kinematics of gas in BCG (Olivares … Scott et al. 2022, A&A 666, 94), the star formation and gas content of BCGs (Kolokythas .. Lagos 2022, MNRAS 510, 41), and the merger histories of these systems as revealed from stellar kinematics (Loubser, Lagos et al. 2022, MNRAS 515, 11).

Extremely metal-poor starburst galaxies and other extreme emission-line galaxies

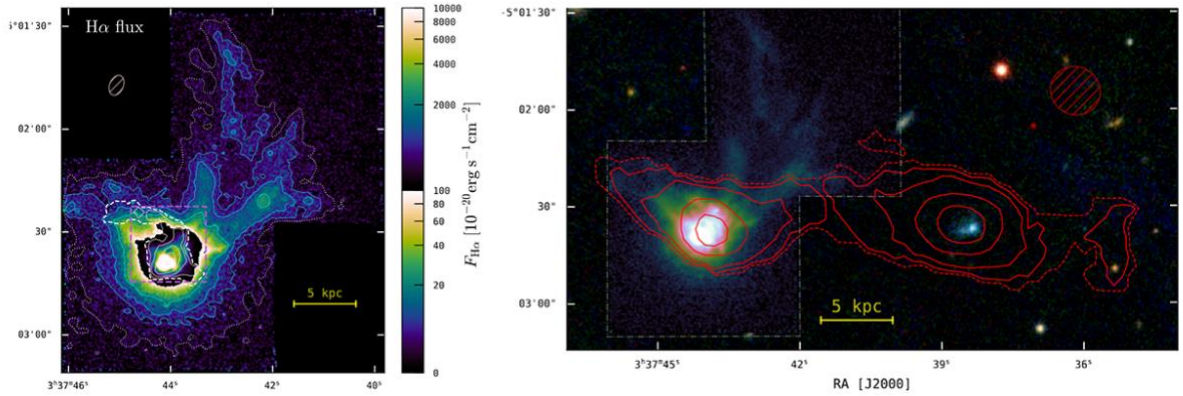
A significant effort by the team has been dedicated to investigations of extremely metal-deficient (12+log(O/H)<7.6) blue compact dwarf (BCD) galaxies and green peas (GPs), as the best local proxies of actively star-forming galaxies in the early Universe.

New, very deep VLT-MUSE data have allowed the detection of a spectacular 15 kpc outflow in the BCD SBS 0335-052E. A combined interpretation of optical IFS data with HI interferometry acquired with the VLA in its B-configuration suggests that Lyman continuum (LyC) radiation produced by young massive stellar clusters in this BCD is escaping anisotropically, in the direction of the outflow (Herenz .. Papaderos et al. 2022, A&A 670, 121). The observational evidence for anisotropic LyC photon leakage may have major implications to our understanding of the role of low-mass galaxies for the reionization of the Universe.

Brinchmann has a key involvement in studies of the UV properties of low-mass starburst galaxies from the COS Legacy Archive Spectroscopic Survey (CLASSY), from the definition of the survey (Berg .., Brinchmann et al. 2022, ApJS, 261, 31) and its technical overview (James … Brinchmann et al. 2022, ApJS 262, 37), to detailed studies of UV diagnostics of the physical conditions of the interstellar medium (Mingozzi … Brinchmann et al.

2022, ApJ, 939, 110), and estimations of the impact of aperture effects on the inferred nebular properties of these local analogs of high-z protogalaxies (Arrelano-Córdova .. Brinchmann et al. 2022, ApJ, 935, 74).

The extremely metal-deficient BCD CGCG007-025 has been the subject of two dedicated articles with the key participation of our IA team. The first one (Fernández .. Papaderos et al. 2022a) uses deep optical spectra with 10.4m GTC, in conjunction with spectral modeling with FADO, and a 16-dimensional model, which for the first time, simultaneously explores the direct method and the photoionization parameter space. Both techniques consistently indicate a low-metallicity interstellar medium (7.76 < 12+log(O/H) < 8.04) ionized by strong radiation from young SSCs.



left: Continuum-subtracted Hα narrowband image of of SBS 0335-052E revealing the spectacular starburst-driven outflow of this BCD. **right:** HI VLA map of SBS 0335-052E and its faint western companion (from Herenz … Papaderos et al. 2022).

The aforementioned direct method versus photoionization model fitting concept was further applied in Fernández … Papaderos (2022b, MNRAS, submitted). Further insights into the spatially-resolved chemodynamics of CGCG 007-025 have emerged through a subsequent study by de Valle-Espinosa .. Papaderos (2022, A&A, submitted).

In a related context, our team has investigated with FADO the stellar content of extreme emission-line galaxies (EELGs) from the Sloan Digital Sky Survey (SDSS) (Breda, Vílchez, Papaderos et al. 2022) and the SFH and emission-line diagnostics in the starburst region Mrk59 of the cometary BCD NGC4861 (Roche … Papaderos et al. 2022, MNRAS, submitted) .

Finally, Papaderos in collaboration with researchers from Stockholm University (Östlin, Hayes, Bik)

has initiated a combined investigation of the connection between the SFH and the properties of extended Lyman-α and Hα halos in BCDs, including the prototypical systems Haro11 and ESO338-IG04.

Fundamental scaling relations and the physical drivers of star formation quenching in galaxies

In preparation of the exploration with VLT MOONS (to start its operations in 2024) of the evolutionary history and chemical properties of galaxies and AGN at the critically important cosmic epoch around z∼1, the IA team has intensively applied the spectral synthesis code FADO for studies of the slope and scatter of fundamental galaxy scaling relations in the low-z universe.

Special emphasis in this regard was placed on the influence of nebular continuum on the physical properties of galaxies, as retrieved from spectral modeling of their spectra.

From a comparative analysis of the spectral synthesis output from FADO with that from the code Starlight for nearly one million spectra from the SDSS, Cardoso et al. (2022, A&A 667, 11) concluded that the neglect of nebular continuum emission in conventional (purely stellar spectral modeling codes) substantially impacts the inferred evolutionary properties of galaxies (e.g., mean age and metallicity). In turn, this can significantly bias determinations of fundamental galaxy scaling relations, such as mass-age or mass-metallicity, especially for actively star-forming galaxies at z>1. Additionally, the influence of nebular emission on the slope and scatter of the star-forming main sequence was studied in detail in Miranda et al. 2022 (A&A, submitted), with a parallel investigation by Duarte Santos et al. (2022, in prep.) focusing on the effect of nebular emission on galaxy stellar

mass determinations and the connection between M_* and gas excitation mechanisms. In a related context, FADO was applied to type Ia supernova host galaxies at intermediate-and high redshift with the goal of inferring their star formation- and metallicity enrichment histories (Millán-Irigoyen … Gomes et al. 2022).

The physical drivers and corresponding timescales of star formation quenching (SFQ) in galaxies constitute a key topic to be investigated by our team with the upcoming VLT-MOONS. For this reason, Breda & Papaderos (2022, A&A, submitted) have used IFS data for 135 galaxies from the CALIFA survey to investigate the connection between present-day galaxy mass and the timescale of SFQ. Through a combined population and evolutionary spectral synthesis approach, these researchers have devised a semi-empirical parameterization for the decline of the star formation rate both in the bulge and the disk component as a function of present-day M_*.

Finally, Papaderos, Breda, Gomes, Humphrey & Pappalardo (2022, A&A 658, 74) have explored from the photometric point of view how the usual neglect of inside-out SFQ influences bulge-disk decomposition studies of galaxies. The main result from this study was that subtraction of an exponential model to the star-forming disk from a galaxy image leads to the oversubtraction of the disk from the old, passively evolving bulge, consequently to a systematic underestimation of the luminosity (and M_*) of the latter.

This effect can, in turn, can substantially bias the slope, and its possible change across z, of the SMBH vs. M_* relation, it thus needs to be accounted for in image decomposition studies both of local and higher-z galaxies.

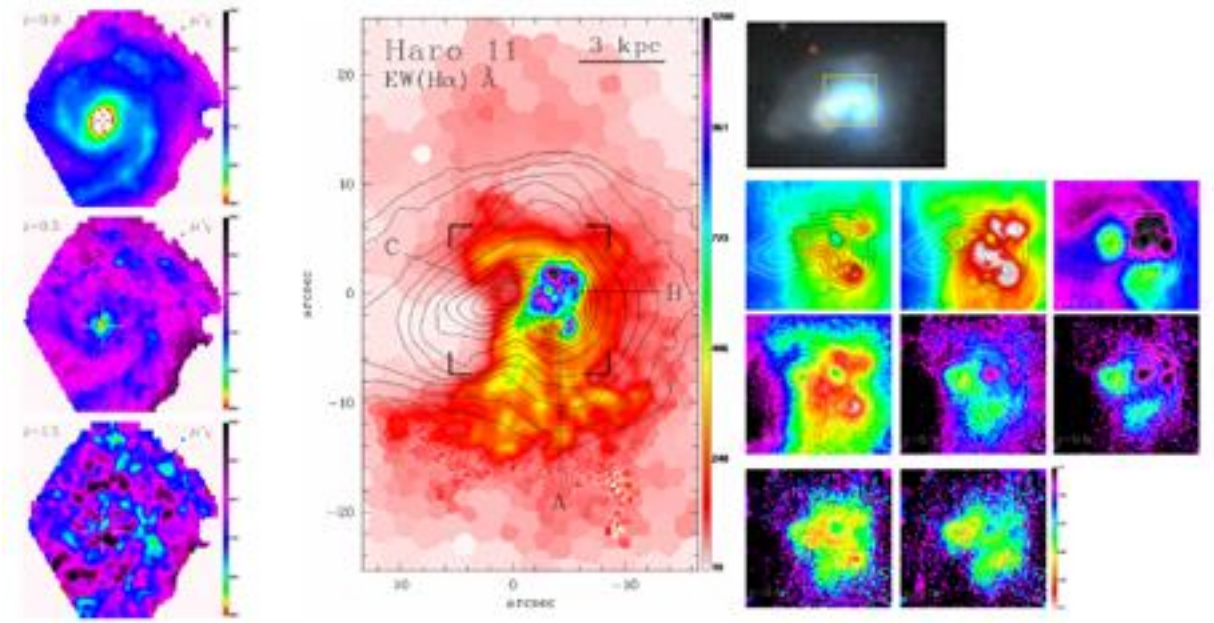
Morphological and structural properties of galaxies at higher-redshift with the JWST and Euclid: the chromatic surface brightness modulation (CMOD) effect

Motivated by the fact that the investigation of the structural and morphological evolution of galaxies with the JWST and Euclid is one of the central scientific goals of IA's Galaxies Group for the coming years, IA researchers have examined in Papaderos, Östlin & Breda (2022, A&A, submitted) how the usual neglect of a k correction (or the application of one single k correction to a galaxy as a whole, both to its non-star-forming bulge and star forming disk) could impact bulge-disk decomposition studies of higher-z galaxies, consequently also the SMBH vs. M_* relation.

The starting point of this study is that the shift of the rest-frame UV into the observer's frame (ObsF) visual leads to the enhancement of the surface brightness of the UV-bright disk relative to UV-faint bulge. This differential effect is referred to by the above mentioned researchers as chromatic surface brightness modulation (CMOD). As they showed, CMOD introduces a strong discrepancy between true (restframe) and ObsF morphology, structural properties and color patterns in higher-z galaxies, and this bias is further amplified by intense nebular emission lines entering into different photometric filters, depending on the redshift of a galaxy.

This study has quantified the CMOD effects using both evolutionary synthesis models for mock two-component (bulge+disk) galaxy models simulated out to z=3 and with spatially resolved population synthesis models for galaxies with observed IFS data.

Two of the main results from this study were that a) galaxies at $z\sim1$ with an old, passively evolving bulge appear in optical broadband images as almost bulgeless disks, and b) the effective radius, which is commonly used to measure the size evolution of galaxies is not robust against the CMOD effect.



left: Synthetic V-band images of the local spiral galaxy NGC 0309 simulated at a redshift z=0, 0.5 and 1.5. It can be appreciated that the prominent bulge of this system becomes virtually absent at z=1.5. **middle:** Hα equivalent width map of the nearby BCD Haro 11, documenting a starburst-driven gas outflow on spatial scales of 10 kpc away from the center of the galaxy. **right:** True-color image of Haro11 (uppermost panel) and simulated V-I color maps of the galaxy out to z=1 (lower panels). It can be seen that the color morphology drastically changes with redshift as a result of intrinsic stellar age gradients in the BCD and the photometric effect of strong emission lines (from Papaderos, Östlin & Breda 2022, A&A, submitted).

Group meetings, Journal Clubs and other activities

With the gradual decline of the COVID19 pandemic, the team has started resuming its normal work mode while maintaining regular internal communication via video conferencing. In 2022, the team significantly increased its productivity, further intensified internal synergies, and established new collaborations. Throughout 2022, the team maintained a busy schedule of weekly Briefings to discuss its scientific work. In addition, the regular weekly journal clubs continued, where the latest scientific results, mostly non-IA, were discussed.

Furthermore, the team organized a two-day internal workshop (Coimbra, 28 and 29 November 2022) to discuss ongoing research and its key strategic goals for the coming years.

The dynamism of the team is also reflected in the continued development and intensive testing of Machine Learning and spectral fitting tools that will strongly support its scientific activities in the context of Euclid, MOONS@VLT, MOSAIC@ELT and BlueMUSE@VLT, as well as the organization of the conference “Escape of Lyman radiation from galactic labyrinths” to be held in Crete, April 18-21, 2023.

Polychronis Papaderos

Group Leader

Report from the Group
Unveiling the dynamics of the Universe

This report highlights contributions in the main subjects of research in the cosmology group, centering around dark energy, modified gravity and cosmic defects. We focus essentially on the Euclid, ESPRESSO and LISA missions.

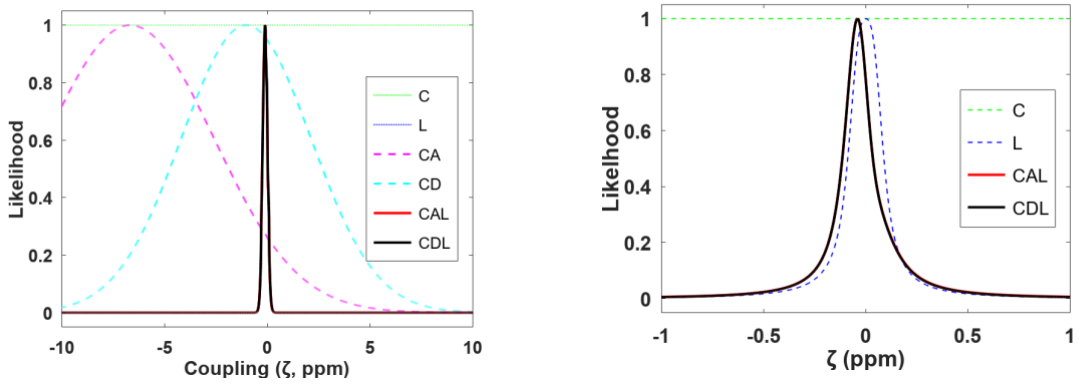
Euclid is a mission dedicated to the exploration of the dark universe through the measurement of the properties of the cosmological large-scale structure. IA is strongly involved in this mission, participating in the consortium board, in various Science Working Groups and in the Survey Design. Several members of the IA cosmology group have participated as lead-authors in key and standard papers published in 2022. One of our members is deputy of the Euclid Survey Working Group and the Survey Model owner having organised the Euclid survey working group meeting in October 2022 at FCUL.

The ESPRESSO spectrograph is an instrument of interest to several groups in IA. For cosmology, its main interest lies in the possibility of measuring variations of the fundamental constant. Following from last year, three papers with several IA members as co-authors were published in 2022 on using ESPRESSO to place constraints on the variation of the fine-structure constant and on models of dark energy with couplings to the electromagnetic fields.

LISA will be a large-scale space mission designed to detect gravitational waves. The LISA cosmology white paper is in the final stages of publication. This has the contribution of several IA members, with one member having the coordination of the cosmic strings section. Work was also done on the development of the LISA template for cosmic string signals that is in the final stages of development.

Scientific Highlights for 2022

Constraints on Bekenstein and dark energy models from ESPRESSO



Constraints on electromagnetic coupling of the Bekenstein (left) and parameterized quintessence (right) dark energy. The dashed lines relate to the following data: Cosmology only (C), Local only (L), Cosmology+Archival+Local (CAL), Cosmology+Dedicated+Local (CDL).

Models of dark energy with dynamical scalar fields can naturally couple to the electromagnetic sector, in particular leading to variations on the value of the fine-structure constant. In a paper published this year, “Fundamental physics with ESPRESSO: Constraints on Bekenstein and dark energy models from astrophysical and local probes”, Martins et al, Phys. Rev. D 105 (2022) 12, 123507 (doi: 10.1103/PhysRevD.105.123507), ESPRESSO measurements of α, together with measurements from other contemporary cosmological and local probes, stringent constraints where placed on two broad classes of models: Bekenstein models and quintessence-type dark energy models. Both of these can also be seen as parametric extensions of the standard ΛCDM model. Local measurements have improved previous results by an order of magnitude, and the single ESPRESSO measurement was shown to be competitive with the other present cosmological probes. The main author and several co-authors are CAUP members.

Euclid: Forecast constraints on consistency tests of the ΛCDM model

An observational violation of spatial homogeneity or isotropy on very large scales is a direct consistency test of the ΛCDM model. The paper "Euclid: Forecast constraints on consistency tests of the ΛCDM model", Astron. Astrophys. 660 (2022) A67 (doi: 10.1051/0004-6361/202142503), has quantified the ability of the Euclid mission, together with contemporary surveys, to improve the current sensitivity of null tests of the canonical cosmological constant Λ and ΛCDM model in redshifts up to 1.8. The study was carried out for a ΛCDM fiducial model, a dark energy CPL parametrized model and an inhomogeneous ΛLTB model. The analysis was done with a machine learning reconstruction method based on genetic algorithms and, alternatively, a theory-agnostic parametric model based on Taylor expansion and data binning. It was found that Euclid, together with external probes, will be able to improve current constraints by approximately a factor of three using the machine learning methods, and a factor of two with the parametric approach. Furthermore, the parametric approach was found to introduce possible biases for some models removed from ΛCDM. This paper was co-written with several CAUP members.

Group meetings, Journal Clubs and other activities

The cosmology group held fourteen IA seminars in 2022, some of them online.

The group also had regular weekly journal club meetings. In total the group held 32 "CosmoClub" meetings. These are in person in both nodes with an online zoom connection. Every week we have a general discussion, and a different team member brings one paper (or more) for discussion. Details can be found in http://ia-cosmoclub.wikidot.com.

The cosmology group also organised COSMONATA, the annual meeting in late December bringing together Portuguese researchers working abroad with researchers in Portugal.

Team members were also actively engaged throughout 2022 in several outreach activities, including talks given in schools. Most of these activities are developed with the Science Communication Team.

Two students of the cosmology team successfully completed their PhD thesis in 2022.

Tiago Barreiro

Group Leader

Report from the Group Instrumentation and Systems

CAUP participates in the scientific and technical development of Astronomical Instrumentation, which transverses both major scientific areas in CAUP. This includes not only the technical design of the instruments themselves but also the respective science exploration of the collected data through big collaboration projects such as consortiums and surveys. Its importance stems from the need to secure privileged access to existing and future facilities of the European Organization for Astronomical Research in the Southern Hemisphere (ESO) and of the European Space Agency (ESA) and to contribute to the long term development of Astronomy in Portugal.

Several CAUP members continued to be involved in the scientific definition of astronomical instrumentation through IA and several projects have been running in collaboration with other Portuguese teams. Given the interlinked nature of this Group, no effort is made to separate activity in Lisbon from that in Porto but the hardware work is all carried out in the laboratories in Lisbon..

The year 2022 brought a return to normality after the previous limitations caused by the pandemic situation. For the Astronomical Instrumentation and Systems Group (AISG), this represented an extra effort caused by the pressure to conclude running projects that were delayed and to start new projects that were postponed.

As seen in this report, there was significant progress during this year, achieving some important milestones in several projects and starting promising future ones.

During 2022, the following instruments had engineering and implementation activities at IA:

- For the European Southern Observatory (ESO): NIRPS, MOONS, ANDES, BlueMUSE and PoET.

- For the European Space Agency (ESA): EUCLID, CHEOPS, PLATO, ARIEL and ATHENA.

Currently the AISG participates in a considerable number of projects, involving all its human resources. This includes not only the technical design of the instruments themselves but also the respective science exploration of the collected data through big collaboration projects such as consortiums and surveys. Its importance stems from the need to secure privileged access to existing and future facilities of the European Organization for Astronomical Research in the Southern Hemisphere (ESO) and of the European Space Agency (ESA) and to contribute to the long term development of Astronomy in Portugal.

In terms of Human Resources, the group was left without a Mechanical Engineer (Pedro Nunes dos Santos), which is now one of the priorities in terms of reinforcements for the team and saw the return of a researcher (David Alves). In total the group has 12 senior members (two of whom are at CAUP) and five PhD students (one who is at CAUP)

In terms of new themes of research, somehow supported by background expertise in Astronomy Instruments / Space missions and consolidated by the work PhD students supervised by AISG researchers, the team is exploring:

a) Stabilisation of calibration light sources for High Accuracy Photometry Instruments resulting from research and develop a device that senses the light source fluctuations and modulates the beam, both in flux and in spectra, to produce a sufficiently stable source, a truly impressive challenge when stabilisation levels of few ppm are required over long periods of observation.

b) Discovery and characterization of temperate Earth-like worlds with ESPRESSO, with a main goal to improve the radial velocity extraction from the ESPRESSO science data. This is a module to be attached to the Data reduction pipeline of ESPRESSO. This thesis is more focused on the analysis of M stars which are trickier to get precise and stable radial velocities for the detection of exoplanets, but at the same time are the more promising targets to find earth-like in the habitable zone.

c) Development of a solar telescope that will allow the detailed study of the Sun (using it as a proxy to understand the sources of noise that affect the observations of other stars). For that, it is fundamental to be able to obtain disk-resolved, HR spectra, opening a whole new path for the detection and characterization of Earth-like planets orbiting other Suns.

d) Development of miniaturised Cross dispersed echelle spectrographs operating in the VIS and UV with the Size Weight and Power (SWaP) requirements for a SmallSat solution and the required spectral resolution to allow the study of this less explored spectral range.

e) Study of space debris detection algorithms in a standalone platform, with the goal to implement and test a star tracker that can be used for space debris detection. The methodological approach consists of selecting the most appropriate debris detection algorithms, adding automatic photometry measurements, developing a standalone platform, implementing the algorithms in the platform, selecting the low-cost materials capable of withstanding the harsh space environment, and optimising the algorithms to work in different scenarios.

Running projects

NIRPS(ESO)

NIRPS is a new (fast-track instrument) high resolution spectrograph working at near-infrared bands, that is being designed for the ESO 3.6-m telescope (La Silla-Paranal Observatory). NIRPS will work together with the existing HARPS spectrograph, allowing us to obtain simultaneous optical and near-IR spectra of stars. The major goal of NIRPS is to detect and characterise planets orbiting late type stars. The NIRPS consortium includes a strong participation from IA, including in the development of hardware and software (the Atmospheric Dispersion Correctors – ADC), and in the definition of scientific activities.

2022 was the year where the instrument had a successful first light for science. The participation of the Group is now concluded and the effort was now passed to the scientific groups for the instrument exploitation.

MOONS (ESO)

The Multi-Object Optical and Near-infrared Spectrograph (MOONS) is a future third-generation instrument for the Very Large Telescope (VLT) to have first light by 2023. It matches an enormous multiplexing capability, reaching up to 1000 positions being spectroscopically observed at the same time over a single telescope pointing, to the grasp of the 8.2m VLT, making it a unique instrument for deep galaxy surveys.

The subsystems under IA responsibility are the MOONS Rotating Front End (RFE) and the Field Corrector (1 m diameter set of two lenses).

2022 saw two important milestones in this project. The first was the delivery of the RFE system to UKATC in Scotland for the final test and integration of all the subsystems in charge of the other partners in the consortium. A first mission was held in September to test the RFE at UKATC premises, work to be followed during 2023 towards the Preliminary Acceptance in Europe.

