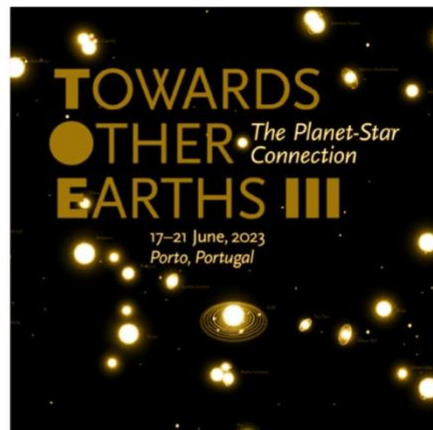


CENTRO DE ASTROFÍSICA UNIVERSIDADE DO PORTO

RELATÓRIO DE GESTÃO E CONTAS



Relatório de Gestão

Versão aprovada pela Assembleia Geral em 2024/04/22

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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 carácter 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 2023 foram:

- **Mesa da Assembleia Geral:**
Presidente – Universidade do Porto (representada por Pedro Rodrigues)
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
- **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 2023 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 m². O espaço atribuído ao CAUP resulta do financiamento atribuído pelo Ministério da Ciência e Tecnologia para a construção do edifício planeado de raiz para albergar o CAUP e o Planetário do Porto.

O espaço dedicado para uso do CAUP é de 915 m², 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 2023, correspondiam a um total de 36 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 2023):

Contratos sem termo (total de 12):

Investigação:

- 1) Jorge H. C. Martins – *Programador científico*

Divulgação:

- 2) Elsa M. P. S. Moreira – *técnico*
- 3) Paulo J. T. Pereira – *assessor gráfico*
- 4) Filipe A. L. Pires – *especialista*
- 5) Ricardo S. S. C. Reis – *técnico*

Informática:

- 6) Manuel A. S. Monteiro – *especialista*

Administração e Serviços:

- 7) Argentina M. T. Pereira – *técnico*
- 8) Carlos A. G. Gonçalves – *porteiro*
- 9) Elsa M. P. P. Silva – *técnico*
- 10) Ernesto J. Silva – *porteiro*
- 11) Fernando M. S. Soares – *porteiro*
- 12) Sara Ramos – *técnico*

Contratos a termo (total de 24):

Investigação:

- 1) Ana S. Paulino Afonso – *investigador júnior*

- 2) Ângela R. G. Santos – *investigador júnior*
- 3) Carlos J. A. P. Martins – *investigador principal*
- 4) Clara Sousa e Silva – *investigador auxiliar*
- 5) Diego Bossini – *investigador júnior*
- 6) Elisa Delgado Mena – *investigador auxiliar*
- 7) Jarle Brinchmann – *investigador principal*
- 8) Jean Michel Gomes – *investigador júnior*
- 9) João Gomes da Silva – *investigador júnior*
- 10) José C. Fonseca – *investigador auxiliar*
- 11) Lara G. Sousa – *investigador júnior*
- 12) L. Filipe Pereira – *investigador júnior*
- 13) Margarida M. S. Cunha – *investigador principal*
- 14) Olivier D. S. Demangeon – *investigador júnior*
- 15) Patricio Lagos – *investigador júnior*
- 16) Polychronis Papaderos – *investigador principal*
- 17) Sérgio A. G. Sousa – *investigador principal*
- 18) Susana C. C. Barros – *investigador júnior*
- 19) Thomas C. Scott – *investigador júnior*
- 20) Tiago J. L. C. E. Campante – *investigador auxiliar*
- 21) Vardan Zh. Adibekyan – *investigador auxiliar*

Divulgação:

- 22) Adriana Silva – *técnico*
- 23) Francisco Miguel Gonçalves - *técnico*

Administração e Serviços:

- 24) Joana Bateira – *técnico*

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

Síntese da Atividade em 2023

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 composta inicialmente por 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.
- **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 2023 no âmbito de cada uma destas unidades é apresentada na componente de relatório de atividades. Aqui, gostaríamos só de destacar dois aspetos mais transversais. Em primeiro lugar, foram feitos esforços em 2023 para melhorar a diversidade e a inclusão no CAUP. O Gender Development Plan para o CAUP foi redigido e um questionário sobre igualdade de género, diversidade e inclusão no IA/CAUP foi realizado e os resultados deste inquérito foram discutidos, tudo isto graças ao grupo de diversidade e inclusão da IA/CAUP. Foram levadas a cabo algumas outras medidas pontuais (e.g. instalação de fraldários nos WC do edifício). Também de relevância geral, fizemos um esforço para melhorar a eficiência energética, substituindo as lâmpadas fluorescentes nos escritórios por LEDs. Estão em curso trabalhos para substituir estas lâmpadas em mais locais, mas tal tem de ser feito em colaboração com a UP, o que leva mais tempo. No entanto, uma evolução positiva a este respeito é o facto de termos agora um contacto oficial com a reitoria, Alexandre Carvalho, que ajuda a planear a manutenção do edifício.

Situação Económico-Financeira

O ano de 2023 marca regresso à normalidade após a pandemia causada pela COVID-19 e a consolidação das atividades desenvolvidas pela Associação, nomeadamente, na exploração do Planetário do Porto - Centro de Ciência Viva. A situação económico-financeira representa o esforço realizado para potenciar esta consolidação, em particular através da contratação de recursos humanos, aumento da oferta de atividades para o público no âmbito do Planetário do Porto e a atualização da infraestrutura tecnológica. O resultado líquido do exercício foi negativo.

O montante global de gastos permaneceu ao nível de 2022, situando-se acima de um milhão e setecentos mil euros, no entanto, os rendimentos tiveram um decréscimo sendo ligeiramente inferiores aos gastos, como se ilustra na Figura 1. O capital próprio, embora com ligeira descida, manteve-se ao nível de 2022, enquanto as disponibilidades no final do ano permanecem acima de dois milhões de euros.

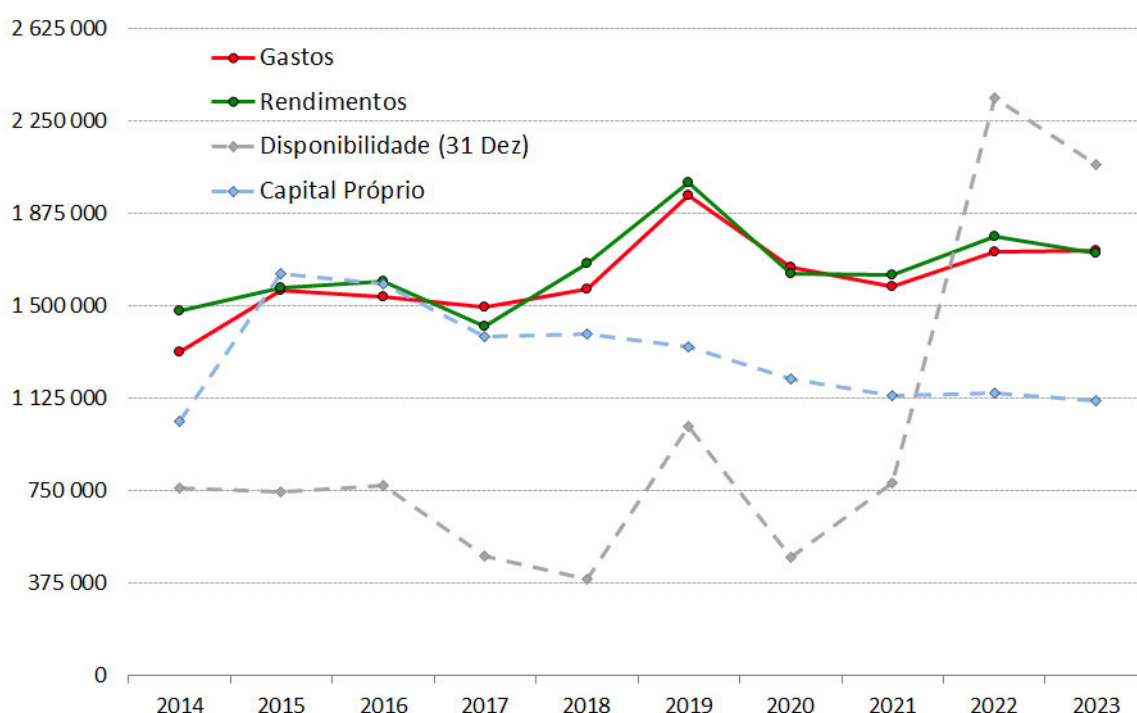


Figura 1: Evolução dos Gastos (linha vermelha) e dos Rendimentos (linha verde), para o exercício por ano fiscal, desde 2014. Os valores dados estão em euros. Também se indica as disponibilidades (linha cinzenta) existentes a 31 de Dezembro de cada ano e o capital próprio (linha azul).

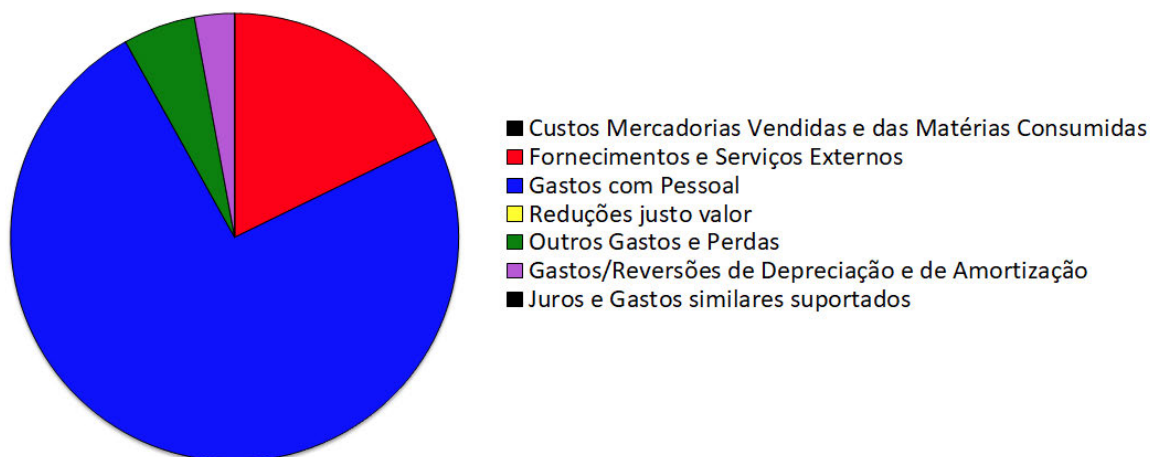


Figura 2: Distribuição dos Gastos do exercício de 2023, correspondendo a um total de 1 727 204,74 euros.

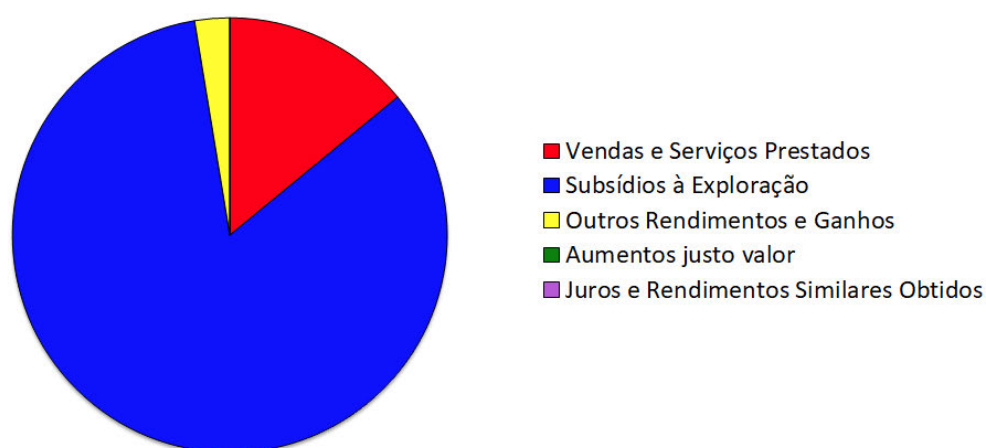


Figura 3: Distribuição dos Rendimentos do exercício de 2023, correspondendo a um total de 1 714 017,81 euros.

A fração dos custos com recursos humanos, quer através de despesas com o pessoal, quer através da contratação de bolseiros, manteve uma tendência de ligeira descida, consequência da retoma das atividades. A Figura 2 ilustra o peso relativo das diferentes componentes de gastos nas contas em 2023. 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).

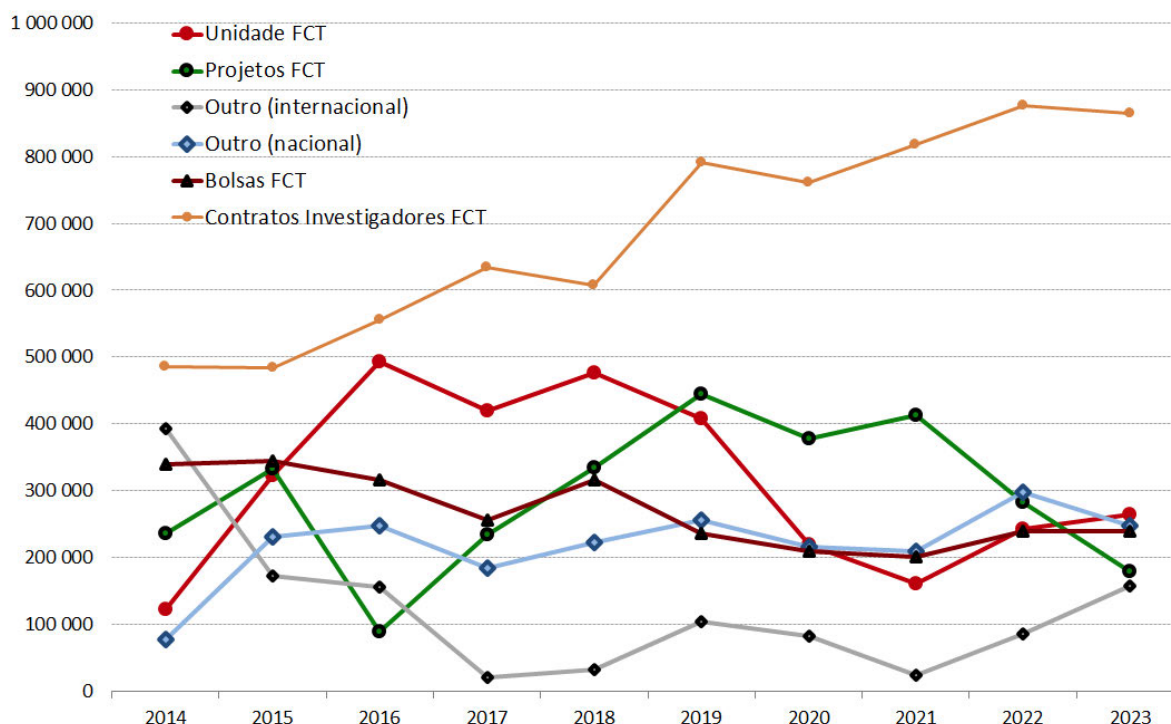


Figura 4: Distribuição das fontes de financiamento para o exercício, por ano fiscal, desde 2014.

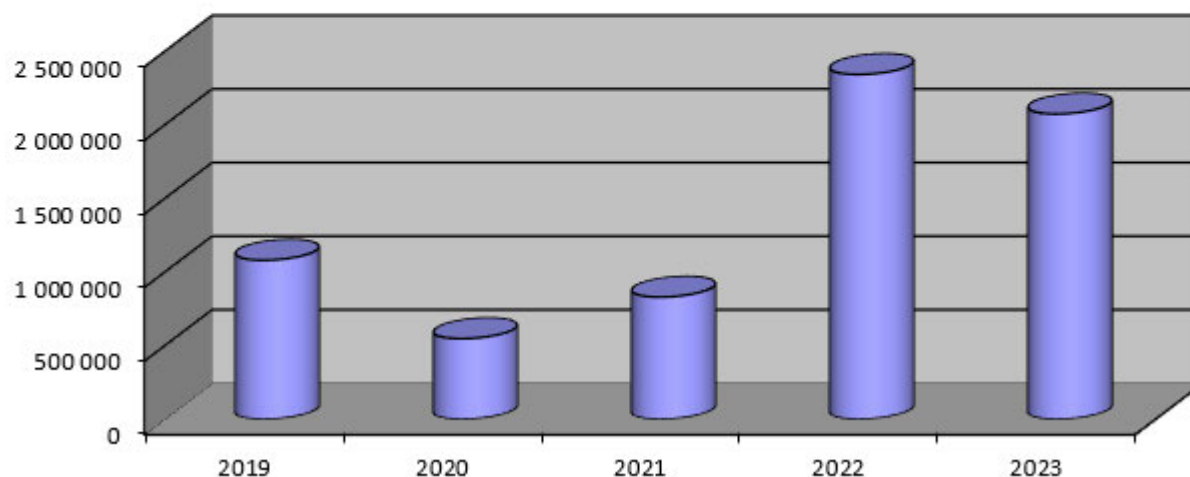
O financiamento proveniente da Unidade I&D continuou a subir em 2023 sobretudo devido ao aumento do número de missões realizadas, regressando a valores similares aos verificados antes da pandemia. O financiamento de projetos FCT voltou a registar uma descida significativa, consequência do término de vários projetos e do atraso no arranque das atividades dos projetos que tiveram o seu início durante o ano. O financiamento nacional proveniente de outras fontes desceu relativamente ao ano anterior, consequência do fim do financiamento NORTE 2020 para capacitação dos Centros de Ciência Viva da Região Norte. No que respeita a outros fundos internacionais verificou-se uma subida significativa, em grande parte devida ao aumento de atividade no projeto FIERCE com financiamento ERC.

O financiamento correspondente aos contratos FCT registou uma ligeira descida devida ao término de alguns contratos realizados no âmbito da norma transitória do DL 57/2016. No ano de 2023, esta componente correspondeu a um total de 864 795 euros (25 investigadores envolvidos). Uma outra fonte de financiamento indireto provém das bolsas de investigação atribuídas diretamente pela FCT cujo valor global manteve-se ao nível de 2022. 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 2023, esta componente correspondeu a um total de 238 802 euros (17 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.

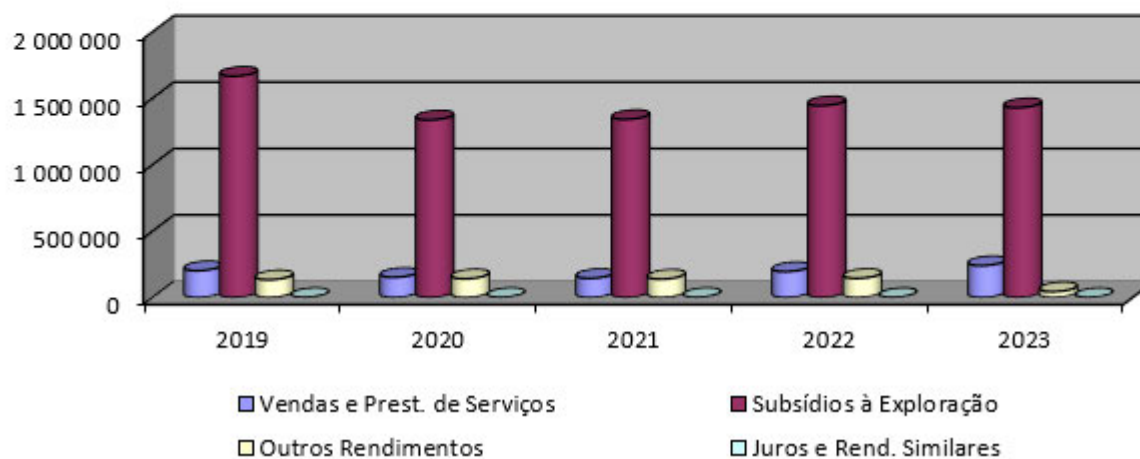
Indicadores Económico-Financeiros

Nesta seção fornecem-se alguns dos indicadores económico-financeiros das contas de 2023, em comparação com os 4 anos anteriores.

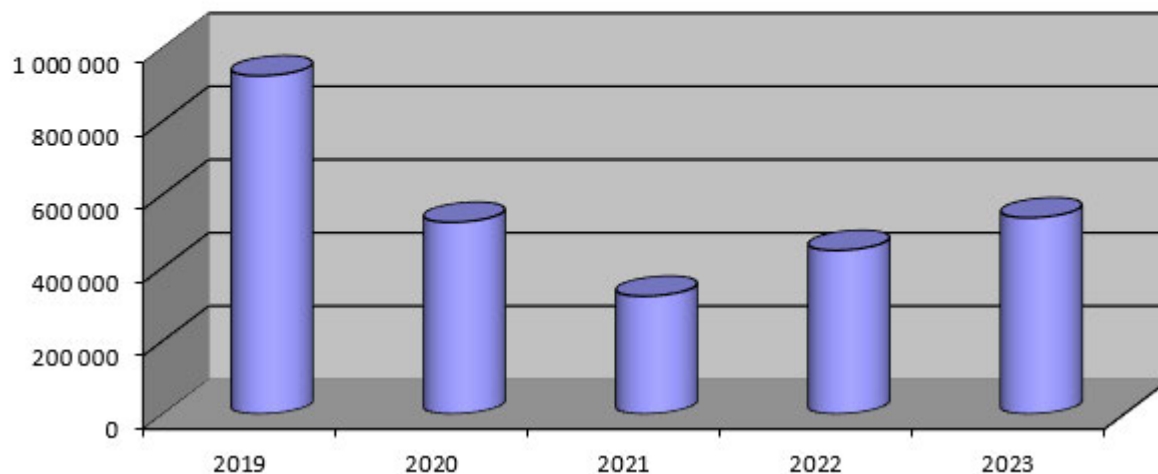
Meios Financeiros Líquidos					
	2019	2020	2021	2022	2023
Caixa	35	35	35	35	35
Depósitos Bancários	1 009 156	477 264	781 028	2 343 397	2 075 049
Outros Instrumentos Financ.	71 803	70 824	49 381	0	0
TOTAIS	1 080 994	548 123	830 444	2 343 432	2 075 084



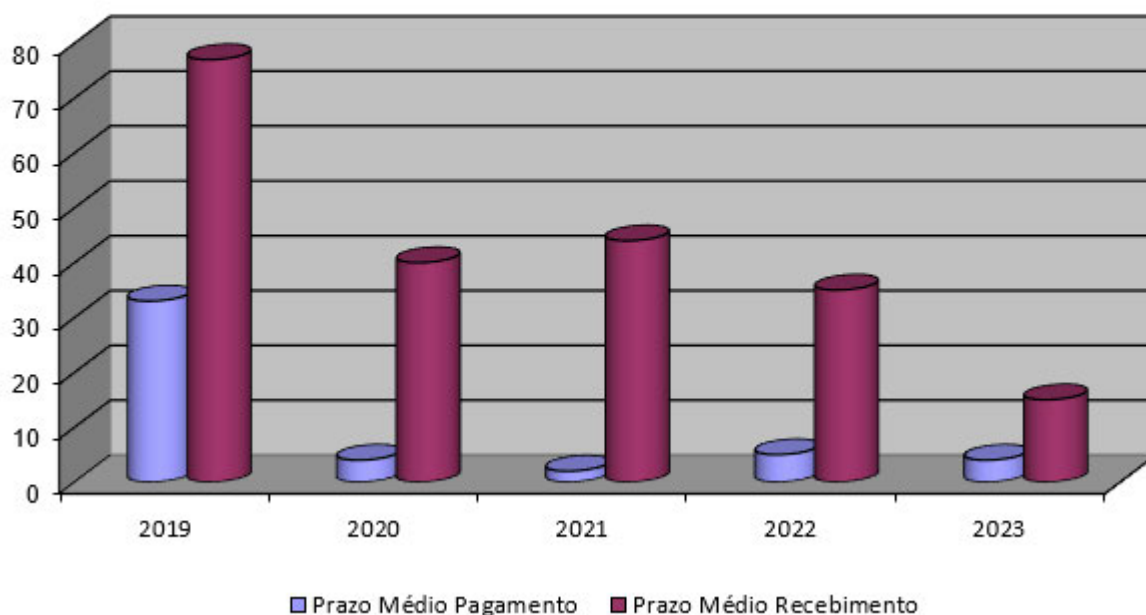
Evolução dos Rendimentos					
	2019	2020	2021	2022	2023
Vendas e Prest. de Serviços	202 436	152 362	144 550	195 424	240 581
Subsídios à Exploração	1 665 765	1 336 622	1 340 789	1 444 064	1 428 904
Outros Rendimentos	134 182	141 325	138 792	144 239	44 523
Juros e Rend. Similares	1 271	1 275	1 271	673	10
TOTAIS	2 003 654	1 631 584	1 625 402	1 784 400	1 714 018



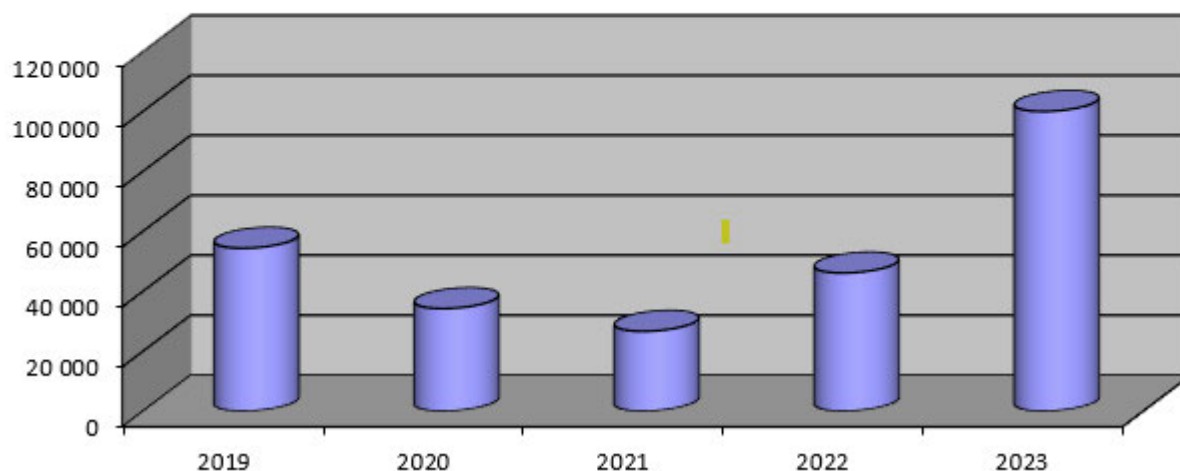
Fornecedores e Outros Passivos Correntes					
	2019	2020	2021	2022	2023
Fornecedores	18 351	886	375	2 663	3 761
Outros Passivos Correntes	905 431	522 785	321 333	444 147	532 187
TOTAIS	923 782	523 671	321 708	446 810	535 948



Tesouraria					
	2019	2020	2021	2022	2023
Prazo Médio Pagamento	33	4	2	5	4
Prazo Médio Recebimento	77	40	44	35	15



	Activo Fixo				
	2019	2020	2021	2022	2023
Aquisições	54 382	34 248	26 668	46 110	100 010
TOTAIS	54 382	34 248	26 668	46 110	100 010



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 e com início de aplicação em 2023 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. Está a ser feito, e planeamos reforçá-lo, um esforço para estimular candidaturas dos investigadores ao Horizonte Europa e ao financiamento do ERC. Temos também conseguido assegurar financiamento para atividades relacionadas com missões espaciais (PLATO, CHEOPS) através do mecanismo PRODEX.

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 teve início uma nova 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. Assim, estamos confiantes de que conseguiremos um bom resultado na próxima avaliação.

Depois de um ano a transitar fora da sombra lançada pela pandemia em 2022, o Planetário teve um bom ano em 2023 e esperamos uma continuação deste facto em 2024. No entanto, planeamos aumentar um pouco o preço dos bilhetes, pelo que temos de estar atentos à capacidade das escolas para participarem nos eventos. Esperamos continuar com o sucesso dos últimos anos na criação de novas sessões de Planetário, mas para isso será provavelmente necessário identificar novas fontes de financiamento. O projeto a Rede de Escolas Ciência Viva teve início em 2023 e decorrerá até março de 2025. Este projeto já proporcionou algum financiamento para preparar um espaço para a Escola CV e é importante que este seja implementado com sucesso em 2024.

Dos projetos financiados pela FCT destaca-se, para além da continuação de seis projetos, a conclusão dos projetos exploratórios “Stellar Activity Modelling for exoplanet detection (SAM)” e “Finding Lyman-alpha emitters through machine learning” (FLAEMING). Em contrapartida um projeto novo começou em 2023: “Phi in the Sky: Astrophysical probes of fundamental physics” e um projeto exploratório: “Using Ap stars as

LABoratories for probing chemical transport mechanisms, with ultra-precise space-based photometry” (ApLAB). O que é preocupante, no entanto, é que quatro projetos terminarão em 2024, o que significa que o número total de projetos diminuirá em 2025, a menos que sejamos muito mais bem-sucedidos no concurso para projetos aberto em 2024 do que fomos nos concursos abertos em anos anteriores..

Em 2023, para além da continuação da Advanced ERC “Finding ExoeArths: tackling the Challenges of stellar activity (FIERCE)”, iniciado em 2022, tivemos a conclusão do projeto “Revealing the Milky Way with Gaia” e em 2023, e em 2024 teremos o início do projeto “Euclid Legacy Science Advanced tools” (ELSA) - todos 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. A participação no “Centro de Operações Científicas CHEOPS”, que tem sido financiada através do PRODEX desde 2013, terminou em 2023, mas foi substituída por um novo projeto PRODEX para apoiar a participação do CAUP na extensão da missão CHEOPS; este projeto decorrerá até ao final de 2025. Por último, foi assegurado financiamento inicial para o instrumento ANDES para o ELT através de uma nova versão do PRODEX para instrumentação terrestre. Esperamos que esta última seja uma forma produtiva de garantir o financiamento de grandes projetos de instrumentação no futuro.

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, criámos um grupo para a computação científica em 2023, que integra a estrutura de unidades do CAUP, com a assinatura de um contrato (JH Martins) e em 2024 este foi alargado com a assinatura de outro contrato (P. Moreno). Embora transversal, este grupo trabalha 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 2023 se apurou um Resultado Líquido do Exercício negativo, no montante de 13 186,93 euros (treze mil cento e oitenta e seis euros e noventa e três 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’.


Prof. Doutor Jarle Brinchmann

(Presidente)


Prof. Doutor Pedro T. P. Viana

(Vogal)

Porto, 12 de abril de 2024.

REPORT OF ACTIVITIES

This component of the report describes the main initiatives and results obtained during the year of 2023.

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 2023 the team included:

• 34 Researchers – corresponding to

11 Lecturers (5.05 FTE): Ilídio André P. M. Costa (AE Santa Bárbara¹), 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)

23 Research Positions (22.20 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, Pedro Figueira (ESO), José C. Fonseca, Jean Michel Gomes, João Gomes da Silva, Patricio Lagos, Carlos J. A. P. Martins, Jorge H. C. Martins, Polychronis Papaderos, Ana S. Paulino Afonso, L. Filipe Pereira, Ângela R. G. Santos, Tom C. Scott, Lara G. Sousa, Sérgio A. G. Sousa, Clara Sousa Silva

• 28 PhD students

Alexandros Antoniadis Karnavas, Alba Barka, 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, António Jorge Fonte, David Grüber, Ricarda Heilemann, Catarina M. J. Marques, Nuno A. M. Moedas, Sandy G. Morais, Sergei Mukovnikov, Andreas W. Neitzel, Jennifer Peralta Lucero, José Rodrigues, Nuno M. Rosário, Carmen San Nicolás Martínéz, André Miguel Silva, Bárbara M. T. B. Soares, Daniel A. D. Vaz, Clara M. Winckler, Paulina M. Zaworska

• 9 Outreach staff (8.5 FTE)

Ilídio André P. M. Costa, Tania F. S. Cunha, José M. C. Dantas, Francisco Miguel Gonçalves, Elsa M. P. S. Moreira, Paulo J. T. Pereira, Filipe A. L. Pires, Ricardo S. S. C. Reis, Adriana Silva

• 9 Supporting staff (6,5 FTE)

Joana Bateira, Carlos A. G. Gonçalves, Manuel A. S. Monteiro, Argentina M. T. Pereira, Sara Ramos, Adriana Silva, 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 2023 were:

Clara Sousa Silva	-	started her contract in June
Polychronis Papaderos	-	started his contract in June

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

- | | |
|---------------------------|-------------------------------------|
| João P. Faria | - ended his contract in July |
| João N. T. Gomes da Silva | - started his contract in September |
| Diego Bossini | - ended his contract in December |

Unl – Research Unit

Research in CAUP is structured according to the organisation 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 were centred around i) the detection, detailed characterization, and study of exoplanet systems and their host stars, and ii) the study of Solar System bodies (with a focus on their atmospheres), seen also as a stepping-stone towards the understanding of exoplanet atmospheres. Exoplanet research has been mostly centred in the Porto node of IA, while Solar System research is divided in planet atmospheres (centred in Lisbon) and the study of minor bodies (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).

In this context, the team focused on tackling high impact questions such as: How diverse are planetary systems in the Galaxy? How frequent are rocky, temperate planets orbiting other Suns? Are there other habitable planets?

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

- 1) the search and detailed characterization of exoplanets, including the study of their atmospheres, using state-of-the-art high-resolution spectroscopy and space-based photometric data;
- 2) the study of astrophysical sources of "noise" that hinder the detection and characterization of planets, as well as developing methods to correct/model them, keeping in mind the end goal of detecting and characterizing rocky planets orbiting other suns
- 3) the study of the star-planet connection as a way to better characterize planetary systems, their properties and formation processes.
- 4) the exploration of new avenues in the study of Solar System atmospheres (focused on Venus, Mars, and Jupiter), namely to understand their dynamics and chemistry.

A significant part of this research is based in our top-level (leading) scientific participation in different international consortia. From the ongoing projects, we highlight ESO's ESPRESSO and ESA's CHEOPS mission (now starting its first extension until 2026), the NIRPS spectrograph (@ESO's 3.6m), as well as the soon-to-be-commissioned (2025) PoET telescope (entirely led by IA and funded through an ERC grant). All these projects serve as stepping-stones for the science opportunities raised by future projects and missions such as ESA's PLATO (2026), as well as (further ahead) projects such as ANDES@ESO's ELT (2031) and ESA's ARIEL (2029), and EnVision (2031) missions. Our high-level participation in all these projects assures continuity, reinforces the existing strategy, and allows the team to be in the forefront of exoplanet detection and characterization for the next decade and beyond.

Scientific Highlights for 2023

In 2023, a total of 9 Press-releases were published by IA announcing scientific results or other major activities (e.g. issuing from ongoing instrumentation projects) with a leading scientific participation of the team. Below we highlight 2 of these of relevance to CAUP.

Discovering planets around giant stars: understanding the fate of our Solar System

In 2023, the IA team made significant progress in the understanding of exoplanet populations around giant stars. In two recently published articles led by Elisa Delgado-Mena and Filipe Pereira, the discoveries of two “Jupiters” and two “hot Jupiters” around stars of this type were announced.

Giant exoplanets, similar to Jupiter, are common in the Universe. But in intermediate mass stars and closer to the end of their life, the frequency of this type of planets decreases considerably – currently, less than 5% of known planets orbit stars with masses greater than 1.6 times the mass of the Sun.

Elisa Delgado Mena (IA & Universidade do Porto) explains that “the abrupt decrease in the frequency of detection of giant planets around stars with masses greater than twice the mass of the Sun led us to observe young open clusters, as they contain many intermediate-mass stars in the giant phase. It is easier to detect planets at this stage, when the stars have cooled down and have a slower rotation, which allows us to measure radial velocities from their spectrum.”

Due to this difficulty, the team began a systematic survey, which has been ongoing for 17 years, with the HARPS spectrograph, mounted on ESO's 3.6-meter Telescope. As a result of this long term effort, they detected two new giant planets in long period orbits (between 744 and 1155 days) around stars from open clusters IC4651 and NGC3680. But the most surprising data was found by looking at 4 other stars that show stable periodic signals for more than 15 years, which despite appearing to be caused by planets, in reality have stellar origins. “It is a mystery how these stellar signals can last so long and whether they are caused by magnetic fields or other types of stellar phenomena. Our work shows that there may be several “planetary impostors”, which we can only unravel after long-term observations”, added Elisa Delgado Mena.

In the article led by Filipe Pereira, the team used transit photometry data, obtained with the TESS space observatory (NASA), to detect two hot Jupiters, around red giant stars. These observations were later confirmed with measurements of radial velocities obtained with different telescopes. Around the star TOI-4377, the team detected an exoplanet with 0.96 times the diameter and 1.35 times the mass of Jupiter, orbiting in just 4.38 days, at a distance of just 0.058 astronomical units from the star. Around the star TOI-4551, the team detected an exoplanet with about 1.06 times the diameter and 1.5 times the mass of Jupiter, which orbits its star in just under 10 days and at a distance of 0.1 astronomical units.

These are two rare examples of “hot Jupiters” orbiting red giant stars. Systematic surveys using radial velocities initially suggested that these planets would be destroyed by their star, which would explain the small number of these types of exoplanets detected. However, more recent results, based on TESS data, appear to suggest that this destruction process occurs later than initially estimated.

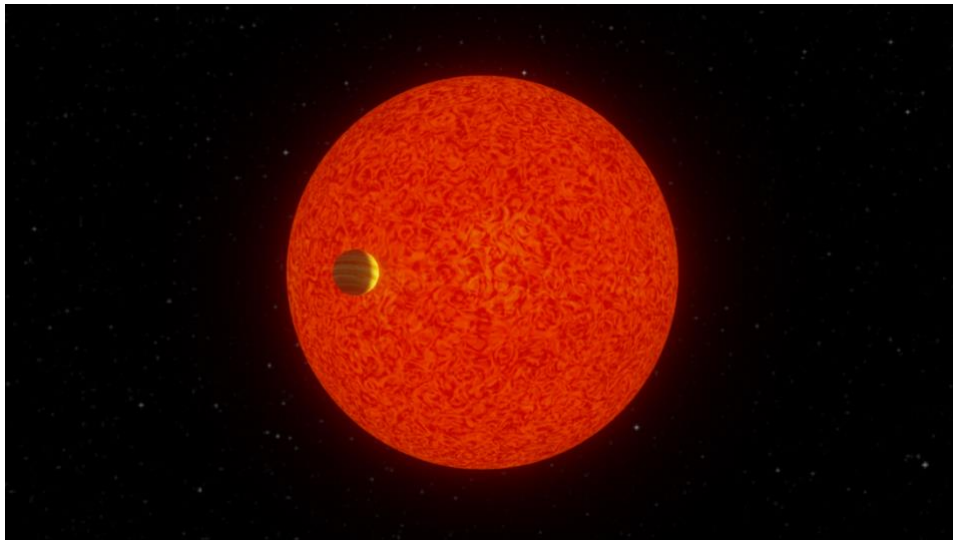


Figure 1: Artist's image of a “hot Jupiter” orbiting a red giant star. (Credit: Tania Cunha - Planetário do Porto - Centro Ciência Viva & Institute of Astrophysics and Space Sciences)

Jupiter as seen by an exoplanet hunter

For the first time, an instrument to find planets light years away was used on an object in the Solar System, in a study on Jupiter's winds carried out by the Institute of Astrophysics and Space Sciences (IA).

We find ourselves at a time when it has become almost commonplace to discover planets orbiting another star, with more than 5,000 already registered. The first distant worlds to incorporate this list were mainly giant planets, similar to but also very different in many ways from Jupiter and Saturn. Astrophysicists have already begun to obtain data on the atmospheres of exoplanets, but fundamental questions about the atmosphere of the largest planet in the Solar System are yet to be answered.

To understand what happens in Jupiter's clouds and air layers, it is necessary to study it over time, in continuous observations. Now, for the first time, an instrument developed to find and analyze worlds light years away, exoplanets, has been pointed at a target in the Solar System, 43 light minutes away from Earth: the planet Jupiter.

The ESPRESSO spectrograph, installed on the European Southern Observatory's (ESO) VLT telescope, was used by a team from the Institute of Astrophysics and Space Sciences (IA) to measure wind speeds on Jupiter. The method used with ESPRESSO was developed by the IA Planetary Systems group with other spectrographs to study the atmosphere of Venus. The IA group has been measuring the winds of this neighboring planet and has been contributing to the modeling of its general atmosphere system for several years.

Now, the exploratory application of this method with a state-of-the-art instrument such as ESPRESSO has resulted in a success that opens new horizons to the knowledge of our cosmic neighborhood. This work affirms the feasibility of systematically monitoring the most distant atmospheres on gaseous planets.

With ESPRESSO, the team was able to measure winds on Jupiter from 60 to 428 km/h with an uncertainty of less than 36 km/h. To verify the effectiveness of Doppler velocimetry from telescopes on Earth in measuring winds on Jupiter, the team also gathered measurements obtained in the past in order to compare the results. Most of the existing data was collected by instruments in space and used a different method, which consists of obtaining average values of wind speed by following cloud patterns in images captured at nearby times.

The consistency between this history and the values measured in this now published study confirms the feasibility of implementing Doppler velocimetry in a program for monitoring Jupiter's winds from Earth. The monitoring will allow us to collect data on how winds change over time and will be essential for developing a

reliable model of the global circulation of Jupiter's atmosphere. This computational model should reproduce the differences in winds depending on latitude, as well as Jupiter's storms, to help understand the causes of the atmospheric phenomena we observe on this planet.

The success of these observations with ESPRESSO proves to be important at a time when its successor, ANDES (on which the IA team is deeply involved), is being designed for the future Extremely Large Telescope (ELT), also from ESO and currently under construction in Chile, but also the future JUICE mission, from the European Space Agency (ESA), dedicated to Jupiter and which will provide additional data.

Thematic line meetings, Journal Clubs and other activities

In 2023, 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 and one researcher, followed by discussion. This format helps the whole team to be acquainted about the research that is being carried out and helps the students to develop presentation skills and identify potential problems and solutions in their 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 event took place in Santarém.

Among the participation in several Scientific Organizing Committees of international conferences, the team organised an international conference in Porto (*Towards Other Earths III*) also started the organisation of one large international conference (*Extreme Precision Radial Velocities 6*) that will take place in 2025. Finally, the 1st PoET workshop was organised in February.

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 2023, 8 MSc dissertations were successfully finished (several other PhD theses and MSc dissertations are ongoing):

- "Estimativa de dose efetiva num corpo humano submetido a um campo de partículas semelhante ao encontrado na superfície de Marte", Dr. Miguel Correia Ralha (MSc)
- "Looking at the Sun, finding other Earths: identification of solar regions", Dr. José Lino (MSc)
- "Fungal melanins as possible biosignatures in exoplanetary conditions", Afonso Mota (MSc)
- "SAR Tomography To Image Asteroid Interior: preparation of the JuRa/HERA data inversion", Miguel José Tavares Gomes (MSc)
- "Collisional Evolution of Jupiter Trojans", Vasco Serra Cardoso (MSc)
- "Stellar flare spectroscopy with ESPRESSO: detecting planets around flaring stars", José Manuel Leiria Amoreira (MSc)
- "Where in the Milky Way do exoplanets preferentially form?", Joana Raquel Aguiar Teixeira (MSc)
- "A Machine Learning approach to determine Stellar Atmospheric Parameters using Spectral Data", Joana Catarina Santos Leite (MSc)

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

- "Development of a tool for the normalization of stellar spectra - application to ESPRESSO data", Diogo Marques
- "Determining the rotational velocity of stars with exoplanets", Bárbara Oliveira
- "Determining the rotational velocity of stars with exoplanets", Pedro Branco
- "A new activity proxy for finding other Earths", Pedro Afonso – A new activity proxy for finding other Earths

In 2023, team funding came mostly from the IA "strategic funding" as well as from 2 running FCT (PEX) projects and one ERC Advanced Grant. The preparation for the response to the FCT 2023 call (deadline in March 2024) was also part of our activities.

Furthermore, funding for our participation in the CHEOPS, PLATO, ARIEL, and ANDES projects was secured through PRODEX. We note, however, the PRODEX funding covers only the "project level activities".

We would further like to highlight the strong collaborative work done in 2023 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 touches several aspects related with the development of new instruments and related software, such as PoET, NIRPS, CHEOPS, 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 2023 was distributed across three main research lines: Sun and Heliosphere, Stellar Physics, and Stellar Populations.

Sun and Heliosphere research line. We continued to participate and collaborate in several national and international projects. Group members lead the Portuguese participation in the SWATNet MSCA Innovative Training Network, are actively contributing to the European Solar Telescope (EST) project, developed the first detailed regional model of the ionosphere, and recently started a partnership with MIT to develop a coupled thermosphere-ionosphere model for the Atlantic mid-latitude regions. 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.

Stellar Physics research line. The exploitation of asteroseismic data from TESS (NASA) 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 also continued to actively contribute 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 team continued to engage in the characterization of pre-main-sequence stars and their environments, in particular of T Tauri stars. Our research also included studies of low-mass stellar and substellar populations in young clusters and star-forming regions in the Milky Way. The team's involvement in SPIRou@CFHT is of particular importance in this respect, with one of its members being part of the consortium's Steering Committee.

Stellar Populations research line. We continued to be actively engaged in several international consortia, including ANDES@ELT, the Maunakea Spectroscopic Explorer (MSE), ESPRESSO@VLT, and NIRPS@ESO 3.6-m Telescope. We highlight the team's involvement in ANDES@ELT, where we play a role in the development of the scientific priorities and the definition of top level requirements for the instrumentation.

Scientific highlights for 2023

A deeper understanding of solar physics with the help of machine learning

The use of machine learning techniques within the field of solar physics holds promise for advancing our comprehension of the intricate phenomena occurring in the Sun's atmosphere. In Asensio Ramos, Cheung, Chifu & Gafira (2023, Living Reviews in Solar Physics, 20, 4), the authors provide a comprehensive review on the topic of machine learning applied to solar physics. Through methodologies like deep learning, it should be possible to sift through vast data sets derived from modern-day solar observations, thus uncovering patterns and trends previously elusive via conventional methods. For instance, this will greatly aid in elucidating phenomena such as solar flares, which have significant influence over Earth's environment. Moreover, machine learning allows delving deeper into solar data, accelerating the development of more intricate models to unravel the Sun's inner mechanisms. Additionally, its application streamlines the analysis process, decreasing the reliance on manual labor and amplifying research efficiency within this domain. A research note was issued by IA accompanying the publication of this review article.

Does the Sun behave like other “Sun-like” stars?

Photometric time series of solar-like stars may exhibit rotational modulation, i.e., brightness variations due to active regions co-rotating with the stellar surface. These signatures allow to constrain properties of stellar rotation and magnetic activity. In Santos et al. (2023, *Astronomy & Astrophysics*, 672, A56), the authors investigate the behaviour of the photometric magnetic activity of Kepler solar-like stars and compare it with that of the Sun. The photometric magnetic activity proxy, S_{ph} , is adopted for this purpose. Sun-like stars were selected from a very narrow parameter space around the solar properties. The authors also paid special attention to KIC 8006161, a very active metal-rich G dwarf, having compared its magnetic activity to that of stars with similar stellar fundamental parameters. They found that the amplitude of S_{ph} variability is strongly correlated with its mean value regardless of spectral type (see Fig. 2 below), similar to a relationship previously found for ground-based observations of chromospheric activity emission. While, depending on the phase of its activity cycle, the Sun is among the less active stars in the sample, the authors found that the $S_{ph}, \odot$ properties are consistent with those observed for Kepler Sun-like stars. KIC 8006161 is, on the other hand, among the most active stars, which also tend to be metal-rich. This supports the interpretation that the strong activity of KIC 8006161 is a consequence of its high metallicity, which in turn affects the depth of the convection zone and, consequently, the efficiency of the underlying dynamo mechanism. A press release was issued by IA accompanying the publication of this article.