The second milestone was the installation in Paranal, in October/November, of the field corrector. The corrector was also commissioned and had a successful first light. The system is now waiting for the observatory for the remaining parts of the instrument.

Figure: The MOONS (ESO) Field Corrector being installed in the ESO Paranal observatory.

Figure: The MOONS (ESO) RFE during testing in the UKATC facilities (Edinburgh, Scotland).

ANDES (ESO)

ANDES, formerly known as HIRES, is the project for a high resolution spectrograph to be installed at the ESO E-ELT telescope. The concept of ANDES is being developed by a consortium that comprises several institutes in different European countries, as well as USA, Canada, Brazil and Chile. The Portuguese participation in this consortium is done through IA that is leading the "front end" work package component of the instrument, the data reduction and analysis software, the software system architecture, and the science drivers for the project. The group also participates in the management of the consortium, having several key persons.

After the finishing of the Phase A studies in 2017 and the Pre-phase B activities of 2021, 2022 saw the start of the Phase B in the final quarter of the year.

BlueMUSE (ESO)

BlueMUSE is a blue-optimised, medium spectral resolution, panoramic integral field spectrograph that is planned for the Very Large Telescope (VLT) with first light foreseen for 2030. BlueMUSE builds on the heritage of the MUSE integral field spectrograph, the currently most oversubscribed instrument on the VLT, and IA is a member of the consortium to build the instrument led by Lyon. The BlueMUSE project had their Gate 0 kick-off meeting in Nov/Dec 2022. The IA contribution to the project will be in the area of control software and electronics.

PoET (ESO)

The detection and characterisation of other Earths, planets with the physical conditions to hold liquid water and thus potential life-sustaining environments, is a bold objective of present day astrophysics. This quest is however severely challenged by astrophysical "noise" from the host stars. To address this problem we started in 2022 a new project to build a dedicated facility, the Paranal Solar Espresso Telescope (PoET). This telescope will be linked to the ESPRESSO spectrograph (ESO) and allow simultaneous acquisition of disk-integrated (sun-as-a-star) and arcsecond level disk-resolved observations of the Sun at a spectral resolution R~200000. The project is funded by the European Union (ERC, FIERCE, 101052347). And it is a Portuguese project.

The project kicked-off in the last quarter of 2022, it is in its preliminary design phase and already has had one mission to Paranal (October 2022) to organise with ESO the interface questions with the Observatory.

CHEOPS (ESA)

The Characterising Exoplanet Satellite (CHEOPS) is the first mission dedicated to search for transits of exoplanets by means of ultrahigh precision photometry of bright stars already known to host planets. It will provide the unique capability of determining accurate radii for a subset of those planets for which the mass has already been estimated from ground-based spectroscopic surveys. CHEOPS will also provide prime targets for future instruments suited to the spectroscopic characterization of exoplanetary atmospheres. IA is strongly contributing for this mission participating both in the board and the core science team of the mission. This work is also closely related with the science data archive which is being developed by our industry partners (DEIMOS), contributing to the development of stronger relations with the Portuguese industry in the area of scientific related software.

Moreover there is a contribution for the mission science operation centre, more specifically for the CHEOPS data reduction pipeline where we are responsible for the calibration of the pipeline.

In 2022, CHEOPS continued to run well within specifications and continued to get scientific observations of high precision. IA continues to give maintenance support to the data reduction pipeline during the CHEOPS mission. During 2022, the CHEOPS consortium has coordinated and submitted the proposition to ESA for the extension to the mission. For the extension we were proposed to take the lead of the maintenance of the Data Reduction Pipeline replacing the team from LAM France which was in charge of this job during the nominal mission with our active participation. To go forward with this very good opportunity we also started discussions with PTSpace to access funding through Prodex. The proposal was submitted for funding at the end of 2022.

PLATO (ESA)

The PLATO mission, whose main scientific focus is the detection and characterization of extra-solar planets orbiting nearby, bright stars, using the transit method, as well as the detailed characterization of their host stars

through asteroseismology, was adopted by ESA in June 2017. The instrumentation team has leadership of several work packages for the development of software for the Plato Data Center (PDC) as well as in the development of the Optical Ground Segment (OGSE) component to test and calibrate the PLATO cameras on ground.

Regarding the contribution to the OGSE, and during the year of 2022, the team integrated and tested the second collimator, which was delivered to CSL (Be). This collimator was commissioned in July 2022, with the presence of two elements of the IA-Instrumentation team at CSL. During the same mission, the first collimator on site was also serviced, with the substitution of some electronic parts that were not working correctly.

At the end of the second trimester of 2022, ESA contacted us for the production of a third OGSE to be provided directly to ESA headquarters at Nordwijk. A contract was celebrated between ESA and IA-Lisbon to this purpose. The delivery date for this item is June 2023.

Figure: PLATO (ESA) being assembled at CSL premises (Liege, Belgium).

ARIEL (ESA)

ARIEL (Atmospheric Remote-sensing Exoplanet Large-survey) was one of the three candidate missions selected by the European Space Agency (ESA) for its next medium-class science mission due for launch in 2028. The goal of the ARIEL mission is to investigate the atmospheres of several hundred planets orbiting distant stars in order to address the fundamental questions on how planetary systems form and evolve.

The main activities of IA – instrumentation in ARIEL and together with the OGSE team led by Oxford University, were associated to the design of part of OGSE system, associated to the illumination module and reference detector subsystem working in the Visible /Near Infrared part of the spectrum. The reference detector function is to monitor the light source fluctuations and to provide source stability data required to detrend the results from the ARIEL instruments when operating in vacuum and cryo conditions.

During the year of 2022, a preliminary design for the VISNIR OGSE was produced. The illumination module was defined and several lab tests were produced to verify system performance in terms of stability, flux and spectral characteristics.

A major effort was also initiated regarding the design and testing of the reference detector that must operate at 70K. During 2022 more than 400 hours of cryo and vacuum cycles were produced in order to test performance of both the detectors and the pre-amplifier solutions. Results obtained until the end of 2022 allowed to confirm and narrow down the several solutions tested, which are performing within the expected requirement limits.

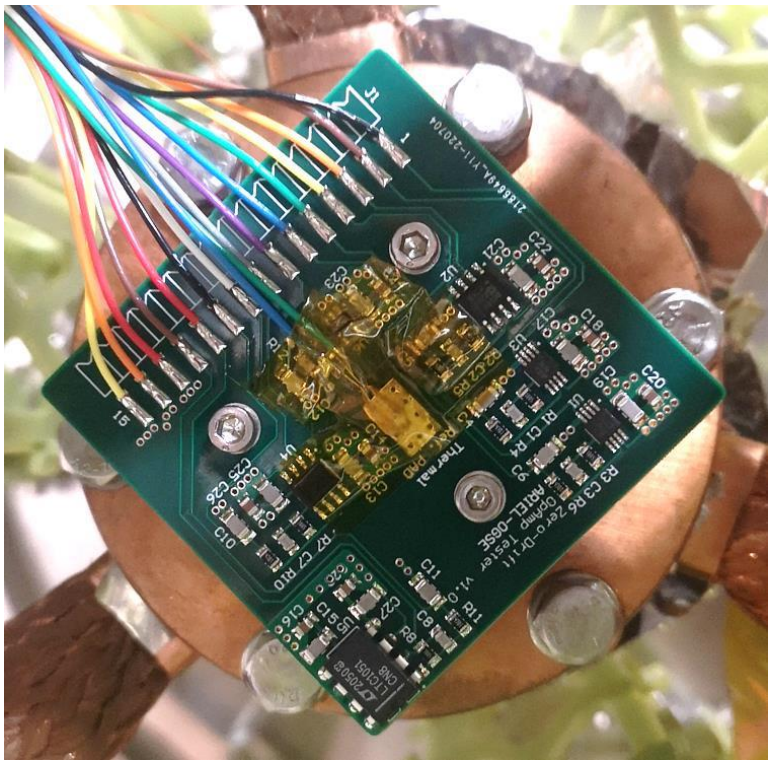


Figure: Ariel OGSE electronics at cryogenic tests.

ATHENA (ESA)

The group of Instrumentation of IA is leading the international consortium for the development of the Athena mission on-board metrology system, in the sequence of the approval of activity proposal to the ESA tender, which had the kick off in June 2020.

The function of the system being developed by the team is measuring the exact pointing of the Athena mirror during the process of switching focus between the X-IFU and WFI Athena instruments. The level of accuracy required for this task is at the level of a fraction of an arcsecond.

During the year of 2022 had to perform a series of adaptations to the design due to the re-definition of some requirements associated to the OBM performance and test conditions.

Most of these modifications were associated with the impossibility of supporting, at system level, certain aspects regarding the proposed design solution. These were related mainly to the definition of location and mount criteria for the fiducials, at the Athena instrument level, due to different development phases on the instrument side. The solution was to assume a reference case, similar to the WFI case, with respect to which the OBM performance verification shall be made.

The PDR milestone was successfully achieved at the beginning of 2022 and the procurement and production of the several parts of the OBM system was initiated.

System tests are expected to occur in May 2023.

Highlights for 2022

1. The installation of the MOONS Field Corrector in ESO Paranal Observatory.
2. The beginning of the PoET project, a Portuguese instrument to be installed at the ESO Paranal Observatory.
3. First light of a Plato Camera using our collimator. Second collimator being finalised for delivery to CSL
4. ARIEL OGSE System requirements review: successful milestone
5. Athena OBM System requirements review: successful milestone

Alexandre Cabral

Group Leader

UnF – Training Unit

Head (for 2012-2022): Carlos J. A. P. Martins

The CAUP Training Unit provides support for those studying astronomy and astrophysics related subjects at U. Porto. CAUP offers a unique environment for research projects and training at all levels, whether provided in-house, supplied to schools and other partners, or benefiting from our extensive international network of collaborators and partners.

Some of the unit-specific activities and outcomes during 2022 were as follows:

- Doctoral level:
  - A total of 3 PhD theses were completed in the calendar year 2022: R. Azevedo, J. Camacho, J.R. Correia
  - As of 31 December CAUP was host to 25 ongoing PhD research projects.

- Masters level:
  - A total of 4 Masters thesis were completed in the calendar year 2022: N. Carvalho, C. Marques, A. Neitzel, R. Silva
  - As of 31 December CAUP was host to 6 Master's thesis projects.

- Undergraduate level:
  - CAUP runs an extremely active program of research internships for undergraduate (and first-year masters) students, most (though not all) in the context of FCUP's PEEC program.
  - A total of at least 7 such internships were completed in 2022. Some of these students published the results of their work in peer-reviewed publications (sometimes as first authors), and also presented them in oral communications at international and national scientific meetings.
  - As of 31 December, 18 new internships were either in progress or scheduled to start in early 2023.

- Future projects:
  - All research projects offered by CAUP researchers for the academic year 2022-23 were compiled and published in a CAUP Projects Booklet, available at the CAUP website (and in printed form at selected events). This lists both projects intended for PhD and Masters theses and those intended for undergraduate internships. The latest edition was released in conjunction with the 2022 edition of our Astronomy Students Day, which was held on 11 May.

- Senior training:
  - We have restarted soft skills training activities (which had been interrupted due to COVID-19) and organised a CV/Job Application workshop in December.
  - No CAUP advanced courses were organised (since no volunteers to give them could be identified). Also two continuing education courses, mostly aimed at high-school teachers but open to others (undergraduate or high-school students, etc) were offered but did not run since the minimum number of registrants was not reached: The Physics of Everyday Life and History of the Universe.
- Junior training:
  - In 2022 we organised the eleventh edition of the AstroCamp (scientific director C. Martins). This is a selective residential school/summer camp for highly motivated high-school students (from the 10th, 11th and 12th grades), which took place on 7-28 August, at the CEIA in Paredes de Coura. For the first time the camp lasted 3 weeks (rather than the 2 of earlier editions). Camp activities for the students included lectures (45h) and practical classes (27h), observations, community service, and other leisure activities. The camp included 10 students, 4 camp monitors and 3 teachers.
  - In July we hosted a two-week internship in the 2022 edition of Ciência Viva's OCJF project. The results were presented by the intern in September in an oral communication at ENAA 2022 (the annual meeting of the Portuguese Astronomical Society) and published in December in a peer-reviewed article in Phys. Lett. B.

- Other activities:
    - In October-November 2022 we participated in the International Space Week's 'Space Goes to School' event, organised by Ciência Viva's ESERO office, giving more than 80 in person and online talks across continental Portugal as well as in the Azores and Madeira islands.

ND – Outreach Unit

Head (for 2009-2022): Filipe A. L. Pires, who is also the Executive Director of the Porto Planetarium.

Context

Science outreach in astronomy and astrophysics is defined in CAUP´s bylaw as one of its activities. CAUP develops the vast majority of its outreach initiatives through the Porto Planetarium, an infrastructure that it fully manages on behalf of the University of Porto. The Porto Planetarium is a Ciência Viva Centre (CCV) and is one of the 20 science centres that comprise the national Network of Ciência Viva Centres. This network is coordinated under the auspices of the national agency Ciência Viva, and it has a varied offer for schools and the public, both in-house and at other places and institutions.

CAUP co-coordinates IA´s Science Communication Group and CAUP´s Outreach Unit is fully committed in the effort to bring IA contents to the public, in particular through its work in the Porto Planetarium. Planetário do Porto is an ESO Outreach Partner Organization.

The year 2022 was initially marked by the COVID-19 pandemic, which influenced the activities of the Outreach Unit. After the release of the restrictions, there was a strong growth in the number of visitors to the Planetarium, closing the year with figures close to historical highs.

Highlights

The activities developed by CAUP´s Outreach Unit during 2022 reached out to more than 54430 people. The Porto Planetarium received 30114 visitors for sessions and 15141 at the hands-on laboratories. About 70% of the visitors were students on school visits. Activities at schools had the participation of 4495 students and we reached more than 4680 people through other science outreach activities including online events, not counting social media interactions nor news features sent to media outlets.

During 2022 we produced 1 new planetarium show “O Céu dos Lusíadas", This film will extend the Planetarium's educational offer for the Portuguese language subject.

Human Resources

During 2022, the human resources allocated to the Outreach Unit were:

• 4 CAUP contracts at 1.0 full time equivalent (FTE): Filipe Pires, Paulo Pereira, Ricardo Reis and Elsa Moreira.

• 1 new collaborator Adriana Silva started working on May 23. (0,8 eft Outreach Unit + 0,2 UNAS)

• 1 Gestão Ciência e Tecnologia (BGCT) grants (direct FCT contracts), via Ciência Viva national agency, for Planetarium activities, at 1 fte: Tânia Cunha.

• 2 teachers in “Mobilidade Estatutária” (deployed teacher), under a public servant contract with the Ministry of Education, via Ciência Viva national agency, for Planetarium activities, at 1 fte: Ilídio André Costa and, since September, José Dantas.

Regular Activities at the Porto Planetarium

Educational offer for schools: the offer implemented in 2017 continued to expand in 2022 by adding new didactic sequences.

● Planetarium shows: 30 114 visitors.

● Hands-on Laboratories: 15 141 visitors.

● “Mais Perto das Estrelas”: Monthly sessions consisting of an introductory planetarium session to the night sky and observations of the night sky with small telescopes. During 2022 we did 7 observation sessions. Total number of participants: 335.

Regular Activities at schools

● Portable Planetarium: planetarium sessions presented for a total of 4495 children.

● General talks given at schools by ND elements and researchers, in particular in the context of the ESERO PT initiative “O Espaço vai à Escola” (mentioned in the UnF section) and “Cientificamente Provável”.

● Workshops and observations in schools for a total of 4680 participants.

Regular activities in collaboration

Academia de Robótica -14 students 2021/2022 , 11 students 2022/2023

Special events

Dia Internacional da Luz – 2022

3 march

The Planetário do Porto – Centro Ciência Viva / Instituto de Astrofísica e Ciências do Espaço – Universidade do Porto, are partners of UNESCO and the Network for Astronomy School Education" (NASE) in the celebrations of the "International Day of Light".

In this activity schools, their students and teachers, from all over the world, were invited to determine the latitude of the place where they are, using the methods that guided the establishment of, for example, the Silk Road and the navigation routes of Columbus and Magellan

50 anos | Missão Tripulada Apollo 16

21 April

In a session at the Ruy Luís Gomes Auditorium, on the 4th floor of the Reitoria da U. Porto, on April 21st, at 9:30 PM, 50 years after the fifth visit to our natural satellite, we will have a conversation with our "astronauts": Onofre Varela (illustrator and author) and Orlando Frazão (FCUP and INESC-TEC), duly assisted, in "orbit", by Emílio Remelhe (FBAUP and ESAD).

Dia Nacional dos Cientistas 2022

May 16th

To celebrate the "scientist's day", the Oporto Planetarium – Ciência Viva Center had its doors open for immersive sessions throughout the weekend.

Exhibition “Um ESPRESSO para outros mundos”

2 july

The exhibition "ESPRESSO – An Adventure in the Atacama Desert" reveals the adventure that was the accomplishment of the ESPRESSO spectrograph, from its development to its installation in the Atacama Desert, in Chile, as well as the scientific challenges and results to which it is contributing.

It is the account of part of that adventure, in photographs and memories, created in the driest desert in the world, in Chile, that two of those pioneers, Alexandre Cabral and Nuno Cardoso Santos, offer in this exhibition and in a book.

Book launch

2 july

Book launch, talk and conversation with Nuno C. Santos (IA and FCUP), Alexandre Cabral (IA and FCUL) and Claudio Melo (Portuguese Space Agency).

A Portuguese astronomy and engineering adventure in the driest desert in the world, the Atacama in Chile.

In the last 30 years we have discovered that almost all the stars we see at night in the sky have planets around them. Most of these planets are likely to be rocky, like the Earth. How do we know this? And what does this change about the way we look at the sky?

With scientific ambition and technological ingenuity, Portuguese scientists and engineers are among the pioneers in the journey to discover other worlds.

Among photographs and memories, come and get to know in this event this technological and human adventure, driven by the desire to find other "Earths" in the Universe.

PLANETARIUM TALK: «À procura de outras Terras no Universo», com Nuno C. Santos

21 july

The Planetário do Porto – CCV, with MHNC-UP and Casa Comum present an anthological lecture with the awakening and stories of a recent science, which pursues some of humanity's greatest quests: to understand our place in the universe, to understand how the stars and the planets that orbit them are formed, and to find other worlds, with the hope of one day showing that we are not alone.

Semana Mundial do Espaço 2022

5 October

World Space Week is an international celebration of the contribution of space science and technology to the betterment of the human condition. It has been officially declared by the United Nations as the week of October 4-10 each year.

The Planetario do Porto – Ciência Viva Centre joins the World Space Week celebrations by preparing a special program on October 5th at its premises.

– 15h00 – Planetarium Session "CHEOPS: Hello Universe!" + "The Sun, our star" – at the planetarium dome

– 16h00 – Lecture "An adventure in Atacama" with Ana Rita Silva, PhD student in Astronomy (FCUP) – at the planetarium auditorium

Teoria das 6 Cordas: Concertos de Guitarra em Espaços Universitários #4

28 October

Teoria das 6 Cordas was a series of guitar concerts presented in spaces of the University of Porto linked to cultural and scientific dissemination.

Curated by Francisco Berény Domingues, it consisted of recitals that presented various faces of guitar music: from Baroque to contemporary music, performed in solo, in duo, in dialogue with the piano, in connection with electronic elements, pre-recorded sequences and even accompanied by video sequences. This amplitude is also reflected in the diversity of composers whose works were presented, so that, if the usual guitar repertoire was present, also the expressions of new music composed for the world's most popular instrument were a strong point of this small festival.

Teoria das 6 Cordas gave continuity, in 2022, to the 1st edition of the Youth Curatorial Festival promoted in 2019 by the University of Porto and the Silva Monteiro Music Course, youth that extends from the curator to the university students or recent graduates who will present each of the concerts. There are four musical moments that you can attend at the Rectory of the U. Porto, the Biodiversity Gallery and the Planetarium of Porto, from October 21 to 28.

Porto/Post/Doc 2022 @ Planetário do Porto CCV

19 and 26 November

In 2022 Porto/Post/Doc embarked once again on a journey through the universe of immersive films in partnership with the Planetário do Porto – CCV. The Planetarium dome is the most unusual exhibition venue of the festival with its huge semi-spherical screen, which is already filled with trips through the known universe, now receiving fulldome films that invite the viewer to dive into a journey of sensations.

Program: "Forward! To The Moon" [30'], "The Inner Island" [6'] and "We Are Guardians" [25'], "Ion" [6']

24º Aniversário do Planetário do Porto / Dia Nacional da Cultura Científica 2022

24 November

On November 24th 2022, National Day for Scientific and Technological Culture, the Oporto Planetarium – Ciência Viva Center celebrated 24 years since its opening to the public with a special program.

On this festive night, we open our doors to the public, at 20:30, for a special free program:

- 20h30 Congratulations and cake for Porto's Planetarium 24th Anniversary
- 21:00 Lecture "The Universe in Camões' time", with Vitor Bonifácio

Vitor Bonifácio, specialist in Astronomical History and professor at the Aveiro University, will give us a glimpse of the vision of the Universe that Europeans had at the time of Camões and how this knowledge was used in maritime voyages.

- 10:00 PM Preview of the immersive session "O Céu d'Os Lusíadas".

A fulldome immersive session that brings Astronomy and Literature together. Using excerpts from "Os Lusíadas", recited by "Camões himself", visitors can follow Vasco da Gama's epic journey, the numerous astronomical references present in the work and also the events that marked the author's life.

50 anos | Missão Tripulada Apollo 17

10 December

A little more than 50 years after humanity left its cradle, it will still be a few more years before it ventures to other parts of its neighborhood in the Cosmos. The celebration of the 50th anniversary of humanity's arrival to the nearest star in our Solar System still raises many questions about our aspirations, dreams, and the way we look at ourselves and our planet, both cradle and home.

In the last session of the cycle "50 years | manned missions to the moon", held at the Casa Comum in the Rectory of the U. Porto, Saturday, December 10, at 9:30 pm, 50 years after the last manned space trip beyond Earth orbit, we will have two minds more "astronauts" than earthlings: Carlos Fiolhais (physicist, university professor, essayist and science communicator) who will be duly assisted in orbit by Miguel Gonçalves (science communicator).

O Dia Mais Curto: a Festa da Curta-Metragem 2022

21 Dezember

In 2022, it will be the tenth edition of THE SHORTEST DAY, which is already a cinematic tradition. The Shorter Day returned in December, with a special anniversary edition, full of celebrations across the country and a program to match this decade of existence.

THE U. Porto joins this initiative for the third time, with the exhibition of 3 free screenings, in 3 different spaces of the university: Planetário do Porto CCV, Galeria da Biodiversidade and Casa Comum (Reitoria da U.Porto).

PROGRAMME at the Planetarium of Porto CCV
–- New Portuguese Short Films:

- THE ROSE HOUSE
  Mónica Santos – Portugal, France, 2022 – ANI – 8'
- THE GARBAGE MAN
  Laura Gonçalves – Portugal, 2022 – ANI, DOC – 12'
- TO THE TWENTIES
  Carlos Lobo – Portugal, 2022 – FIC – 14'
- PÊ
  Margarida Vila-Nova – Portugal, 2022 – FIC – 20'
- ICE MERCHANTS
  João Gonzalez – Portugal, France, UK, 2022 – ANI – 14'
  First Portuguese animated film to be nominated for the Oscars.