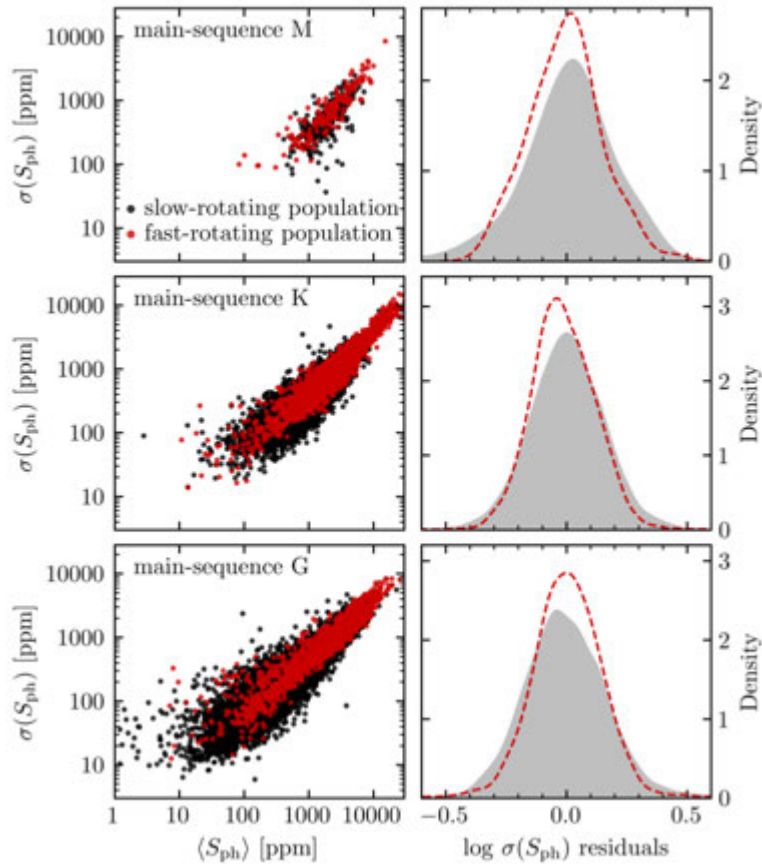


Figure 2: Relation between $\sigma(S_{ph})$ and $\langle S_{ph} \rangle$ for main-sequence GKM stars. From Santos et al. (2023).

Detailed seismic modeling of evolved RGB stars

Asteroseismology is playing an increasingly important role in the characterization of red giant host stars and their planetary systems. In Campante et al. (2023, *The Astronomical Journal*, 165, 214), the authors conduct detailed asteroseismic modeling of the evolved red giant branch (RGB) hosts KOI-3886 and Draconis, making use of end-of-mission Kepler (KOI-3886) and multisector TESS (Draconis) time-series photometry. They also model

the benchmark star KIC 8410637, a member of an eclipsing binary, thus providing a direct test to the seismic determination. The authors aimed at testing the impact of adopting different sets of observed modes as seismic constraints. Given the very small spacing of adjacent dipole mixed modes in evolved RGB stars, the sparse set of observed g-dominated modes was not able to provide extra constraints, further leading to highly multimodal posteriors (see Fig. 3 below). Furthermore, they tested the impact of varying the atmospheric boundary condition in their stellar models. They found the mass and radius estimates to be insensitive to the description of the near-surface layers, at the expense of substantially changing both the near-surface structure of the best-fitting models and the values of associated parameters like the initial helium abundance, Y_i . Attempts to measure Y_i from seismic modeling of red giants may thus be systematically dependent on the choice of atmospheric physics.

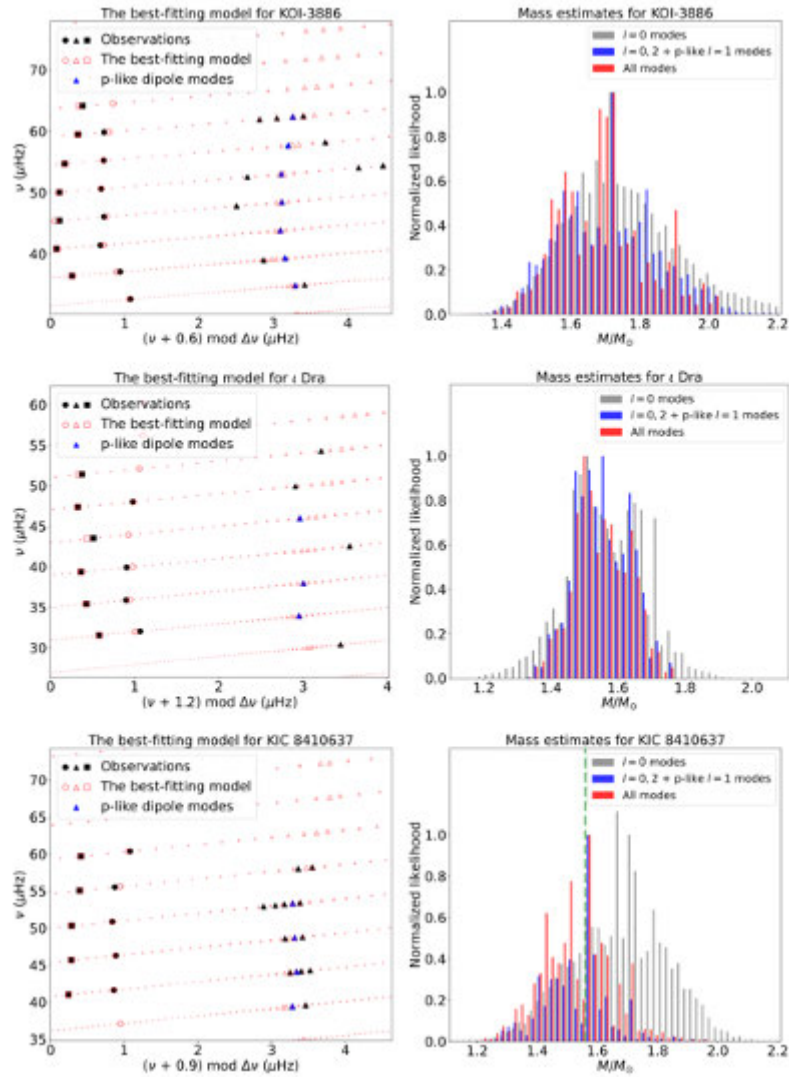


Figure 3: Left column: Échelle diagrams of the best-fitting models for (from top to bottom) KOI-3886, Dra, and KIC 8410637 constrained by all the observed mode frequencies (method “A”). Right column: Probability distributions for the stellar mass estimated using each of the three optimization methods (“0” in gray, “P” in blue, and “A” in red). The vertical dashed line in the bottom panel represents the dynamical mass of KIC 8410637. From Campante et al. (2023).

e-book: Challenges of asteroseismology in the era of space missions

New insights into the physics of stellar interiors and evolution are being made possible by asteroseismology. Moreover, asteroseismology is being increasingly applied to studies of Galactic archaeology, exoplanetary systems, and even tests of fundamental physics. Nevertheless, more data does not necessarily mean a better

understanding, and there are long-standing problems that remain unresolved and others that have emerged as a result of the unprecedented quality of the data collected by space missions like CNES/ESA's CoRoT, and NASA's Kepler/K2 and TESS. In the e-book "Challenges of asteroseismology in the era of space missions" (Pascual Granado, Campante, García Hernández & Guo, Eds., 2023, Frontiers in Astronomy and Space Sciences), the editors aimed at providing contributing authors with an opportunity to publish studies that tackle unresolved problems in asteroseismology, doing so from an original perspective, be it of a theoretical or observational nature. The eleven articles published therein fulfill that role, making use of a diverse set of techniques while addressing a heterogeneous mix of subfields.

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 2023, namely, funded projects, completed theses, organization of conferences and workshops, visiting scientists, and outreach activities.

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 2023, we had two more installments of Stars Day (one in May and the other in December), a biannual in-person meeting with a strong social component. Stars Day events are fully organized by our students.

Communication

The group website is regularly updated, containing the latest group-related news as well as information on our research and other activities.

Tiago Campante
Group Leader

Report from the Group

The assembly history of galaxies resolved in space and time

In 2023, the Group continued to successfully implement its scientific strategy, making significant progress in investigating the formation history of galaxies and their structural components, the genesis and growth of super-massive black holes (SMBHs) in galactic nuclei and their influence on the assembly history of galaxies, the origin and implications of starburst activity and the influence of the environment on galaxy evolution.

These scientific objectives, pursued by a team of 12 researchers, 13 collaborators and 10 students, are served by the IA participation with leadership roles in the ESO instrument consortia of MOONS@VLT, BlueMUSE@VLT, MOSAIC@ELT of ESO, and ESA missions with key importance for the Group's strategy (Euclid, Athena), as well as by the parallel development of highly optimized 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 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 at the end of 2024. During 2023, 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, as well as data from the Hubble Space Telescope (HST) and the James Webb Space Telescope (JWST), 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, the spatial and temporal progression of starburst activity and starburst-driven feedback processes in galaxies, the mechanisms facilitating and regulating the escape of Lyman- α and Lyman-continuum radiation from galaxies, age and metallicity patterns in spiral and elliptical galaxies, cooling flows and ram pressure stripping effects in galaxy clusters, and the nature of ultra-faint galaxies. 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 2023

Physical characterization of high-redshift galaxies in the era of Euclid and JWST

The advent of Euclid and JWST, and the availability of large multi-wavelength data sets for galaxies near and far have intensified activities by our team toward the physical characterization of high- z galaxies. Several parallel efforts by our team have focused on the development of ML tools for the unambiguous identification of high- z AGN (Sect. 1) and the automated characterization of galaxies on the basis of their spectral energy distribution (SED) and morphology.

a) Building upon ML techniques for the classification of astronomical sources in Humphrey et al. 2022 and Cunha & Humphrey 2022, Humphrey et al. (2023) have developed a novel ML-based pipeline (ARIADNE) for the selection of quiescent (non-star-forming) galaxies from Euclid broadband imaging data in combination with multi-wavelength photometry from other large surveys (e.g. the Rubin LSST). ARIADNE combines meta-learning to fuse decision-tree ensembles, nearest-neighbors, and deep-learning methods into a single classifier that yields significantly higher accuracy than any of the individual learning methods separately, and offers a powerful new tool for galaxy characterization.

b) Morphology, structural properties and color gradients of high-redshift galaxies: the chromatic surface brightness modulation (CMOD) effect

Papaderos, Östlin & Breda (2023) have investigated the connection between rest-frame and observer's frame (ObsF) morphological and structural properties of high- z galaxies using i) mock galaxy images computed with evolutionary synthesis models, and ii) a novel technique that predicts the rest-frame SED of galaxies in the UV on the basis of their spatially resolved star formation history (SFH), dust attenuation and nebular characteristics. The starting point of this project was that the shift of the rest-frame UV into the ObsF optical and near-infrared leads to a surface brightness enhancement (dimming) of the UV-bright (UV-faint) disk (bulge). This differential effect, dubbed chromatic surface brightness modulation (CMOD) by these researchers, results in a global change in the morphology, structural properties and color patterns of high- z galaxies. For example, one implication of it is that old (UV-faint) bulges at $z \sim 1$ almost disappear in the optical ObsF, potentially leading to the erroneous conclusion that spiral galaxies in this cosmic epoch have been pure disks, and bulge formation begun only ~ 8 Gyr ago. This misconception could then strongly biases our understanding of the co-evolution of bulges and SMBHs. This study also showed that "HST-dark" galaxies is a natural expectation from CMOD since even a low level of dust obscuration could lead to the virtual disappearance of the central part of a high- z galaxy.

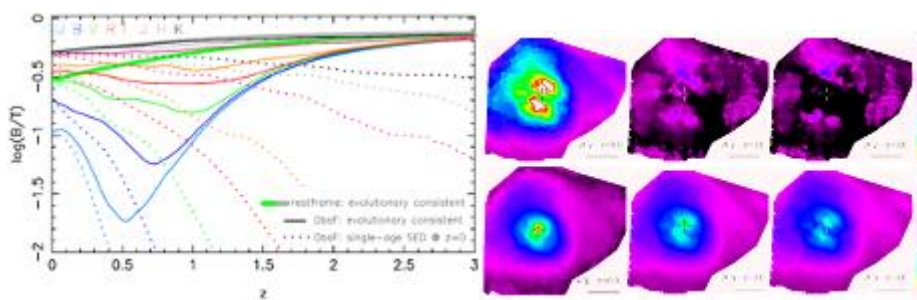


Figure 4: Left: Logarithm of the bulge-to-total (B/T) luminosity ratio vs. redshift z in different filters, as obtained from structural decomposition of synthetic galaxy images that take into account CMOD effects. Thin solid and dotted curves show the predicted ObsF B/T ratio from models assuming, respectively, a time-evolving and time-invariant SED, and thick curves the true (rest-frame) value in the V and H filter (green and gray, respectively). It can be seen that the B/T ratio of a spiral galaxy is strongly underestimated at $z \sim 1$. right: Simulated V and H images (upper and lower panel, respectively) of the ultraluminous infrared galaxy Arp 220 at $z=0, 1$ and 1.6 (from left to right). The (achromatic) effect of cosmological dimming is not taken into account for the sake of better visualization: the central part of the galaxy where dust obscuration is significant entirely evades detection in the optical at $z > 1$ (from Papaderos, Östlin & Breda 2023).

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

galaxies

In preparation for the spectroscopic investigation of evolutionary and chemical properties of galaxies in the critical cosmic epoch around $z \sim 1$ with the upcoming MOONS@VLT, the team has deepened its expertise in spectral modeling and studied in great detail fundamental scaling relations of galaxies in the low- z universe. Miranda et al. (2023) applied the IA-developed spectral synthesis code FADO (Gomes & Papaderos 2017) to study the slope and scatter of the “star formation main sequence”, placing particular attention to the self-consistent treatment of nebular emission as a prerequisite for the accurate determination of the star formation history (SFH) and stellar mass of star-forming galaxies through spectral modeling.

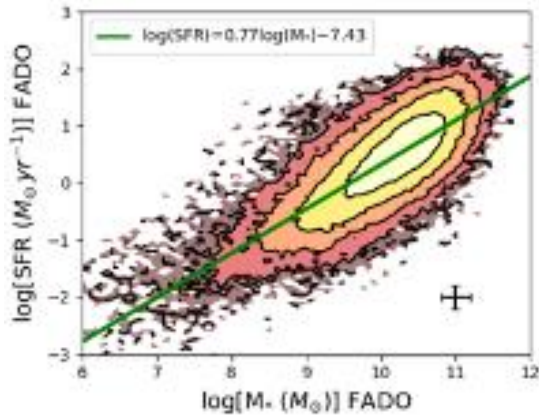


Fig. 5: Star formation main sequence in the nearby universe ($\langle z \rangle = 0.07$) as derived from spectral modeling of ~ 0.2 million galaxies from SDSS with FADO. The cross at the bottom-right corner depicts a median error, and contours delineate areas encompassing 20, 40, 60, 80, and 100% of the sample. A linear fit (equation in the upper-left corner) is shown with the green line (from Miranda et al. 2023).

Finally, in anticipation of studies with MOONS of the physical mechanisms behind the gradual cessation (“quenching”) of star formation (SF) activity since $z \sim 1$, Breda & Papaderos (2023) investigated the dependence of the SF quenching timescale (τ) on the stellar surface density and galactocentric radius of galaxies. Observational constraints in this respect are crucial for disentangling rapid (< 0.5 Gyr) SF shut-off caused by negative AGN feedback from a gentle SF decline over several Gyr that likely reflects a gradual consumption of the available gas reservoir. This work, based on spectral modeling of nearly one million individual spaxels in 135 local galaxies from the CALIFA IFS survey, has allowed for the first time to define a semi-empirical parameterization of τ for both the bulge and the disk component of galaxies as a function of their total stellar mass.

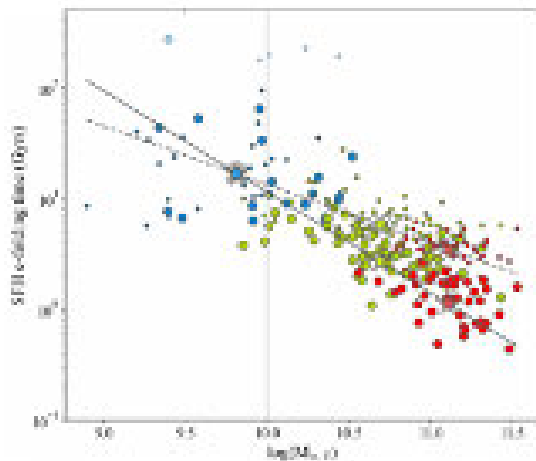


Fig. 6: e -folding time τ (Gyr) quantifying the duration of SF quenching in the bulge and disk component (large and small dots, respectively) of local spiral galaxies vs. logarithm of their present-day stellar mass M_* . Linear

relations for both components are over-plotted (solid and dashed line, respectively). It can be appreciated from this diagram that the SF quenching timescale of galaxies is inversely related to $M_\star$ (from Breda & Papaderos 2023).

Starburst activity and starburst-driven galactic outflows

Starburst activity, prevalent at high redshift, is a fundamental driver of the stellar mass growth and chemical enrichment of galaxies and likely the main driver of the escape of ionizing Lyman continuum (LyC) radiation that led to the reionization of the Universe. Hence, understanding the spatial and temporal progression of this phenomenon and its role in galaxy evolution is of utmost importance.

Starburst-driven galactic outflows are believed to play a critical role in the evolution of galaxies by regulating their mass build-up and star formation history. Theoretical models assume bipolar shapes for the outflows that extend well into the circumgalactic medium, up to tens of kiloparsecs (kpc) perpendicular to the galaxies. They have been directly observed in several local galaxies, however remained elusive in the high- z Universe. Recently, Guo ... Brinchmann et al. (2023, Nature) detected for the first time extended Mg II emission surrounding a sample of galaxies at $z \approx 1$ through ultra-deep IFS observations with MUSE@VLT. This discovery strongly suggests the presence of galactic winds reaching out to more than 10 kpc. Quite importantly, it revealed a strong dependence of the detected winds on galaxy orientation, with edge-on galaxies clearly showing enhanced Mg II emission along the minor axis, whereas face-on galaxies show much weaker and more isotropic emission. This is an important observational proof that bipolar gas outflows develop perpendicular to galactic disks and are prevalent among young galaxies with very active star formation in the early Universe.

Low-mass starburst galaxies in the nearby Universe (see recent review by the team member P. Lagos in National Geographic Portugal) offer the possibility to study such galactic outflows at a much better spatial resolution than possible at high redshift. One such example is the extremely metal-poor blue compact dwarf (BCD) galaxy SBS 0335-052E in which very deep MUSE@VLT observations allowed the detection of a spectacular 15 kpc outflow by Herenz ... Papaderos et al. (2023). A combined interpretation of IFS data with HI interferometric data from the VLA suggests that LyC radiation produced by massive young stellar clusters in this BCD is escaping anisotropically. Anisotropic LyC photon escape, if common at high z , may have major implications for our understanding of the role of low-mass starburst galaxies on the reionization of the Universe.

The least massive dwarf galaxies as laboratories of galaxy formation

Vaz, Brinchmann et al. (2023) have studied with MUSE Leo T ($M_V = -8.0$ mag), a peculiar dwarf galaxy that stands out for being both the faintest and the least massive galaxy known to contain neutral gas and to display signs of recent SF. It is also extremely dark matter-dominated. As a result, Leo T presents an invaluable opportunity to study the processes of gas and star formation at the limit where galaxies are found to have rejuvenating episodes of SF.

A surprising result from this study was that the galaxy consists of two stellar populations, a young (<500 Myr) and old (5-10 Gyr) stellar component, with the latter characterized by a factor of ~ 4 higher velocity dispersion. This observational insight holds important clues to the star formation history and dynamical evolution of the least massive galaxies in the local universe.

Júlio, Brinchmann et al. (2023) have studied with MUSE stellar line-of-sight velocities in the faint dwarf galaxy Antlia B with the aim to derive constraints on the fundamental properties of scalar field dark matter (SFDM), which was originally proposed to solve the small-scale problems faced by cold dark matter models. Based on measurements of 127 individual stars with MUSE, they modeled the dark matter density profile of the galaxy and found that the scale for repulsive self-interaction of the SFDM model is $\lesssim 180$ pc, which is inconsistent with the

value required to match observations of dwarf galaxies in the Local Group. This implies that the central cores in the dark matter profile of these systems are not caused by SFDM.

Group meetings, Journal Clubs and other activities:

In 2023, the team significantly increased its productivity, further strengthened internal synergies, and established new collaborations. Throughout this year the team maintained a busy schedule of weekly briefings to discuss its scientific work. In addition, regular weekly journal clubs continued, where the latest scientific results, mostly non-IA, were discussed. In addition, the team organized two internal workshops (in Porto and Coimbra, respectively, in June and September) to discuss current research and key objectives for the coming years.

The dynamism of the team is also reflected in the continuous development and intensive scientific exploitation of machine learning tools that will strongly support its scientific activities within Euclid, JWST, MOONS@VLT, MOSAIC@ELT and BlueMUSE@VLT, as well as in the co-organization of the conferences “Escape of Lyman radiation from galactic labyrinths” (Crete, April 2023), and the upcoming “Science with the Hubble and James Webb Space Telescopes VII: Stars, Gas & Dust in the Universe” and “Beyond the Edge of the Universe: Latest results from the deepest astronomical surveys” (to be held in Porto and Sintra, respectively, in spring and autumn 2024).

Polychronis Papaderos
Group Leader

Report from the Group

Unveiling the dynamics of the Universe

The activity of the cosmology group was focused on testing the validity of the current standard cosmological model, looking to answer the question: Do we need new physics to understand the Universe? Specifically, does Einstein's general relativity accurately describe gravitation? Is a cosmological constant the correct explanation for the currently observed accelerated expansion of the Universe? Is the Standard Model of particle physics all we need to adequately describe the early Universe? We do this by exploring tests to Einstein's general relativity, delving into the detailed structure of the dark sector and investigating observational signatures of topological defects networks. Our contributions involve our continuing participation in various international consortia. ESA's Euclid mission (in operation), LISA (2035 launch), ESO's ESPRESSO (in operation) and ANDES (2028). This year the team centered its activities on:

1. 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. Our participation in the consortium last year was focused on producing Euclid forecasts. Our team was involved in testing the Copernican principle, the use of higher order weak lensing statistics and constraints on modified gravity models.
2. Putting the present standard cosmological constant model to the test is one of the strongest objectives of our group. Towards this goal, we explored extensions to Einstein's general relativity and their observational signatures and worked on observational signatures of dynamical dark energy models with couplings to the dark matter, or to neutrinos. Most of this work is aligned with the goals of the BEYLA FCT project.
3. The first detection of gravitational waves in 2015 opened a new era for astronomical observations. Several of our members have dedicated their time to studying the stochastic gravitational wave background that can be generated from topological defects, namely cosmic strings and domain wall networks. This background can possibly be detected by the LISA space telescope and building a database of cosmic string signals is crucial towards this goal.
4. The observational measurement of the fine structure constant at different redshifts presents a direct form of testing the validity of its constancy. This is something that the ESPRESSO spectrograph is particularly suited to doing and will be significantly improved with ANDES. With ANDES there is also the possibility of a direct measurement of the expansion rate of the Universe from observing the redshift drift. Several of our members have been directly involved in exploring these possibilities.

Scientific highlights for 2023

Euclid: Testing the Copernican principle with next-generation surveys

The Copernican principle, the notion that we are not at a special location in the Universe, is one of the cornerstones of modern cosmology. Its violation would invalidate the Friedmann-Lemaître-Robertson-Walker metric, causing a major change in our understanding of the Universe. In the publication “Euclid: Testing the Copernican principle with next-generation surveys”, Camarena et al. (2023) A&A 671, A68 constraints on an inhomogeneous Lemaître-Tolman-Bondi model with a cosmological constant were forecast for combinations of present data with simulated Euclid data. It was shown that for a Λ CDM fiducial model Euclid data will improve present constraints by around 30%, with some variation dependent on the observables and scales considered.

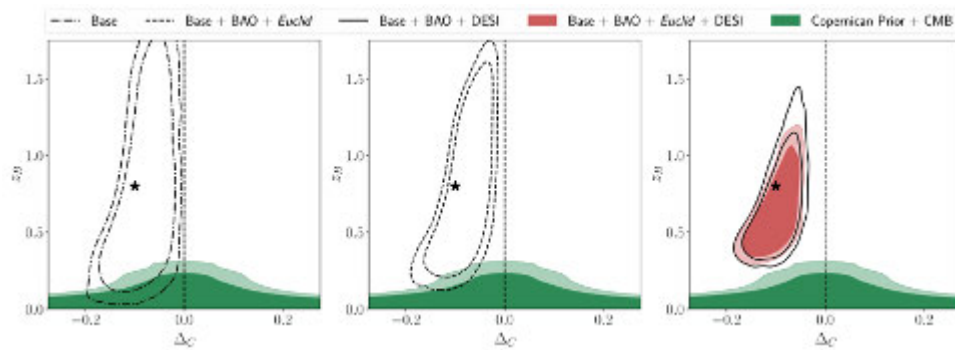


Figure 7: Comparison between present and mock datasets constraints on the two parameters z_B and ΔC that classify the profile of the inhomogeneity in a specific ALTB model. The star depicts the fiducial model at $\Delta C = -0.1$ and $z_B = 0.8$.

Reference: <http://doi.org/10.1051/0004-361/202244557>

Fundamental cosmology from ANDES precision spectroscopy

Fundamental cosmology observations, such as the detection of the redshift drift and tests of the universality of physical laws, are key science and design drivers of the Armazones high Dispersion Echelle Spectrograph (ANDES), an Extremely Large Telescope instrument.

In the work “Fundamental cosmology from ANDES precision spectroscopy”, Marques et al., (2023) MNRAS, 522, 4, 5937, Fisher matrix forecast tools combining both observables were developed. This demonstrates a possible synergy between the two ANDES datasets, quantifying the improvements in the constraints and working towards optimizing ANDES observation strategy.

Reference: <http://doi.org/10.1093/mnras/stad1359>

Cosmology with the Laser Interferometer Space Antenna

The Laser Interferometer Space Antenna (LISA) has two primary cosmological goals: to probe the expansion rate of the universe and to understand stochastic gravitational-wave backgrounds and their implication to our knowledge of the early universe and its relation to particle physics. This white paper publication from the Cosmology working group in LISA, Auclair et al., Living Reviews in Rel. (2023) 26, 1, 5 presents a summary of the state of the art in LISA cosmology. Our group was particularly involved in the work on the topological defects background and on the use of standard sirens to probe the dark sector.

Reference: <http://doi.org/10.1007/s41114-023-00045-2>

The observed number counts in luminosity distance

Next generation surveys will give us unprecedented detections of supernovae Type Ia and gravitational wave merger events. Cross-correlations of such objects offer novel and powerful insights into the large-scale distribution of matter in the universe. Both sources carry information on their luminosity distance but remain uninformative about their redshifts; hence their clustering analyses and cross-correlations must be done in luminosity distance space, as opposed to redshift space. In the paper “The observed number counts in luminosity distance”, Fonseca et al. JCAP (2023) 08, 050, the full expression for the number count fluctuation in terms of a perturbation to the observed luminosity distance was calculated. The expression was found to differ significantly from the one commonly used in redshift space. Furthermore, a comparison of the number count angular power spectra between luminosity distance and redshift spaces was presented. We see a wide divergence between the two at large scales, and lensing seems to be the main contribution to such differences. On such scales and at higher redshifts the difference between the angular power spectra in luminosity distance and redshift spaces can

be roughly 50%. The conclusion is that in a cosmic variance limited survey, the relativistic corrections to the density-only term ought to be included.

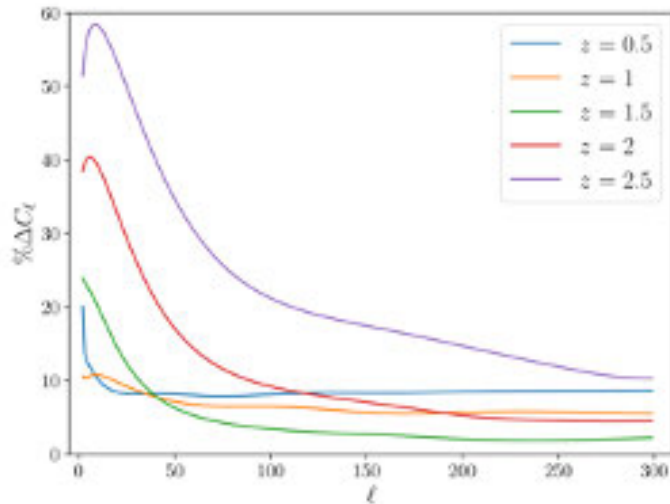


Figure 8: Percentage difference between the angular power spectrum in luminosity distance space and redshift space for a $\sigma = 0.2$ binning. At high redshift lower l can differ substantially. Smaller scales with higher values of l exhibit a milder effect. This difference is also impacted by the binning used, improving for smaller bin size.

Reference: <http://doi.org/10.1088/1475-7516/2023/08/050>

Group meetings, Journal Clubs and other activities

The group has regular weekly journal club meetings, our “Cosmoclub”. 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-cosmocclub.wikidot.com/>.

We participated in the international Cosmoverse meeting that took place at FCUL in Lisbon, on 30 May to 1 June 2023. This was a meeting within the framework of the Cosmoverse e-COST action from the EU.

The cosmology group also organized 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.

Tiago Barreiro
Group Leader

Report from the Group Instrumentation and Systems

The year 2023 was a very intense period for the group, with some projects reaching their final stages and others beginning the detailed design phases, which usually involve additional effort and dedication. 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 2023, the following instruments had engineering and implementation activities at IA:

- For the European Southern Observatory (ESO): 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 has currently a handicap on the Mechanical Engineering side, a problem to be solved in the start of 2024 with the opening of a technical position on this area. On the software side, a new member has reinforced the team.

The current composition of the AISG is:

Researchers (PhDs)

Alexandre Cabral

Bachar Wehbe

David Alves

Elena Duarte

João Dinis

João Coelho

Jorge Gameiro

José M. Rebordão

Manuel Abreu

Sérgio A. G. Sousa*

Nuno Peixinho*

Others

António Joaquim Marques de Oliveira

Manuel Monteiro

PhD Students

André Miguel Silva* (PhD student since 01/10/2019)

Cédric Pereira (PhD student since 01/10/2019)

Inês Leite (PhD student since 01/10/2021)

Nuno Gonçalves (PhD student since 01/10/2021)

Joel Filho* (PhD student since 01/09/2022)

Researchers that work in more than one group are marked with (*).

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.

Following is listed the activity detail of the running projects.

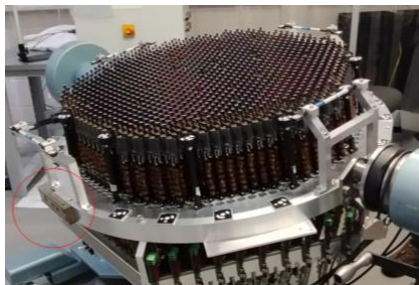
MOONS (ESO)

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).

In 2023, after the RFE was delivered to UKATC in Scotland at the end of 2022, the IA team did 4 missions in UKATC to integrate all the subsystems that the RFE will support and to perform all the performance tests. All the 4 missions were very successful, ending in November with the integration of the Focal Plate Module, the critical core of the front end with its 1000 robot fibre positioners (under the responsibility of UKATC) into the RFE structure.

The first semester of 2024 will see the conclusion of the MOONS integrations and tests towards the Preliminary Acceptance in Europe, before the shipping to Paranal in the second semester.



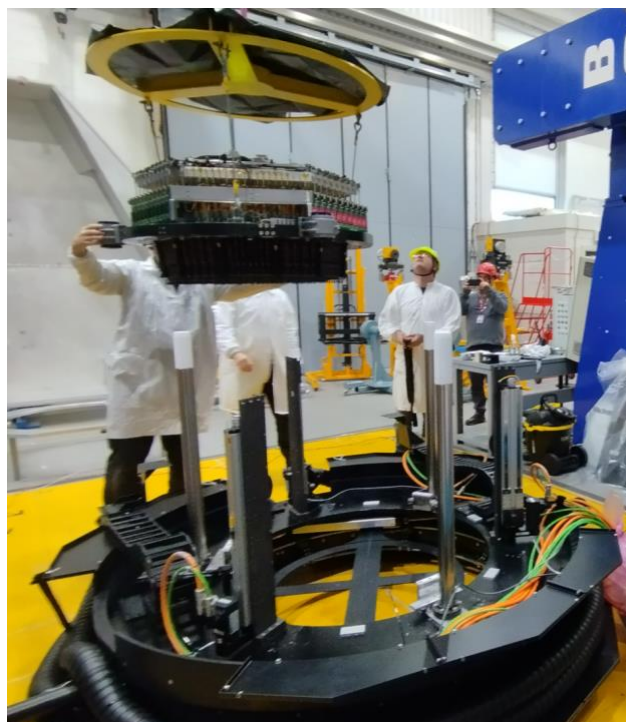


Figure: The MOONS (ESO) RFE during the integration for the Focal Plane Module.

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.

2023 was a very busy successful year for ANDES. The team participated in the preparation of all the documentation package that was sent to ESO regarding the System Architecture Review (SAR). The review was held in ESO's headquarters in Germany on October 17-18, 2023, with the participation of the IA instrumentation team.

On November 15, 2023, ANDES received the certificate of provisional acceptance (PVA) of the SAR, which officially closes the Phase B1 contract with ESO. ESO has granted the PVA without reservation and offered the consortium one night of Guaranteed Time Observation (GTO) on one of the instruments at the ELT telescope in return for the consortium's contribution to the System Architecture Review.

Another milestone, with high importance for the FE, was achieved. The team submitted a change request to ESO to change the architecture of the FE structure. Since we will no longer need the possibility to observe two targets simultaneously, that led to huge simplification to the FE. We no longer need the rotating structure, and we will now adapt the fixed structure architecture. The change request was recently approved by ESO.

On top of these two milestones, the FE team organised and participated in several working meetings (in Italy, and in Portugal). The team is also preparing the documentation package for the subsystems preliminary design review that will be held in October 2024.

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 $R \sim 200000$. The project is funded by the European Union (ERC, FIERCE, 101052347). And it is a Portuguese project.

During 2023, the project had its first full year of work, ending with the delivery of the “PoET Design and Interface Report” that will be reviewed by ESO in the beginning of 2024, followed by the final design and construction phase.

BlueMUSE (ESO)

IA has been invited to participate in the ESO-BLueMUSE instrument, which is a blue-optimised, medium spectral resolution, panoramic integral field spectrograph based on the MUSE instrument, proposed for the Very Large Telescope (installed at Nasmyth platform level). Phase A of this project is scheduled for the beginning of 2024, but preparatory works already took place during 2023.

With an optimised transmission down to 350 nm, BlueMUSE builds upon the heritage of MUSE but includes both obvious and novel improvements (e.g., improved stability with better temperature control and automated alignment processes). Along with all the core subsystems supporting the increased performance of BlueMUSE, the instrument shall be managed at hardware and software level according to the new standards currently in use at the VLT.

The Instrumentation team of IA will be responsible for the Instrument Control Electronics and for the Instrument Control Software of the full instrument.

Euclid (ESA)

Euclid is ESA's 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 the consortium coordination group, in various science working groups, and leading the Survey operations support team.

In 2023, IA's Instrumentation and Systems Group continued its long-standing participation in the preparation of the Survey Design, focusing on the development of the ECTile software. This software computes the mission's Reference Survey, i.e., it produces schedules of the Euclid Deep and Wide surveys, including implementation of all calibrations, that are compliant with all constraints and requirements. The IA-computed reference survey is the basis of the operational survey to be executed by the Euclid satellite during the nominal science observations phase (NSOP).

During the first half of the year, we further consolidated ECTile as an operational tool. This included the incorporation of precise on-target times specified in the observation configuration files, the usage of proper motion of blinding stars when tessellating the sky, updating to new calibration specifications, implementation of a refined region-of-interest, new computation of the Euclid common FoV. In addition a new tool was developed to schedule some of the observations of the performance verification phase (PV). These activities led to the generation of two surveys RSD2023A and B. A workshop on ECTile usage and RSD generation was organised in FCUL (May 2023) to Euclid consortium and ESA users.

On July 1st, Euclid was successfully launched. The launch was followed by commissioning, then the PV phase and finally the Wave Front Error campaign (WFE), prior to the NSOP scheduled to start in February 2024. Measurements in these early observing phases led to changes in some of the operational specifications. In particular, the telescope orientation was strongly restricted which invalidated the usage of RSD2023A and B in the NSOP. The second half of the year was dedicated to modifying ECTile to cope with the new unforeseen requirements. This included adding the capability of placing tilted FoVs and adapting the algorithms to cope with them. In addition, ECTile was adapted to consider a specific orbit file in its computations. A test survey, RSD2023C, was generated with the modified ECTile. The final month of the year was dedicated to the computation of RSD2024A, the first RSD version to be used for NSOP.

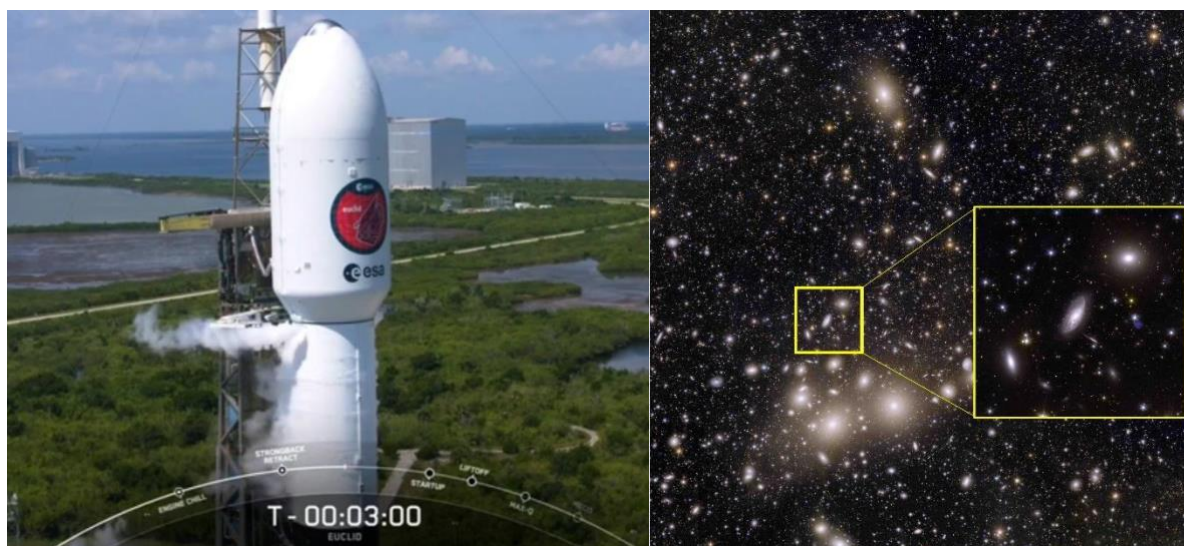


Figure: (Left) (Launch: July 1st 2023, Euclid launch countdown. The nose cone enclosing the Euclid spacecraft sits on top of the Falcon 9 rocket on platform 40 of the Kennedy Space Center, 3 seconds to launch. (Right) Perseus: The first Euclid science images were released on November 7th 2023. This image of the Perseus Cluster shows 1000 galaxies belonging to the cluster, and more than 100 000 additional galaxies further away in the background. The full cluster is contained in the Euclid wide field-of-view, and the whole area is imaged with high resolution as shown in the cut-out. This image showcases the power of Euclid: to obtain extremely sharp images of the distant Universe over a large region of the sky in one single pointing.

CHEOPS (ESA)

The Characterising Exoplanet Satellite (CHEOPS) is the first mission dedicated to search for transits of exoplanets by means of ultrahigh precision photometry on 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 were responsible for the calibration of the pipeline until the end of the nominal mission.

In 2023, CHEOPS continued to run well within specifications and continued to get scientific observations of high precision. IA continued to give maintenance support to the data reduction pipeline during the CHEOPS nominal mission until September 2023. With the end of the nominal mission and the start of the extension of the mission we took the responsibility for the maintenance of the full data reduction software where we will need to deal with the ageing of the instrument. During this year we also signed the contract for the funding of this task through Prodex. The proposal will allow hiring a dedicated person to this task for which a call was already issued in December 2023. It is expected that the hired person will start working on this in the beginning of the next year.

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, has been 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 activity for the OGSE work package, two units were already delivered and commissioned to the Centre Spatial de Liège (CSL), and during the year of 2023, the team has as main activity the support and maintenance of the two units that are now fully integrated in the PLATO cameras integration and testing work

path. In this scope, the IA team assured remote assistance and support to the CSL team, analysing log data generated by housekeeping processes running in our unit. During the past year, the main problem encountered was associated with a broken optical fibre which was promptly replaced by a spare item.

As referred in the previous report, ESA contracted us to produce a 3rd unit of the collimator, which was adapted to different light sources, and whose objective was to provide ESA with extra camera testing capability, reinforcing the different test houses' resources.

This collimator was commissioned in August 2023 and successfully tested with a PLATO EM camera.



Figure: Plato OGSE in test before installation at ESA

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 Instrumentation group 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 during calibration and verification procedure.

The work performed during the period of this activity reporting refer to all the tasks regarding the preparation of the CDR, which should have happened during 2023 but, for reasons external to the OGSE team, is being scheduled for the end of the 1st semester of 2024.

During this last year the OGSE team adapted the previous design to current OGSE configuration, namely with the substitution of the “target projector unit” with the “periscope unit”. This is the subsystem that interfaces the OGSE with the Ariel M1 mirror.

A considerable effort was also focused on the interface of the ambient optical bench (where all the illumination sources sit) with the Integrating Sphere (vacuum and cryo conditions), mainly due to the need to cope with significant thermoelastic deformations arising during the cool-down process.

In terms of the development of hardware, the PCB circuits for the reference detectors pre-amplifiers were designed and tested in real operating conditions (vacuum and 70 K temperature ambient) to be able to evaluate

its noise characteristics. The best amplifier / reference detector pair was chosen based on its performance in these working conditions.

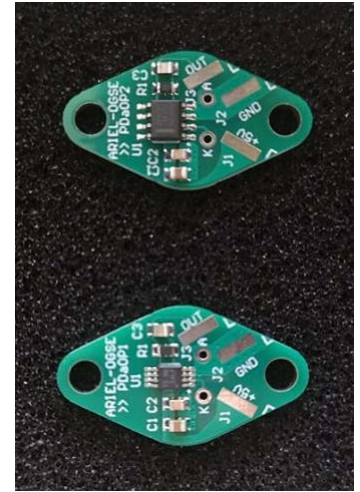
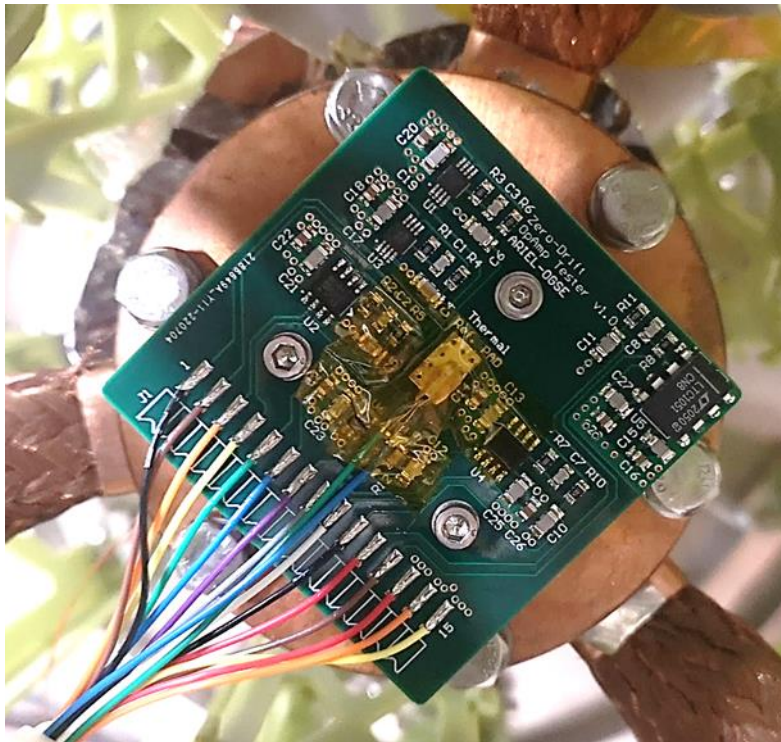


Figure: Electronic circuits for reference detector and pre-amplifier testing at cryo conditions (70K)

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 IA team is to measure 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.

Most of the work done during 2023 was related to the development of the optical test setup in our labs. This testbed will be used to verify all the metrological and operational requirements defined for the EM version of the On-board Metrology system developed by our group.

At this moment, the OBM hardware and camera are being integrated for the testing phase. The consortium led by IA has already partially achieved the TRR milestone (test readiness review), which assures the group readiness for the initiation of the verification and compliance testing. Full readiness is however being delayed by some problems associated to the image sensor operation, which are being actively pursued and debugged by the team with the support of the sensor manufacturer (Teledyne).

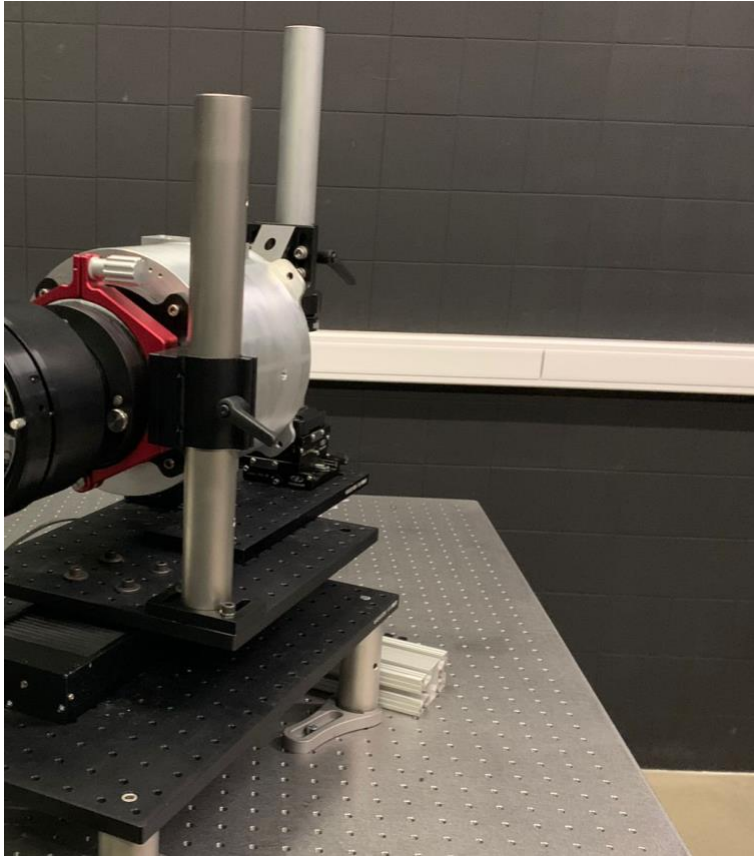


Figure: OBM camera being prepared for verification testing

Highlights for 2023

1. In November 2023, the integration of the MOONS Focal Plante Unit with its 1000 fibre positioner robots, developed by UKATC, into the Rotating Front End developed by IA, was successfully concluded, finishing one of the last and critical phases of the MOONS instrument.
2. ANDES received in November 2023 the certificate of provisional acceptance (PVA) of the SAR, which officially closes the Phase B1 contract with ESO. ESO has granted the PVA without reservation and offered the consortium one night of Guaranteed Time Observation (GTO) on one of the instruments at the ELT telescope in return for the consortium's contribution to the System Architecture Review.
3. Sixteen years after the first proposal in 2007, and with IA's participation since 2012, the Euclid mission was successfully launched this year, on July 1st. Euclid is a cosmology survey mission, designed to determine the properties of dark energy and dark matter on cosmological scales. It is unique in combining a wide field with high resolution and far reaching, and it will build a large archive, unprecedented for a space-based mission. Observations have started and the first images were released on November 7th. IA has a leading role in some aspects of the mission: developing the survey planning software, leading the survey operations support team, and coordinating the astrophysics (non-cosmology) program of the mission.
4. In the scope of the PLATO project, as result of direct contract from ESA, a 3rd unit of the OGSE collimator was produced and commissioned @ ESA premises at ESTEC.
5. The work on the Athena OBM led by IA achieved the TRR milestone, which determines the start of the testing and compliance verification of the prototype developed by the consortium.

UnF – Training Unit

Head (for 2012-2023): 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 2023 were as follows:

- **Doctoral level:**
 - No PhD theses were completed in the calendar year 2023.
 - As of 31 December CAUP was host to 28 ongoing PhD research projects.
- **Masters level:**
 - A total of 10 Masters dissertations were completed in the calendar year 2023, of which 4 in astronomy (A. Correia, F. Pimenta, I. Rolo, J. Teixeira), 2 in physics (M. Carvalho, A. Falorca), 1 in physics engineering (J. Lino), 1 in medical physics (M. Ralha), 1 in astrophysics and space instrumentation at U.Coimbra (E. Silva) and 1 in technological physics engineering at U. Lisbon (J. Amoreira).
 - As of 31 December CAUP was host to 7 Master's dissertation 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 16 such internships were completed in 2023. 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, 12 new internships were either in progress or scheduled to start in early 2024.
- **Future projects:**
 - All research projects offered by CAUP researchers for the academic year 2023-24 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 theses and Masters dissertations and those intended for undergraduate internships. The latest edition was released in conjunction with the 2023 edition of our Astronomy Students Day, which was held on 9 May.
- **Senior training:**
 - Two CAUP advanced courses have been organised: Python for Astronomers (J. Martins, A. Silva) and Phi in the Sky - Astrophysical probes of fundamental physics (C. Martins).
 - One continuing education course, mostly aimed at high-school teachers but open to others (undergraduate or high-school students, etc) was taught, The Physics of Everyday Life (C. Martins).
- **Junior training:**
 - In 2023 we organised the twelfth 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 6-27 August, at the CEIA in Paredes de Coura. Camp activities for the students included lectures (45h) and practical classes (27h), observations, community service, and other leisure activities. The camp included 12 students, 4 camp monitors and 3 teachers.