Clubes Ciência Viva nas Escolas

In the context of the Clubes Ciências Viva nas Escolas project, promoted by the Ciência Viva national agency, for the implementation of various A&A activities with schools, protocols were established with 89 schools: Agrupamento de Escolas (AE) DR Mário Fonseca EB JI de Macieira; AE DR Mário Fonseca JI Uchas – Aveleda; AE D.Dinis; AE de Santa Maria da Feira; AE Soares Basto; AE DR Mário Fonseca – EB Lustosa; AE

DR Mário Fonseca – EB/JI Telheiro – São Miguel; AE DR Mário Fonseca – EB de Sousela; AE Paços de Ferreira; AE Carlos Amarante; AE Abel Salazar; AE Ribeiro Sanches; AE Pedrouços; AE Vilela; AE Penafiel Sudeste; AE Professor Abel Salazar; AE de Pinheiro; AE Eng. Fernando Pinto de Oliveira; AE Dr. Flávio Gonçalves; AE de Caminha; AE Arqueólogo Mário Cardoso; AE Paredes de Coura; AE Souselo; AE Canas de Senhorim; AE Valadares; AE Santa Bárbara; AE de Abação; AE Tomaz Pelayo; AE Santa Cruz da Trapa; AE D Afonso Henriques; AE Rates; AE Garcia de Orta; Escola Básica Irmãos Passos; AE de Rio Tinto; AE Vialonga; AE Dr Carlos Pinto Ferreira; AE Latino Coelho; AE de Monserrate; AE nº1 de Gondomar; AE de Paços de Brandão; AE Senhora da Hora; AE Perafita; AE António Sérgio; AE Cristelo; AE Maia; AE Aurélia de Sousa; AE Carregado; AE Frazão; AE Viso; AE Sophia de Mello Breyner; AE Amares; Escola Básica e Secundária Dr. Vieira de Carvalho; AE da Gafanha da Encarnação; AE Infante D Henrique; Escola Secundária Almeida Garrett; AE D. Pedro I; Escola Secundária de Rocha Peixoto; AE de Ponte de Lima; AE de Santa Iria da Azóia; AE Lavra; AE D Mafalda; AE Resende; AE Daniel Faria; AE Rodrigues de Freitas; AE Manuel Laranjeira; AE À Beira Douro; AE Armamar; AE Clara de Resende; AE de Caldas de Vizela; AE Alexandre Herculano; AE Freamunde; AE D Antonio Taipa; AE Matosinhos; AE Lordelo; Escola Secundária de Paredes; AE Coronado e Castro; AE Rio Tinto 3; AE Fajões; AE Lousada Oeste; Conservatório de Música do Porto; AE Amadeo de Souza-Cardoso; AE Gaia Nascente; AE Castêlo da Maia; AE Padre Bartolomeu de Gusmão; AE Padrão da Légua; AE Manuel Oliveira; AE Adelaide Cabbet – Odivelas; AE Arrifana – Milheirós; AE Paulo Gama; ES S. Pedro da Cova.

Staff Training

Attendance at Continuing Education / Other courses

- Congresso, VI Erasmus+ Equity and Inclusion Seminar, online, 30/11
- Seminário, Que papel para o feedback, para as rubricas e para os alunos na Avaliação Pedagógica?, online, 24/11
- Congresso, Jornadas de Educação: da escola que temos à escola que queremos, Santa Maria da Feira, 20/11
- Seminário, Ponto do Cidadão: um roteiro para a prática multidisciplinar, online, 18/11
- 2nd Workshop on Astronomy Beyond the Common Senses for Accessibility and Inclusion, online, 17 a 18/11
- ECSITE Workroom – Sharing Space: Creative Collaboration for Cutting-edge Astronomy Public Engagement, online, 17/11 a 15/12
- Encontro, Educar pela positiva, online, 4/11
- -Seminário, Contextualising STEM Carrers in Integrated STEM Teaching, online, 2/11
- Encontro, Bullying: violência não é brincadeira!, onlinem, 21/10
- Oficina (workshop), 3rd Shaw-IAU Workshop on Astronomy for Education, online, 12 a 15/10
- Encontro, Escola Amiga da Criança – Professores Notáveis!, online, 5/10
- Oficina (workshop), Metodologias, Métodos e Situações de Aprendizagem: Propostas e Estratégias de Ação, online, 25/9
- Conferência, 6º Encontro sobre Inovação Pedagógica Supertabi – 3ª sessão, online, 18/9
- Conferência, 6º Encontro sobre Inovação Pedagógica Supertabi – 2ª sessão, online, 11/9
- Encontro, VI Jornadas Pedagógicas TEIP – da sala de aula às tecnologias digitais: um percurso com sentido obrigatório, online, 8/9
- -Conferência, 6º Encontro sobre Inovação Pedagógica Supertabi – 1ª sessão, online, 4/9
- Oficina (workshop), Ferramentas para os professores alcançarem a sua realização pessoal e profissional, online, 15/7
- Oficina (workshop), NASE course BOXES ONLINE: Astroculture, online, 1/7
- Oficina (workshop), NASE course BOXES ONLINE: Astrophysics, online, 30/6
- Encontro, Ciência 2021, online, 28 a 30/6
- Oficina (workshop), NASE course BOXES ONLINE: Astrobiology, online, 18/6
- Oficina (workshop), NASE course BOXES ONLINE: Astronomy, online, 8/6
- Seminário, Formação de professores: o que foi feito e o que está por fazer, online, 2/6
- Seminário, Inteligência Artificial na Educação: o quê e quando, online, 26/5
- Seminário, A Nova Geração de Manuais, online, 12/5
- Seminário, Manuais e outros REDs: experiências e perspetivas, online, 12/5
- Oficina (workshop), E@D nas Escolas, online, 3/3 a 12/5
- Encontro, X A Ciência por quem a faz e por quem a ensina, online, 8/5
- Encontro, Novidades no ensino da Biologia-Geologia, online, 6/5
- Encontro, Novidades no ensino das Ciências Naturais, São João da Madeira, 29/4
- Seminário, A Escola depois do E@D, online, 28/4
- Seminário, Seminário Permanente de Políticas de Ciência, Comunicação e Cultura, online, 22/4
- Seminário, SELFIE tool for schools, online, 21/4

- Encontro, Nova geração de manuais escolares, online, 20/4
- Oficina (workshop), I Workshop Ibero-Americano de Educação Inclusiva, online, 14 a 16/4
- Encontro, Ambientes híbridos de aprendizagem, online, 8/4
- Seminário, Ecossistema(s) de Educação Digital e Ambientes Híbridos de Aprendizagem – Um Processo de Inovação Sustentada, online, 31/3
- Seminário, Apps & Companhia, online, 23/3
- Seminário, Saídas de campo virtuais em ambiente Google Earth – Serra da Freita (Arouca), online, 16/3
- Seminário, Geologia aos 12 anos... Que desafios?, online, 11/3
- Seminário, Capacitar para a relação pedagógica com os alunos, online, 10/3
- Seminário, Alterações climáticas: mitigação ou adaptação?, online, 9/3
- Seminário, "Olhar" a Terra | Mobile learning, online, 4/3
- Encontro, O manual como ferramenta de aprendizagem ativa, online, 2/3
- Seminário, À conversa com… Os nossos alunos: O manual escolar de Biologia e Geologia, online, 25/2
- Seminário, "Olhar" a Terra | Tectónica, online, 25/2
- Encontro, Recursos Educativos Digitais de Geologia, online, 23/2
- Encontro, E@D… e agora?, online, 18/2
- Seminário, "Olhar" a Terra | Sismologia, online, 18/2
- Seminário, Estudo eficiente de ciências exatas – uma visão da neuropsicologia, online, 12/2
- Seminário, "Olhar" a Terra | Vulcanismo, online, 11/2
- Encontro, O ensino das Ciências através de laboratórios remotos e virtuais, online, 11/2
- Seminário, Avaliação das Aprendizagens – Propostas e Estratégias de Ação, online, 10/2
- Encontro, Paleontologia na sala de aula: práticas presenciais e em E@D, online, 9/2
- Seminário, STEM School Label – a European-wide accreditation?, online, 12/12
- Seminário, Avaliação pedagógica: uma abordagem prática, online, 12/12
- Seminário, A felicidade e o bem-estar nas escolas portuguesas, 24/11
- Seminário, Orientações e estratégias para uma Escola Feliz, 9/11
- Seminário, Felicidade dos Professores: quem assegura?, 10/11
- Seminário, O Scratch – De A a Z, 29/9
- Conferência, 7º Encontro sobre Inovação Pedagógica Supertabi, 10/9
- Summer School, The Climate Education Summer University (CESU), 18 a 22/7
- Conferência, 2022 EDULOG International Conference – Teacher Education: building an agenda for the 21st century, 5 e 6/7
- Oficina, Science Communication for Professionals, 6 a 8 de junho
- Seminário, Será a Diferenciação Pedagógica para todos? , 7 de junho
- Conferência, Transição Digital nos Ensinos Básico e Secundário – estratégias e práticas, 27 e 28/5
- Seminário, Que não se brinque com o brincar, 26/5
- Oficina, MW-Gaia WG5 workshop – Breaking Barriers: Inspiring the Next Generation, 23 a 25/5
- Encontro, Novos Desafios, novas soluções digitais, 17/5
- Encontro, A mais recente geração de manuais escolares, 9/5
- Seminário, A nova geração de Manuais e a Escola Virtual como ecossistema digital, 4/5
- Oficina, Communicating Science to Non-Specialists, 25/3 a 7/4
- Encontro, Monitorização de Atividades de Projeto: casos práticos, 6/4
- Encontro, Avaliar e Aprender numa Cultura de Inovação Pedagógica, 24/3
- Seminário, ECO@CienTISTA – Investigar para aprender, 12/3
- Seminário, Bridging STEM gaps among students globally, 10/3
- Seminário, O digital na formação de professores (inicial e contínua), 9/3
- Congresso, X Convenção Nacional: A Escola que desconhecemos, 5/3
- Encontro, Atividades Outdoor virtuais em ambiente Google Earth: Parque Nacional da
- Peneda-Gerês, 23/2
- Seminário, Cooperação: Estratégia e Finalidade de Aprendizagem, 18/2
- Seminário, Teaching Sustainability for Action, 10/1 a 16/2
- Encontro, Biodiversidade: componentes e novas tecnologias, 15/2
- Encontro, Atividades outdoor virtuais em ambiente Google Earth – Portugal Insular, 2/2
- Encontro, Cidadania Digital, 17/1
- Oficina, Educador Inovador Microsoft, 10/1
- Encontro, Como integrar facilmente os recursos digitais na sala de aula?, 5/1

Supervision of short projects/internships

- Faculdade de Belas Artes da Universidade do Porto
  The Planetário do Porto hosted 2 undergraduate students for a 3-month internship.

- Faculdade de Ciências da Universidade do Porto
  The Porto Planetarium supervised **three FCUP students** in the "Programa de Estágios Extra-Curricular – PEEC" .
- Instituto Politécnico do Porto – Escola Superior de Educação
  The Porto Planetarium supervised **nineteen students** of the Basic Education degree, in their research "on non formal education institutions".
- Instituto do Emprego e Formação Profissional: The Planetário do Porto hosted **two students** from a 3-month internship. The students developed a 3d visualisation and mapping application of the stars with extrasolar planets.
- Summer Internships: IA organised online summer internships in all IA's six areas of work, including Science Communication. During three weeks, four students attended the internship in Science Communication promoted by PP-CCV.

Teaching of courses, short courses or others

Organized and implemented the following training courses (TC) and short duration actions (SDA) for school teachers:

- TC (25 hours – 20 Portuguese teachers) "Curso ESERO – Compreender a Terra através do espaço I" (6th edition3, 4 and 5 editions);
- TC (25 Portuguese hours – 20 teachers) "Curso ESERO – Compreender a Terra através do espaço II (1st edition);
- SDA (4 hours – 20 Portuguese teachers – including teachers from Portuguese islands) "ESERO – James Webb Space Telescope: uma nova janela para o universo" (1st edition);
- TC (50 hours – 80 teachers – including teachers from Portuguese islands) "Oficina CFJR, Governo Regional dos Açores, Governo Regional da Madeira – Metodologias orientadas para a investigação com recursos digitais" (4 editions);
- SDA (6 hours – 20 Portuguese teachers – including teachers from Portuguese islands) " Curso NASE – Astrobiologia I" (1st edition);
- SDA (6 hours – 20 Portuguese teachers – including teachers from Portuguese islands) "Curso NASE – Astrobiologia II" (1st edition);
- SDA (6 hours – 20 Portuguese and CPLP teachers – including teachers from Portuguese islands) "Curso NASE – Astrofísica I" (1st edition);
- SDA (6 hours – 20 Portuguese and CPLP teachers – including teachers from Portuguese islands) "Curso NASE – Astrofísica II" (1st edition);
- SDA (6 hours – 20 teachers from Timor-Leste) "Curso NASE – Astronomia I" (1st edition);
- SDA (6 hours – 20 teachers from Timor-Leste) "Curso NASE – Astronomia II" (1st edition);
- SDA (4 hours – 60 Portuguese teachers – including teachers from Portuguese islands) "ESERO/FCUP – Descobrir o Universo com Telescópios Escolares 2022/2023" (3 editions)

Contributed/Invited Talks & Posters

Invited Talks

- E. Moreira, S. Pereira; Science Communication overview; IA-ON 8, online, Portugal; 10 November 2021

Contributed talks

- Elsa Moreira, "CoAstro: @an Astronomy Condo-a new possible path for GAIA a dissemination strategy", Santiago de Compostela, 25/05/2022
- Ilídio André Costa, Da formação contínua ao desenvolvimento profissional: de um imperativo laboral, a uma necessidade intrínseca – a estratégia co desenhada do Planetário do Porto – Centro Ciência Viva, I Congresso Internacional Escola, Identidades e democracia, Porto, Portugal, 2022/07/08.
- Ilídio André Costa, Knowledge of Primary Teachers about Key Concepts: the fragile foundation of Astronomy Education, 4th Shaw-IAU Workshop on Astronomy for Education, online, 2022/11/15 and 2022/11/16.

Participation in committees

Participation in Working Groups

- Representantes Nacionais da European Association for Astronomy Education
- Embaixadores do European Space Education Resource Office (ESERO) – Portugal
- Membros do European Network of Science Centres and Museums (Ecsite) Space Group
- Membros do EROAD – European Regional Office of Astronomy for Development – Portugal
- Membros do Pale Blue Dot: Astronomy for Global Citizenship and Environmental Awareness
- Membros do Cartas Com Ciência – Associação Native Scientist
- Membros do Grupo de trabalho de Formação – Rede Portuguesa de Ciência Cidadã – CC.pt
- Membros do Citizen Science & Open Science Community of Practice – Citizen Science Global Partnership
- Membros da European Science Education Research Association (ESERA)
- Membros da RICAP – Rede Iberoamericana de Ciência Participativa
- Membros da Rede de Comunicação de Ciência e Tecnologia de Portugal (SciComPT)
- Parceiros do projeto The Impact of Career-Long Professional Learning on Physics Teacher Identity, Wellbeing and Self Efficacy.
- Parceiros do projeto (componente de comunicação do projeto) do Cosmology and Fundamental Physics with ESPRESSO (CosmoESPRESSO)
- Parceiros do CoAstro: um Condomínio de @stronomia
- Membro do "CA18104 Revealing the Milky Way with Gaia – WG5: Impact, Inclusiveness and Outreach"
- Membro do "IAU EC WG on Astronomy for Equity and Inclusion sWG5: Inclusive Outreach (Inspiring Stars)"
- Embaixador Scientix – European Schoolnet
- Strand chair do European Science Education Research Association (ESERA) 2023
- Representante Nacional da European Association for Astronomy Education
- Embaixador do European Space Education Resource Office (ESERO) – Portugal
- Membro do European Network of Science Centres and Museums (Ecsite) Space Group
- Membro do EROAD – European Regional Office of Astronomy for Development – Portugal
- Membro da EAS – European Astronomical Society
- Membro do Pale Blue Dot: Astronomy for Global Citizenship and Environmental Awareness
- Membro do Cartas Com Ciência – Associação Native Scientist
- Membro do Grupo de trabalho de Formação – Rede Portuguesa de Ciência Cidadã – CC.pt
- Membro do Citizen Science & Open Science Community of Practice – Citizen Science Global Partnership
- Membro da European Science Education Research Association (ESERA)
- Membro da RICAP – Rede Iberoamericana de Ciência Participativa
- Membro da Rede de Comunicação de Ciência e Tecnologia de Portugal (SciComPT)
- Membro do “STEM Discovery Campaign 2022”, Scientix –European Schoolnet.

Participation in panels/committees

- Comissão de avaliação externa, Agência de Avaliação e Acreditação do Ensino Superior (A3ES)
- Division C Education, Outreach and Heritage – IAU
- Executive Committee WG Junior Members – IAU
- Network for Astronomy School Education (NASE) – IAU
- Commission of Astronomy Education and Development – IAU
- Commission of Communicating Astronomy with the Public – IAU
- Working Group – Communicating Astronomy with the Public (CAP) Conferences – IAU
- Astronomy Education Resources (AstroEDU) – IAU
- Working group – Key Initiatives in Education, Outreach and Development – IAU
- Membro da Comissão Científica do 22nd International Multidisciplinary Scientific
- GeoConference SGEM (Survey, Geology, Ecology and Management) 2022.
- Jurado no concurso internacional “Catch a star 2021/2022”, European Association for
- Astronomy Education & European Southern Observatory.
- Coordenador nacional do concurso internacional “Latitude para viajar e navegar”,
- United Nations Educational Scientific and Cultural Organization (UNESCO) & Network
- for Astronomy School Education (NASE).
- Coordenador nacional do concurso internacional “Moonwalkers”, European Association
- for Astronomy Education (EAAE) & European Southern Observatory (ESO).

Peer review in journals

- Education Applications & Developments VI, InScience Press
- APEduC Journal – Research and Practices in Science, Mathematics and Technology Education, Associação Portuguesa de Educação em Ciências (APEduC)
- Revista Educação em Foco, Universidade Federal de Juiz de Fora
- Avaliador da componente pedagógica dos materiais submetidos ao Projecto EDULOG – Casa das Ciências
- CAPjournal, International Astronomical Union – Communicating Astronomy with the Public
- AstroEdu Journal, União Astronómica Internacional
- EPS – Earth and Planetary Science
- Avaliador da componente pedagógica dos materiais submetidos ao Projecto EDULOG -
- Casa das Ciências
- APEduC Journal – Research and Practices in Science, Mathematics and Technology
- Education, Associação Portuguesa de Educação em Ciências (APEduC)
- Revista Educação em Foco, Universidade Federal de Juiz de Fora

UnAS – Administration and Services Unit

Head (for 2012-2022): Manuel A. S. Monteiro

This Unit integrates all supporting services necessary to build an efficient and effective set of resources that provide adequate support for the different activities in CAUP and IA.

During 2020 the pandemic caused by covid-19 introduced unexpected challenges that required changes to standard working methods and procedures. These continued to evolve and adapt to the situation during 2022 which helped to recover most of the lost productivity. Cyber security continues to be a great concern due to the increase of tailored phishing campaigns.

During this year:

- One staff member continues to be dedicated to support the principal investigators of european and national projects, and as a project manager for IA;
- The staff member dedicated to public procurement and human resources starts at CAUP;
- Network security policies hardened to decrease the number of potential attack vectors;
- Update of several web services and migration to a new server.

Regarding project management, the overall activity of the year included:

- Preparation and submission to FCT of 20 pedidos de pagamento;
- Preparation and submission to FCT of 10 pedidos de pagamento for Investigador FCT;
- Preparation and submission to European Commission of 1 pedido de pagamento;
- Preparation and submission to Ciência Viva of 2 pedidos de pagamento;
- Preparation and submission of 3 pedidos de pagamento for other funding.

Regarding human resources, the overall activity of the year included:

- 4 Research work contracts;
- 15 Research fellowship contracts;
- 20 Academic internship contracts;
- 4 Work contracts.

The staff has participated in specific training actions/events, including:

- Curso de Especialização em Compras e Contratação Pública – 2 May to 6 June, CEACP (Joana Bateira)

- Formação On-line "Nova Versão anoGov – R7" – 8 June, ANO – Sistemas de Informática e Serviços Lda (Joana Bateira)
- Curso de Competências Transversais – Emergência: procedimentos e prática – 2 to 4 November, FCUP (Joana Bateira)
- 3rd virtual BESTPRAC-EARMA meeting – 24 to 25 January, EARMA (Elsa Marta Silva)
- Darwin, racismo, machismo, colonialismo e política – 4 April, FCUP (Elsa Marta Silva)
- ERCEA PI Centric Event – 29 September, ERC & EC + PERIN-FCT (Elsa Marta Silva)
- ERCEA Grant Management Workshop for Portuguese HI – 30 September, ERC & EC + PERIN-FCT (Elsa Marta Silva)
- Meetup Temático – Do empreendedorismo tecnológico para o empreendedorismo social: práticas de gestão de talento – 19 October, CIS Porto + Infraspeak (Elsa Marta Silva)
- Sessão Informativa MSCA COFUND – 27 October, PERIN-FCT (Elsa Marta Silva)
- Competências Transversais – Emergência: procedimentos e prática – 2 to 4 November, FCUP + Batalhão de Sapadores Bombeiros do Porto (Elsa Marta Silva)
- De olhos vendados e ouvidos surdos – porque é tão difícil aceitar o invisível? – 7 December, Núcleo de Apoio à Inclusão UP (Elsa Marta Silva)
- Competências Transversais – Emergência: procedimentos e prática – 2 to 4 November, FCUP (Elsa Moreira)
- V Encontro Formativo Ciência Viva – 19 to 21 September, Rede de Centros Ciênca Viva (Adriana Silva)
- Workshop "Ciência, Pseudociência e Desinformação", Ciclo de Conferências "Como Dialogar com quem não quer ouvir" – 17 January, Associação Portuguesa de Sociologia (Ricardo Reis)
- Workshop "Origens da desinformação e fake news", Ciclo de Conferências "Como Dialogar com quem não quer ouvir" – 25 March, Associação Portuguesa de Sociologia (Ricardo Reis)
- GlobalSCAPE Nature Research Academies Webinar 1: Understanding Science Communication – 25 March, Nature (Harry Shirley) (Ricardo Reis)
- GlobalSCAPE Nature Research Academies Webinar 2: Effective Writing Strategies – 30 March, Nature (Harry Shirley) (Ricardo Reis)
- GlobalSCAPE Nature Research Academies Webinar 3: Platforms for Communicating Science to the Publice – 31 March, Nature (Harry Shirley) (Ricardo Reis)
- Popular science writing course – 23 April, Colin Stewart (Ricardo Reis)
- GlobalSCAPE Nature Research Academies Webinar 4: Working with Scientists – 6 June, Nature (Jeffrey Robens) (Ricardo Reis)
- GlobalSCAPE Nature Research Academies Webinar 5: Writing Effective Press Releases – 7 June, Nature (Jeffrey Robens) (Ricardo Reis)
- GlobalSCAPE Nature Research Academies Webinar 6: Maximizing External Promotion – 8 June, Nature (Jeffrey Robens) (Ricardo Reis)

Research projects/programmes

During 2022 there were 48 funded projects in CAUP, which provided most of the funds available for research related expenses, as well as for outreach and basic expenses. The research projects that in 2022 were supported by national and European funds are:

(i) Projects funded by the European Commission (EC):

- SKilled, Innovative & Entrepreneurial Scientists (SKIES) (GA Nº 101006212)

PI: Jarle Brinchmann
[start date: 01 March 2021 – end date: 31 August 2022]

- Revealing the Milky Way with Gaia (MW-GAIA) (COST ACTION CA18104)

PI: Vardan Adibekyan & Nuno Santos
[start date: 14 March 2019 – end date: 13 March 2023]

- FInding ExoeaRths: tackling the ChallengEs of stellar activity (FIERCE) (ERC GAP-101052347)

PI: Nuno Santos
[start date: 01 October 2022 – end date: 30 September 2027]

(ii) Research projects funded by Fundação para a Ciência e a Tecnologia (FCT):

- Characterizing the smallest planet hosts (IF/00849/2015/CP1276/CT0003)

PI: Elisa Delgado Mena
[start date: 01 January 2017 – end date: 31 March 2022]

- Zoom-In ON hIgh-mass Star forMation (IF/00956/2015/CP1273/CT0002)

PI: Nanda Kumar
[start date: 15 December 2016 – end date: 14 March 2022]

- Probing cosmic strings and other topological defects with gravitational waves (Gwstrings)

(POCI-01-0145-FEDER-031938 & PTDC/FIS-PAR/31938/2017)
PI: Lara Sousa
[start date: 15 October 2018 – end date: 14 October 2022]