- In July we hosted two-week internships for 7 secondary school students, in the context of the AstroCamp, the Ciência Viva's OCJF project, and other partnerships.
- Other activities:
 - In October-November 2023 we participated in the International Space Week's 'Space Goes to School' event, organised by Ciência Viva's ESERO office, giving more than 50 in person and online talks across continental Portugal as well as in the Azores and Madeira islands.

ND – Outreach Unit

Head (for 2009-2023): Filipe A. L. Pires, who is also the Executive Director of the Porto Planetarium.

Context

For the Porto Planetarium, the year 2023 was a year of growth and consolidation, with an increase in the number of visitors and an expansion of offerings. The Porto Planetarium surpassed its previous year's record of the highest number of participants in all its activities with 64,715 attendees, an increase of 14% compared to the previous year. This increase is due to a reinforcement of activities outside the premises with schools, particularly sessions with the portable planetarium.

The Porto Planetarium increased the offering of sessions with the acquisition of the licence for a new session "We Are the Guardians," a session that addresses the importance of satellites in acquiring important data for the adoption of more appropriate measures for the protection of ecosystems.

The year 2023 is also marked by the inauguration of the Ciência Viva School for Earth and Space, an educational project in collaboration with the Porto City Council, the University of Porto, the Galeria da Biodiversidade - Centro Ciência Viva, and the Planetário do Porto – Centro Ciência Viva. Opened in September 2023, the School addresses essential learning from various areas of knowledge of the 1st cycle of basic education, using research-oriented work methodologies. Starting from the problem question, "Why is there only Life, and so much on Earth?", students have the opportunity, for one week, to visit exhibitions, attend planetarium sessions, work in scientific research laboratories, go on field trips, conduct experiments and investigations, develop their creative vein, and ask all their questions!

Human Resources

During 2023, the human resources allocated to the Outreach Unit were:

- 5 CAUP contracts at 1.0 full time equivalent (FTE): Filipe Pires, Paulo Pereira, Ricardo Reis, Elsa Moreira and Francisco Miguel Gonçalves. One CAUP contract at 0.8 FTE to outreach unit: Adriana Silva.
- 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 José Dantas.

Regular Activities at the Porto Planetarium

Educational offer for schools: the offer implemented in 2017 continued to expand in 2023 with the following number of participants:

- Planetarium shows: 33 653 visitors.
- Hands-on Laboratories: 19 002 visitors.

Regular Activities at schools

- Portable Planetarium: planetarium sessions presented for a total of 6 044 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 3 101 participants.

Special Events

O Dia Mais Curto: a Festa da Curta-Metragem 2023

Every year, between December 21st and 22nd, Winter arrives in the Northern Hemisphere of the Earth. This transition, known as the Winter Solstice, also marks the shortest day of the year, which inspired the creation of the festival celebrating the shortest and most original format of Cinema worldwide: The Shortest Day.

Strange Attractors: Phantom Fatal

Audiovisual and immersive performances, promoted by De Liceiras 18 - Temporary Art Community, within the framework of the Criatório program of Ágora - Culture and Sports of Porto, E.M.

25º Aniversário do Planetário do Porto / Dia Nacional da Cultura Científica 2023

Commemorative event of the National Day of Scientific and Technological Culture, and the 25th anniversary of the opening to the public of the Porto Planetarium - Center for Living Science.

CIÊNCIA de VIVA voz: com Pedro Ré

Pedro Ré, a full professor, biologist, and amateur astronomer, was invited to speak at the Auditorium of the Porto Planetarium - CCV, about the importance of Pro-am activity in Portugal and the evolution of telescopes – presenting some historical and some very current instruments.

«O Afeto da Escuta» – festival of sound ecologies

Curated by the Institute for Postnatural Studies (Madrid, Spain), and organized by the Contemporary Art Department of Ágora - Cultura e Desporto do Porto, E.M, the festival "The Affection of Listening" brings together in various locations in Porto, including Passos Manuel, Galeria da Biodiversidade, and Porto Planetarium, between November 10th and 12th, around two dozen international artists, including composers, sound artists, and acoustic researchers.

Rochas deste e d'outros Mundos

Workshop developed by Professor Álvaro Pinto (director of the Centro Ciência Viva do Lousal - Mina de Ciência) with various participatory and interactive games for the identification of rocks, minerals, and meteorites.

In orbit, by Flaviu Rogojan

Immersive video with live narration by artist Flaviu Rogojan.

Based on the true story of a space probe that NASA lost contact with in 2013, this project combines scientific fact and speculative fiction to imagine the probe's current existence and the newly discovered life in orbit.

Launch of the Euclid Space Mission

The Planetário do Porto - Ciência Viva Centre and the Institute of Astrophysics and Space Science joined the launch event of the ESA Euclid mission. Before watching the broadcast of the mission's launch in the auditorium of the Porto Planetarium, researcher Carlos Martins summarised the mission and its scientific objectives.

World Children's Day 2023 special - Premiere of the immersive film

World Children's Day is a special celebration that reminds us of the importance of caring for and protecting the very young, providing them with a safe and healthy environment in which to grow and thrive. As we honour this date, we should also reflect on the responsibility we have to preserve our planet as a sustainable home for children and future generations. The Porto Planetarium has joined the celebration by premiering a new immersive film dedicated to the whole family, "We are the Guardians", and offering all children (up to the age of 12) free entry to all screenings on the weekend of 3 and 4 June 2023.

National Scientists' Day 2023

In 2016, through Assembly of the Republic Resolution No. 228/2016, 16 May was established as National Scientists' Day. The date coincides with the birthday of the former Minister of Science and Higher Education

José Mariano Gago, with the aim of celebrating and recognising the historic, relevant and innovative contribution of the scientific community to the advancement of knowledge, progress and the well-being of society.

"Sea Monsters" and "Sea of Plastic" exhibitions at the Porto Planetarium

CIIMAR - the Interdisciplinary Centre for Marine and Environmental Research, brought its "Sea Monsters" and "Plastic Sea" exhibitions to the Porto CCV Planetarium between 17 April and 31 October 2023. Both exhibitions combine art and science to raise awareness of the problem of marine litter and the need for people to adopt environmentally responsible behaviour.

International Day of Light 2023

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 celebrating the "International Day of Light".

In this activity, schools, their students and teachers from all over the world carried out various activities throughout 2023 to mark this anniversary.

PLANETÁRIOS/PT 2023 - 2º Encontro Nacional de Planetários

On 20 February 2023, the 2nd National Planetarium Meeting was held at the Planetário do Porto - Centro Ciência Viva. This informal meeting was aimed at planetarium professionals and digital content producers, with special emphasis on fulldome production.

Astronomia no Feminino - International Day of Women and Girls in Science 2023

The Planetário do Porto - CCV and the Instituto de Astrofísica e Ciências do Espaço joined in the celebrations of the Day of Women and Girls in Astronomy, with activities that aim to demystify the concept of a woman scientist, particularly in areas such as physics and maths, and to encourage girls to pursue studies and careers in these areas.

ESO 60 years - Feet on Earth, Eyes on the Sky

On 11 February, the Planetário do Porto - CCV joined in the celebrations of the 60th anniversary of the ESO - European Southern Observatory with a special programme at its facilities.

On 5 October 1962, five countries signed the convention to create the European Southern Observatory (ESO). Now, six decades later and supported by 16 Member States, of which Portugal is one, and strategic partners, ESO brings together scientists and engineers from all over the world to develop and operate advanced ground-based observatories in Chile that enable revolutionary astronomical discoveries.

UnAS – Administration and Services Unit

Head (for 2012-2023): 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.

The year 2023 marks the return to a new normality after the pandemic caused by covid-19 where remote working became an important option. During this year the changes implemented to working methods and procedures during the last years were consolidated. CAUP IT infrastructures suffered major improvements, namely, with the implementation of a new mail service, the acquisition of a next generation firewall and the installation of a new and more efficient air conditioned system in the data center to cope with current and future demands.

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;
- One staff member continues to be dedicated to public procurement and human resources;
- Deployment of a new next-generation firewall, with improved security and control;
- Remaining websites moved to a new server;
- Implementation and deployment of a new mail service;
- Deployment of a new mailing list service;
- Installation of a new AC system in the datacenter.

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

- Preparation and submission to FCT of 11 pedidos de pagamento;
- Preparation and submission to FCT of 14 pedidos de pagamento for Investigador FCT;
- Preparation and submission to Ciência Viva of 5 pedidos de pagamento;
- Preparation and submission of 5 pedidos de pagamento for other funding.

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

- 3 Research work contracts;
- 16 Research fellowship contracts;
- 21 Academic internship contracts;
- 4 Work contracts.

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

- Agenda do Trabalho Digno; Ordem dos Contabilistas Certificados - Porto; 18 April (Joana Bateira)
- Ética e Direito à Proteção de Dados - Univ. Porto & INESC TEC - Online; 4 July (Elsa Silva)
- Princípio da Proteção de Dados desde a Conceção em Projetos de I&D - Univ. Porto & INESC TEC - Porto; 5 July (Elsa Silva)
- Sage 50 - Faturação Eletrónica; Sage University - Online; 12 July (Argentina Pereira)
- Segurança e Saúde no Trabalho; Preseg- Prevenção e Segurança no Trabalho Lda; 20 September (Argentina Pereira, Carlos Gonçalves, Elsa Silva, Fernando Soares, Joana Bateira, Sara Ramos)
- Plug-in Contratação Pública; Ordem dos Contabilistas Certificados - Online; 16 November (Argentina Pereira, Elsa Silva, Joana Bateira)
- As férias, faltas e licença no âmbito da LTFT e do Código do Trabalho - Atualizado; IGAP - Instituto de Gestão e Administração Pública - Online; 27 November - 4 December (Joana Bateira)
- Abordagens à contratação de RH para equipas em projetos de I&D+i; Reitoria da Universidade do Porto - Online; 13 December (Argentina Pereira, Joana Bateira)

Research projects/programmes

During 2023 there were 15 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 2023 were supported by national and European funds are:

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

- 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):

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

PI: Jarle Brinchmann

[start date: 01 September 2021 – end date: 31 August 2025]

- 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: 31 December 2023]

- Phi in the Sky: Astrophysical probes of fundamental physics (PTDC/FIS-AST/4862/2020)

PI: Carlos Martins

[start date: 01 January 2023 – end date: 31 December 2025]

- Star-exoplanet compositional link: towards realistic characterization of terrestrial planets (2022.06962.PTDC)

PI: Vardan Adibekyan

[start date: 01 January 2023 – end date: 31 December 2024]

- Cool Stars in the near-Infrared (2022.04416.PTDC)

PI: Elisa Delgado Mena

[start date: 01 January 2023 – end date: 30 June 2024]

- Uncovering the nature of cosmic strings (2022.03495..PTDC)

PI: Lara Sousa

[start date: 01 January 2023 – end date: 30 June 2024]

- Using Ap stars as LABORatories for probing chemical transport mechanisms, with ultra-precise space-based photometry (2022.03993..PTDC)

PI: Margarida Cunha

[start date: 10 March 2023 – end date: 09 September 2024]

(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 2024]

(iv) 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 (ESA Contract No. 4000133026)

PI: Nuno Santos

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

- ANDES@ELT (ESA Contract No. 4000143136)

PI: Nuno Santos

[start date: 01 January 2023 – end date: 31 December 2025]

- e-CHEOPS: Extending the CHEOPS mission (ESA Contract No. 4000142255)

PI: Sérgio Sousa

[start date: 01 October 2023 – end date: 31 December 2025]

Outreach and educational projects

During 2023, there were 5 funded outreach/educational projects in CAUP, which provide funds available for outreach and/or education related expenses. These were:

- AstroCamp 2023

PI: Carlos Martins

[start date: 01 January 2023 – end date: 31 December 2023]

- Ocupação Científica dos Jovens nas Férias 2023

PI: Carlos Martins

[start date: 01 January 2023 – end date: 31 December 2023]

- Formação ESERO 2023

PI: Filipe Pires/Ilídio Lopes

[start date: 01 January 2023 – end date: 31 December 2023]

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

PI: Filipe Pires

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

- Rede de Escolas Ciência Viva (RE-C06-i04.02 - Impulso Jovem Steam, PRR_ID73)

PI: Filipe Pires

[start date: 01 March 2023 – end date: 30 March 2025]

Research grants

Several grants that have been active in 2023 with financial support of CAUP or with CAUP as the host institution.

The ongoing research grants for PhD students were:

1. Jennifer Peralta Lucero, Research assistantship grant for PhD degree (CIAAUP-22/2023-BI-D), CAUP, 15 December 2023
2. Clara Marie Winckler, Research assistantship grant for PhD degree (UI/BD/154758/2023), Fundação para a Ciência e a Tecnologia, 01 December 2023
3. Alba Barka, Research assistantship grant for PhD degree (CIAAUP-21/2023-BI-D), CAUP, 01 November 2023
4. Ricarda Heilemann, Research assistantship grant for PhD degree (CIAAUP-18/2023-BI-D), CAUP, 01 October 2023
5. Catarina M. J. Marques, Research assistantship grant for PhD degree (2023.03984.BD), Fundação para a Ciência e a Tecnologia, 01 October 2023
6. Carmen San Nicolás Martínéz, Research assistantship grant for PhD degree (CIAAUP-12/2023-BI-D), CAUP, 15 September 2023
7. Daniel A. D. Vaz, Research assistantship grant for PhD degree (2022.13277.BD), Fundação para a Ciência e a Tecnologia, 01 January 2023
8. Pedro Alexandre C. Cunha, Research assistantship grant for PhD degree (2022.11477.BD), Fundação para a Ciência e a Tecnologia, 01 September 2022
9. Bárbara M. T. B. Soares, Research assistantship grant for PhD degree (2022.11805.BD), Fundação para a Ciência e a Tecnologia, 01 September 2022
10. Sergei Mukovnikov, PhD grant (UI/BD/152220/2021), Fundação para a Ciência e a Tecnologia, 15 January 2022
11. Eduardo A. S. Cristo, PhD grant (PRT/BD/152703/2022), Fundação para a Ciência e a Tecnologia, 01 January 2022
12. Ana Rita Costa Silva, PhD grant (2021.07856.BD), Fundação para a Ciência e a Tecnologia, 01 October 2021
13. Nuno A. M. Moedas, PhD grant (UI/BD/152075/2021), Fundação para a Ciência e a Tecnologia, 15 September 2021
14. João D. F. Dias, PhD grant (SFRH/BD/150990/2021), Fundação para a Ciência e a Tecnologia, 01 February 2021
15. Nuno M. Rosário, PhD grant (2020.05472.BD), Fundação para a Ciência e a Tecnologia, 01 February 2021
16. André Miguel A. C. V. Silva, PhD grant (2020.05387.BD), Fundação para a Ciência e a Tecnologia, 01 January 2021
17. David Grüber, PhD grant (2020.07632.BD), Fundação para a Ciência e a Tecnologia, 01 October 2020
18. Miguel T. Clara, PhD grant (2020.07530.BD), Fundação para a Ciência e a Tecnologia, 01 October 2020
19. Abhishek Chougule, PhD grant (PD/BD/150439/2019), Fundação para a Ciência e a Tecnologia, 01 October 2019
20. Tomás de Azevedo Silva, PhD grant (PD/BD/150416/2019), Fundação para a Ciência e a Tecnologia, 01 October 2019

The completed research grants for PhD students in 2023 were:

1. Catarina M. J. Marques, Research assistantship grant for PhD degree (CIAAUP-07/2023-BI-D), CAUP, 15 March 2023 to 14 September 2023
2. José Rodrigues, Research assistantship grant for PhD degree (CIAAUP-17/2022-BI), CAUP, 01 July 2022 to 30 June 2023
3. Thibault Boulet, PhD grant (PD/BD/150426/2019), Fundação para a Ciência e a Tecnologia, 01 October 2019 to 30 November 2023

The ongoing research grants for master students were:

1. Yuri C. Damasceno, Research assistantship grant for MSc degree (CIAAUP-20/2023-BI-M), CAUP, 01 November 2023
2. Inês Martins Rolo, Research assistantship grant for MSc degree (CIAAUP-15/2023-BI-M), CAUP, 01 October 2023
3. Pedro Miguel H. Branco, Research assistantship grant for MSc degree (CIAAUP-16/2023-BI-M), CAUP, 01 October 2023

4. Eduardo Campos Gonçalves, Research assistantship grant for MSc degree (CIAAUP-17/2023-BI-M), CAUP, 01 October 2023
5. Joana Raquel A. Teixeira, Research assistantship grant for MSc degree (CIAAUP-11/2023-BI-M), CAUP, 15 July 2023

The completed research grants for master students in 2023 were:

1. Yuri C. Damasceno, Research assistantship grant for MSc degree (CIAAUP-01/2023-BI-M), CAUP, 09 January 2023 to 08 July 2023
2. Bruno B. Cerqueira, Research assistantship grant for MSc degree (CIAAUP-21/2022-BI-M), CAUP, 01 October 2022 to 30 June 2023
3. Afonso M. A. Vale, Research assistantship grant for MSc degree (CIAAUP-22/2022-BI-M), CAUP, 01 October 2022 to 30 June 2023
4. Inês Martins Rolo, Research assistantship grant for MSc degree (CIAAUP-19/2022-BI-M), CAUP, 15 September 2022 to 14 March 2023
5. Eva L. Silva, Research assistantship grant for MSc degree (CIAAUP-18/2022-BI-M), CAUP, 15 September 2022 to 14 March 2023
6. Maria Inês M. F. S. Ferreira, Research assistantship grant for MSc degree (CIAAUP-20/2022-BI-M), CAUP, 15 September 2022 to 14 March 2023

The active research grants for initialisation to research in 2023 were:

1. Bruno Francisco Parracho, Research Initiation Fellowship (BII) (CIAAUP-08/2023-BII), CAUP, 16 March 2023
2. Bárbara Silva Oliveira, Research Initiation Fellowship (BII) (CIAAUP-02/2023-BII), CAUP, 01 March 2023
3. Diogo G. S. Marques, Research Initiation Fellowship (BII) (CIAAUP-03/2023-BII), CAUP, 01 March 2023
4. Samuel R. P. Veiga, Research Initiation Fellowship (BII) (CIAAUP-04/2023-BII), CAUP, 01 March 2023
5. Pedro Miguel H. Branco, Research Initiation Fellowship (BII) (CIAAUP-05/2023-BII), CAUP, 01 March 2023
6. Anselmo J. G. Falorca, Research Initiation Fellowship (BII) (CIAAUP-06/2023-BII), CAUP, 01 March 2023

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 2023 was (see below):

Papers in refereed journals	153
Papers in proceedings	11
Communications in international meetings	67
Communications in national meetings	19
Observing runs	18

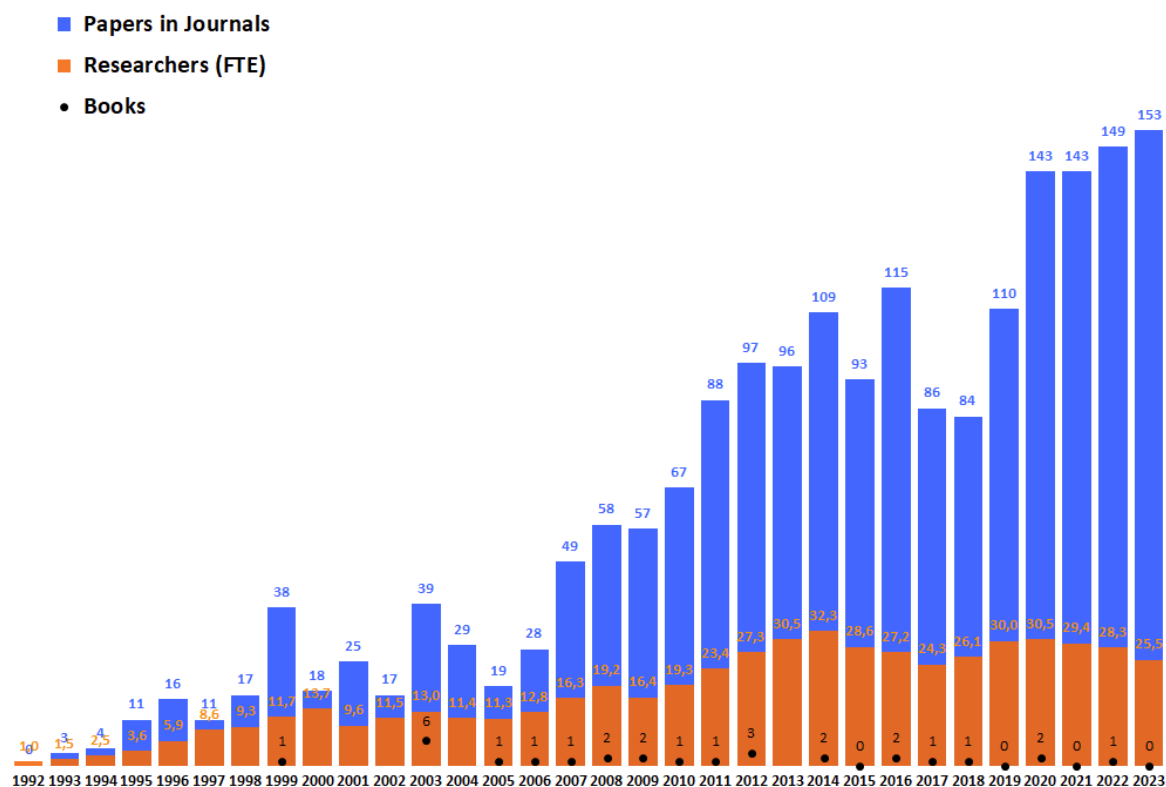


Figure 5: Blue bars – CAUP Publications in refereed journals per year; Orange bars – number of researchers with a PhD in full-time-equivalent (FTE) units; dots – books edited/published per year.

The h-index of CAUP is 148 (for a total of 118 051 accumulated citations).

If only refereed papers – as defined by ISI – are considered, the average number of citations per article is above 59. 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.

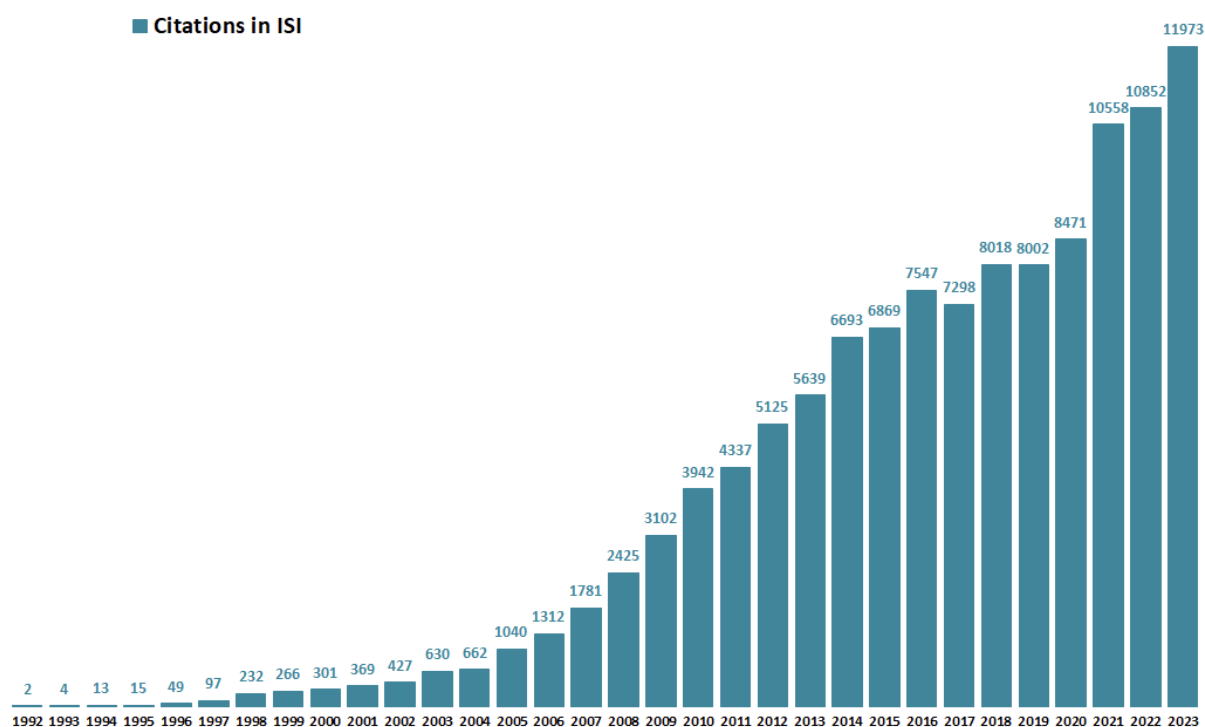


Figure 6: Citations per year from ISI using all entries in the database with CAUP/IA Porto in the affiliation.