- Planets – Towards Understanding their General circulation Atmospheres (P-TUGA)

(PTDC/FIS-AST/29942/2017)
PI: Pedro Machado
[start date: 03 September 2018 – end date: 02 September 2022]

- Identify the Earliest Supermassive Black Holes with ALMA (IdEaS with ALMA)

(PTDC/FIS-AST/29245)
PI: José Afonso
[start date: 03 September 2018 – end date: 02 September 2022]

- a Generation of Earth-ANalogs Exploration Spectrographs (G.EANES)

(POCI-01-0145-FEDER-032113 & PTDC/FIS-AST/32113/2017

PI: Nuno Santos
[start date: 01 August 2018 – end date: 31 July 2022]

- Cosmology and Fundamental Physics with ESPRESSO (CosmoESPRESSO)

(POCI-01-0145-FEDER-028987 & PTDC/FIS-AST/28987/2017
PI: Carlos Martins
[start date: 01 June 2018 – end date: 31 May 2022]

- Exploring exoPlanets wIth CHEOPS (EPIC)

(POCI-01-0145-FEDER-028953 & PTDC/FIS-AST/28953/2017)
PI: Sérgio Sousa
[start date: 01 June 2018 – end date: 31 May 2022]

- Breaking through outstanding problems in stellar evolution with ultra-precise

space-based photometry (BreakStarS) (POCI-01-0145-FEDER-030389 &
PTDC/FIS-AST/30389/2017)
PI: Margarida Cunha
[start date: 01 May 2018 – end date: 30 April 2022]

- Dark matter and metals in galaxies (DarkMAGE) (PTDC/FIS-AST/4862/2020)

PI: Jarle Brinchmann
[start date: 01 September 2021 – end date: 31 August 2024]

- Stellar Activity Modelling for exoplanet detection (SAM) (EXPL/FIS-AST/0615/2021)

PI: João Faria
[start date: 01 January 2022 – end date: 31 December 2023]

- Finding Lyman-alpha emitters through machine learning (FLAEMING) (EXPL/FIS-AST/1085/2021)

PI: Ana Paulino Afonso
[start date: 01 January 2022 – end date: 30 June 2023]

(iii) Infrastructure funded projects (FCT):

- R&D Unit 2020-2023 Financing: Instituto de Astrofísica e Ciências do Espaço (UIDB/04434/2020 & (UIDP/04434/2020)

PI: Francisco Lobo
[start date: 01 January 2020 – end date: 31 December 2023]

(iv) Cooperation projects funded by Gabinete de Relações Internacionais da Ciência e do Ensino Superior (FCT) and by Conselho de Reitores das Universidades Portuguesas:

- Strategic partnership in astrophysics Portugal-Brazil: the connection between black holes and galaxies using powerful new instrumentation and theoretical insights (Cooperação Científica e Tecnológica FCT/CAPES)

PI: Andrew Humphrey / Jean Michel Gomes
[start date: 01 May 2018 – end date: 31 December 2022]

- Evolution of realistic cosmic strings and superstrings (Convénio FCT/CNRS)

PI: Carlos Martins
[start date: 01 January 2021 – end date: 31 December 2022]

- Black Hole mergers as probes of Large Scale Structure (PARSUK)

PI: José Fonseca
[start date: 01 September 2022 – end date: 31 December 2022]

(vi) Other projects:

- Participation to CHEOPS Science Operations Centre (SOC)

PI: Nuno Santos
[start date: 31 October 2013 – end date: 31 October 2023]

- PLATO OGSE and PDC Phase B (ESA Contract No. 4000133026)

PI: Nuno Santos
[start date: 1 January 2018 – end date: 31 December 2025]

Outreach projects

During 2022, there were 6 funded outreach projects in CAUP, which provide funds available for outreach related expenses. These were:

- AstroCamp 2022

PI: Carlos Martins

[start date: 01 january 2022 – end date: 31 December 2022]

- Ocupação Científica dos Jovens nas Férias 2022

PI: Carlos Martins

[start date: 01 january 2022 – end date: 31 December 2022]

- Formação ESERO

PI: Filipe Pires/Ilídio Lopes

[start date: 01 January 2022 – end date: 31 December 2022]

- Light Fingerprints – Europlanet Society

PI: Nuno Santos

[start date: 01 january 2021 – end date: 31 December 2022]

- SDSS block grants for Plate distribution

PI: Filipe Pires/Ilídio Lopes

[start date: 01 january 2021 – end date: 31 December 2022]

- Capacitação dos Centros de Ciência Viva (NORTE-09-5864-FSE-000027)

PI: Filipe Pires

[start date: 01 April 2021 – end date: 31 March 2023]

Research grants

Several grants have been active in 2022 with financial support of CAUP or with CAUP as the host institution.

Completed Post-Doctoral grants:

1. José E. O. Silva, Research fellowship - postdoctoral (CIAAUP-15/2022-BIPD), CAUP, 01 June 2022 to 31 August 2022
2. Pedro M. Palmeirim, Postdoctoral grant (SFRH/BPD/110176/2015), Fundação para a Ciência e a Tecnologia, 01 September 2016 to 29 November 2022

Ongoing PhD grants:

1. Sergei Mukovnikov, PhD grant (UI/BD/152220/2021), Fundação para a Ciência e a Tecnologia, 15 January 2022
2. Eduardo A. S. Cristo, PhD grant (PRT/BD/152703/2022), Fundação para a Ciência e a Tecnologia, 01 January 2022
3. Ana Rita Costa Silva, PhD grant (2021.07856.BD), Fundação para a Ciência e a Tecnologia, 01 October 2021
4. Nuno A. M. Moedas, PhD grant (UI/BD/152075/2021), Fundação para a Ciência e a Tecnologia, 15 September 2021
5. João D. F. Dias, PhD grant (SFRH/BD/150990/2021), Fundação para a Ciência e a Tecnologia, 01 February 2021
6. Nuno M. Rosário, PhD grant (2020.05472.BD), Fundação para a Ciência e a Tecnologia, 01 February 2021
7. André Miguel A. C. V. Silva, PhD grant (2020.05387.BD), Fundação para a Ciência e a Tecnologia, 01 January 2021
8. David Grüber, PhD grant (2020.07632.BD), Fundação para a Ciência e a Tecnologia, 01 October 2020
9. Miguel T. Clara, PhD grant (2020.07530.BD), Fundação para a Ciência e a Tecnologia, 01 October 2020
10. Abhishek Chougule, PhD grant (PD/BD/150439/2019), Fundação para a Ciência e a Tecnologia, 01 October 2019
11. Tomás de Azevedo Silva, PhD grant (PD/BD/150416/2019), Fundação para a Ciência e a Tecnologia, 01 October 2019
12. Thibault Boulet, PhD grant (PD/BD/150426/2019), Fundação para a Ciência e a Tecnologia, 01 October 2019

Completed PhD grants in 2022:

1. Sandy G. Morais, PhD grant (COVID/BD/152181/2021), Fundação para a Ciência e a Tecnologia, 01 December 2021 to 30 September 2022

The ongoing Research grants (PhD students, master students or graduates) were:

1. Bruno B. Cerqueira, Research assistantship grant for MSc degree (CIAAUP-21/2022-BI-M), CAUP, 01 October 2022
2. Afonso M. A. Vale, Research assistantship grant for MSc degree (CIAAUP-22/2022-BI-M), CAUP, 01 October 2022
3. Inês M. Rolo, Research assistantship grant for MSc degree (CIAAUP-19/2022-BI-M), CAUP, 15 September 2022
4. Eva L. Silva, Research assistantship grant for MSc degree (CIAAUP-18/2022-BI-M), CAUP, 15 September 2022
5. Maria Inês M. F. S. Ferreira, Research assistantship grant - MSc (CIAAUP-20/2022-BI-M), CAUP, 15 September 2022
6. José Rodrigues, Research assistantship grant - MSc (CIAAUP-17/2022-BI), CAUP, 01 July 2022

Completed research grants (PhD students, master students or graduates) in 2022 were:

1. Pedro Alexandre C. Cunha, Research assistantship grant - MSc (CIAAUP-16/2022-BI), CAUP, 01 June 2022 to 31 August 2022
2. Maria Inês M. F. S. Ferreira, Research Initiation Fellowship (BII) (CIAAUP-08/2022-BII), CAUP, 01 March 2022 to 30 April 2022
3. Tatiana S. S. Mendes, Research Initiation Fellowship (BII) (CIAAUP-05/2022-BII), CAUP, 01 March 2022 to 30 April 2022
4. Anselmo J. G. Falorca, Research Initiation Fellowship (BII) (CIAAUP-06/2022-BII), CAUP, 01 March 2022 to 30 April 2022
5. João M. A. Custódio, Research Initiation Fellowship (BII) (CIAAUP-07/2022-BII), CAUP, 01 March 2022 to 30 April 2022

6. José Rodrigues, Research assistantship grant for PhD degree (CIAAUP-13/2021-BI-D), CAUP, 01 January 2022 to 31 May 2022
7. Pedro Alexandre C. Cunha, Research assistantship grant for PhD degree (CIAAUP-12/2021-BI-D), CAUP, 15 November 2021 to 14 May 2022
8. Andreas W. Neitzel, Research assistantship grant for MSc degree (CIAAUP-08/2021-BI-M), CAUP, 01 September 2021 to 28 February 2022
9. Bárbara M. T. B. Soares, Research assistantship grant for MSc degree (CIAAUP-09/2021-BI-M), CAUP, 15 July 2021 to 14 January 2022
10. Sergei Mukovnikov, Research assistantship grant - MSc (CIAAUP-11-2020-BIM), CAUP, 05 November 2020 to 04 January 2022
11. Bárbara M. T. B. Soares, Research assistantship grant - Ph.D. (CIAAUP-12/2022-BI-D), CAUP, 01 May 2022 to 31 July 2022
12. Daniel A. D. Vaz, Research assistantship grant - Ph.D. (CIAAUP-03/2022-BI-D), CAUP, 01 March 2022 to 31 December 2022

The ongoing Science and Technology Management Grants were:

1. Tania F. S. Cunha, Science and Technology Management Grant (SFRH/BGCT/143136/2019), Fundação para a Ciência e a Tecnologia, 01 February 2019

Scientific Output and Activities

The scientific output of CAUP in 2022 was (see below):

Papers in refereed journals	149
Papers in proceedings	6
Communications in international meetings	52
Communications in national meetings	17
Observing runs	14

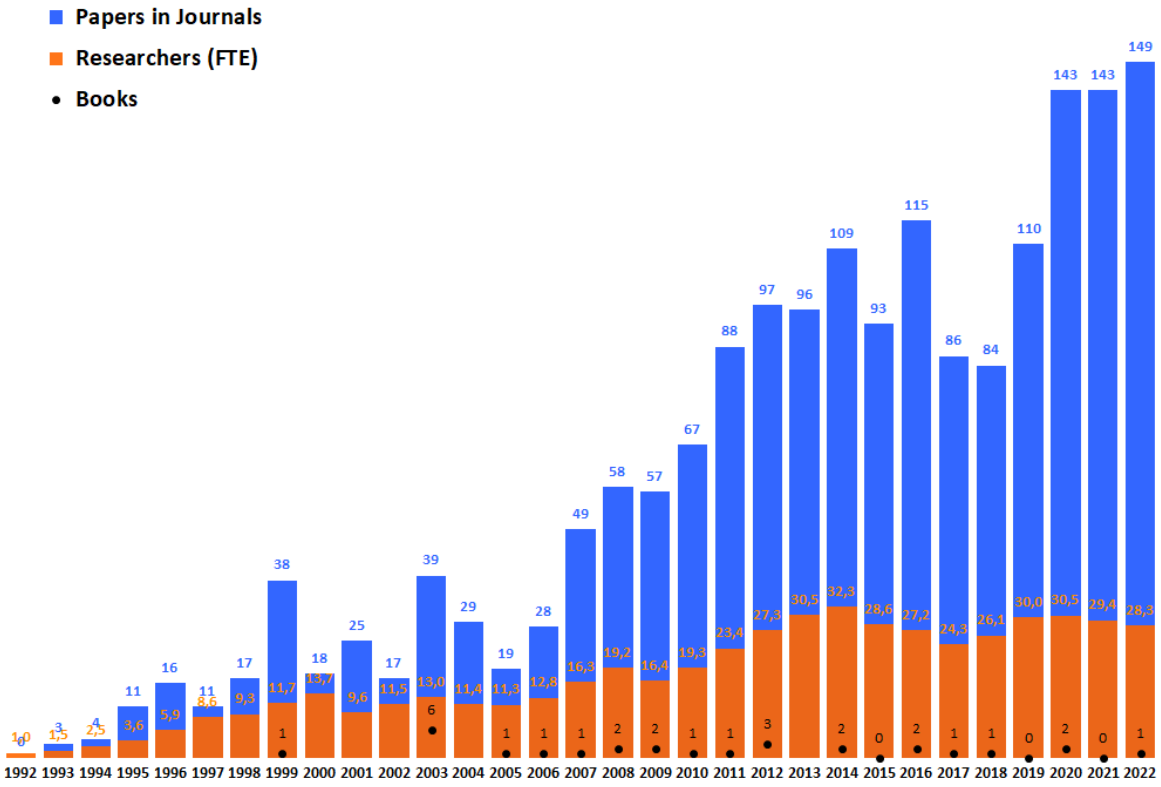


Figure 5: Blue bars – CAUP Publications in refereed journals per year; Orange bars – number of researchers with a PhD in full-time-equivalent (FTE) units; dots – books edited/published per year.

The h-index of CAUP is 141 (for a total of 108 067 accumulated citations).

If only refereed papers – as defined by ISI – are considered, the average number of citations per article is above 58. The evolution of this number over the years can be seen in Figure 7. The curve shows that the quality of the papers produced by CAUP (as measured by the average number of citations) continues to increase steadily.

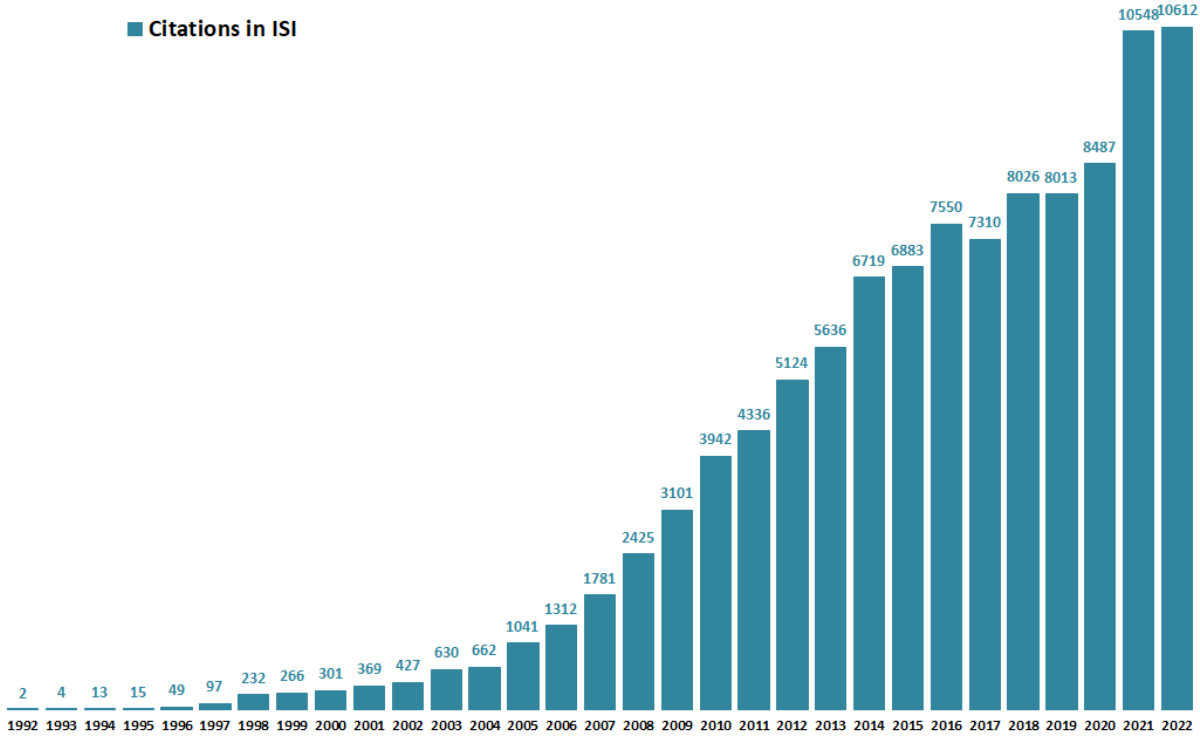


Figure 6: Citations per year from ISI using all entries in the database with CAUP/IA Porto in the affiliation.

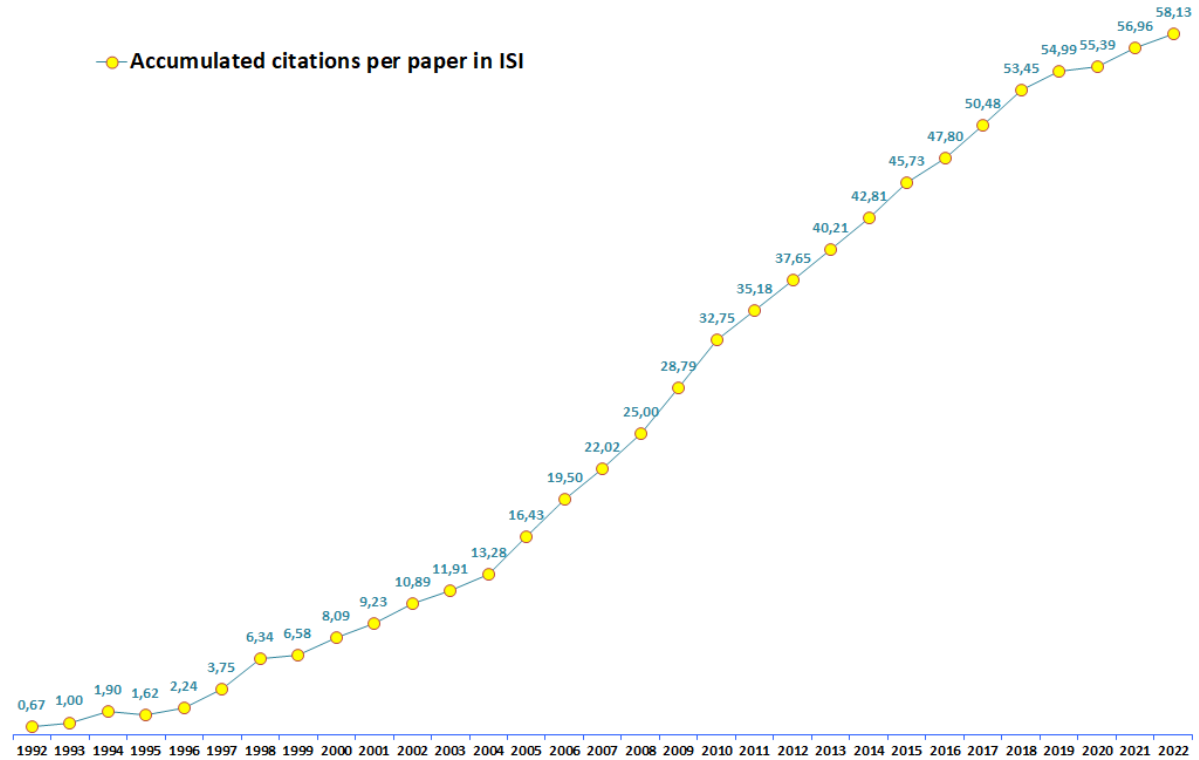


Figure 7: Accumulated citations per paper in ISI using all entries in the database with CAUP in the affiliation.

During 2022 CAUP organized, or co-organized, the following conferences, workshops, meetings or schools:

- Cosmonata 2022; 22 December 2022; Porto and Lisbon, Portugal
- Starts Day 2022; 16 December 2022; Porto, Portugal
- Scientific Workshop of the IA Group ‘’The assembly history of galaxies resolved in space and time’’; 28 to 29 November 2022; Coimbra, Portugal
- IA-ON9; Instituto de Astrofísica e Ciências do Espaço 9th internal workshop; 11 November 2022, Portugal
- 2DEMOC; 3 to 4 November 2022; Aveiro, Portugal
- General Relativistic effects in observing the Large Scale Structure of the Universe; 20 to 23 June 2022, Porto, Portugal
- Starts Day 1.5; 20 May 2022; Coimbra, Portugal
- SAM workshop #1; 13 May 2022; Porto, Portugal

Several team members also integrated the scientific organising committees of international Meetings/Conferences and have continued to serve as referees in all major international astronomy research journals. Several members of CAUP were also involved in activities within international Consortia and/or Working Groups.

In 2022 some members of the Research Unit served as National Delegates to European Organizations (ESA, ESO), served individually as experts in several international organisations, integrate on an individual basis European Commission Research Structures, or integrate the Scientific Committees, Commissions and/or Working Groups of the International Astronomical Union (IAU). CAUP researchers also served as evaluators for FCT panels (projects and/or grants) and in panels of several European programmes.

In 2022, CAUP received 13 visitors to develop collaborative work with team members, most of them being supported under the ongoing exchange programmes and projects, and organised 17 scientific seminars + 11 further organised by IA/U.Lisboa with CAUP participation, as well as frequent journal clubs in the various groups, the majority online.