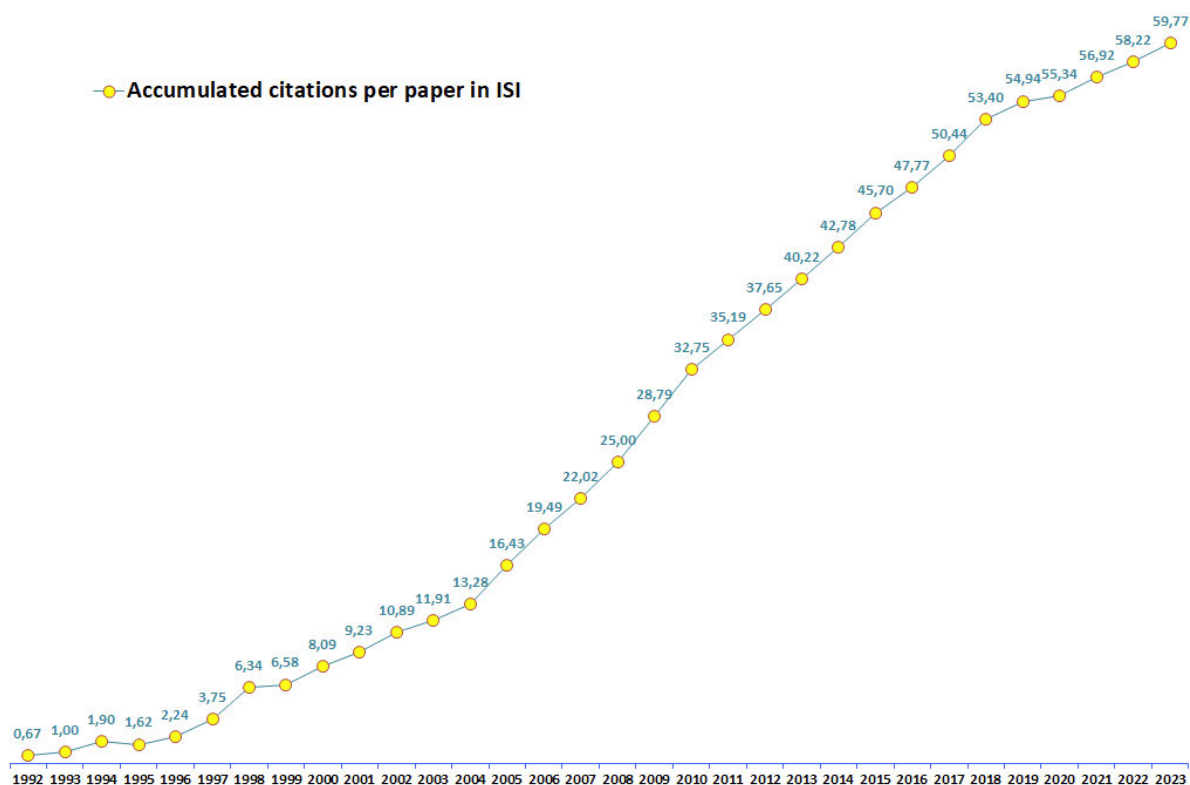


Figure 7: Accumulated citations per paper in ISI using all entries in the database with CAUP in the affiliation.

During 2023 CAUP organized, or co-organized, the following conferences, workshops, meetings or schools:

- Cosmonata 2023; 21 December 2023; Porto and Lisbon, Portugal
- ANDES meeting; 11 to 12 December 2023; Porto, Portugal
- Starts Day 2023; 04 December 2023; Porto, Portugal
- 2DEMOC; 21 to 22 September 2023; Santarém, Portugal
- Internal Workshop of the Researcher Group “The assembly history of galaxies resolved in space and time”; 06 September 2023; Coimbra, Portugal
- Towards Other Earths III: The Planet-Star Connection; 17 to 21 July 2023; Porto, Portugal
- Internal Workshop of the Researcher Group “The assembly history of galaxies resolved in space and time”; 14 to 16 June 2023; Porto, Portugal
- Starts Day 2.5; 24 May 2023; Coimbra, Portugal
- Escape of Lyman radiation from galactic labyrinths; 18 to 21 April 2023; Kolymbari - Crete, Grécia
- IberiCos 2023: 17th Iberian Cosmology Meeting; 03 to 05 April 2023; Ponte de Lima, Portugal
- PoET Workshop; 23 to 24 February 2023; Porto, Portugal
- Encontro Nacional de Planetários; 20 February 2023; Porto, Portugal
- IA-ON10; Instituto de Astrofísica e Ciências do Espaço 10th internal workshop; 26 to 27 January 2023, Fátima, Portugal
- Planetary Systems Day #3; 20 February 13 January 2023; 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 2023 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 2023, CAUP received 30 visitors to develop collaborative work with team members, most of them being supported under the ongoing exchange programmes and projects, and organised 27 scientific seminars + 9 further organised by IA/U.Lisboa with CAUP participation, as well as frequent journal clubs in the various groups, the majority online.

Refereed publications in 2023

1. A. Tuson, D. Queloz, H. P. Osborn, T. G. Wilson, M. J. Hooton, M. Beck, M. Lendl, G. Olofsson, A. Fortier, A. Bonfanti et al. (including: **J. Gomes da Silva, S. G. Sousa, S. C. C. Barros, O. D. S. Demangeon, N. C. Santos**), 2023; *TESS and CHEOPS discover two warm sub-Neptunes transiting the bright K-dwarf HD 15906*; Monthly Notices of the Royal Astronomical Society, 523, 2, 28
2. D. S. Aguado, E. Caffau, P. Molaro, C. Allende Prieto, P. Bonifacio, J. I. González Hernández, R. Rebolo, S. Salvadori, M. R. Zapatero Osorio, S. Cristiani et al. (including: **N. C. Santos, N. J. Nunes, C. J. A. P. Martins, J. Rodrigues**), 2023; *The pristine nature of SMSS 1605–1443 revealed by ESPRESSO*; Astronomy & Astrophysics, 669, L4, 8
3. K. Al Moulla, X. Dumusque, **P. Figueira**, G. Lo Curto, **N. C. Santos**, F. Wildi, 2023; *Stellar signal components seen in HARPS and HARPS-N solar radial velocities*; Astronomy & Astrophysics, 669, A39, 13
4. R. Alonso, S. Hoyer, M. Deleuil, A. E. Simon, M. Beck, W. Benz, H.-G. Florén, P. Guterman, L. Borsato, A. Brandeker et al. (including: **S. C. C. Barros, O. D. S. Demangeon, N. C. Santos, S. G. Sousa**), 2023; *No random transits in CHEOPS observations of HD 139139*; Astronomy & Astrophysics, 680, A78, 7
5. D. J. Armstrong, A. Osborn, **V. Zh. Adibekyan, E. Delgado-Mena**, S. Hojjatpanah, S. B. Howell, S. Hoyer, H. Knierim, **S. G. Sousa**, K. G. Stassun et al. (including: **J. Rodrigues, N. C. Santos**), 2023; *Discovery and characterization of two Neptune-mass planets orbiting HD 212729 with TESS*; Monthly Notices of the Royal Astronomical Society, 524, 4, 12
6. N. Arulanantham, M. Gronke, E. Fiorellino, **J. F. Gameiro**, A. Frasca, J. Green, S. Chang, R. A. B. Claes, C. C. Espaillat, K. France, 2023; *Lya Scattering Models Trace Accretion and Outflow Kinematics in T Tauri Systems*; The Astrophysical Journal, 944, 2
7. D. Arzoumanian, S. Arakawa, M. I. N. Kobayashi, K. Iwasaki, K. Fukuda, S. Mori, Y. Hirai, M. Kunitomo, **M. S. N. Kumar**, E. Kokubo, 2023; *Insights on the Sun Birth Environment in the Context of Star Cluster Formation in Hub–Filament Systems*; The Astrophysical Journal, 947, 2, 10
8. P. Auclair, D. Bacon, T. Baker, **T. Barreiro**, N. Bartolo, E. Belgacem, N. Bellomo, I. Ben-Dayan, D. Bertacca, M. Besancon et al. (including: **L. Sousa, P. P. Avelino, A. d. Silva, C. J. A. P. Martins, J. P. Mimoso, N. J. Nunes, I. Tereno**), 2023; *Cosmology with the Laser Interferometer Space Antenna*; Living Reviews in Relativity, 26, 5
9. **P. P. Avelino**, 2023; *Can gravitational vacuum condensate stars be a dark energy source?*; Journal of Cosmology and Astroparticle Physics, 2023, 08, 7
10. **P. P. Avelino**, 2023; *Halos of dark energy*; Physical Review D, 107, 10
11. **P. P. Avelino**, B. F. de Oliveira, R. S. Trintin, 2023; *Role of predator-prey reversal in rock-paper-scissors models*; Europhysics Letters, 142, 4
12. G. M. Azevedo, A. L. Chies-Santos, R. Riffel, **J. M. Gomes**, A. E. Lassen, J. P. V. Benedetti, R. S. de Souza, Q. Xu, 2023; *Spatially resolved self-consistent spectral modelling of jellyfish galaxies from MUSE with FADO: trends with mass and stripping intensity*; Monthly Notices of the Royal Astronomical Society, 523, 3, 12
13. C. Babusiaux, C. Fabricius, S. Khanna, T. Muraveva, C. Reylé, F. Spoto, A. Vallenari, X. Luri, F. Arenou, M. A. Álvarez et al. (including: **D. Bossini**), 2023; *Gaia Data Release 3 Catalogue validation*; Astronomy & Astrophysics, 674, A32, 25
14. R. Bacon, **J. Brinchmann**, N. F. Bouché, T. Contini, S. Kamann, D. Krajnović, A. Monreal Ibero, J. Richard, T. Urrutia, L. Wisotzki, MUSE Collaboration, 2023; *Scientific Highlights from Ten Years of the MUSE Collaboration*; The Messenger, 191
15. R. Bacon, **J. Brinchmann**, S. Conseil, M. V. Maseda, T. Nanayakkara, M. Wendt, R. M. Roettenbacher, D. Mary, P. M. Weilbacher, D. Krajnović, 2023; *The MUSE Hubble Ultra Deep Field surveys: Data release II*; Astronomy & Astrophysics, 670, A4, 42
16. O. Balsalobre-Ruza, J. Lillo-Box, A. Berihuete, **A. M. Silva, N. C. Santos**, A. Castro-González, **J. P. Faria**, N. Huélamo, D. Barrado, **O. Demangeon** et al. (including: **S. C. C. Barros**), 2023; *KOBESim: A Bayesian observing strategy algorithm for planet detection in radial velocity blind-search surveys*; Astronomy & Astrophysics, 669, A18, 14
17. D. Barbato, D. Ségransan, S. Udry, N. Unger, F. Bouchy, C. Lovis, M. Mayor, F. Pepe, D. Queloz, **N. C. Santos**, 2023; *The CORALIE survey for southern extrasolar planets XIX. Brown dwarfs and stellar companions unveiled by radial velocity and astrometry*; Astronomy & Astrophysics, 674, A114, 34
18. K. Barkaoui, M. Timmermans, A. Soubkiou, B. V. Rackham, A. J. Burgasser, J. Chouqar, F. J. Pozuelos, K. A. Collins, S. B. Howell, R. Simcoe et al. (including: **O. Demangeon**), 2023; *TOI-2084 b and TOI-4184 b: Two new sub-Neptunes around M dwarf stars*; Astronomy & Astrophysics

19. B. J. Barros, **D. M. L. Castelão**, **V. da Fonseca**, **T. Barreiro**, **N. J. Nunes**, **I. Tereno**, 2023; Abstract Citations (1) References (64) Co-Reads Similar Papers Volume Content Graphics Metrics Export Citation Feedback Is there evidence for CIDER in the Universe?; *Journal of Cosmology and Astroparticle Physics*, 2023, 1
20. **S. C. C. Barros**, **O. D. S. Demangeon**, D. J. Armstrong, **E. Delgado Mena**, L. Acuña, J. Fernández Fernández, M. Deleuil, K. A. Collins, S. B. Howell, C. Ziegler et al. (including: **V. Zh. Adibekyan**, **S. G. Sousa**, **N. C. Santos**), 2023; *The young mini-Neptune HD 207496b that is either a naked core or on the verge of becoming one*; *Astronomy & Astrophysics*, 673, A4, 18
21. T. A. Baycroft, A. H. M. J. Triaud, **J. P. Faria**, A. C. M. Correia, M. R. Standing, 2023; *Improving circumbinary planet detections by fitting their binary's apsidal precession*; *Monthly Notices of the Royal Astronomical Society*, 521, 2, 8
22. L. Binette, Y. Krongold, S. A. R. Haro-Corzo, **A. Humphrey**, **S. G. Morais**, 2023; *Optimized Spectral Energy Distribution for Seyfert Galaxies*; *Revista Mexicana de Astronomía y Astrofísica*, 53, 9
23. Boldog, G. M. Szabó, L. Kriskovics, A. Brandeker, F. Kiefer, A. Bekkelien, P. Guterman, G. Olofsson, A. E. Simon, D. Gandolfi et al. (including: **S. G. Sousa**, **S. C. C. Barros**, **O. D. S. Demangeon**, **N. C. Santos**), 2023; *Glancing through the debris disk: Photometric analysis of DE Boo with CHEOPS*; *Astronomy & Astrophysics*, 671, A127, 10
24. A. Bonfanti, D. Gandolfi, J. A. Egger, L. Fossati, J. Cabrera, A. Krenn, Y. Alibert, W. Benz, N. Billot, H. - G. Florén et al. (including: **V. Zh. Adibekyan**, **N. C. Santos**, **S. G. Sousa**, **S. C. C. Barros**, **O. D. S. Demangeon**), 2023; *TOI-1055 b: Neptunian planet characterised with HARPS, TESS, and CHEOPS*; *Astronomy & Astrophysics*, 671, L8, 13
25. M. Bonici, C. Carbone, S. Davini, P. E. Vielzeuf, L. Paganin, V. F. Cardone, N. Hamaus, A. Pisani, A. J. Hawken, A. Kovacs et al. (including: **J. Brinchmann**, **A. C. da Silva**, **I. Tereno**), 2023; *Euclid: Forecasts from the void-lensing cross-correlation*; *Astronomy & Astrophysics*, 670, A47, 20
26. A. Boucher, D. Lafrenière, S. Pelletier, A. Darveau-Bernier, M. Radica, R. Allart, E. Artigau, N. J. Cook, F. Debras, R. Doyon et al. (including: **J. H. C. Martins**), 2023; *CO or no CO? Narrowing the CO abundance constraint and recovering the H₂O detection in the atmosphere of WASP-127 b using SPIRou*; *Monthly Notices of the Royal Astronomical Society*, 522, 4, 21
27. J. Bouvier, A. Sousa, K. Pouilly, J. -M. Almenara, J.-F. Donati, S. Alencar, A. Frasca, K. N. Grankin, A. Carmona, G. Pantolmos et al. (including: **J. F. Gameiro**), 2023; *Stable accretion and episodic outflows in the young transition disk system GM Aurigae*
A semester-long optical and near-infrared spectrophotometric monitoring campaign; *Astronomy & Astrophysics*, 672, A5, 30
28. **I. P. Breda**, **P. Papaderos**, 2023; *Exploring the genesis of spiral galaxies*
Classical and pseudo bulges as extremities of a continuous sequence; *Astronomy & Astrophysics*, 669, A70, 10
29. S. N. Breton, H. Dhoub, R. A. Garcia, A. S. Brun, S. Mathis, F. Pérez Hernández, S. Mathur, A. Dyrek, **A. R. G. Santos**, P. L. Pallé, 2023; *In search of gravity mode signatures in main sequence solar-type stars observed by Kepler*; *Astronomy & Astrophysics*, 679, A104, 19
30. **J. Brinchmann**, 2023; *High-z galaxies with JWST and local analogues – it is not only star formation*; *Monthly Notices of the Royal Astronomical Society*, 525, 2, 20
31. L. Cabayol, M. Eriksen, J. Carretero, R. Casas, F. J. Castander, E. Fernández, J. Garcia-Bellido, E. Gaztanaga, H. Hildebrandt, H. Hoekstra et al. (including: **J. Brinchmann**, **A. C. da Silva**, **I. Tereno**), 2023; *The PAU Survey and Euclid: Improving broadband photometric redshifts with multi-task learning*; *Astronomy & Astrophysics*, 671, A153, 23
32. J. Cabrera, D. Gandolfi, L. M. Serrano, S. Csizmadia, J. A. Egger, P. Baumeister, A. Krenn, W. Benz, A. Deline, H. -G. Florén et al. (including: **V. Zh. Adibekyan**, **S. G. Sousa**, **S. C. C. Barros**, **O. D. S. Demangeon**, **N. C. Santos**), 2023; *The planetary system around HD 190622 (TOI-1054)*
Measuring the gas content of low-mass planets orbiting F-stars; *Astronomy & Astrophysics*, 675, A183, 14
33. T. Caglar, M. J. Koss, L. Burtscher, B. Trakhtenbrot, M. K. Erdim, J. E. Mejía-Restrepo, F. Ricci, M. C. Powell, C. Ricci, R. Mushotzky et al. (including: **J. Brinchmann**), 2023; *BASS. XXXV. The $M_{\text{BH}}-\sigma^*$ Relation of 105 Month Swift-BAT Type I AGNs*; *The Astrophysical Journal*, 956, 60, 22
34. **J. D. Camacho**, **J. P. Faria**, **P. T. P. Viana**, 2023; *Modelling stellar activity with Gaussian process regression networks*; *Monthly Notices of the Royal Astronomical Society*, 519, 4, 14
35. D. Camarena, V. Marra, Z. Sakr, S. Nesseris, **A. C. da Silva**, J. Garcia-Bellido, P. Fleury, L. Lombriser, M. Martinelli, **C. J. A. P. Martins** et al. (including: **J. P. Mimoso**, **J. Brinchmann**, **I. Tereno**), 2023; *Euclid: Testing the Copernican principle with next-generation surveys*; *Astronomy & Astrophysics*, 671, A68, 15

36. **T. L. Campante**, T. Li, J. M. J. Ong, E. Corsaro, **M. S. Cunha**, T. R. Bedding, **D. Bossini**, S. N. Breton, D. L. Buzasi, W. J. Chaplin et al. (including: **M. Deal**, **M. J. P. F. G. Monteiro**, **L. F. Pereira**, **N. C. Santos**), 2023; *Revisiting the Red Giant Branch Hosts KOI-3886 and ι Draconis. Detailed Asteroseismic Modeling and Consolidated Stellar Parameters*; The Astronomical Journal, 165, 5, 21
37. J. Campbell-White, C. F. Manara, A. Sicilia-Aguilar, A. Frasca, L. D. Nielsen, C. Schneider, B. Nisini, A. Bayo, B. Ercolano, P. Ábrahám et al. (including: **J. F. Gameiro**), 2023; *Empirical determination of the lithium 6707.856 Å wavelength in young stars*; Astronomy & Astrophysics, 673, A80, 13
38. A. Carmona, X. Delfosse, S. Bellotti, P. Cortés-Zuleta, M. Ould-Elhkim, N. Heidari, L. Mignon, J.-F. Donati, C. Moutou, N. J. Cook et al. (including: **O. D. S. Demangeon**), 2023; *Near-IR and optical radial velocities of the active M dwarf star Gl 388 (AD Leo) with SPIRou at CFHT and SOPHIE at OHP*; Astronomy & Astrophysics, 674, A110, 25
39. **R. Carvajal**, **I. Matute**, **J. Afonso**, R. P. Norris, K. J. Luken, P. Sánchez-Sáez, **P. A. C. Cunha**, **A. Humphrey**, H. Messias, **S. Amarantidis** et al. (including: **H. Miranda**, **A. Paulino-Afonso**, **C. Pappalardo**), 2023; *Selection of powerful radio galaxies with machine learning*; Astronomy & Astrophysics, 679, A101, 24
40. A. Castro-González, **O. D. S. Demangeon**, J. Lillo-Box, C. Lovis, B. Lavie, **V. Zh. Adibekyan**, L. Acuña, M. Deleuil, A. Aguichine, M. R. Zapatero Osorio et al. (including: **N. C. Santos**, **S. G. Sousa**, **A. Antoniadis-Karnavas**, **P. Figueira**, **A. M. Silva**, **S. C. C. Barros**, **C. J. A. P. Martins**), 2023; *An unusually low-density super-Earth transiting the bright early-type M-dwarf GJ 1018 (TOI-244)*; Astronomy & Astrophysics, 675, A52, 23
41. S. Chatterjee, R. Garani, R. K. Jain, B. Kanodia, **M. S. N. Kumar**, S. K. Vempati, 2023; *Faint light of old neutron stars and detectability at the James Webb Space Telescope*; Physical Review D, 108, 2, L021301
42. J. Chouqar, J. Lustig-Yaeger, Z. Benkhaldoun, A. Szentgyorgyi, A. Jabiri, **A. Soubkiou**, 2023; *Surface pressure impact on nitrogen-dominated USP super-Earth atmospheres*; Monthly Notices of the Royal Astronomical Society, 522, 1, 648
43. P. Cortés-Zuleta, I. Boisse, B. Klein, E. Martioli, P. I. Cristofari, **A. Antoniadis-Karnavas**, J.-F. Donati, X. Delfosse, C. Cadieux, N. Heidari et al. (including: **O. D. S. Demangeon**, **J. Gomes da Silva**, **N. C. Santos**), 2023; *Optical and near-infrared stellar activity characterization of the early M dwarf Gl 205 with SOPHIE and SPIRou*; Astronomy & Astrophysics, 673, A14, 40
44. **I. A. Costa**, **R. S. S. C. Reis**, **E. M. P. S. Moreira**, 2023; *Science communication through astronomy education: The creation, implementation, and assessment of Porto Planetarium's science education strategy; Communicating Astronomy with the Public*, 33, 24
45. S. Cristiani, M. Porru, F. Guarneri, G. Calderone, K. Boutsia, A. Grazian, G. Cupani, V. D'Odorico, F. Fontanot, **C. J. A. P. Martins** et al. (including: **C. M. J. Marques**), 2023; *Spectroscopy of QUBRICS quasar candidates: 1672 new redshifts and a golden sample for the Sandage test of the redshift drift*; Monthly Notices of the Royal Astronomical Society, 522, 2, 9
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30. **E. Delgado Mena**; 2023; Long period RV signals in intermediate mass evolved stars: planets, oscillations or stellar activity?; Towards Other Earths III: The Planet-Star connection, Porto, Portugal
31. **P. Fanha, M. S. Cunha, D. Bossini, M. I. M. F. S. Ferreira**, M. Deal; 2023; *Testing a new tool to distinguish the stage of evolution of red-giant stars*; PLATO Stellar Science Conference 2023, Milazzo, Italy
32. **J. D. F. Dias**; 2023; *Constraints on extended Bekenstein models from cosmological, astrophysical, and local data*; IberiCos 2023 - 17th Iberian Cosmology Meeting, Ponte de Lima, Portugal
33. **J. C. Fonseca**; 2023; *The observed number counts in luminosity distance space*; 26th International Conference on Particle Physics and Cosmology (COSMO23), Madrid, Spain
34. **J. M. Gomes**; 2023; *Nebular Emission in Early-Type Galaxies*; S-PLUS meeting, , Brazil
35. **C. M. J. Marques, C. J. A. P. Martins**, C. S. Alves; 2023; *Fundamental cosmology from ANDES precision spectroscopy*; IberiCos 2023 - 17th Iberian Cosmology Meeting, Ponte de Lima, Portugal
36. **C. J. A. P. Martins**; 2023; Reaching new heights in fundamental cosmology with the redshift drift; StEm65, Sexten, Bozen, Italy
37. **C. J. A. P. Martins**; 2023; *Testing the standard model with QSO absorption lines*; Spectral Fidelity, Florence, Italy
38. **C. J. A. P. Martins**; 2023; *To scale, or not to scale*; VII Olentzero Workshop, Bilbao, Spain
39. **C. J. A. P. Martins**; 2023; *The ESPRESSO Redshift Drift Experiment*; ESPRESSO Science Team Meeting 2023, Lanzarote, Spain
40. **C. J. A. P. Martins**; 2023; *The ESPRESSO I2 Cell Experiment*; ESPRESSO Science Team Meeting 2023, Lanzarote, Spain
41. **C. J. A. P. Martins**; 2023; *The ESPRESSO I2 Cell Experiment*; ANDES System Architecture Meeting 2023, La Laguna, Tenerife, Spain
42. **N. A. M. Moedas**; 2023; Radiative accelerations in solar-like stars: a more efficient way to compute them in MESA; 10th Iberian Meeting on Asteroseismology, Lanzarote, Spain
43. **N. A. M. Moedas, D. Bossini**, M. Deal; 2023; An efficient way to compute dense and accurate grids of stellar models including the effect of radiative accelerations; PLATO Stellar Science Conference 2023, Milazzo, Italy
44. **N. A. M. Moedas, D. Bossini**, M. Deal; 2023; Accurate Characterisation of FG-type Stars with Improved Chemical Transport Mechanisms; TASC7/KASC14 workshop, Honolulu, USA
45. **A. Paulino-Afonso**; 2023; *FLAEMING: are we able to find SC4K-like LAEs using AI?*; Escape of Lyman radiation from galactic labyrinths, Kolymbari, Crete, Greece
46. **A. Paulino-Afonso**; 2023; *Identifying more than 7K new LAEs in the COSMOS field: implications for the Ly α luminosity function*; Shedding new light on the first billion years of the Universe 16th edition of the GECO team conference cycle, Marseille, France
47. **A. Paulino-Afonso**; 2023; *How to find LAEs in a galaxy haystack?*; European Astronomical Society Annual Meeting, Kraków, Poland
48. **N. M. Rosário**; 2023; Constraining the structure and composition of two short-period rocky planets spanning the radius valley; European Astronomical Society Annual Meeting, Kraków, Poland
49. **N. M. Rosário**; 2023; Constraining the structure and composition of two short-period rocky planets spanning the radius valley; Towards Other Earths III: the planet-star connection, Porto, Portugal
50. **A. R. G. Santos**; 2023; *Measuring stellar rotation and magnetic activity from photometric time-series*; PLATO Stellar Science Conference 2023, Milazzo, Italy
51. **A. R. G. Santos**; 2023; *Stellar Physics @ Institute of Astrophysics and Space Sciences*; 10th Iberian Meeting on Asteroseismology, Lanzarote, Spain
52. **N. C. Santos**; 2023; *PoET, the Paranal solar ESPRESSO Telescope*; Spectral Fidelity, Florence, Italy
53. **N. C. Santos**; 2023; *Science, Technoly, and Industry: The virtuous circle of space sciences*; 6th New Space Atlantic Summit: a global effort for space sustainability, European Maritime, Lisboa, Portugal
54. **N. C. Santos**; 2023; *Looking at the Sun, finding other Earths: the Paranal solar ESPRESSO Telescope*; Towards Other Earths III: the planet-star connection, Porto, Portugal
55. **N. C. Santos**; 2023; *The Paranal Solar ESPRESSO Telescope*; PoET workshop, Porto, Portugal
56. **A. M. Silva**; 2023; *Towards a fully Bayesian RV extraction model*; The Extreme Precision Radial Velocity 5, Santa Barbara, California, USA
57. **A. M. Silva**; 2023; *sBART application to the ESPRESSO WG1 targets*; ESPRESSO Science Team Meeting 2023, Lanzarote, Spain
58. **A. M. Silva**; 2023; *Approaches for RV extraction: s-BART and the first steps towards a fully Bayesian model*; Towards Other Earths III: The Planet-Star connection, Porto, Portugal
59. **B. Soares, V. Zh. Adibekyan**, C. Mordasini, **E. Delgado Mena, S. G. Sousa, N. C. Santos**; 2023; *Assessing the processes behind planet engulfment and its imprints*; Towards Other Earths III: The Planet-Star connection, Porto, Portugal
60. **L. Sousa**; 2023; *Update on the cosmic strings parameter estimation project*; 10th LISA Cosmology Working Group Workshop, University of Stavanger, Norway