Books in 2022

1. **C. J. A. P. Martins**, 2022; A História do Universo - A Nossa Visão Actual e como Chegámos a Ela; Edições 70

Refereed publications in 2022

1. L. S. M. Cardoso, **J. M. Gomes**, **P. Papaderos**, C. Pappalardo, H. Miranda, **A. Paulino-Afonso**, J. Afonso, **P. Lagos**, 2022; *Revisiting stellar properties of star-forming galaxies with stellar and nebular spectral modelling*; Astronomy & Astrophysics, 667, A11, 26
2. O. Barragán, D. J. Armstrong, D. Gandolfi, I. Carleo, A. A. Vidotto, C. Villarreal D'Angelo, A. Oklopčić, H. Isaacson, D. Oddo, K. A. Collins et al. (*including:* **S. G. Sousa, V. Zh. Adibekyan, S. C. C. Barros, O. Demangeon, P. Figueira, N. C. Santos**), 2022; *The young HD 73583 (TOI-560) planetary system: two 10-M⊕ mini-Neptunes transiting a 500-Myr-old, bright, and active K dwarf*; Monthly Notices of the Royal Astronomical Society, 514, 2, 1606

3. R. A. B. Claes, C. F. Manara, R. Garcia-Lopez, A. Natta, M. Fang, Z. P. Fockter, P. Ábrahám, J. M. Alcalá, J. Campbell-White, A. Caratti o Garatti et al. (*including:* **J. F. Gameiro**), 2022; *PENELLOPE. III. The peculiar accretion variability of XX Cha and its impact on the observed spread of accretion rates*; Astronomy & Astrophysics, 664, L7, 12
4. V. M. Passegger, A. Bello-García, J. Ordieres-Meré, **A. Antoniadis-Karnavas**, E. Marfil, C. Duque-Arribas, P. J. Amado, **E. Delgado-Mena**, D. Montes, B. Rojas-Ayala, 2022; *Metallicities in M dwarfs: Investigating different determination techniques*; Astronomy & Astrophysics, 658, A194, 33
5. M. Damasso, M. Perger, J. -M. Almenara, D. Nardiello, M. Pérez-Torres, A. Sozzetti, N. Hara, A. Quirrenbach, X. Bonfils, M. R. Zapatero Osorio et al. (*including:* **P. Figueira**), 2022; *A quarter century of spectroscopic monitoring of the nearby M dwarf Gl 514. A super-Earth on an eccentric orbit moving in and out of the habitable zone*; Astronomy & Astrophysics, 666, A187, 33
6. Euclid Collaboration, S. Ilić, N. Aghanim, C. Baccigalupi, J. R. Bermejo-Climent, G. Fabbian, L. Legrand, D. Paoletti, M. Ballardini, M. Archidiacono et al. (*including:* **J. Brinchmann**, **A. C. da Silva**, I. Tereno, C. S. Carvalho), 2022; *Euclid preparation. XV. Forecasting cosmological constraints for the Euclid and CMB joint analysis*; Astronomy & Astrophysics, 657, A91, 18
7. Euclid Collaboration, A. S. Borlaff, P. Gómez-Alvarez, B. Altieri, P. M. Marcum, R. Vavrek, R. J. Laureijs, R. Kohley, F. Buitrago, J.-C. Cuillandre et al. (*including:* **J. Brinchmann**, C. S. Carvalho, **A. C. da Silva**, I. Tereno), 2022; *Euclid preparation. XVI. Exploring the ultra-low surface brightness Universe with Euclid/VIS*; Astronomy & Astrophysics, 657, A92, 21
8. N. Hamaus, M. Aubert, A. Pisani, S. Contarini, G. Verza, M. -. Cousinou, S. Escoffier, A. J. Hawken, G. Lavaux, G. Pollina et al. (*including:* **J. Brinchmann**, **A. C. da Silva**, I. Tereno), 2022; *Euclid: Forecasts from redshift-space distortions and the Alcock-Paczynski test with cosmic voids*; Astronomy & Astrophysics, 658, A20, 14
9. Euclid Collaboration, A. Moneti, H. J. McCracken, M. Shuntov, O. B. Kauffmann, P. Capak, I. Davidzon, O. Ilbert, C. Scarlata, S. Toft et al. (*including:* **J. Brinchmann**, **A. C. da Silva**, I. Tereno, C. S. Carvalho), 2022; *Euclid preparation. XVII. Cosmic Dawn Survey: Spitzer Space Telescope observations of the Euclid deep fields and calibration fields*; Astronomy & Astrophysics, 658, A126, 15
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11. S. Nesseris, D. Sapone, M. Martinelli, D. Camarena, V. Marra, Z. Sakr, J. Garcia-Bellido, **C. J. A. P. Martins**, C. Clarkson, A. C. da Silva et al. (*including:* J. P. Mimoso, I. Tereno), 2022; *Euclid: Forecast constraints on consistency tests of the ΛCDM model*; Astronomy & Astrophysics, 660, A67, 23
12. Euclid Collaboration, F. Lepori, I. Tutusaus, C. Viglione, C. Bonvin, S. Camera, F. J. Castander, R. Durrer, P. Fosalba, G. Jelic-Cizmek et al. (*including:* **J. Brinchmann**, **A. C. da Silva**, I. Tereno, C. S. Carvalho), 2022; *Euclid preparation. XIX. Impact of magnification on photometric galaxy clustering*; Astronomy & Astrophysics, 662, A93, 26
13. Euclid Collaboration, M. Schirmer, K. Jahnke, G. Seidel, H. Aussel, C. Bodendorf, F. Grupp, F. Hormuth, S. Wachter, P. N. Appleton et al. (*including:* **J. Brinchmann**, **A. C. da Silva**, I. Tereno, C. S. Carvalho), 2022; *Euclid preparation. XVIII. The NISP photometric system*; Astronomy & Astrophysics, 662, A92, 32
14. Euclid Collaboration, R. Saglia, S. De Nicola, M. Fabricius, V. Guglielmo, J. Snigula, R. Zöller, R. Bender, J. Heidt, D. C. Masters et al. (*including:* **J. Brinchmann**, **A. C. da Silva**, I. Tereno, C. S. Carvalho), 2022; *Euclid preparation. XX. The Complete Calibration of the Color-Redshift Relation survey: LBT observations and data release*; Astronomy & Astrophysics, 664, A196, 22
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34. K. Z. Arellano-Córdova, M. Mingozzi, D. A. Berg, B. L. James, N. S. J. Rogers, A. Aloisi, R. O. Amorín Barbieri, **J. Brinchmann**, S. Charlot, J. Chisholm, 2022; *CLASSY V: The Impact of Aperture Effects on the Inferred Nebular Properties of Local Star-forming Galaxies*; The Astrophysical Journal, 935, 2
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130. D. J. Turner, P. A. Giles, A. K. Romer, R. Wilkinson, E. Upsdell, M. Klein, **P. T. P. Viana**, M. Hilton, S. Bhargava, C. A. Collins, 2022; *The XMM Cluster Survey: an independent demonstration of the fidelity of the eFEDS galaxy cluster data products and implications for future studies*; Monthly Notices of the Royal Astronomical Society, 517, 1, 657
131. **D. Arzoumanian**, D. Russeil, A. Zavagno, M. Chun-Yuan Chen, Ph. André, S.-I. Inutsuka, Y. Misugi, Á. Sánchez-Monge, P. Schilke, A. Men'shchikov, M. Kohno, 2022; *Velocity structure of the 50 pc long NGC 6334 filamentary cloud. Hints of multiple compressions and their impact on the cloud properties*; Astronomy & Astrophysics, 660, A56, 20
132. Q. Noraz, S. N. Breton, A. S. Brun, R. García, A. Strugarek, **A. R. G. Santos**, S. Mathur, L. Amard, 2022; *Hunting for anti-solar differentially rotating stars using the Rossby number. An application to the Kepler field*; Astronomy & Astrophysics, 667, A50, 16
133. R. Dungee, J. L. Van Saders, E. Gaidos, M. Chun, R. García, E. Magnier, S. Mathur, **A. R. G. Santos**, 2022; *A 4 Gyr M-dwarf Gyrochrone from CFHT/MegaPrime Monitoring of the Open Cluster M67*; The Astrophysical Journal, 938, 2
134. N. Heidari, I. Boisse, J. Orell-Miquel, G. Hébrard, L. Acuña, N. Hara, J. Lillo-Box, J. D. Eastman, L. Arnold, N. Astudillo-Defru et al. (*including:* **V. Zh. Adibekyan**, **O. Demangeon**, **E. Delgado Mena**, **N. C. Santos**, **S. G. Sousa**), 2022; *HD 207897 b: A dense sub-Neptune transiting a nearby and bright K-type star*; Astronomy & Astrophysics, 658, A176, 17
135. **C. J. A. P. Martins**, S. Cristiani, G. Cupani, V. D'Odorico, R. Génova Santos, **A. C. O. Leite**, **C. M. J. Marques**, D. Milaković, P. Molaro, M. T. Murphy et al. (*including:* **N. J. Nunes**, **V. Zh. Adibekyan**, **N. C. Santos**, **S. G. Sousa**), 2022; *Fundamental physics with ESPRESSO: Constraints on Bekenstein and dark energy models from astrophysical and local probes*; Physical Review D, 105, 12
136. **N. M. Rosário**, **S. C. C. Barros**, **O. Demangeon**, **N. C. Santos**, 2022; *Measuring the orbit shrinkage rate of hot Jupiters due to tides*; Astronomy & Astrophysics, 668, A114, 15
137. **J. Gomes da Silva**, **A. Bensabat**, **T. Monteiro**, **N. C. Santos**, 2022; Optimising the Hα index for the identification of activity signals in FGK stars. Improvement of the correlation between Hα and Ca II H&K; Astronomy & Astrophysics, 668, A174, 25
138. J. Lillo-Box, **N. C. Santos**, A. Santerne, **A. M. Silva**, D. Barrado, **J. P. Faria**, A. Castro-González, O. Balsalobre-Ruza, M. Morales-Calderón, A. Saavedra et al. (*including:* **S. G. Sousa**, **V. Zh. Adibekyan**, **S. C. C. Barros**, **E. Delgado-Mena**, **O. Demangeon**), 2022; *The KOBE experiment: K-dwarfs Orbited By habitable Exoplanets. Project goals, target selection, and stellar characterization*; Astronomy & Astrophysics, 667, A102, 12
139. C. Sauty, **R. M. G. Albuquerque**, V. Cayatte, **J. J. G. Lima**, **J. F. Gameiro**, 2022; *Nonradial and nonpolytropic astrophysical outflows. XI. Simulations of the circumstellar environment of RY Tauri*; Astronomy & Astrophysics, 664, A176, 13
140. P. Jáchym, M. Sun, M. Yagi, C. Ge, R. Luo, F. Combes, A. Kabátová, J. D. P. Kenney, **T. C. Scott**, E. Brinks, 2022; Citations (1) References (43) Co-Reads Similar Papers Volume Content Graphics Metrics Export Citation Feedback Non-star-forming molecular gas in the Abell 1367 intra-cluster multiphase orphan cloud; Astronomy & Astrophysics, 658, L5, 6
141. **P. Lagos**, S. I. Loubser, **T. C. Scott**, E. O'Sullivan, K. Kolokythas, A. Babul, A. Nigoche-Netro, V. Olivares, C. Sengupta, 2022; *Spatially resolved properties of early-type group-dominant galaxies with MUSE: gas content, ionization mechanisms, and metallicity gradients*; Monthly Notices of the Royal Astronomical Society, 516, 4, 5487
142. B. Deshev, R. Taylor, R. Minchin, **T. C. Scott**, E. Brinks, 2022; The Arecibo Galaxy Environment Survey (AGES). XI. The expanded Abell 1367 field: Data catalogue and H I census over the surveyed volume; Astronomy & Astrophysics, 665, A155, 18
143. N. Deg, K. Spekkens, T. Westmeier, T. N. Reynolds, P. Venkataraman, S. Goliath, A. X. Shen, R. Halloran, A. Bosma, B. Catinella et al. (*including:* **T. C. Scott**), 2022; *WALLABY Pilot Survey: Public release of HI kinematic models for more than 100 galaxies from phase 1 of ASKAP pilot observations*; Publications of the Astronomical Society of Australia, 39
144. Y. -F. Zhou, C. Sengupta, Y. Chandola, O. I. Wong, **T. C. Scott**, Y. -Z. Ma, H. Chen, 2022; *HIPASS study of southern ultradiffuse galaxies and low surface brightness galaxies*; Monthly Notices of the Royal Astronomical Society, 516, 2, 1781

145. **I. Yu. Rybak**, **L. Sousa**, 2022; *Emission of gravitational waves by superconducting cosmic strings*; Journal of Cosmology and Astroparticle Physics, 2022, 11
146. L. Magrini, C. Danielski, **D. Bossini**, M. Rainer, D. Turrini, S. Benatti, A. Brucalassi, M. Tsantaki, **E. Delgado Mena**, N. Sanna et al. (*including:* **T. L. Campante**, **S. G. Sousa**, **A. W. Neitzel**, **V. Zh. Adibekyan**), 2022; *Ariel stellar characterisation. I. Homogeneous stellar parameters of 187 FGK planet host stars: Description and validation of the method*; Astronomy & Astrophysics, 663, A161, 13
147. D. Mounzer, C. Lovis, J. V. Seidel, O. Attia, R. Allart, V. Bourrier, D. Ehrenreich, A. Wyttenbach, N. Astudillo-Defru, T. G. Beatty et al. (*including:* **S. G. Sousa**), 2022; *Hot Exoplanet Atmospheres Resolved with Transit Spectroscopy (HEARTS). VII. Detection of sodium on the long-transiting inflated sub-Saturn KELT-11 b*; Astronomy & Astrophysics, 668, A1, 18
148. M. R. Standing, A. H. M. J. Triaud, **J. P. Faria**, D. Martin, I. Boisse, A. C. M. Correia, M. Deleuil, G. Dransfield, M. Gillon, G. Hébrard, 2022; *BEBOP II: sensitivity to sub-Saturn circumbinary planets using radial-velocities*; Monthly Notices of the Royal Astronomical Society, 511, 3, 3571
149. **T. de Azevedo Silva**, **O. Demangeon**, **S. C. C. Barros**, D. J. Armstrong, J. F. Otegi, **D. Bossini**, **E. Delgado Mena**, **S. G. Sousa**, **V. Zh. Adibekyan**, L. D. Nielsen et al. (*including:* **N. C. Santos**, **P. Figueira**), 2022; *The HD 137496 system: A dense, hot super-Mercury and a cold Jupiter*; Astronomy & Astrophysics, 657, A68, 19

Proceedings published in 2022

1. A. Cabral, B. Wehbe, N. Blind, J. Coelho, M. Abreu, A. G. Segovia Milla, M. Sordet, F. Wildi, F. Bouchy, N. C. Santos, R. Doyon, G. Lo Curto, G. Zins, J. Kolb; 2022; NIRPS – the Near Infra-Red Planet Searcher: design, integration, and tests of the atmospheric dispersion corrector; Ground-based and Airborne Instrumentation for Astronomy IX; (Eds.)Christopher J. Evans; Julia J. Bryant; Kentaro Motohara, SPIE, Proceedings of the SPIE, 12184
2. I. A. Costa, C. Morais, M. J. P. F. G. Monteiro; 2022; CoAstro Citizen Science Project: contributions to teaching practices, attitudes, and beliefs towards science; Fostering Scientific Citizenship in an Uncertain World (Proceedings of ESERA 2021); (Eds.)Graça S. Carvalho; Ana Sofia Afonso; Zélia Anastácio, Universidade do Minho
3. I. A. Costa, C. Morais, M. J. P. F. G. Monteiro; 2022; CoAstro: @n Astronomy Condo – a new citizen science proposal for communicating astronomy with the public; Book of Proceedings Communicating Astronomy with the Public Conference 2021, NAOJ
4. I. A. Costa, C. Morais, M. J. P. F. G. Monteiro; 2022; Citizen science (CS): from a scientific technique to a science education and communication method – the CoAstro practical example; Proceedings of Science&You 2021 Paralel Sessions; (Eds.)Martin W. Bauer et al, Université de Lorraine
5. A. Marconi, M. Abreu, V. Zh. Adibekyan, V. Alberti, S. Albrecht, J. Alcaniz, M. Aliverti, C. Allende Prieto, J. D. Alvarado Gómez, P. J. Amado at al. (including: A. Cabral, O. Demangeon, J. P. Faria, C. J. A. P. Martins, M. A. Monteiro, N. J. Nunes, P. Papaderos, N. C. Santos, S. G. Sousa, B. Wehbe); 2022; ANDES, the high resolution spectrograph for the ELT: science case, baseline design and path to construction; Ground-based and Airborne Instrumentation for Astronomy IX; (Eds.)Christopher J. Evans; Julia J. Bryant; Kentaro Motohara, SPIE, Proceedings of the SPIE, 12184
6. M. Martinelli, C. J. A. P. Martins, S. Nesseris, I. Tutusaus, A. Avgoustidis, A. Blanchard, S. Camera, C. Carbone, S. Casas, S. Ilic, V. Pettorino, Z. Sakr, D. Sapone, V. Yankelevich; 2022; Testing fundamental cosmological assumptions with Euclid; 17th edition of the International Conference on Topics in Astroparticle and Underground Physics, Journal of Physics: Conference Series, 2156, 1

Reports in 2022

1. R.X. Adhikari et al. (including C. J. A. P. Martins), Report of the Topical Group on Cosmic Probes of Fundamental Physics for Snowmass 2021 (2022), Report for the U.S. decadal Particle Physics Planning Exercise, Snowmass 2021 (arXiv:2209.11726)
2. I. A. Costa, Building capacity for open science, UNESCO (DOI: 10.54677/dlyw1405)
3. I. A. Costa, Funding open science, UNESCO (DOI: 10.54677/mgvx2222)
4. U. Wehn, L. Hepburn, at al (including I. A. Costa), Guidance for the implementation of the UNESCO Open Science Recommendation re. "Opening science to society", 2022 (DOI: 10.5281/zenodo.7472827)
5. Leanne Guy, Jean-Charles Cuillandre, Etienne Bachelet, Manda Banerji, Franz E. Bauer, Thomas Collet, Christopher J. Conselice, Siegfried Eggl, Annette Ferguson, Adriano Fontana, Catherine Heymans, Isobel M. Hook, Éric Aubourg, Hervé Aussel, James Bosch, Benoit Carry, Henk Hoekstra, Konrad Kuijken, François Lanusse, … and the Rubin-Euclid DDP community (including, J. Brinchmann). (2022). Rubin-Euclid Derived Data Products – Initial Recommendations (1.1). Zenodo. https://doi.org/10.5281/zenodo.7195671

International Scientific Communications in 2022

1. V. Zh. Adibekyan; 2022; Understanding planets through their host stars in the eyes of PLATO; PLATO WP122 Liège workshop #5, Liege, Belgium
2. V. Zh. Adibekyan; 2022; The Chemical link between stars and their rocky planets; CHEOPS Science Workshop VI, Online, Switzerland
3. V. Zh. Adibekyan; 2022; Composition of super-Earths, super-Mercuries, and their host stars; Forming and Exploring Habitable Worlds, Edinburgh, Uk
4. V. Zh. Adibekyan; 2022; Diversity of terrestrial planets: a link to the chemical makeup of their host stars; Europlanet Science Congress (EPSC) 2022, Granada, Spain
5. S. C. C. Barros; 2022; Exoplanets with PLATO and GAIA; Transient sky with Gaia, Coimbra, Portugal
6. S. C. C. Barros; 2022; Status of the WG5 Feature characterise; CHEOPS Science Team Meeting #24, Online, switzerland
7. S. C. C. Barros; 2022; Status of the WG5 Feature characterise; CHEOPS Science Team Meeting #25, Padova, Italy
8. S. C. C. Barros; 2022; Status of the WG5 Feature characterise; CHEOPS Science Team Meeting #26, Online, Switzerland
9. S. C. C. Barros; 2022; Cheops reveals the tidal deformation of WASP-103b; Cool Stars 21, Toulouse, France
10. S. C. C. Barros; 2022; Cheops reveals the tidal deformation of WASP-103b; CHEOPS Science Workshop VI, Online, Switzerland
11. D. Bossini; 2022; IA and asteroseismology; 9th Iberian Meeting on Asteroseismology, Montanejos, Spain
12. J. Brinchmann; 2022; EUCLID and Gaia; Transient Sky with Gaia, MW-Gaia WG2-WG4 workshop, Univ. Coimbra, Portugal
13. J. Brinchmann; 2022; Update on MUSE-Faint; Muse Busy Week, Potsdam, Germany
14. J. Brinchmann; 2022; Update on Antlia B; Muse Busy Week, Leiden, The Netherlands
15. T. L. Campante; 2022; Galactic Archaeology and Asteroseismology: A Synergetic Approach; Sub-Saharan Africa Advanced Astronomy Summer School, Entebbe, Uganda
16. T. L. Campante; 2022; Homogeneous ages and masses for stars in the Ariel Reference Sample; Ariel Consortium Meeting, Bologna, Italy
17. T. L. Campante; 2022; Pushing the boundaries of cool-dwarf asteroseismology with ESPRESSO; Asteroseismology in the Era of Surveys from Space and the Ground: Stars, Planets, and the Milky Way - TASC6/KASC13 Workshop, KU Luven, Belgium
18. M. T. Clara, M. S. Cunha, P. P. Avelino, T. L. Campante, D. R. Reese, S. Deheuvels; 2022; Towards a Comprehensive Characterization of Seismic Forward Modelling and Grid Interpolation; Asteroseismology in the Era of Surveys from Space and the Ground: Stars, Planets, and the Milky Way - TASC6/KASC13 Workshop, KU Luven, Belgium
19. I. A. Costa, D. F. M. Folha, F. A. L. Pires; 2022; A astronomia como ciência portal para o ensino interdisciplinar: de uma práxis eficaz, ao desaparecimento curricular da astronomia;; Porto International Conference on Research in Education 2022, Porto, Portugal
20. I. A. Costa, D. F. M. Folha, F. A. L. Pires; 2022; Da formação contínua ao desenvolvimento profissional: de um imperativo laboral, a uma necessidade intrínseca – a estratégia co desenhada do Planetário do Porto – Centro Ciência Viva; Congresso Internacional Escola, Identidades e Democracia, Porto, Portugal
21. I. A. Costa; 2022; Knowledge of Primary Teachers About Key Concepts: the Fragile Foundation of Astronomy Education; 4th Shaw-IAU Workshop on Astronomy for Education, , Online
22. M. S. Cunha; 2022; The legacy of space-based asteroseismolgy; Cool Stars 21, Toulouse, France
23. M. S. Cunha; 2022; An asteroseismic view of the A-F pulsators: intriguing and challenging!; Asteroseismology in the Era of Surveys from Space and the Ground: Stars, Planets, and the Milky Way - TASC6/KASC13 Workshop, KU Luven, Belgium
24. M. Deal; 2022; CESTAM: Transport of chemical elements; Atelier codes stellaires du PNPS, Observatoire de Paris, France
25. M. Deal; 2022; Le Soleil est-il une étoile chimiquement particulière?; Journées SF2A 2022, Besançon, France
26. E. Delgado Mena; 2022; Exoplanet host stars and the star-planet connection; Exoplanets IV, Las Vegas, USA
27. E. Delgado Mena; 2022; ARIEL stellar characterization: Stellar abundances sub-WG; Ariel Consortium Meeting, Paris - Online, France
28. O. Demangeon; 2022; ESPRESSO scratches the surface of the small planet population; Exoplanets IV, Las Vegas, USA

29. J. D. F. Dias; 2022; Generalizing models with variations of the fine-structure constant driven by scalar fields: extended Bekenstein model coupled to the dark sector; 33rd Rencontres de Blois: Exploring the Dark Universe, Château of Blois, France
30. A. J. G. Falorca, M. S. Cunha, P. P. Avelino, J. Amaral, J. Pessoa, D. Bossini; 2022; Probing the interior of Subdwarf B stars through asymptotic fitting of glitch signatures; Cool Stars 21, Toulouse, Toulouse
31. J. P. Faria; 2022; Stellar activity at the cm/s level with ESPRESSO; GPRV workshop, All Souls College, Oxford, UK
32. J. C. Fonseca; 2022; On the relevance of the relativistic effects in cross-correlations of future spectroscopic surveys; General Relativistic effects in observing the Large Scale Structure of the Universe, Porto, Portugal
33. J. C. Fonseca; 2022; Fisher forecasts for the MeerKLASS survey; HITS 2022 - Hi Intensity Mapping in Trieste, Institute for Fundamental Physics of the Universe (IFPU), Trieste, Italy
34. N. A. M. Moedas; 2022; Exploring the effect of turbulent mixing in F-type stars; 9th Iberian Meeting on Asteroseismology, Montanejos, Spain
35. N. A. M. Moedas, D. Bossini, M. Deal, B. Campilho; 2022; Atomic Diffusion and Turbulent Mixing in Solar-Like Stars: Impact on the Fundamental Properties of FG-Type Stars; Cool Stars 21, Toulouse, France
36. N. A. M. Moedas; 2022; Chemical Transport Mechanisms in Solar-Like Stars: Exploring the Turbulent Mixing in FG-Type Stars; Asteroseismology in the Era of Surveys from Space and the Ground: Stars, Planets, and the Milky Way - TASC6/KASC13 Workshop, KU Luven, Belgium
37. E. M. P. S. Moreira, I. A. Costa; 2022; CoAstro: @an Astronomy Condo-a new possible path for GAIA's dissemination strategy; MW-Gaia WG5 workshop. Breaking Barriers: Inspiring the Next Generation, Santiago de Compostela, Spain
38. A. R. G. Santos, S. Mathur, R. García; 2022; The impact of metallicity on the evolution of rotation and magnetism of solar-like stars; 9th Iberian Meeting on Asteroseismology, Montanejos, Spain
39. A. R. G. Santos, S. N. Breton, S. Mathur, R. García; 2022; Surface Rotation And Photometric Magnetic Activity For 55,000+ Solar-Like Stars Observed By Kepler; Cool Stars 21, Toulouse, France
40. A. R. G. Santos, S. Mathur, R. García, Z. R. Claytor, A.-M. Broomhall, J. L. Van Saders, R. Egeland; 2022; Magnetic activity in the Sun and solar-like stars; Cool Stars 21, Toulouse, France
41. N. C. Santos; 2022; Stellar astrophysics and exoplanets: lessons and challenges; MWGaia workshop on Fundamental Stellar parameters from asteroseismology in the era of Gaia, Aarhus, Denmark
42. N. C. Santos; 2022; Top Level Requirements for Astronomical Instrumentation; Sub-Saharan Africa Advanced Astronomy Summer School, Entebbe, Uganda
43. N. C. Santos; 2022; The star-planet connection; Sub-Saharan Africa Advanced Astronomy Summer School, Entebbe, Uganda
44. N. C. Santos; 2022; Exoplanet detection methods; Sub-Saharan Africa Advanced Astronomy Summer School, Entebbe, Uganda
45. N. C. Santos; 2022; Looking for other Earths; XLV reunião anual da Sociedade Astronómica Brasileira, Online, Brazil
46. A. M. Silva; 2022; s-BART: a semi-Bayesian implementation of template matching for precise Radial Velocities; Exoplanets IV, Las Vegas, USA
47. B. Soares, V. Zh. Adibekyan, C. Dorn, S. G. Sousa, N. C. Santos, B. Bitsch, G. Israelian, C. Mordasini, M. Oshagh, M. Kunimoto, Y. Takeda, E. Jofré, R. Petrucci, E. Martioli; 2022; A compositional link between rocky exoplanets and their host stars; MW-Gaia WG5 workshop. Breaking Barriers: Inspiring the Next Generation, Santiago de Compostela, Spain
48. L. Sousa; 2022; Emission of gravitational waves by superconducting cosmic strings; Gravitational Wave Probes of Physics Beyond Standard Model 2, University of Warsaw (online), Poland
49. S. G. Sousa; 2022; CHEOPS TS3 report; CHEOPS Science Team Meeting #24, Online, Switzerland
50. S. G. Sousa, M. Carena; 2022; CHEOPS TS3 report; CHEOPS Science Team Meeting #25, Padova, Italy
51. D. A. D. Vaz, J. Brinchmann; 2022; Leo T Ultra-Faint Dwarf; 23rd MUSE Science Busy Week, Potsdam, Germany
52. D. A. D. Vaz, J. Brinchmann; 2022; Leo T dissected with MUSE-Faint; 24th MUSE Science Busy Week, Leiden, The Netherlands