61. **L. Sousa**; 2023; *Emission of gravitational waves by superconducting cosmic strings*; Spanish and Portuguese Relativity Meeting, University of the Basque Country, Bilbao, Spain
62. **L. Sousa**; 2023; *Emission of gravitational waves by superconducting cosmic strings*; IberiCos 2023 - 17th Iberian Cosmology Meeting, Ponte de Lima, Portugal
63. **S. G. Sousa**; 2023; *Challenges in inferring fundamental stellar parameters*; PLATO Stellar Science Conference 2023, Milazzo, Italy
64. **S. G. Sousa**; 2023; *CHEOPS TS3 report*; CHEOPS Science Team Meeting #28, , Online
65. **S. G. Sousa**; 2023; *SWEET-Cat: The Cat is still SWEETer*; Towards Other Earths III: The Planet-Star connection, Porto, Portugal
66. **D. A. D. Vaz, J. Brinchmann**; 2023; *Leo T Dissected with the MUSE-Faint Survey*; IAU Symposium 379: Dynamical Masses of Local Group Galaxies, Potsdam, Germany
67. **D. A. D. Vaz, J. Brinchmann**, S. L. Zoutendijk; 2023; *A Window Through Cosmic Time: Unlocking the Properties of the First Galaxies with Observations of Nearby Relics*; European Astronomical Society Annual Meeting, Kraków, Poland

National Scientific Communications in 2023

1. **T. Boulet**; 2023; *Advancing our Understanding of the Milky Way's Formation: Machine Learning-Based Stellar Age Predictions and Age Mapping*; XXXIII Encontro Nacional de Astronomia e Astrofísica, Coimbra, Portugal
2. **J. Brinchmann**; 2023; *Euclid - a brief summary and outlook*; XXXIII Encontro Nacional de Astronomia e Astrofísica, Coimbra, Portugal
3. **T. L. Campante**; 2023; *Homogeneous ages and masses for stars in the Ariel Reference Sample*; 3rd Planetary Systems Day @IA, Porto, Portugal
4. **M. M. C. D. Carvalho, C. J. A. P. Martins**; 2023; *Observational consequences of string theory inspired scalar fields*; XXXIII Encontro Nacional de Astronomia e Astrofísica, Coimbra, Portugal
5. **A. Chougule**; 2023; *Spectral Synthesis of Seyfert 2 Galaxies Using FADO*; XXXIII Encontro Nacional de Astronomia e Astrofísica, Coimbra, Portugal
6. **M. T. Clara**; 2023; *Characterizing Grid Interpolation in the Context of Grid-Based Modelling of Subgiant Stars*; XXXIII Encontro Nacional de Astronomia e Astrofísica, Coimbra, Portugal
7. **A. R. Costa Silva, O. Demangeon, N. C. Santos**; 2023; *Neutral iron detection in dayside emission spectra of WASP-76 b*; XXXIII Encontro Nacional de Astronomia e Astrofísica, Coimbra, Portugal
8. **I. A. Costa**; 2023; *O Ensino da Astronomia na Escolaridade Obrigatória: um Olhar Sobre as Aprendizagens Essenciais*; XXXIII Encontro Nacional de Astronomia e Astrofísica, Coimbra, Portugal
9. **I. A. Costa**; 2023; *CoAstro: um Condomínio de Astronomi@*; Conferência Nacional Scientix - Novos Desafios da Educação em Ciência, Online, Portugal
10. **I. A. Costa**; 2023; *CoAstro: um Condomínio de Astronomi@*; Conferência Nacional Scientix - Novos Desafios da Educação em Ciência, Online, Portugal
11. **P. A. C. Cunha, A. Humphrey, J. Brinchmann**; 2023; *Unveiling the Physical Properties of Type II Quasars Candidates in the Redshift Desert*; XXXIII Encontro Nacional de Astronomia e Astrofísica, Coimbra, Portugal
12. **J. D. F. Dias**; 2023; *Runaway dilaton models: Improved constraints from the full cosmological evolution*; XXXIII Encontro Nacional de Astronomia e Astrofísica, Coimbra, Portugal
13. **J. D. F. Dias**; 2023; *Astrophysical and Local Tests of the Einstein Equivalence Principle*; MAP-Fis Research Conference, Online, Portugal
14. **C. M. J. Marques, C. J. A. P. Martins, C. S. Alves**; 2023; *Fundamental cosmology from ANDES precision spectroscopy*; IJUP 2023, Porto, Portugal
15. **N. A. M. Moedas**; 2023; *Study of Planet Host FG-Type Stars With Improved Chemical Transport Mechanisms*; XXXIII Encontro Nacional de Astronomia e Astrofísica, Coimbra, Portugal
16. **N. A. M. Moedas**; 2023; *Precise Characterisation of HD15337 with CHEOPS*; XXXIII Encontro Nacional de Astronomia e Astrofísica, Coimbra, Portugal
17. **A. W. Neitzel**; 2023; *Machine Learning Applied to Galactic Archaeology*; XXXIII Encontro Nacional de Astronomia e Astrofísica, Coimbra, Portugal
18. **A. Paulino-Afonso**; 2023; *Illuminating the secrets of the Universe with over 7,000 newly discovered Lyman- α emitters and their impact on the Ly α luminosity function*; XXXIII Encontro Nacional de Astronomia e Astrofísica, Coimbra, Portugal
19. **N. C. Santos**; 2023; *Invited Panel Member*; Desafios da Ciência no Ensino Superior em Portugal, Faculdade de Psicologia e de Ciências da Educação da Universidade do Porto, Portugal

Visitors in 2023

The researchers/lecturers that have visited CAUP in 2023 were:

1. Rogério Riffel, Universidade Federal do Rio Grande do Sul, Brazil, 12 - 16 December 2023

2. Paul G. Beck, Instituto de Astrofísica de Canarias, Spain, 28 - 30 November 2023
3. Afonso Mota, German Aerospace Center, Germany, 22 November 2023
4. Morgan Deal, Université de Montpellier, France, 13 - 17 November 2023
5. Alexander Pietrow, Leibniz Institute for Astrophysics Potsdam, Germany, 7 - 10 November 2023
6. Chadi Meskini, Université de Montpellier, France, 28 October - 1 November 2023
7. Miguel Zilhão, Universidade de Aveiro, Portugal, 25 October 2023
8. Claudia Mendez de Oliveira, Universidade de São Paulo, Brazil, 2 - 4 October 2023
9. Adam Frank, University of Rochester, United States, 24 - 28 September 2023
10. Christian Duque-Arribas, Universidad Complutense de Madrid, Spain, 11 September - 15 December 2023
11. Rome Samanta, CEICO, Institute of Physics of the Czech Academy of Sciences, Czech Republic, 25 - 28 July 2023
12. William Dethier, Université Grenoble Alpes, France, 11 - 14 July 2023
13. Julia V. Seidel, ESO, Chile, 10 - 21 July 2023
14. Romain Allart, Institut Trottier de recherche sur les exoplanètes, Université de Montreal, Canada, 3 - 6 July 2023
15. Mathieu Vrad, Université Côte d'Azur, OCA, CNRS, Lagrange, France, 20 - 22 June 2023
16. Evelyne Alecian, Université Grenoble Alpes, France, 5 - 8 June 2023
17. Vivien Parmentier, Université Côte d'Azur, France, 30 May - 1 June 2023
18. Bas Zoutendijk, Leiden Observatory, Netherlands, 7 - 13 May 2023
19. Jørgen Christensen-Dalsgaard, Aarhus University, Denmark, 25 April - 5 May 2023
20. David A. Tamayo Ramirez, ., Portugal, 13 April 2023
21. Rita Tojeiro, University of St. Andrews, United Kingdom, 12 April 2023
22. Savita Mathur, Instituto de Astrofísica de Canarias, Spain, 19 - 25 March 2023
23. Rafael A. García, Université de Paris-Saclay, Université Paris Cité, CEA, CNRS, AIM, France, 19 - 25 March 2023
24. Michael Palumbo, Penn State University, United States, 23 February - 3 March 2023
25. Mahmoudreza Oshagh, ., United Kingdom, 22 - 26 February 2023
26. A. Castro-González, Center for Astrobiology (CAB, CSIC-INTA), Spain, 20 February - 31 March 2023
27. Adalto R. Gomes, Universidade Federal do Maranhão, Brazil, 14 February - 9 March 2023
28. F. C. Simas, Universidade Federal do Maranhão, Brazil, 14 February - 9 March 2023
29. Benard Nsamba, Kyambogo University (Uganda) & Max-Planck Institute for Astrophysics (Germany), Uganda, 21 - 27 January 2023
30. Daphné Golaz, University of Zurich, Switzerland, 19 - 20 January 2023

Scientific Seminars in 2023

1. Alecian, E.; 2023; Stellar magnetic field origin and impact during the stellar formation
2. Allart, R.; 2023; Exoplanet atmospheres at high spectral resolution: toward statistical surveys
3. Beck, P. G.; 2023; Constraining stellar and orbital co-evolution from the oscillating red-giant binaries revealed by Gaia DR3
4. Christensen-Dalsgaard, J.; 2023; Asteroseismic inferences of red-giant internal magnetic fields
5. Duque-Arribas, C.; 2023; Chemical composition of M-type dwarf stars
6. Ellison, S. L.; 2023; Gas and star formation in the nearby universe with the ALMA-MaNGA QUEnching and STar formation (ALMaQUEST) survey
7. Frank, A.; 2023; Biosignatures and Technosignatures. The Telescopic Search for Life Across Interstellar Distances.
8. García, R. A.; 2023; Architecture of Kepler single exoplanet systems compared to star-planet evolution models
9. Humphrey, A.; 2023; Exploring Machine Learning for the Euclid and Rubin/LSST Era
10. James, B. L.; 2023; Exploring ISM Properties in Pristine Environments Throughout the Universe
11. Mathur, S.; 2023; Evolution of magnetic activity of solar-like stars with age
12. Mendes de Oliveira, C.; 2023; The Southern Photometric Local Universe Survey
13. Mota, A.; 2023; Astrobiology and Exoplanet Habitability: a Holistic Approach Joining Biology and Astrophysics
14. Neyrinck, M.; 2023; Swirls, Information and Eddies, Cosmic and Chaotic
15. Nsamba, B.; 2023; Progress of astronomy research at Kyambogo University
16. Palumbo, M. L.; 2023; Finding other Earths by observing the Sun: physical insights from ground- and space-based solar observations
17. Parmentier, V.; 2023; Exoplanets atmospheres in the 2020s: from the JWST to the E-ELTs
18. Pietrow, A.; 2023; Bridging the gap: Translating high-resolution solar observations to the stellar regime

19. Riffel, R.; 2023; The star formation history of nearby active galactic nuclei
20. Samanta, R.; 2023; A new parametric window for QCD axion dark matter
21. Seidel, J. V.; 2023; Exoplanet atmospheric dynamics - Observations in high spectral resolution
22. Seymour, N.; 2023; The GLEAMing of the First Black Holes
23. Tamayo Ramirez, D. A.; 2023; Some applications of thermodynamics to explore dark energy and inflation
24. Tojeiro, R.; 2023; Teacher-researcher collaborations: bridging the gap between contemporary science and the classroom and the impact on teacher identity, self-efficacy and wellbeing
25. Ulmer-Moll, S.; 2023; Detection and modeling of cool giants
26. Vrad, M.; 2023; First characterization of the precise structure of red-giant star cores
27. Zilhão, M.; 2023; Dynamics of black holes and scalar field

Observing runs during 2023

1. Bárbara Soares (PI), Vardan Adibekyan, Nuno Santos, Sergio Sousa, Elisa Delgado Mena, Diego Bossini, Pedro Figueira, Garik Israelian, Artur Hakobyan, Bertram Bitsch, Caroline Dorn, Christoph Mordasini, Susana Barros, Olivier Demangeon, K. G. Strassmeier, João Faria; UPFRONT: Ultra-high Precision spectroscopy of ROcky plaNet hosTs; 112.25T4, ESPRESSO@VLT 1UT; 1 October 2023 - 31 March 2024
2. C. Danielski et al. (including, **Elisa Delgado Mena**); “Building a public catalogue of homogeneously characterised Ariel exoplanet-host stars”; 110.24BU-111.2542; UVES/VLT; period 110-111 service mode
3. **Carlos Martins**, Stefano Cristiani, Valentina D’Odorico, Paolo Molaro, Francesco Guarneri, Michael Murphy, Tobias Schmidt, Dinko Milakovic, L. Pasquini, Gaspare Lo Curto, **Catarina Marques**, Ricardo Genova-Santos, Guido Cupani, Carlos Allende Prieto, David Ehrenreich, **Pedro Figueira**, Jonay I. Gonzalez Hernandez, Christophe Lovis, Andrea Mehner, **Nelson Nunes**, Francesco Pepe, Rafael Rebolo, **Sergio Sousa**, Alessandro Sozzetti, S. Udry, Alejandro Suárez Mascareño, María Rosa Zapatero Osorio, **N. C. Santos**, Ennio Poretti, Giorgio Calderone, Andrea Grazian, Andrea Trost; An ESPRESSO Redshift Drift Experiment, Part Ia; 110.247Q; ESPRESSO - VLT; P110 (GTO)
4. **Carlos Martins**, Stefano Cristiani, Valentina D’Odorico, Paolo Molaro, Francesco Guarneri, Michael Murphy, Tobias Schmidt, Dinko Milakovic, L. Pasquini, Gaspare Lo Curto, **Catarina Marques**, Ricardo Genova-Santos, Guido Cupani, Carlos Allende Prieto, David Ehrenreich, **Pedro Figueira**, Jonay I. Gonzalez Hernandez, Christophe Lovis, Andrea Mehner, **Nelson Nunes**, Francesco Pepe, Rafael Rebolo, **Sergio Sousa**, Alessandro Sozzetti, S. Udry, Alejandro Suárez Mascareño, María Rosa Zapatero Osorio, **Nuno Santos**, Ennio Poretti, Giorgio Calderone, Andrea Grazian, Andrea Trost; An ESPRESSO Redshift Drift Experiment, Part Ib; 111.251D; ESPRESSO - VLT; P111 (GTO)
5. **Carlos Martins**, Stefano Cristiani, Valentina D’Odorico, Paolo Molaro, Francesco Guarneri, Michael Murphy, Tobias Schmidt, Dinko Milakovic, L. Pasquini, Gaspare Lo Curto, **Catarina Marques**, Ricardo Genova-Santos, Guido Cupani, Carlos Allende Prieto, David Ehrenreich, **Pedro Figueira**, Jonay I. Gonzalez Hernandez, Christophe Lovis, Andrea Mehner, **Nelson Nunes**, Francesco Pepe, Rafael Rebolo, **Sergio Sousa**, Alessandro Sozzetti, S. Udry, Alejandro Suárez Mascareño, María Rosa Zapatero Osorio, **Nuno Santos**, Ennio Poretti, Giorgio Calderone, Andrea Grazian, Andrea Trost; An ESPRESSO Redshift Drift Experiment, Part IIa; 112.25K7; ESPRESSO - VLT; P112 (GTO)
6. **Ana Rita Costa Silva**, Allart, R., **Olivier Demangeon**, Borsa, F., Palle, E., Lillo-Box, J., Herrero-Cisneros, E., Zapatero-Osorio, M. R., Lovis, C., Tabernero, H., **Nuno Santos**, **Vardan Adibekyan**, Ehrenreich, D., Steiner, M., **Tomás Azevedo Silva**, Pepe, F.; Emission spectroscopy survey of ultra hot Jupiters; 112.25UT; ESPRESSO, Very Large Telescope (European Southern Observatory); 2023 Oct 09, 2023 Nov 04, 2023 Dec 04, 2023 Dec 17, 2023 Dec 20, 2.21 nights (out of 3.55 nights in ESO P112, Oct 2023 - Mar 2024)
7. D. Hodsworth et al. (including, **Margarida Cunha**), Defining a new chemically peculiar star catalogue, 2023-2-SCI-006, ID 12394, HRS/SALT, start: November 2023 (1 semester)
8. **Elisa Delgado Mena** et al. (as part of the NIRPS GTO Other Science proposals); NIRPS GTO - Other Science 1: Improving metallicity determination of M dwarfs with FGK binaries; NIRPS-ESO-3.6m; ESO period 111 and 112
9. **Elisa Delgado Mena** et al. (as part of the NIRPS GTO Other Science proposals); NIRPS GTO - Other Science 2: Radial-velocity variations in cool giants: exoplanets or stellar activity?; NIRPS-ESO-3.6m; ESO period 111 and 112
10. **Eduardo Cristo**; ESPRESSO GTO; GTO mixed program targets; ESPRESSO@VLT; 2 Jan 2023
11. **Eduardo Cristo** NIRPS commissioning; GTO mixed program targets for the commissioning; HARPS&NIRPS@3.6m La Silla; 1 - 12 February 2023

12. **Eduardo Cristo**; NIRPS GTO; GTO mixed program targets; HARPS&NIRPS@3.6m La Silla; 31 May - 9 June 2023
13. Jachym, P., Fumagalli, M., Palous, J., Cortese, L., Cramer, W., Sivanandam, S., Brinks, E., Kabatova, A., Kenney, J., **Tom Scott**, Combes, F. ; ALMA JELLY - Survey of Nearby Jellyfish and Ram Pressure Stripped Galaxies;2021.1.01616.L;ALMA Large program; 2023 ongoing
14. Jachym, P., Ge, C., Yagi, M., Sun, M., Luo, R., Brinks, E., Kabatova, A., Kenney, J., **Tom Scott**, Combes, F.; Non-star-forming molecular gas in intra-cluster multiphase orphan cloud; 2022.1.01626.S,2023
15. Jean-François Donati (PI), **Jorge Filipe Gameiro**; SPICE: Consolidating & Enhancing the SPIRou Legacy Survey
16. **Jorge Filipe Gameiro**; CFHT/SPIRou, 174.28 nights (4 semesters (2022b-2024a)).
17. Mousumi Das (PI); **Daniel Vaz** (Co-PI), Amrutha S.; Imaging Star Formation in the Milky Way Satellite Dwarf Galaxy Leo T; A13_077; Astrosat-UVIT; Cycle A13
18. **Sérgio SOUSA**/ MORTIER/ **Nuno SANTOS**/ ROJAS AYALA/ **Vardan ADIBEKYAN**/ ISRAELIAN/ **Olivier DEMANGEON**/ **Susana BARROS**/ **Alexandros ANTONIADIS** KARNAVAS/ **Elisa DELGADO MENA**/ TSANTAKI/ **Bárbara SOARES**; KNOW THE STAR TO KNOW THE PLANET: IMPROVING SWEET-CAT WITH HOMOGENEOUS PLANET-HOST PARAMETERS; UVES, VLT UT2, SM 110.23TD.001; 111.24HZ.001