National Scientific Communications in 2022

1. **P. A. C. Cunha**, A. Humphrey; 2022; *Photometric redshift-aided classification using ensemble learning*; XXXII Encontro Nacional de Astronomia e Astrofísica, Lisboa, Portugal
2. **T. de Azevedo Silva**; 2022; *Detection of Barium in the atmospheres of ultra-hot gas giants*; XXXII Encontro Nacional de Astronomia e Astrofísica, Lisboa, Portugal

3. **J. D. F. Dias**; 2022; Generalizing models with variations of the fine-structure constant driven by scalar fields: extended Bekenstein; 7th IDPASC/LIP Students Workshop, Universidade de Coimbra, Portugal
4. **J. D. F. Dias**; 2022; *Constraints on extended Bekenstein models from cosmological, astrophysical and local data*; XXXII Encontro Nacional de Astronomia e Astrofísica, Lisboa, Portugal
5. **C. J. A. P. Martins**; 2022; *An overview of ELT Line Calibrations WG activities*; XXXII Encontro Nacional de Astronomia e Astrofísica, Lisboa, Portugal
6. **N. A. M. Moedas**; 2022; The chemical transport mechanisms in stellar interiors: atomic diffusion and macroscopic transport process; Encontro com a Ciência e Tecnologia em Portugal 2022, Lisboa, Portugal
7. **A. W. Neitzel**, **D. Bossini**, **T. L. Campante**, **N. A. M. Moedas**; 2022; *Stellar Characterization for the Ariel Space Mission*; FÍSICA 2022 – 23ª Conferência Nacional de Física e 32º Encontro Ibérico para o Ensino da Física, Porto, Portugal
8. **A. W. Neitzel**, **D. Bossini**, **T. L. Campante**; 2022; *Homogenous Stellar Characterization for the Ariel Space Mission*; XXXII Encontro Nacional de Astronomia e Astrofísica, Lisboa, Portugal
9. **A. R. G. Santos**; 2022; Variability in the magnetic activity of Kepler solar-like stars; Stars Day 2022, Porto, Portugal
10. **A. R. G. Santos**; 2022; *Magnetic activity in the Sun and solar-like stars*; SAM workshop #1, Porto, Portugal
11. **N. C. Santos**; 2022; *PoET: a solar telescope for planet hunters*; XXXII Encontro Nacional de Astronomia e Astrofísica, Lisboa, Portugal
12. **N. C. Santos**; 2022; *Our Solar System and Exoplanets*; Space Studies Program 2022, International Space University, Oeiras, Portugal
13. **N. C. Santos**; 2022; *The PoET solar telescope*; SAM workshop #1, Porto, Portugal
14. **N. C. Santos**; 2022; *Planetary Systems@IA*; IA-ON9 meeting, Online, Portugal
15. **A. M. Silva**; 2022; Spectral modelling with GPs: first steps towards a fully Bayesian RV model; SAM workshop #1, Porto, Portugal
16. **B. Soares**, **V. Zh. Adibekyan**, **N. C. Santos**, **E. Delgado Mena**, **S. G. Sousa**; 2022; *From stellar to planetary compositions: the challenging case of M dwarfs*; IJUP'22 – 15º Encontro de Investigação Jovem da Universidade do Porto, Porto, Portugal
17. **S. R. P. Veiga**, **A. H. M. Cabral**, **C. J. A. P. Martins**; 2022; *Statistical analysis of different dark energy and modified gravity type models*; XXXII Encontro Nacional de Astronomia e Astrofísica, Lisboa, Portugal

Visitors in 2022

The researchers/lecturers that have visited CAUP in 2022 were:

1. Monserrat Villar Martín, Centro de Astrobiologia, CSIC-INTA, Spain, 21 - 26 November 2022
2. Simon Albrecht, Department of Physics and Astronomy, Aarhus University, Denmark, 16 - 18 November 2022
3. Lilit V. Barkhudaryan, A. Alikhanian Yerevan Insitute of Physics, Armenia, 11 November - 20 December 2022
4. Michael T. Murphy, Swinburne University of Technology, Australia, 30 October - 2 November 2022
5. Brandon Nicholas Engelbrecht, University of the Western Cape, South Africa, 26 September - 24 October 2022
6. Stefano Zazzera, Queen Mary University of London, United Kingdom, 23 September - 1 November 2022
7. Alessandro Sozzetti, INAF - Osservatorio Astrofisico di Torino, Italy, 12 - 16 June 2022
8. Oscar Barragán, University of Oxford, United Kingdom, 12 - 16 June 2022
9. Adam Frank, Department of Physics and Astronomy, University of Rochester, United States, 31 May - 1 June 2022
10. Patrick Peter, IAP, France, 11 - 14 May 2022
11. E. P. S. Shellard, DAMTP, CMS, United Kingdom, 10 - 14 May 2022
12. Lisa Kaltenegger, Carl Sagan Institute, Cornell University, United States, 20 - 22 March 2022
13. Christophe Sauty, Observatoire de Paris, France, 13 - 19 March 2022

Scientific Seminars in 2022

1. Albrecht, S.; 2022; Exoplanet system architecture: Planets on peculiar orbits
2. Barkhudaryan, L. V.; 2022; Constraining Type Ia supernovae through their heights in edge-on galaxies
3. Barragán, O.; 2022; Detection of planetary signals in cases of extreme stellar activity
4. Conzinu, P.; 2022; Adiabatic renormalization with an IR cut-off
5. Corasaniti, P. S.; 2022; Probing Cosmology with Galaxy Cluster Sparsity
6. Farrah, D.; 2022; The cosmic evolution of active galaxies, and the assembly of their black holes

7. Frank, A.; 2022; The Photo-Evaporation of Exoplanet Atmospheres: What We Learn From 3-D Simulations
8. Kaltenegger, L.; 2022; Searching for another Earth
9. Koksbang, S. M.; 2022; Redshift drift in inhomogeneous universe models with concrete abstract cosmology
10. Magg, E.; 2022; Our Sun's chemical makeup: a fresh look at the old question
11. Messias, H.; 2022; The Atacama Compact Array as a survey machine of the early Universe
12. Murphy, M. T.; 2022; Fundamental physics with solar twins
13. Nielsen, M. B.; 2022; Detecting solar-like oscillators with TESS
14. Nurmi, S.; 2022; Looking beyond the inflaton sector: why should we be interested in spectators?
15. Saadeh, D.; 2022; Dark energy: can we Vainshtein screen a fifth fundamental force?
16. Sozzetti, A.; 2022; Gaia and exoplanets: DR2, (E)DR3, and beyond
17. Umeh, O.; 2022; The art of building a smooth cosmic distance ladder in a perturbed universe

Observing runs during 2022

1. E. Delgado Mena et al.; "RV variations in evolved stars in open clusters: planets, oscillations or stellar activity?"; 108.22LE (other observers); HARPS/ESO-La Silla 3.6m; period 108 remote observing
2. S. Sousa et al. (including, E. Delgado Mena); "Know the star to know the planet: improving SWEET-CAT with homogeneous planet-host parameters"; 109.22VY; UVES/VLT; period 109 service mode
3. C. Danielski et al. (including, E. Delgado Mena); "Building a public catalogue of homogeneously characterised Ariel exoplanet-host stars"; 109.23J9; UVES/VLT; period 109 service mode
4. D. Armstrong et al. (including, E. Delgado Mena); "Uncovering the origin of remnant planets in the hot Neptunian Desert"; 108.21YY (other observers); HARPS/ESO-La Silla 3.6m., P108-P109 remote observing
5. MUSE GTO team (including, J. Brinchmann); MUSE GTO run 48; MUSE/VLT; 22-28 Oct 2022
6. João Gomes da Silva, Nuno Santos, Pedro Figueira, Mahmoudreza Oshagh, João Faria, Susana Barros, Olivier Demangeon, Vardan Adibekyan, Sérgio Sousa, Elisa Delgado Mena, Jorge Martins; Follow-up observations of G 9-40b with ESPRESSO: A temperate super-Earth or sub-Neptune?; 108.22BT, ESPRESSO @ VLT; P108
7. J. P. Faria, HARPS programs, HARPS, ESO 3.6m, 15-19 April 2022
8. J.-F. Donati et al. (including J. F. Gameiro); SPICE: Consolidating & Enhancing the SPIRou Legacy Survey; CFHT/SPIRou, 174.28 nights, 4 semesters 2022b - 2024a.
9. G. Alecian, C. Dougados et al. (including, J. F. Gameiro); Magnetic-snapshot survey of Class I and Flat Spectrum protostars; CFHT/SPIRou; K1-01-00039, 36 hours, semester 22B, November 2022 – January 2023
10. C. Manara et al. (including, J. F. Gameiro); PENELLOPE: the ESO data legacy program to complete the Hubble UV Legacy Library of Young Stars (ULLYSES); 1106.C-1047, VLT (ESO)/ESPRESSO+XSHOOTER+UVES, 255.7hours, October 2020 - September 2022
11. S. A. G. Sousa; A. Mortier; N. C. Santos; B. Rojas Ayala; V. Adibekyan; G. Israelian; O. Demangeon; S. C. C. Barros; A. Antoniadis Karnavas; E. Delgado Mena; M. Tsantaki; B. Soares, Know the star to know the planet: improving SWEET-CAT with homogeneous planet-host parameters; UVES, VLT UT2, SM
12. T. L. Campante et al. (including, N. C. Santos, V. Adibekyan, M. S. Cunha), Pushing the boundaries of cool-dwarf asteroseismology with ESPRESSO, Program ID: 109.236P, Echelle SPectrograph for Rocky Exoplanets and Stable Spectroscopic Observations (ESPRESSO) at the Very Large Telescope (VLT), Period 109
13. C. Danielski et al. (including, T. L. Campante, M. Tsantaki, E. Delgado Mena), Building a public catalogue of homogeneously characterised Ariel exoplanet-host stars, Program ID: 109.23J9, Ultraviolet and Visual Echelle Spectrograph (UVES) at the Very Large Telescope (VLT), Period 109
14. P. Jáchym et al. (including, T. Scott), C8 large program, ALMA JELLY, ALMA, ongoing

External seminars by CAUP researchers in 2022

1. A. R. G. Santos, Rotation and magnetic activity of solar-type stars observed by Kepler; Astrophysics Department - American Museum of Natural History - New York (NY), United States, 26 April 2022
2. C. J. A. P. Martins, CosmoESPRESSO: A scientific research project from alpha to Omega, Physics & Astronomy Department, U.Porto, 27 April 2022
3. J. C. Fonseca, Prospects for multi-wavelength Cosmology as gravity and inflation probes, Queen Mary University of London, United Kingdom, 25 March 2022

4. J. C. Fonseca, Prospects for multi-wavelength Cosmology as gravity and inflation probes, Institute of Cosmology and Gravitation, United Kingdom, 28 March 2022
5. L. Sousa, Probing cosmic (super)strings with gravitational waves, London-Oldenburg Relativity Seminars, online, Uk/Germany, 13 June 2022
6. M. S. Nanda Kumar, Star cluster formation in hub-filament systems, Nagoya University, Japan, 9 December 2022
7. M. S. Nanda Kumar, Star cluster formation in hub-filament systems, National Astronomical Observatories of Japan, Mitaka, Japan, 12 December 2022
8. N. C. Santos, Looking for other Earths, Observatório do Valongo, Universidade Federal do Rio de Janeiro, Online, Brazil, 22 November 2022
9. S. C. C. Barros, Tidal deformation and tidal decay of WASP-103b, Rio de Janeiro, Brazil-online, LIneA SEMINARS, 9 June 2022
10. S. C. C. Barros, Frontiers of exoplanet characterisation, Birmingham, UK, 3 March 2022
11. S. C. C. Barros, Tidal deformation and tidal decay of WASP-103b, SCI-S SEMINARS - ESA, Madrid, Spain, 10 February 2022
12. V. Adibekyan, Other Suns and other Earths in the Milky Way (in Armenian), Yerevan State University, Armenia, 13 October 2022
13. A. Chougule, Self-Consistent Spectral modelling of Seyfert 2 galaxies, Universidade Federal do Rio Grande do Sul (UFRGS), Brazil, 23 November 2022
14. B. Soares, Composition of terrestrial planets orbiting M dwarfs, Bern, Switzerland, 22 April 2022
15. J. D. F. Dias, Statistical Methods in Astrophysics AstroCamp 2022, Viana do Castelo, Portugal, 15 August 2022
16. N. Moedas, Atomic Diffusion and Turbulent Mixing in Solar-Like Stars: Impact on the Fundamental Properties of FG-Type Stars, Meudon, France, 4 March 2022

Outreach talks in 2022

1. A. R. G. Santos, Testimony in the context of the International Day of Women and Girls in Science, Escola Secundária Dr Jaime de Magalhães Lima - Aveiro - Portugal, 8 March
2. A. R. G. Santos, Stellar Magnetic Activity, 4th Summer School of Astronomy - IST - Lisbon - Portugal, 8 September
3. C. Lobo, A evolução atribulada das galáxias, Faculdade de Ciências da Universidade do Porto (Etapa regional das Olimpíadas de Física), 23 April
4. C. Lobo, A Via Láctea e as outras galáxias, online talk for Escola Secundária de São Pedro do Sul (in the framework of ESERO - O Espaço vai à Escola), 12 October
5. C. Lobo, A Via Láctea e as outras galáxias, online talk for Clube Ciência Viva da Escola Básica de Santo Onofre, Caldas da Rainha (in the framework of ESERO - O Espaço vai à Escola), 12 October
6. C. Lobo, A Via Láctea e as outras galáxias, Escola Secundária Dr. José Macedo Fragateiro, Ovar (in the framework of ESERO - O Espaço vai à Escola), 19 October
7. C. Lobo, A Via Láctea e as outras galáxias, online talk for Escola Básica Guilherme Stephens, Marinha Grande (in the framework of ESERO - O Espaço vai à Escola), 26 October
8. C. Lobo, A Via Láctea e as outras galáxias: uma viagem através do Universo, Escola Básica Maria Lamas, Porto, 3 November
9. C. Lobo, A Via Láctea e as outras galáxias: uma viagem através do Universo, Escola Básica e Secundária de Fontes Pereira de Melo, Porto, 4 November
10. C. J. A. P. Martins, A Física da Relatividade, 9 May, ES Raul Proença, Caldas da Rainha
11. C. J. A. P. Martins, A Física da Atmosfera e do Aquecimento Global, 6 October, ES de Rio Tinto
12. C. J. A. P. Martins, A Física da Vida e dos Extraterrestres, 7 October, ES de Fornos de Algodres
13. C. J. A. P. Martins, A Física da Atmosfera e do Aquecimento Global, 11 October, ES de S. Roque do Pico
14. C. J. A. P. Martins, The Physics of the Atmosphere and Global Warming, 12 October, ES Camilo Castelo Branco, Famalicão
15. C. J. A. P. Martins, A Física da Relatividade, 12 October, ES Camilo Castelo Branco, Famalicão
16. C. J. A. P. Martins, A Física da Radioactividade e do Cancro, 12 October, ES D.Sancho I, Famalicão
17. C. J. A. P. Martins, A Física da Relatividade, 14 October, ES José Saramago, Mafra
18. C. J. A. P. Martins, A Física da Atmosfera e do Aquecimento Global, 17 October, ES de S. Pedro do Sul
19. C. J. A. P. Martins, A Física da Radioactividade e do Cancro, 19 October, ES Martinho Vaz de Castelo Branco, Póvoa de Santa Iria
20. C. J. A. P. Martins, A Física da Atmosfera e do Aquecimento Global, 19 October, ES Gago Coutinho, Alverca
21. C. J. A. P. Martins, A Física da Vida e dos Extraterrestres, 20 October, Colégio Vasco da Gama, Sintra
22. C. J. A. P. Martins, A Física da Atmosfera e do Aquecimento Global, 20 October, ES da Portela, Lisboa

23. C. J. A. P. Martins, A Física da Relatividade, 21 October, ES António Damásio, Lisboa
24. C. J. A. P. Martins, A Física da Gravidade e dos Satélites, 21 October, ES José Gomes Ferreira, Lisboa
25. C. J. A. P. Martins, A Física do Big Bang, 24 October, ES Josefa de Óbidos, Lisboa
26. C. J. A. P. Martins, A Física da Vida e dos Extraterrestres, 25 October, ES da Bemposta, Portimão
27. C. J. A. P. Martins, A Física da Radioactividade e do Cancro, 26 October, ES Aurélia de Sousa, Porto
28. C. J. A. P. Martins, A Física da Relatividade, 26 October, ES Clara de Resende, Porto
29. C. J. A. P. Martins, A Física da Gravidade e dos Satélites, 28 October, ES da Ribeira Grande
30. C. J. A. P. Martins, A Física da Gravidade e dos Satélites, 28 October, ES Emídio Navarro, Almada
31. C. J. A. P. Martins, A Física da Atmosfera e do Aquecimento Global, 3 November, ES da Amadora
32. C. J. A. P. Martins, A Física da Gravidade e dos Satélites, 3 November, ES António Carvalho Figueiredo, Loures
33. C. J. A. P. Martins, A Física da Gravidade e dos Satélites, 4 November, ES Afonso de Albuquerque, Guarda
34. C. J. A. P. Martins, A Física da Gravidade e dos Satélites, 4 November, ES de Pinhal de Rei, Marinha Grande
35. C. J. A. P. Martins, A Física do Big Bang, 8 November, ES Francisco Fernandes Lopes. Olhão
36. C. J. A. P. Martins, A Física da Radioactividade e do Cancro, 8 November, ES Laura Ayres, Quarteira
37. C. J. A. P. Martins, A Física do Big Bang, 9 November, ES Mouzinho da Silveira, Portalegre
38. C. J. A. P. Martins, A Física da Radioactividade e do Cancro, 10 November, ES António Granjo, Chaves
39. C. J. A. P. Martins, A Física da Gravidade e dos Satélites, 11 November, ES Júlio Martins, Chaves
40. C. J. A. P. Martins, A Física da Atmosfera e do Aquecimento Global, 14 November, ES de Mora
41. C. J. A. P. Martins, A Física da Relatividade, ES de Camilo Castelo Branco, Carnaxide, 14 November 2022
42. C. J. A. P. Martins, A Física da Radioactividade e do Cancro, ES de Santa Maria Maior, Viana do Castelo, 17 November 2022
43. C. J. A. P. Martins, A Física da Gravidade e dos Satélites, ES Inês de Castro, Vila Nova de Gaia, 17 November 2022
44. C. J. A. P. Martins, A Física do Big Bang, ES Sebastião de Gama, Setúbal, 22 November 2022
45. C. J. A. P. Martins, A Física da Gravidade e dos Satélites, Externato Cooperativo da Benedita, Alcobaça, 22 November 2022
46. C. J. A. P. Martins, A Física da Gravidade e dos Satélites, ES de Ponte de Sôr, 25 November 2022
47. C. J. A. P. Martins, A Física da Atmosfera e do Aquecimento Global, ES Amadeu Gaudêncio, Nazaré, 30 November 2022
48. D. F. M. Folha, A Impressão Digital dos Astros, Escola Secundária do Entroncamento, Agrupamento de Escolas do Entroncamento, online, 8 February 2022
49. D. F. M. Folha, Astrobiologia: Um Universo para explorar, ENEF 2022, Covilhã, 26 February 2022
50. D. F. M. Folha, A Impressão Digital dos Astros, Agrupamento de Escolas de Constância, via zoom, 16 March 2022
51. D. F. M. Folha, O céu não é o limite, Escola Secundária Augusto Gomes, Matosinhos, 11 October 2022
52. J. Brinchmann, Exoplanets, Tomter, Norway, 8 February 2022
53. J. Brinchmann, SDSS plates, Professores em Funchal, Madeira, online, 5 March 2022
54. J. Brinchmann, SDSS plates, Professores em São Miguel, Açores, online, 7 May 2022
55. L. Sousa, As três mensageiras do Universo: Luz, Partículas, e Ondas Gravitacionais, Dia Internacional das Mulheres e Raparigas na Ciência, online, 11 February 2022
56. I. A. Costa, Um dia muito especial, Escola Básica de Guetim, Espinho, 6 October 2022
57. I. A. Costa, Um dia muito especial, Colégio da Imaculada Conceição, Coimbra, 7 October 2022
58. I. A. Costa, Um dia muito especial, Escola Básica Alexandre Herculano, Lisboa, 10 October 2022
59. I. A. Costa, Um dia muito especial, Escola Básica de Pedreiras, Porto de Mós, 11 October 2022
60. I. A. Costa, Um dia muito especial, Escola Básica de São João da Foz, Porto, 12 October 2022
61. I. A. Costa, Um dia muito especial, Escola Básica Louro Artur, Almada, 17 October 2022
62. I. A. Costa, Um dia muito especial, Colégio do Oriente, Lisboa, 18 October 2022
63. I. A. Costa, Um dia muito especial, Escola Básica de Gens, Gondomar, 19 October 2022
64. I. A. Costa, Um dia muito especial, Escola Básica de Pedreiras, Porto de Mós, 20 October 2022
65. I. A. Costa, Um dia muito especial, Escola Básica de Pedreiras, Porto de Mós, 21 October 2022
66. I. A. Costa, Com a verdade me enganas, Escola Básica de Abação, Guimarães, 21 October 2022
67. I. A. Costa, Um dia muito especial, Escola Básica e Secundária de Airães, Felgueira, 24 October 2022
68. I. A. Costa, Um dia muito especial, Escola Básica de Outeiro, Gondomar, 25 October 2022
69. I. A. Costa, Um dia muito especial, Externato "Bom Jesus" , Matosinhos, 26 October 2022
70. I. A. Costa, Um dia muito especial, Escola Básica de Vila Nova de Poiares, Vila Nova de Poiares, 27 October 2022
71. I. A. Costa, Um dia muito especial, Escola Básica e Secundária de Santa Maria, Açores, 28 October 2022

72. I. A. Costa, Com a verdade me enganas, Escola Básica do Carregado, Alenquer, 28 October 2022
73. I. A. Costa, Um dia muito especial, Externato "Bom Jesus" , Matosinhos, 28 October 2022
74. I. A. Costa, Um dia muito especial, Escola Básica n.º 3 de Espinho, Espinho, 31 October 2022
75. I. A. Costa, Um dia muito especial, Escola Básica de Vouzela, Vouzela, 2 November 2022
76. I. A. Costa, Um dia muito especial, EB da Vilarinha - AE Manoel Oliveira, Porto, 3 November 2022
77. I. A. Costa, Com a verdade me enganas, Escola Básica Maria Pais Ribeiro - A Ribeirinha, Vila do Conde, 3 November 2022
78. I. A. Costa, Com a verdade me enganas, Escola Básica D. Pedro IV, Mindelo, Vila do Conde, 3 November 2022
79. I. A. Costa, Um dia muito especial, Escola Secundária de Ponte de Sor, Ponte de Sôr, 4 November 2022
80. I. A. Costa, Um dia muito especial, Escola Básica Júlio Dinis, Grijó, Vila Nova de Gaia, 7 November 2022
81. I. A. Costa, Um dia muito especial, Escola Básica de Vouzela, Vouzela, 9 November 2022
82. I. A. Costa, Com a verdade me enganas, Escola Básica e Secundária Michel Giacometti, Sesimbra, 10 November 2022
83. I. A. Costa, Um dia muito especial, Jardim do Fraldinhas, Leiria, 10 November 2022
84. I. A. Costa, Com a verdade me enganas, Escola Básica e Secundária de Miranda do Douro, Miranda do Douro, 11 November 2022
85. I. A. Costa, Com a verdade me enganas, Escola Profissional do Pico, Açores, 14 November 2022
86. I. A. Costa, Um dia muito especial, Escola Básica das Sarzedas, Castelo Branco, 14 November 2022
87. I. A. Costa, Um dia muito especial, Escola Básica de Chave, Arouca, 15 November 2022
88. I. A. Costa, Um dia muito especial, Agrupamento de Escolas Frei Heitor Pinto, Covilhã, 16 November 2022
89. I. A. Costa, Um dia muito especial, Jardim de Infância de S Caetano 2, Gondomar, 16 November 2022
90. I. A. Costa, Um dia muito especial, Escola Básica n.º 2 de São Caetano, Gondomar, 16 November 2022
91. I. A. Costa, Um dia muito especial, Externato "S. João Bosco", Porto, 17 November 2022
92. I. A. Costa, Um dia muito especial, Salesianos do Porto - Colégio, Porto, 18 November 2022
93. I. A. Costa, Um dia muito especial, Salesianos do Porto - Colégio, Porto, 19 November 2022
94. I. A. Costa, Um dia muito especial, Salesianos do Porto - Colégio, Porto, 20 November 2022
95. I. A. Costa, Um dia muito especial, Escola Básica de Atães, Gondomar, 21 November 2022
96. I. A. Costa, Um dia muito especial, Escola Básica D. Pedro IV, Sintra, 22 November 2022
97. I. A. Costa, Um dia muito especial, Escola Básica de Lagoa, Lagoa, 23 November 2022
98. I. A. Costa, Com a verdade me enganas, Escola Básica de Amareleja, Moura, 23 November 2022
99. I. A. Costa, Um dia muito especial, Escola Básica da Ponte, Porto, 24 November 2022
100. I. A. Costa, Com a verdade me enganas, Escola Básica da Agrela e Vale do Leça, Santo Tirso, 24 November 2022
101. I. A. Costa, Com a verdade me enganas, Escola Básica do Sudeste de Baião, Baião, 25 November 2022
102. I. A. Costa, Com a verdade me enganas, Escola Básica 2, 3 de Mundão, Viseu, 28 November 2022
103. I. A. Costa, Um dia muito especial, Escola Básica de Casal de Esporão, Viseu, 28 November 2022
104. I. A. Costa, Um dia muito especial, Colégio da Trofa, Trofa, 29 November 2022
105. I. A. Costa, Um dia muito especial, Escola Básica n.º 1 de Junqueira, Vila do Conde, 30 November 2022
106. I. A. Costa, Um dia muito especial, Escola Básica de Pego Longo, Sintra, 30 November 2022
107. I. A. Costa, Um dia muito especial, Escola Básica n.º 1 de Cesar, Oliveira de Azeméis, 2 December 2022
108. I. A. Costa, Com a verdade me enganas, Escola Básica Dr. Guilherme Correia de Carvalho, Seia, 5 December 2022
109. I. A. Costa, Um dia muito especial, Escola Básica Costa Cabral, Porto, 6 December 2022
110. I. A. Costa, Um dia muito especial, Escola Básica Eugénio de Andrade, Porto, 6 December 2022
111. I. A. Costa, Um dia muito especial, Externato "Ribadouro", Porto, 9 December 2022
112. I. A. Costa, Com a verdade me enganas, Escola Básica de Gafanha da Encarnação-Centro, Ílhavo, 12 December 2022
113. I. A. Costa, Um dia muito especial, Escola Básica n.º 2 de Espinho, Espinho, 13 December 2022
114. I. A. Costa, Um dia muito especial, Escola Básica de Paramos, Espinho, Espinho, 13 December 2022
115. I. A. Costa, Um dia muito especial, EB Silvalde, Silvalde, 13 December 2022
116. M. S. Cunha, LeV — Literatura em Viagem 2022 (Matosinhos), Os limites da Ciência e da Ficção; Conversa de registo informal, descontraída, com o autor Afonso Cruz, o professor Vítor Cardoso e moderação de Miguel Gonçalves; 15 May 2022
117. N. C. Santos, À procura de outras terras no Universo, em “Noites no Pátio do Museu”, Reitoria da UP, Porto, 21 July 2022
118. N. C. Santos, Conversa online sobre o Telescópio Espacial James Webb (JWST), Ciência Viva, 6 January 2022

119. J. P. M. de Carvalho, Da Idade da Magia a Galileu, Encontros com Ciência: A Terra no Universo e Nós na Terra, Paredes de Coura, 27 May 2022
120. J. P. M. de Carvalho, Robôs Espaciais, Colégio Flor da Linha, Paço de Arcos, 3 May 2022
121. J. P. M. de Carvalho, Da Idade da Magia a Galileu, Escola Secundária Eça de Queirós, Póvoa de Varzim, May 2022
122. J. P. M. de Carvalho, O Universo: Escalas e Conteúdo, Escola Básica de Santo Onofre, 2500-205 Caldas da Rainha, 3 October 2022
123. J. P. M. de Carvalho, Da Idade da Magia a Galileu, Colégio da Imaculada Conceição, 3510-094 VISEU, 4 October 2022
124. J. P. M. de Carvalho, O Universo: Escalas e Conteúdo, EB 4.º Conde de Ourém, 2490-529 Ourém, 6 October 2022
125. J. P. M. de Carvalho, O Universo: Escalas e Conteúdo, EB de Esporões, Rua Padre Manuel Carvalho, 4705-474 Esporões, Braga, 10 October 2022
126. J. P. M. de Carvalho, O Universo: Escalas e Conteúdo, EB+S D. Martinho Vaz de Castelo Branco, 2626-504 Póvoa Sta Iria, V.F.Xira, 11 October 2022
127. J. P. M. de Carvalho, O Universo: Escalas e Conteúdo, Escola Básica Mello Falcão, 1675-185 Pontinha, Odivelas, 12 October 2022
128. J. P. M. de Carvalho, O Universo: Escalas e Conteúdo, Escola Básica de Abação, Guimarães, 12 October 2022
129. J. P. M. de Carvalho, Da Idade da Magia a Galileu, EB Professor João de Meira, 4810-257 Guimaraes, 13 October 2022
130. J. P. M. de Carvalho, Da Idade da Magia a Galileu, EB Professor João de Meira, 4810-257 Guimaraes, 13 October 2022
131. J. P. M. de Carvalho, O Universo: Escalas e Conteúdo, Escola Secundária Raul Proença, 2500-852 Caldas da Rainha, 14 October 2022
132. J. P. M. de Carvalho, O Universo: Escalas e Conteúdo, EB da Vilarinha, Porto, 14 October 2022
133. J. P. M. de Carvalho, Da Idade da Magia a Galileu, EB+S Santos Simões, Guimarães; 4810-767 Mesão Frio, 17 October 2022
134. J. P. M. de Carvalho, Da Idade da Magia a Galileu, EB+S Santos Simões, Guimarães; 4810-767 Mesão Frio, 17 October 2022
135. J. P. M. de Carvalho, Da Idade da Magia a Galileu, EB Marquesa de Alorna,1070-095 LISBOA, 18 October 2022
136. J. P. M. de Carvalho, Da Idade da Magia a Galileu, EB Monsenhor Jerónimo do Amaral, 5000-290 Vila Real, 20 October 2022
137. J. P. M. de Carvalho, Da Idade da Magia a Galileu, EB+S D. Martinho Vaz de Castelo Branco, 2626-504 Póvoa Sta Iria, 21 October 2022
138. J. P. M. de Carvalho, Da Idade da Magia a Galileu, Colégio Machado Ruivo - Escolinha de Famalicão, V.N. de Famalicão, 21 October 2022
139. J. P. M. de Carvalho, O Universo: Escalas e Conteúdo, Colégio da Imaculada Conceição, 3510-094 VISEU, 24 October 2022
140. J. P. M. de Carvalho, Um universo de informação - A Luz, Colégio Militar, 1600-498 Lisboa, 25 October 2022
141. J. P. M. de Carvalho, Um universo de informação - A Luz, EB José Sobral, 8500-132 Mexilhoeira Grande, Portimão, 26 October 2022
142. J. P. M. de Carvalho, Um universo de informação - A Luz, EB + S da Bemposta, 8500-000 Portimão, 27 October 2022
143. J. P. M. de Carvalho, Um universo de informação - A Luz, Escola Secundária Dr. José Macedo Fragateiro, 3880-307 Ovar, 28 October 2022
144. J. P. M. de Carvalho, O Universo: Escalas e Conteúdo, Escola Básica e Secundária de Airães, 4650-078 Airães, Felgueiras, 31 October 2022
145. J. P. M. de Carvalho, O Universo: Escalas e Conteúdo, Agrupamento de Escolas Diogo de Macedo, Vila November de Gaia, 3 November 2022
146. J. P. M. de Carvalho, O Universo: Escalas e Conteúdo, Escola Básica e Secundária Santa Maria, Açores, 4 November 2022
147. J. P. M. de Carvalho, O Universo: Escalas e Conteúdo, Escola Básica e Secundária Matilde Rosa Araújo, 2785-438 Matarraque, Cascais, 7 November 2022
148. J. P. M. de Carvalho, Da Idade da Magia a Galileu, Escola Básica e Secundária Mestre Domingos Saraiva, 2725-043 Algueirão, 8 November 2022
149. J. P. M. de Carvalho, O Universo: Escalas e Conteúdo, ES Daniel Sampaio, 2815-811 Vale de Figueira, 8 November 2022
150. J. P. M. de Carvalho, Um universo de informação - A Luz, EB Dr. Carlos Pinto Ferreira, 4480-260 Junqueira, Vila do Conde, 9 November 2022

151. J. P. M. de Carvalho, O Universo: Escalas e Conteúdo, Agrupamento de Escolas Diogo de Macedo, Vila November de Gaia, 10 November 2022
152. J. P. M. de Carvalho, Um universo de informação - A Luz, Escola Secundária de S. Pedro do Sul, 3660-428 S. Pedro do Sul, 11 November 2022
153. J. P. M. de Carvalho, Um universo de informação - A Luz, Escola Portuguesa de São Tomé e Príncipe, 15 November 2022
154. J. P. M. de Carvalho, O Universo: Escalas e Conteúdo, Escola Básica e Secundária de Mora, 7490-000 Mora, 15 November 2022
155. J. P. M. de Carvalho, Um universo de informação - A Luz, EB do Sudeste de Baião, Santa Marinha do Zêzere, 4640-462 Barreiro, 16 November 2022
156. J. P. M. de Carvalho, O Universo: Escalas e Conteúdo, Agrupamento de Escolas Diogo de Macedo, Vila November de Gaia, 17 November 2022
157. J. P. M. de Carvalho, Da Idade da Magia a Galileu, Casa Pia de Lisboa, Lisboa, 21 November 2022
158. J. P. M. de Carvalho, O Universo: Escalas e Conteúdo, Escola Básica de Vila Boim, Elvas, 7350-501 Vila Boim, 22 November 2022
159. J. P. M. de Carvalho, O Universo: Escalas e Conteúdo, Escola Básica da Quinta de Marrocos, 1549-017 Lisboa, 22 November 202
160. J. P. M. de Carvalho, O Universo: Escalas e Conteúdo, Escola Secundária São Pedro, R. Morgado Mateus, 5000-455 Vila Real, 23 November 2022
161. J. P. M. de Carvalho, O Universo: Escalas e Conteúdo, Escola Secundária Viriato, Abraveses, 3510-204 Viseu, 28 November 2022
162. J. P. M. de Carvalho, O Universo: Escalas e Conteúdo, Escola Básica D. Afonso III, 8004-014 Faro, 29 November 2022
163. J. P. M. de Carvalho, Um universo de informação - A Luz, Escola Básica e Secundária de Miranda do Douro, 5210-192 Miranda do Douro, 5 December 2022
164. J. P. M. de Carvalho, O Universo: Escalas e Conteúdo, Agrupamento de Escolas Júdice Fialho, 8500-305 Portimão, 9 December 2022
165. J. P. M. de Carvalho, O Universo: Escalas e Conteúdo em Potências de 10, Escola Secundária de Rio Tinto, 4435-162 Rio Tinto, 13 December 2022
166. S. A. G. Sousa, À descoberta de outros Mundos, MonsarAstro, OLA, September 2022
167. S. A. G. Sousa, O mundo para além da terra, Jornadas da Ciência de Arouca, Arouca, December 2022
168. T. L. Campante, The music of the stars, Taibah International School, Kampala-Entebbe Rd, Uganda, 22 September 2022
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170. V. Adibekyan, Other Suns and other Earths in the Milky Way (in Armenian), Online, Armenia, 15 October 2022
171. A. R. Costa Silva, Uma Aventura no Atacama, Planetário do Porto, 5 October 2022
172. A. R. Costa Silva, Como detetar planetas longínquos?, Online, 23 November 2022
173. A. W. Neitzel, Determinação da idade e da massa de estrelas sísmicas no catálogo Ariel, Universidade do Porto, 27 April 2022
174. J. D. F. Dias, Statistical Methods in Astrophysics AstroCamp 2022, Viana do Castelo, Portugal, 15 August 2022
175. T. de Azevedo Silva, Lecture on the discovery of exoplanets to undergraduate/master students, VIII Jornadas de Engenharia Física, IST, Lisboa, March 2022

CONTAS

Balanço individual em 31 de Dezembro de 2022, valores em euro:

RUBRICAS	NOTAS	DATAS	
		12/31/2022	12/31/2021
ACTIVO			
Activo não corrente			
Activos fixos tangíveis	5	52,110.41	100,142.16
Activos intangíveis	4	4,240.23	6,569.26
Investimentos financeiros	15.2	16,342.35	19,208.35
		72,692.99	125,919.77
Activo corrente			
Inventários	6	4,191.08	4,291.76
Créditos a receber	8	18,889.45	17,672.02
Estado e Outros Entes Públicos	8	1,436.98	11,955.70
Diferimentos	8	5,716.08	7,175.21
Outros ativos correntes	8/15.1	2,457,138.35	2,090,660.78
Caixa e depósitos bancários	15.3	2,343,432.01	781,063.00
		4,830,803.95	2,912,818.47
Total do activo		4,903,496.94	3,038,738.24
FUNDOS PATRIMONIAIS E PASSIVO			
Fundos Patrimoniais			
Resultados transitados	8	1,045,095.83	998,773.50
Ajustamentos/Outras variações nos fundos patrimoniais	8	39,349.75	93,721.80
		1,084,445.58	1,092,495.30
Resultado líquido do período	8	61,675.80	46,322.33
Total dos fundos patrimoniais		1,146,121.38	1,138,817.63
Passivo			
Passivo corrente			
Fornecedores	8	2,663.02	374.95
Estado e outros entes públicos	8	27,261.89	42,343.56
Diferimentos	8	3,283,303.56	1,535,868.97
Outros passivos correntes	8	444,147.09	321,333.13
		3,757,375.56	1,899,920.61
Total do passivo		3,757,375.56	1,899,920.61
Total dos fundos patrimoniais e do passivo		4,903,496.94	3,038,738.24

Demonstrações Financeiras

Alterações no capital

Demonstração individual das alterações nos fundos patrimoniais no período de 2021

DESCRIÇÃO		NOTAS	Fundos Patrimoniais atribuidos aos instituidores da entidade-mãe							Interesses que não controlam	Total dos fundos patrimoniais
			Fundos	Encedentes Técnicos	Reservas	Resultados Transitados	Excedentes de revalorização	Ajustamentos/Outras variações nos fundos patrimoniais	Resultado líquido do período	Total	
POSIÇÃO NO INÍCIO DO PERÍODO 2021	1					1026233.29		204059.44	-27459.79	1202832.94	1202832.94
ALTERAÇÕES NO PERÍODO											
Primeira adopção de novo referencial contabilístico								0.00		0.00	0.00
Alterações de políticas contabilísticas											
Diferenças de conversão de demonstrações financeiras											
Realização de excedente de revalorização											
Excedentes de revalorização											
Ajustamentos por impostos diferidos											
Outras alterações reconhecidas nos fundos patrimoniais						-27459.79		-110337.64	27459.79	-110337.64	-110337.64
	2					-27459.79		-110337.64	27459.79	-110337.64	-110337.64
RESULTADO LÍQUIDO DO PERÍODO	3								46322.33	46322.33	46322.33
RESULTADO INTEGRAL	4=2+3								73782.12	-64015.31	-64015.31
OPERAÇÕES COM INSTITUIDORES NO PERÍODO											
Fundos											
Subsídios, doações e legados											
Distribuições											
Outras operações											
	5										0.00
POSIÇÃO NO FIM DO PERÍODO 2021	6=1+2+3+5					998773.50		93721.80	46322.33	1138817.63	1138817.63

Demonstração individual das alterações nos fundos patrimoniais no período de 2022

DESCRIÇÃO		NOTAS	Fundos Patrimoniais atribuidos aos instituidores da entidade-mãe							Interesses que não controlam	Total dos fundos patrimoniais
			Fundos	Encedentes Técnicos	Reservas	Resultados Transitados	Excedentes de revalorização	Outras variações nos fundos patrimoniais	Resultado líquido do período	Total	
POSIÇÃO NO INÍCIO DO PERÍODO 2022	6					998773.50		93721.80	46322.33	1138817.63	1138817.63
ALTERAÇÕES NO PERÍODO		2									
Primeira adopção de novo referencial contabilístico											
Alterações de políticas contabilísticas											
Diferenças de conversão de demonstrações financeiras											
Realização de excedente de revalorização											
Excedentes de revalorização											
Ajustamentos por impostos diferidos											
Outras alterações reconhecidas nos fundos patrimoniais						46322.33		-54372.05	-46322.33	-54372.05	-54372.05
	7					46322.33		-54372.05	-46322.33	-54372.05	-54372.05
RESULTADO LÍQUIDO DO PERÍODO	8								61675.80	61675.80	61675.80
RESULTADO INTEGRAL	9=7+8								15353.47	7303.75	7303.75
OPERAÇÕES COM INSTITUIDORES NO PERÍODO											
Fundos											
Subsídios, doações e legados											
Distribuições											
Outras operações											
	10										0.00
POSIÇÃO NO FIM DO PERÍODO 2022	6+7+8+10					1045095.83		39349.75	61675.80	1146121.38	1146121.38

Fluxos de Caixa

RUBRICAS	NOTAS	PERÍODOS	
		31-12-2022	31-12-2021
Fluxos de Caixa das actividades operacionais-método directo			
Recebimento de Clientes e Utentes		193 904.98	143 865.64
Pagamentos de subsídios			
Pagamentos de apoios			
Pagamentos de bolsas		-62 941.92	-76 272.91
Pagamento a fornecedores		-204 280.52	-84 007.86
Pagamentos ao pessoal		-1 321 198.86	-1 258 390.91
Caixa gerada pelas operações		-1 394 516.32	-1 274 806.04
Pagamento/recebimento do imposto s/ rendimento			
Outros recebimentos/pagamentos		2 969 733.22	1 582 453.16
FLUXO DE CAIXA DAS ACTIVIDADES OPERACIONAIS		1 575 216.90	307 647.12
Fluxos de caixa das actividades de investimento			
Pagamentos respeitantes a :			
Activos fixos tangíveis		-49 326.49	-26 667.85
Activos intangíveis			
Investimentos financeiros		-6 969.64	-4 286.78
Outros activos			
Recebimentos provenientes de:			
Activos fixos tangíveis			
Activos intangíveis			
Investimentos financeiros		9 835.64	
Outros activos			
Subsídios ao investimento		32 939.91	25 800.60
Juros e rendimentos similares		672.69	1 271.40
Dividendos			
FLUXO DE CAIXA DAS ACTIVIDADES DE INVESTIMENTO		-12 847.89	-3 882.63
Fluxos de caixa das actividades de financiamento			
Recebimentos provenientes de:			
Financiamentos Obtidos			
Realização de fundos			
Cobertura de prejuízos			
Doações			
Outras operações de financiamento			
Pagamentos respeitantes a:			
Financiamento Obtidos			
Juros e gastos similares			
Dividendos			
Redução de fundos			
Outras operações de financiamento			
FLUXO DE CAIXA DAS ACTIVIDADES DE FINANCIAMENTO		0.00	0.00
VARIAÇÃO DE CAIXA E SEUS EQUIVALENTES		1 562 369.01	303 764.49
EFEITO DAS DIFERENÇAS CÂMBIO			
CAIXA E SEUS EQUIVALENTES NO INICIO PERIODO		781 063.00	477 298.51
CAIXA E SEUS EQUIVALENTES NO FIM PERIODO		2 343 432.01	781 063.00

Resultados por natureza

RENDIMENTOS E GASTOS	NOTAS	PERIODOS	
		31/12/2022	31/12/2021
Vendas e serviços prestados	9	195 424.11	144 549.77
Subsídios, doações e legados á exploração	7	1 444 064.49	1 340 788.67
Custo das mercadorias vendidas e das matérias consumidas	6	-1.35	-0.30
Fornecimentos e serviços externos	10	-204 122.18	-90 690.14
Gastos com o pessoal	11	-1 300 900.19	-1 257 929.90
Aumentos/reduções justo valor	15.2		-1 443.10
Outros rendimentos	12	144 238.64	138 791.74
Outros gastos	13	-121 230.00	-84 895.54
Resultado antes de depreciações, gastos de financiamento e impostos		157 473.52	189 171.20
Gastos/reversões de depreciação e de amortização	5/6	-96 470.41	-144 120.27
Resultado operacional (antes de gastos de financiamento e impostos)		61 003.11	45 050.93
Juros e rendimentos similares obtidos	9/14	672.69	1 271.40
Juros e gastos similares suportados	14		0.00
Resultado antes de impostos		61 675.80	46 322.33
Resultado líquido do período		61 675.80	46 322.33

Anexo

Anexo às demonstrações financeiras do período findo em 31 de Dezembro de 2022.
(Montantes expressos em euros).

1. NOTA INTRODUTÓRIA

O Centro de Astrofísica da Universidade do Porto, contribuinte 502 216 450, com sede na Rua das Estrelas, s/n, no Porto, criado em Maio de 1989 (Programa Mobilizador de Ciência e Tecnologia), iniciou as atividades em Outubro de 1990.

É uma associação científica e técnica privada, sem fins lucrativos e reconhecida de utilidade pública.

Inscreve entre os seus objectivos apoiar e promover a Astronomia, nomeadamente:

- a investigação cientifica;

- a formação ao nível pós-graduado e universitário;

- o ensino da Astronomia ao nível não universitário (ensino básico e secundário);

- e a divulgação da ciência e promoção da cultura científica.

2. REFERENCIAL CONTABILÍSTICO DE PREPARAÇÃO DAS DEMONSTRAÇÕES FINANCEIRAS

As demonstrações financeiras anexas estão em conformidade com todas as normas que integram o Sistema de Normalização Contabilística para as Entidades do Sector Não Lucrativo (ESNL). Devem entender-se como fazendo parte daquelas normas as Bases para a Apresentação de Demonstrações Financeiras, os Modelos de Demonstrações Financeiras, o Código de Contas e as Normas Contabilísticas e de Relato Financeiro (NCRF-ESNL) e as Normas Interpretativas.

Sempre que o ESNL não responda a aspetos particulares de transações ou situações, são aplicadas supletivamente e pela ordem indicada, as Normas Internacionais de Contabilidade, adotadas ao abrigo do Regulamento (CE) nº. 1606/2002, do Parlamento Europeu e do Conselho, de 19 de Julho; e as Normas Internacionais de Contabilidade (IAS) e Normas Internacionais de Relato Financeiro (IFRS), emitidas pelo IASB, e respetivas interpretações SIC-IFRIC.

Adoção pela primeira vez das Normas Contabilísticas e de Relato Financeiro (NCRF-ESNL)

Desde 01 de Janeiro de 2010 até 31 de Dezembro de 2011, o CENTRO DE ASTROFISICA elaborou e aprovou, demonstrações financeiras de acordo com o SNC, conforme legislação em vigor.

Em 31 de Dezembro de 2012, a preparação destas demonstrações financeiras foi efetuada de acordo com o Sistema de Normalização Contabilística para as Entidades do Sector não Lucrativo (ESNL), não havendo no entanto lugar a quaisquer ajustamentos, nem foi afetada a comparabilidade dos exercícios.

3. PRINCIPAIS POLÍTICAS CONTABILÍSTICAS, ALTERAÇÕES NAS ESTIMATIVAS CONTABILÍSTICAS E ERROS

As principais políticas contabilísticas adoptadas na preparação das demonstrações financeiras anexas são as seguintes:

3.1- Bases de apresentação

As demonstrações financeiras anexas foram preparadas no pressuposto da continuidade das operações, a partir dos livros e registos contabilísticos da empresa, mantidos de acordo com as NCRF-ESNL em vigor à data da elaboração das demonstrações financeiras.

3.2 – Rédito

O rédito é mensurado pelo justo valor da contraprestação recebida ou a receber.

O rédito proveniente da prestação de serviços é reconhecido com referência à data da transacção, desde que as seguintes condições sejam satisfeitas:

• O montante do rédito pode ser mensurado com fiabilidade;

• É provável que benefícios económicos futuros associados à transacção fluam para o CENTRO DE ASTROFÍSICA;

3.3 – Subsídios e outros apoios

Os subsídios apenas são reconhecidos quando há uma certeza razoável de que o CENTRO DE ASTROFÍSICA irá cumprir com as condições de atribuição dos mesmos e de que os mesmos irão ser recebidos.

Os subsídios associados à aquisição de activos não correntes são reconhecidos inicialmente no capital próprio, sendo subsequentemente imputados numa base sistemática como rendimentos do exercício durante as vidas úteis dos activos com os quais se relacionam.

Outros subsídios são, de uma forma geral, reconhecidos como rendimentos de uma forma sistemática durante os períodos necessários para os balancear com os gastos que é suposto compensarem.

3.4- Ativos fixos tangíveis

Os ativos fixos tangíveis adquiridos até 31 de Dezembro de 2009, encontram-se registados ao custo considerado, deduzido das correspondentes depreciações acumuladas.

Os activos fixos tangíveis adquiridos após essa data são inicialmente registados ao custo de aquisição o qual inclui o custo de compra, quaisquer custos directamente atribuíveis às actividades necessárias para colocar os activos na localização e condição necessárias para funcionarem da forma pretendida e, quando aplicável, a estimativa inicial dos custos de desmantelamento e remoção dos activos.

As depreciações são calculadas, após o momento em que o bem se encontra em condições de ser utilizado, de acordo com método da linha recta, em conformidade com o período de vida útil estimado para cada grupo de bens.

As taxas de depreciação utilizadas correspondem aos seguintes períodos de vida útil estimada:

Designação	Anos
Equipamento básico	4 – 10
Equipamento administrativo	3 – 10
Outros activos tangíveis	3 – 10

As vidas úteis e método de depreciação dos vários bens são revistos anualmente. O efeito de alguma alteração a estas estimativas é reconhecido na demonstração dos resultados prospectivamente.

As despesas de manutenção e reparação (dispêndios subsequentes) que não são susceptíveis de gerar benefícios económicos futuros são registadas como gastos no período em que são incorridos.

O ganho (ou a perda) resultante da alienação ou abate de um activo fixo tangível é determinado como a diferença entre o montante recebido na transacção e a quantia escriturada do activo e é reconhecido em resultados no período em que ocorre a alienação.

3.5 – Intangíveis

Os activos intangíveis adquiridos são registados ao custo deduzido de amortizações e perdas por imparidade acumuladas. As amortizações são reconhecidas numa base de linha recta durante a vida útil estimada dos activos intangíveis. As vidas úteis e método de amortização dos vários activos intangíveis são revistos anualmente. O efeito de alguma alteração a estas estimativas é reconhecido na demonstração dos resultados prospectivamente.

3.6 – Imparidade de activos fixos tangíveis e intangíveis

Em cada data de relato é efectuada uma revisão das quantias escrituradas dos activos fixos tangíveis e intangíveis da empresa com vista a determinar se existe algum indicador de que possam estar em imparidade. Se existir algum indicador, é estimada a quantia recuperável dos respectivos activos a fim de determinar a extensão da perda por imparidade (se for o caso).

Quando não é possível determinar a quantia recuperável de um activo individual, é estimada a quantia recuperável da unidade geradora de caixa a que esse activo pertence.

A quantia recuperável do activo ou da unidade geradora de caixa consiste no maior de entre o justo valor deduzido de custos para vender e o valor de uso. Na determinação do valor de uso, os fluxos de caixa futuros estimados são descontados usando uma taxa de desconto antes de impostos que reflicta as expectativas do mercado quanto ao valor temporal do dinheiro e quanto aos riscos específicos do activo ou da unidade geradora de caixa relativamente aos quais as estimativas de fluxos de caixa futuros não tenham sido ajustadas.

Sempre que a quantia escriturada do activo ou da unidade geradora de caixa for superior à sua quantia recuperável, é reconhecida uma perda por imparidade. A perda por imparidade é registada de imediato na demonstração dos resultados na rubrica de "Perdas por imparidade".

A reversão de perdas por imparidade reconhecidas em exercícios anteriores é registada quando há evidências de que as perdas por imparidade reconhecidas já não existem ou diminuíram, sendo reconhecida na demonstração de resultados na rubrica "Reversões de perdas por imparidade", e efectuada até ao limite da quantia que estaria reconhecida (líquida de amortizações) caso a perda não tivesse sido registada.

3.7 – Activos e passivos financeiros

Os activos e os passivos financeiros são reconhecidos no balanço quando o CENTRO DE ASTROFÍSICA se torna parte das correspondentes disposições contratuais.

Clientes e dívidas de terceiros

As dívidas de clientes e de outros terceiros encontram-se registadas pelo seu valor nominal deduzido de eventuais perdas de imparidade. As perdas de imparidade correspondem à diferença entre a quantia inicialmente registada e o seu valor recuperável, sendo este o valor presente dos "cash-flows" esperados, descontados à taxa efectiva, as quais são reconhecidas na demonstração dos resultados do período em que são em que são estimadas.

Caixa e equivalentes a caixa

Os montantes incluídos na rubrica de caixa e seus equivalentes correspondem aos valores em caixa, depósitos á ordem e a prazo.

Contas a pagar

As contas a pagar são registadas pelo seu valor nominal dado que não vencem juros e o efeito do desconto é considerado imaterial.

3.8 – Juízos de valor críticos e principais fontes de incerteza associada a estimativas

Na preparação das demonstrações financeiras anexas foram efectuados juízos de valor e estimativas e utilizados diversos pressupostos que afectam as quantias relatadas de activos e passivos, assim como as quantias relatadas de rendimentos e gastos do período. Durante o decurso do ano de 2022, não ocorreram alterações de políticas contabilísticas ou estimativas relevantes, relativamente às utilizadas na preparação e apresentação das demonstrações financeiras do exercício findo em 31 de Dezembro de 2021.

As estimativas e os pressupostos subjacentes foram determinados com base no melhor conhecimento existente à data de aprovação das demonstrações financeiras dos eventos e transacções em curso, assim como na experiência de eventos passados e/ou correntes.

Contudo, poderão ocorrer situações em períodos subsequentes que, não sendo previsíveis à data de aprovação das demonstrações financeiras, não foram consideradas nessas estimativas. As alterações às estimativas que ocorram posteriormente à data das demonstrações financeiras serão corrigidas de forma prospectiva. Por este motivo e dado o grau de incerteza associado, os resultados reais das transacções em questão poderão diferir das correspondentes estimativas.

Os principais juízos de valor e estimativas efectuadas na preparação das demonstrações financeiras anexas foram os seguintes:

Activos fixos tangíveis / estimativas de vidas úteis

As depreciações são calculadas sobre o custo de aquisição sendo utilizado o método da linha recta, a partir da data em que o activo se encontra disponível para utilização, utilizando-se as taxas que melhor reflectem a sua vida útil estimada. Os valores residuais dos activos e as respectivas vidas úteis são revistos e ajustados, se necessário em cada data de relato.

3.9 – Acontecimentos subsequentes

Os acontecimentos após a data do balanço que proporcionem informação adicional sobre condições que existiam à data do balanço ("adjusting events") são reflectidos nas demonstrações financeiras. Os eventos após a data do balanço que proporcionem informação sobre condições que ocorram após a data do balanço ("non adjusting events") são divulgados nas demonstrações financeiras, se forem considerados materiais.

3.10 – Especialização dos exercícios

As receitas e despesas são registadas de acordo com o princípio da especialização de exercícios, pelo qual estas são reconhecidas á medida em que são geradas, independentemente do momento em que são recebidas ou pagas. As diferenças entre as receitas e despesas geradas e os correspondentes montantes facturados são registadas nas rubricas de diferimentos.

4. ACTIVOS INTANGÍVEIS

Durante os períodos findos em 31 de Dezembro de 2022 e 31 de Dezembro de 2021, o movimento ocorrido na quantia escriturada dos activos intangíveis, bem como nas respectivas amortizações acumuladas, foi o seguinte:

	Activos intangíveis: quantias brutas escrituradas	Projectos de desenvolvimento	Programas de computador			Activos intangíveis em curso	Totais
		Outros		Marcas comerciais			
	Saldo Inicial		4.077,14	17.492,90			21.570,04
	Adições						
	Revalorizações						
	Transferências						
	Alienações						
	Sinistros						
	Abates						
	Saldo Final		4.077,14	17.492,90			21.570,04

	Activos intangíveis: amortizações	Projectos de desenvolvimento	Programas de computador			Activos intangíveis em curso	Totais
		Outros		Marcas comerciais			
	Saldo Inicial		4.077,14	10.923,64			15.000,78
	Reforços			2.329,03			2.329,03
	Reversões						
	Alienações						
	Sinistros						
	Abates						
	Saldo Final		4.077,14	13.252,67			17.329,81

5. ACTIVOS FIXOS TANGÍVEIS

Durante os períodos findos em 31 de Dezembro de 2022 e 31 de Dezembro de 2021, o movimento ocorrido na quantia escriturada dos activos fixos tangíveis, bem como nas respectivas depreciações acumuladas, foi o seguinte:

Activos fixos tangíveis: quantias brutas escrituradas	Equipamento básico	Equipamento de transporte	Equipamento administrativo	Outros activos fixos tangíveis	Activos fixos tangíveis em curso	Totais
Saldo Inicial	1.013.502,06	35.400,00	791.662,71	45.181,08		1.885.745,85
Adições	41.613,04		4.496,59			46.109,63
Revalorizações						
Alienações			-169,99			-169.99
Transferências						
Abates			-1.039.57			-1.039.57
Saldo Final	1.055.115,10	35.400,00	794.949.74	45.181,08		1.930.645,92

Activos fixos tangíveis: depreciações	Equipamento básico	Equipamento de transporte	Equipamento administrativo	Outros activos fixos tangíveis	Activos fixos tangíveis em curso	Totais
Saldo Inicial	919.577,34	35.400,00	790.393,64	40.232,71		1.785.603,69
Reforços	88.426,83		2.260,11	3.454,44		94.141,38
Reversões						
Alienações			-169,99			-169,99
Abates			-1.039.57			-1.039,57
Saldo Final	1.008.004,17	35.400,00	791.444,19	43.687,15		1.878.535,51

6. CUSTO DAS MERCADORIAS VENDIDAS E MATÉRIAS CONSUMIDAS

O custo das mercadorias vendidas e das matérias consumidas reconhecido nos períodos findos 31 de Dezembro de 2022 e em 31 de Dezembro de 2021 é detalhado conforme segue:

CMVMC		Mercadorias	TOTAIS
Em 31.12.2022	Saldo Inicial	4.291,76	4.291,76
	Compras		
	Regularizações (+/-)	-99.33	-99.33
	Saldo Final	4.191,08	4.191,08
	CMVMC	1,35	1,35
Em 31.12.2021	Saldo Inicial	4.327,37	4.327,37
	Compras		

	Regularizações (+/-)	-35,31	-35,31
	Saldo Final	4.291,76	4.291,76
	CMVMC	0,30	0,30

7. SUBSÍDIOS E OUTROS APOIOS

O montante dos subsídios, reconhecidos nos períodos findos em 31 de Dezembro de 2022 e em 31 de Dezembro de 2021, é detalhado como se segue:

No que se refere aos subsídios relacionados com activos, os valores recebidos são reconhecidos como réditos à medida que os bens subsidiados vão sendo amortizados.

Os subsídios á exploração são reconhecidos como réditos, na medida em que o gasto é realizado.

Relação dos subsídios obtidos e outros apoios			Quantias Concedidas	
			2022	2021
Não reembolsáveis	Subsídios relacionados com activos	Estado e Outros Entes Públicos	32.939,91	25.800,60
		Outras Entidades		
		Subtotais	32.939,91	25.800,60
	Subsídios à exploração	Estado e Outros Entes Públicos	1.295.363,27	1.284.961,19
		Outras Entidades	148.701,22	55.827,48
		Subtotais	1.444.064,49	1.340.788,67
Totais			1.477.004,40	1.366.589,27

8. INSTRUMENTOS FINANCEIROS

CRÉDITOS A RECEBER						
	Quantia Nominal		Imparidade		Valor Liquido	
	2022	2021	2021	2020	2022	2021
Clientes Correntes	18.889,45	17.672,02			18.889,45	17.672,02
Clientes Cob. Duvidosa						
Totais	18.889,45	17.672,02	0	0	18.889,45	17.672,02

	OUTROS ATIVOS CORRENTES	
	2022	2021
Fornecedores (Saldos contrários)	649,45	
Adiant. e outras operações c/ pessoal		
Adiant. A fornecedores de investimentos	7.342,02	
Devedores por acréscimo de rendimentos		
Juros a receber		
Subsídios a receber	0	75.000,00
Outros acréscimos de rendimentos	77.270,27	187.821,55

Outros devedores	2.371.876,61	1.778.458,33
Totais	2.457.138,35	2.041.279,88

	ESTADO E OUTROS ENTES PÚBLICOS	
	2022	2021
Finanças	18.162,93	4.781,30
Segurança Social e Fundo de Compensação	7.661,98	25.606,56
Totais	25.824,91	30.387,86
Saldos Devedores		
Retenção Imp. s/ Rendimento		
Iva Restituição	1.436,98	3.659,68
Iva a recuperar		8.296,02
Restantes impostos		
Totais	1.436,98	11.955,70
Saldos Credores		
Corrente		
Retenção Imp. s/ Rendimento	14.357,00	16.737,00
Iva a pagar	5.242,91	
Contribuições seg. social	7.083,16	24.955,38
Outras Tributações (Fundo de Compensação)	578,82	651,18
Totais	27.261,89	42.343,56

	DIFERIMENTOS	
	2022	2021
Gastos a reconhecer		
Seguros	912,53	791,95
Outros gastos diferidos	4.803,55	6.383,26
Totais	5.716,08	7.175,21
Rendimentos a reconhecer		
Subsídios	3.281.026,31	1.535.836,45
Outros rendimentos	2.277,25	32,52
Totais	3.283.303,56	1.535.868,97

	OUTROS PASSIVOS CORRENTES	
	2022	2021
Não correntes		
Clientes (saldos contrários)		
Pessoal		
Fornecedores de investimentos		
Totais	0	0
Correntes		
Clientes (saldos contrários)		301,70

Pessoal		46,45
Fornecedores de investimentos	2.915,60	
Credores por acréscimos de gastos		
Remunerações a pagar	172.799,22	182.357,00
Outros acréscimos de gastos	7.591,08	1.289,39
Outros Credores	260.841,19	137.338,59
Totais	444.147,09	321.333,13

	FORNECEDORES	
	2022	2021
Fornecedores, conta corrente	2.663,02	374,95
Fornecedores, títulos a pagar		
Fornecedores, faturas em rec. conf.		
Totais	2.663,02	374,95

MOVIMENTOS NAS RUBRICAS DE FUNDOS PATRIMONIAIS				
	Saldo Inicial	Aumentos	Reduções	Saldo Final
Fundos				
Reservas				
Resultados transitados	998.773,50	46.322,33		1.045.095,83
Excedentes de revalorização				
Outras variações nos fundos patrimoniais	93.721,80	32.939,91	87.311,96	39.349,75
Resultado liquido do exercício	46.322,33	61.675,80	46.322,33	61.675,80
Totais	1.138.817,63	140.938,04	133.634,29	1.146.121,38

9. RÉDITO

Em 31 de Dezembro de 2022 e em 31 de Dezembro de 2021 os réditos apresentavam a seguinte composição:

Quantias dos réditos reconhecidas no período	2022	2021
	Réditos reconhecidos no período	Réditos reconhecidos no período
Venda de bens	102,73	1,14
Prestação de serviços	195.321,38	144.548,63
Juros	672,69	1.271,40
Royalties		
Dividendos		
Totais	196.096,80	145.821,17

10. FORNECIMENTOS E SERVIÇOS EXTERNOS

A rubrica de “Fornecimentos e serviços externos” em 31 de Dezembro de 2022 e 31 de Dezembro de 2021 é detalhada conforme se segue:

Fornecimentos e Serviços Externos	2022	2021
Subcontratos	2.680,31	2.137,88
Serviços Especializados:	51.405,29	38.472,30
Trabalhos Especializados	11.525,10	9.803,10
Publicidade e propaganda		516,60
Vigilância e Segurança	74,42	
Honorários	6.800,00	5.722,50
Conservação e Reparação	31.892,73	21.841,05
Outros Serviços Especializados	1.113,04	589,05
Materiais	14.181,42	10.563,06
Energia e fluídos	1.403,30	419,27
Deslocações, Estadas e Transportes	110.524,97	25.895,18
Serviços Diversos:	23.926,89	13.202,45
Rendas e Alugueres		
Comunicação	217,55	722,84
Seguros	3.296,69	2.714,91
Contencioso e notariado	280,00	302,50
Limpeza, higiene e conforto		
Outros Serviços	20.132,65	9.462,20
Totais	204.122,18	90.690,14

11. GASTOS COM O PESSOAL

A rubrica de “Gastos com o pessoal” em 31 de Dezembro de 2022 e em 31 de Dezembro de 2021 detalha-se da seguinte forma:

Gastos com o Pessoal	2022	2021
Remunerações do Pessoal	1.042.494,19	1.027.032,05
Encargos sobre Remunerações	209.971,62	221.060,05
Seguro de acidentes de trabalho e doenças profissionais	7.902,02	7.699,51
Outros gastos com Pessoal	40.532,36	2.138,29
Totais	1.300.900,19	1.257.929,90

12. OUTROS RENDIMENTOS

A composição da rubrica de “Outros rendimentos e ganhos” em 31 de Dezembro de 2022 e 31 de Dezembro de 2021 é conforme se segue:

Outros Rendimentos	2022	2021
Descontos de pronto pagamento		
Rendimentos e ganhos rest. Activos financeiros	182,68	53,98
Rendimentos e ganhos em Inv. não financeiros	229,98	
Outros	143.825,98	138.737,76
Totais	144.238,64	138.791,74

13. OUTROS GASTOS

A decomposição da rubrica de "Outros gastos e perdas" em 31 de Dezembro de 2022 e em 31 de Dezembro de 2021 é conforme se segue:

Outros Gastos	2022	2021
Impostos	54,39	54,41
Perdas em Inventários		
Gastos e Perdas em Investimentos Não Financ.	380,90	779,96
Outros	120.794,71	84.061,17
Totais	121.230,00	84.895,54

14. JUROS E OUTROS RENDIMENTOS E GASTOS SIMILARES

Os gastos e perdas de financiamento em 31 de Dezembro de 2022 e 31 de Dezembro de 2021 são detalhados conforme se segue:

Juros e Rendimentos Similares Obtidos	2022	2021
Juros Depósitos	10,15	10,15
Outros	662,54	1.261,25
Totais	672,69	1.271,40

Juros e Gastos Similares Suportados	2022	2021
Juros Suportados		
Diferenças de câmbio desfavoráveis		
Outros		
Totais	0	0

15. OUTRAS INFORMAÇÕES

15.1. Outros Ativos Correntes

OUTROS ATIVOS CORRENTES						
	Quantia Nominal		Aum/Red.J.Valor		Valor Liquido	
	2022	2021	2022	2021	2022	2021
Obrigações do Tesouro	0	50.824,00		-1.443,10	0	49.380,90
Totais	0	50.824,00		-1.443,10	0	49.380,90

15.2. Investimentos Financeiros

INVESTIMENTOS FINANCEIROS						
	Quantia Nominal		Imparidade		Valor Liquido	
	2022	2021	2022	2021	2022	2021
Fundo Compensação	16.342,35	19.208,35			16.342,35	19.208,35
Totais	16.342,35	19.208,35	0	0	16.342,35	19.208,35

15.3 Desagregação dos valores inscritos na rúbrica caixa e depósitos bancários.

Caixa, Depósitos e Outros Inst. Financeiros	2022	2021
Caixa	35,00	35,00
Depósitos Bancários	2.343.397,01	781.028,00
Total	2.343.432,01	781.063,00

16. DATA DE AUTORIZAÇÃO PARA EMISSÃO

As demonstrações financeiras do exercício findo em 31 de Dezembro de 2022 foram aprovadas pela Direcção e autorizadas para emissão em 6-04-2023.

RELATÓRIO E PARECER DO CONSELHO FISCAL

RELATÓRIO E PARECER DO CONSELHO FISCAL

Senhores Associados do Centro de Astrofísica da Universidade do Porto,

Em conformidade com a legislação em vigor e com o mandato que nos foi confiado, vimos submeter à vossa apreciação o nosso Relatório e Parecer que abrange a atividade por nós desenvolvida e os documentos de prestação de contas do CAUP – Centro de Astrofísica da Universidade do Porto, relativos ao exercício findo em 31 de dezembro de 2022, os quais são da responsabilidade da Direção.

Acompanhamos a evolução da atividade do Centro, da sua contabilidade e o cumprimento do normativo legal e estatutário em vigor, tendo recebido da Direção e serviços do CAUP todas as informações e esclarecimentos solicitados.

No âmbito das nossas funções analisamos o Relatório de Gestão da Direção e as contas do exercício findo em 31 de dezembro de 2022, que compreendem o Balanço (que evidencia um total de 4.903.496,94 euros e um total dos fundos patrimoniais de 1.146.121,38 euros, incluindo um resultado líquido do período de 61.675,80 euros), a Demonstração dos Resultados, a Demonstração dos Fluxos de Caixa e o respetivo Anexo, composto pelas notas explicativas.

A análise dos documentos acima referidos permite concluir pela boa compreensão da situação financeira do CAUP em 31 de dezembro de 2022, assim como pela satisfação das disposições legais e estatutárias aplicáveis.

Face ao referido, o Conselho Fiscal do CAUP – Centro de Astrofísica da Universidade do Porto, pronuncia-se com o seguinte parecer:

Que seja aprovado o Relatório de Gestão, a proposta nele expressa, bem como as Contas referentes ao ano findo a 31 de dezembro de 2022.

Porto, 14 de abril de 2023

Presidente,

[redacted]

(Dr. Filipe Pires)

Vogal,

[redacted]

(Prof. Jorge F. Gameiro)

Relator,

[redacted]

(Dra. Marlene Rebelo)