External seminars by CAUP researchers in 2023

1. **Ana Paulino Afonso**, Exploring LAEs across cosmic time: numbers and insights powered by Machine Learning; Faculty of Sciences of the University of Lisbon, Physics Department, Lisbon, Portugal; 13 December 2023
2. **Carlos Martins**, The ANDES Calibration Validation Strategy, CAUP, 9 January 2023
3. **Clara Sousa Silva**, Quantum Astrochemistry; PSI, Switzerland; 1 June 2023
4. **Daniel Vaz**, The MUSE-Faint Survey; University of Surrey, UK; 8 June 2023
5. **Eduardo Cristo**, "Exploring Exoplanet Atmospheres and Stellar Surfaces with the Rossiter-McLaughlin Effect", Warwick University, UK, 3 May 2023
6. **Elisa Delgado Mena**, The impact of stellar composition: from Galactic chemical evolution to planet formation; online-IAA, Granada, Spain; 1 June 2023
7. **Jarle Brinchmann**, "MUSE-Faint - Dissecting the faintest galaxies with MUSE"; University of Surrey, United Kingdom; 27 June 2023
8. **Jarle Brinchmann**, "MUSE-Faint - Dissecting the faintest galaxies with MUSE"; Arcetri, Italy; 19 October 2023
9. **Jarle Brinchmann**, "MUSE-Faint - Dissecting the faintest galaxies with MUSE"; Milano Bicocca, Italy; 23 October 2023
10. **Jarle Brinchmann**, "MUSE-Faint - Dissecting the faintest galaxies with MUSE"; Instituto Superior Técnico, Portugal; 14 December 2023
11. **J. M. Gomes**, Physical and Mathematical foundations of the FADO spectral synthesis code (online), IATE, Argentina, 25 August 2023
12. **Jorge Martins**, "Um Nobel para a Astronomia: à descoberta de outros mundos", Dias da Física - FCUP, Portugal, 30 March 2023
13. **José Fonseca**, Prospects for multi-probe Cosmology as gravity and inflation probes, University of the Western Cape, Cape Town, South Africa, 5 March 2023
14. **José Fonseca**, Prospects for multi-probe Cosmology as gravity and inflation probes, Universidade de Aveiro, Aveiro, Portugal, 17 May 2023
15. **José Fonseca**, Prospects for multi-probe Cosmology as gravity and inflation probes, Oskar Klein Centre, Stockholm, Sweden, 1 December 2023
16. **Lara Sousa**, Cosmic Microwave Background Anisotropies generated by Domain Walls and Cosmic Strings, IFAE Institut de Física d'Altes Energies, Universitat Autònoma de Barcelona, Spain, 19 January 2023
17. **Lara Sousa**, Radiação gravitacional de fundo gerada por cordas cósmicas, Universidade do Maranhão, Brazil, 21 November 2023

18. **Margarida Cunha**, Asteroseismology and Interferometry, Cherenkov Telescope Array - CTA, Germany (online), 11 January 2023
19. **Nuno Moedas**, Analyzing the effect of turbulent mixing in F-type stars; Montpellier, France; 26 April 2023
20. **Nuno Santos**, “Detection and characterization of Earth-like planets using high resolution spectroscopy”, at the meeting of the European Space Sciences Committee, Lisboa, 5 June 2023
21. **Nuno Santos**, “Towards the detection and characterisation of Earth like planets”, for the course on “Descobertas da Física Moderna”, Instituto Superior Técnico, 2 October 2023
22. **Tiago Campante**, Asteroseismology: probing the interiors of stars; FCUL, Lisbon, Portugal, 17 May 2023
23. **Tiago Campante**, Expanding the frontiers of cool-dwarf asteroseismology with next-generation spectrographs; Department of Physics and Astronomy, Aarhus University, Aarhus, Denmark, 12 October 2023

Outreach talks in 2023

1. **Ana Rita Costa Silva**, Astronomia 101, Escola de Verão de Astronomia, Instituto Superior Técnico, Lisboa, 6 September 2023
2. **Ana Rita Costa Silva**, Astronomia no Feminino, Planetário do Porto, Porto, 11 February 2023
3. **Ana Rita Costa Silva**, Exoplanetas e a procura por vida extraterrestre, Astrofesta XXVIII, Centro de Ciência Viva de Constância, 26 August 2023
4. **Ana Rita Costa Silva**, Exoplanetas, Universidade Júnior do Porto, Centro de Astrofísica da Universidade do Porto, 11 & 18 July 2023
5. **Ana Rita Costa Silva**, Instagram como ferramenta para comunicação de ciência e influência para a ciência, Encontro Nacional de Astronomia e Astrofísica XXXIII, Coimbra, 9 September 2023
6. **Ana Rita Costa Silva**, Outros mundos, outras atmosferas, Ignite IAstro, Torres Vedras, 15 April 2023
7. **Ana Rita Costa Silva**, Quando for grande, quero andar com a cabeça na Lua, Escolas Secundárias e Observatório Astronómico de Santana, São Miguel, Açores, 11-12 May 2023
8. **Ana Rita Costa Silva**, Ver estrelas através do Instagram, INOVA+ Webinar series Ciência às Quartas, 13 September 2023
9. **Ana Paulino Afonso**, Portugal at the International Astronomy Olympiad, Coimbra, 9 September 2023
10. **André Silva**, Espaço vai à Escola 2023: À procura por outra Terra - deteção de planetas fora do sistema solar, Agrupamento de Escolas Conde de Ourém (online), Ourém, 11 October 2023
11. **André Silva**, Espaço vai à Escola 2023: À procura por outra Terra - deteção de planetas fora do sistema solar, Agrupamento de Escolas da Bemposta (online), Portimão, 11 October 2023
12. **André Silva**, Espaço vai à Escola 2023: À procura por outra Terra - deteção de planetas fora do sistema solar, Escola Secundária Gonçalves Zarco, Matosinhos, 16 October 2023
13. **André Silva**, Espaço vai à Escola 2023: À procura por outra Terra - deteção de planetas fora do sistema solar, escola Básica e Secundária de Águas Santas, Maia, 26 October 2023
14. **André Silva**, Espaço vai à Escola 2023: À procura por outra Terra - deteção de planetas fora do sistema solar, (online), 26 October 2023
15. **André Silva**, Espaço vai à Escola 2023: À procura por outra Terra - deteção de planetas fora do sistema solar, Escola Secundária Aurélia de Sousa, Porto, 30 October 2023
16. **André Silva**, Espaço vai à Escola 2023: À procura por outra Terra - deteção de planetas fora do sistema solar, Agrupamento de Escolas Professor Paula Nogueira (online), Olhão, 2 November 2023
17. **André Silva**, Espaço vai à Escola 2023: À procura por outra Terra - deteção de planetas fora do sistema solar, Agrupamento de Escolas Professor Ruy Luís Gomes (online), Almada, 9 November 2023
18. **André Silva**, Espaço vai à Escola 2023: À procura por outra Terra - deteção de planetas fora do sistema solar, Escola Básica Sophia de Mello Breyner, Corvo, 24 November 2023
19. **Ângela Santos**, O envelhecimento ativo das estrelas, Ignite IAstro, Ílhavo, 14 September 2023
20. **Ângela Santos**, O envelhecimento ativo das estrelas, Ignite IAstro, Marco de Canaveses, 11 November 2023
21. **Ângela Santos**, O envelhecimento ativo das estrelas, Ignite IAstro, Torres Vedras, 15 April 2023
22. **Ângela Santos**, O género da nossa estrela: a atividade das estrelas, Online - Noite de observação: Apresentação às estrelas do Centro Ciência Viva do Algarve, 09 February 2023

23. **Bárbara Soares**, How to swallow a planet: Processes and consequences of planet engulfment; PlanetS@Fantasy Basel 2023, Basel, Switzerland; 18 May 2023
24. **Bárbara Soares**, Dia das Mulheres e Raparigas na Astronomia 2023, 11 February 2023
25. **Carlos Martins**, A Física da Energia e do Aquecimento Global, ES Fonseca Benevides, Lisboa, 9 October
26. **Carlos Martins**, A Física da Energia e do Aquecimento Global, ES José Macedo Fragateiro, Ovar, 17 October 2023
27. **Carlos Martins**, A Física da Energia e do Aquecimento Global, ES Josefa de Óbidos, Lisboa, 19 October 2023
28. **Carlos Martins**, A Física da Energia e do Aquecimento Global, ES Maria Amália Vaz de Carvalho, Lisboa, 25 October 2023
29. **Carlos Martins**, A Física da Energia e do Aquecimento Global, ES Emídio Navarro, Almada, 26 October 2023
30. **Carlos Martins**, A Física da Energia e do Aquecimento Global, ES de Vouzela, 8 November 2023
31. **Carlos Martins**, A Física da Gravidade e dos Satélites, Colégio da Trofa, Portugal, 12 October 2023
32. **Carlos Martins**, A Física da Gravidade e dos Satélites, ES da Ribeira Grande, Azores, 11 October 2023
33. **Carlos Martins**, A Física da Gravidade e dos Satélites, ES de Pinhal de Rei, Marinha Grande, 13 October 2023
34. **Carlos Martins**, A Física da Gravidade e dos Satélites, ES da Maia, 20 October 2023
35. **Carlos Martins**, A Física da Gravidade e dos Satélites, ES da Bemposta, Portimão, 24 October 2023
36. **Carlos Martins**, A Física da Gravidade e dos Satélites, ES de Fajões, Oliveira de Azeméis, 10 November 2023
37. **Carlos Martins**, A Física da Gravidade e dos Satélites, Nobel International School Algarve, Lagoa, 24 October 2023
38. **Carlos Martins**, A Física da Radioactividade e do Cancro, ES de Castro Verde, 27 March 2023
39. **Carlos Martins**, A Física da Radioactividade e do Cancro, ES de S. Roque do Pico, 9 October 2023
40. **Carlos Martins**, A Física da Radioactividade e do Cancro, ES de Estarreja, 17 October 2023
41. **Carlos Martins**, A Física da Radioactividade e do Cancro, ES Filipa de Vilhena, Porto, 27 November 2023
42. **Carlos Martins**, A Física da Relatividade, ES Filipa de Vilhena, Porto, 20 October 2023
43. **Carlos Martins**, A Física da Relatividade, ES Latino Coelho, Lamego, 30 October 2023
44. **Carlos Martins**, A Física da Relatividade, ES Rocha Peixoto, Póvoa de Varzim, 9 November 2023
45. **Carlos Martins**, A Física da Vida e dos Extraterrestres, ES Aurélia de Sousa, Porto, 13 November 2023
46. **Carlos Martins**, A Física do Big Bang, ES Camilo Castelo Branco, Famalicão, 12 October 2023
47. **Carlos Martins**, A Física do Big Bang, ES Sebastião da Gama, Setúbal, 26 October 2023
48. **Carlos Martins**, A Física do Big Bang, IberiCos 2023 Public Talk, Ponte de Lima, 3 April 2023
49. **Carlos Martins**, Euclid e o lado escuro do Universo, CAUP Public Talk, 1 July 2023
50. **Carlos Martins**, How to improve Portuguese secondary education, CEIA-PPCB, Paredes de Coura, 18 August 2023
51. **Carlos Martins**, The Phi in the Sky project, CEIA-PPCB, Paredes de Coura, 21 August 2023
52. **Catarina Lobo**, "A nossa galáxia e as outras: uma viagem através do Universo", Escola Secundária Gonçalves Zarco (Matosinhos), 24 November 2023
53. **Catarina Lobo**, "A nossa galáxia e as outras: uma viagem através do Universo", Colégio Casa Mãe (Baltar), 12 December 2023
54. **Catarina Lobo**, "A Via Láctea e as outras galáxias", Centro de Astrofísica da Universidade do Porto (Universidade Júnior UP), 11 July 2023
55. **Catarina Lobo**, "A Via Láctea e as outras galáxias", Centro de Astrofísica da Universidade do Porto (Universidade Júnior UP), 18 July 2023
56. **Catarina Lobo**, "Dentro de um enxame... de galáxias!" - Ignite IAstro 2023, Vizela (Auditório Francisco Ferreira), 20 May 2023
57. **Catarina Lobo**, "Dentro de um enxame... de galáxias!" - Ignite IAstro, Marco de Canaveses, 11 November 2023

58. **Catarina Marques**, Cosmologia Observacional: o caminho do ESPRESSO ao ANDES, DFA - FCUP, 18 April 2023
59. **Catarina Marques**, Os mistérios do nosso Universo: em busca das respostas, Escola Secundária de São Pedro do Sul (online), Viseu, 23 October 2023
60. **Catarina Marques**, Os mistérios do nosso Universo: em busca das respostas, Escola Básica de Montenegro (online), Faro, 26 October 2023
61. **Catarina Marques**, Os mistérios do nosso Universo: em busca das respostas, Escola Secundária Inês de Castro, Vila Nova de Gaia, 10 November 2023
62. **Catarina Marques**, Os mistérios do nosso Universo: em busca das respostas, Escola Básica do Sudeste de Baião (online), Porto, 13 November 2023
63. **Catarina Marques**, Os mistérios do nosso Universo: em busca das respostas, Escola Secundária de São Pedro da Cova, Gondomar, 14 November 2023
64. **Clara Sousa Silva**, Life and how to find it - Hudson Canal Historical Society, 29 September 2023
65. **Clara Sousa Silva**, Life and how to find it - Lifelong Learning Institute, 6 October 2023
66. **Clara Sousa Silva**, Space Talk - Liberty Science Center, 16 November 2023
67. **Daniel Folha**, The Wow Factor - Science communication for the general public, Instituto Universitário de Ciências da Saúde - CESPU PhD Day, October 2023
68. **David Grüber**, I gave an outreach talk with the title "A brief history of our universe" held within the format "Astronomy on Tap" at Catraio/Porto, 3 May 2023
69. **Elisa Delgado Mena**, Del Big Bang a los exoplanetas: un viaje químico a través del espacio, University of Valladolid, Spain, 5 October 2023
70. **Ilídio André Costa**, Um dia muito especial; Escola Básica Manoel de Oliveira, Porto; 09 October 2023
71. **Ilídio André Costa**, Um dia muito especial; Escola Básica dos Miosótiis, Porto; 10 October 2023
72. **Ilídio André Costa**, Um dia muito especial; Escola Básica de Santa Cruz da Trapa, São Pedro do Sul; 10 October 2023
73. **Ilídio André Costa**, Um dia muito especial; Escola Básica Júlio Dinis, Grijó, Vila Nova de Gaia; 10 October 2023
74. **Ilídio André Costa**, Com a verdade me enganas; Escola Secundária Jaime Moniz; 12 October 2023
75. **Ilídio André Costa**, Um dia muito especial; Escola Básica de Ponte das Três Entradas, Oliveira do Hospital; 12 October 2023
76. **Ilídio André Costa**, Um dia muito especial; Jardim de Infância de Areias, Gondomar; 12 October 2023
77. **Ilídio André Costa**, Um dia muito especial; Escola Básica de Casal do Malta, Marinha Grande; 16 October 2023
78. **Ilídio André Costa**, Um dia muito especial; Escola Básica n.º 1 de São Caetano, Gondomar; 16 October 2023
79. **Ilídio André Costa**, Com a verdade me enganas; Escola Básica do Castro, Alvarelos, Trofa; 16 October 2023
80. **Ilídio André Costa**, Com a verdade me enganas; Escola Básica Soares dos Reis, Vila Nova de Gaia; 16 October 2023
81. **Ilídio André Costa**, Um dia muito especial; Ilha de Santa Maria- Açores; 17 October 2023
82. **Ilídio André Costa**, Um dia muito especial; Escola Básica de Amareleja, Moura; 17 October 2023
83. **Ilídio André Costa**, Um dia muito especial; Jardim Escola João De Deus Tomar 1; 17 October 2023
84. **Ilídio André Costa**, Um dia muito especial; Escola Básica Manuel Augusto Papança, Reguengos de Monsaraz; 23 October 2023
85. **Ilídio André Costa**, Um dia muito especial; Escola Básica e Secundária de Mora; 24 October 2023
86. **Ilídio André Costa**, Um dia muito especial; Escola Básica de Guetim, Espinho; 24 October 2023
87. **Ilídio André Costa**, Um dia muito especial; Escola Básica de Azagães, Carregosa, Oliveira de Azeméis; 24 October 2023
88. **Ilídio André Costa**, Um dia muito especial; Escola Básica de Azagães, Carregosa, Oliveira de Azeméis; 25 October 2023
89. **Ilídio André Costa**, Um dia muito especial; Escola Básica da Agrela e Vale do Leça, Santo Tirso; 25 October 2023

90. **Ilídio André Costa**; Com a verdade me enganas; Escola Básica D. Afonso Henriques, Creixomil, Guimarães; 25 October 2023
91. **Ilídio André Costa**; Um dia muito especial; Escola Básica de Santa Marta do Pinhal, Corroios, Seixal; 26 October 2023
92. **Ilídio André Costa**; Um dia muito especial; Escola Básica Arquitecto Victor Palla, Lisboa; 27 October 2023
93. **Ilídio André Costa**; Um dia muito especial; Escola Básica de Azagães, Carregosa, Oliveira de Azeméis; 30 October 2023
94. **Ilídio André Costa**; Um dia muito especial; Escola Básica de São João de Deus, Lisboa; 30 October 2023
95. **Ilídio André Costa**; Um dia muito especial; Escola Básica de São Paio, Canidelo, Vila Nova de Gaia; 30 October 2023
96. **Ilídio André Costa**; Com a verdade me enganas; Escola Secundária Filipa de Vilhena, Porto; 30 October 2023
97. **Ilídio André Costa**; Com a verdade me enganas; Escola Secundária Filipa de Vilhena, Porto; 30 October 2023
98. **Ilídio André Costa**; Um dia muito especial; Escola Básica de Pedreira, Argivai, Póvoa de Varzim; 31 October 2023
99. **Ilídio André Costa**; Com a verdade me enganas; Escola Secundária de Molelos, Tondela; 31 October 2023
100. **Ilídio André Costa**; Com a verdade me enganas; Escola Básica da Agrela e Vale do Leça, Santo Tirso; 02 November 2023
101. **Ilídio André Costa**; Com a verdade me enganas; Escola Básica e Secundária D. João V, Damaia, Amadora; 02 November 2023
102. **Ilídio André Costa**; Um dia muito especial; Escola Básica de Azagães, Carregosa, Oliveira de Azeméis; 03 November 2023
103. **Ilídio André Costa**; Com a verdade me enganas; Escola Básica e Secundária de Arrifana, Santa Maria da Feira; 06 November 2023
104. **Ilídio André Costa**; Com a verdade me enganas; Escola Básica e Secundária D. Martinho Vaz de Castelo Branco, Póvoa de Santa Iria, Vila Franca de Xira; 06 November 2023
105. **Ilídio André Costa**; Um dia muito especial; Jardim de Infância de Viladra, Vouzela; 07 November 2023
106. **Ilídio André Costa**; Um dia muito especial; Escola Básica de Monte Abraão, Sintra; 08 November 2023
107. **Ilídio André Costa**; Um dia muito especial; Escola Básica de Pindelo, Oliveira de Azeméis; 08 November 2023
108. **Ilídio André Costa**; Com a verdade me enganas; Escola Básica Sophia de Mello Breyner, Corvo, Vila Nova de Gaia; 08 November 2023
109. **Ilídio André Costa**; Um dia muito especial; Escola Básica e Secundária Padre Alberto Neto, Queluz, Sintra; 09 November 2023
110. **Ilídio André Costa**; Um dia muito especial; Escola Básica da Bobadela, Loures; 14 November 2023
111. **Ilídio André Costa**; Um dia muito especial; Escola Básica n.º 2 do Lavradio, Barreiro; 14 November 2023
112. **Ilídio André Costa**; Com a verdade me enganas; Pevidém; 14 November 2023
113. **Ilídio André Costa**; Com a verdade me enganas; Escola Secundária Dr. Joaquim Gomes Ferreira Alves, Valadares, Vila Nova de Gaia; 14 November 2023
114. **Ilídio André Costa**; Um dia muito especial; Escola Básica Álvaro Velho, Lavradio, Barreiro; 15 November 2023
115. **Ilídio André Costa**; Um dia muito especial; Escola Básica Engenheiro Duarte Pacheco, Lisboa; 15 November 2023
116. **Ilídio André Costa**; Com a verdade me enganas; Escola Secundária Aurélia de Sousa, Porto; 16 November 2023
117. **Ilídio André Costa**; Com a verdade me enganas; Escola Secundária Frei Heitor Pinto, Covilhã; 16 November 2023
118. **Ilídio André Costa**; Um dia muito especial; Escola Básica de Fidalguinhos, Barreiro; 17 November 2023
119. **Ilídio André Costa**; Um dia muito especial; Escola Básica do Bairro do Restelo, Lisboa; 17 November 2023
120. **Ilídio André Costa**; Um dia muito especial; Externato Ribadouro; 16 November 2023

121. **Ilídio Costa**, Um dia muito especial, online (para Timor-Leste), 18 April 2023
122. **Jarle Brinchmann**, "De Dark Ages á Dark Matter - as questões escuras que iluminam a astronomia", Romulo Coimbra, 23 March 2023
123. **Jarle Brinchmann**, "Euclid - e o Universo escuro", Conferência de Professores Espaciais, Lisboa, 17 November 2023
124. **João Lima**, "Nem sempre o Sol está calmo", Ignite IAstro, Torres Vedras, 15 April 2023
125. **Lara Sousa**, "Ouvir o Universo", Ignite IAstro, Marco Canaveses, 11 November 2023
126. **Margarida Cunha**, A Música das Estrelas, Ignite IAstro, Ílhavo, 14 October 2023
127. **Nuno Santos**, Palestra e debate "Noite Europeia dos Investigadores – Armamar", Armamar, 29 September 2023
128. **Nuno Santos**, Participação na Mostra da Universidade do Porto, Pavilhão Multiusos de Gondomar - stand do DFA, 20 April 2023
129. **Patricio Lagos**, Anãs, azuis e compactas, Ignite IAstro, Vizela, 20 May 2023
130. **Paulo Maurício de Carvalho**, The "Phi in the Sky" project for secondary schools, Escola Secundária de Paredes, Paredes, 12 January 2023
131. **Paulo Maurício de Carvalho**, Um universo em expansão acelerada, Escola Secundária de Latino Coelho, Lamego, 1 February 2023
132. **Paulo Maurício de Carvalho**, Da Idade da Magia a Galileu (Online), Centro de Educação e Desenvolvimento D. Maria Pia (Casa Pia), Lisboa, 3 October 2023
133. **Paulo Maurício de Carvalho**, Da Idade da Magia a Galileu (Presencial), Escola Jasmim, Valadares, Vila Nova de Gaia, 4 October 2023
134. **Paulo Maurício de Carvalho**, Da Idade da Magia a Galileu (Presencial), Escola Básica Júlio Dinis, Grijó, Vila Nova de Gaia, 9 October 2023
135. **Paulo Maurício de Carvalho**, Da Idade da Magia a Galileu (Presencial), Escola Secundária Cristina Torres, Figueira da Foz, 10 October 2023
136. **Paulo Maurício de Carvalho**, Da Idade da Magia a Galileu (Presencial), Escola Básica Manoel de Oliveira, Aldoar, Porto, 11 October 2023
137. **Paulo Maurício de Carvalho**, Um Universo de Informação - A Luz (Presencial), Escola Básica n.º 1 de São Caetano, S. Caetano, Gondomar, 12 October 2023
138. **Paulo Maurício de Carvalho**, Um Universo de Informação - A Luz (Presencial), Colégio "Casa Mãe", Baltar, 12 October 2023
139. **Paulo Maurício de Carvalho**, Da Idade da Magia a Galileu (Presencial), Escola Básica de Argoncilhe, Sta. Maria da Feira, 13 October 2023
140. **Paulo Maurício de Carvalho**, Da Idade da Magia a Galileu (Online), Escola EB1/JI de Aeroporto, Santa Maria, Açores, 16 October 2023
141. **Paulo Maurício de Carvalho**, Um Universo de Informação - A Luz (Online), Escola Profissional do Pico, Açores, 16 October 2023
142. **Paulo Maurício de Carvalho**, Da Idade da Magia a Galileu (Online), Escola Portuguesa de São Tomé e Príncipe, S. Tomé e Príncipe, 17 October 2023
143. **Paulo Maurício de Carvalho**, Da Idade da Magia a Galileu (Online), Escola Básica e Secundária da Bemposta, Portimão, 18 October 2023
144. **Paulo Maurício de Carvalho**, Da Idade da Magia a Galileu (Presencial), Escola Básica de Pedome, Vila Nova de Famalicão, 18 October 2023
145. **Paulo Maurício de Carvalho**, Um Universo de Informação - A Luz (Online), Escola Básica D. Carlos I, Sintra, 19 October 2023
146. **Paulo Maurício de Carvalho**, Um Universo de Informação - A Luz (Presencial), Jardim Escola João De Deus, Salreu, Estarreja, 19 October 2023
147. **Paulo Maurício de Carvalho**, Um Universo de Informação - A Luz (Online), Escola Secundária de Figueira de Castelo Rodrigo, Figueira de Castelo Rodrigo, 19 October 2023
148. **Paulo Maurício de Carvalho**, Um Universo de Informação - A Luz (Presencial), Escola Secundária Filipa de Vilhena, Porto, 20 October 2023
149. **Paulo Maurício de Carvalho**, Da Idade da Magia a Galileu (Online), Escola Secundária Viriato, Viseu, 23 October 2023

150. **Paulo Maurício de Carvalho**, Um Universo de Informação - A Luz (Presencial), Escola Básica Professor Doutor Carlos Mota Pinto, Lajeosa do Dão, Tondela, 23 October 2023
151. **Paulo Maurício de Carvalho**, Um Universo de Informação - A Luz (Presencial), Jardim de Infância de São Caetano 2, Rio Tinto, 24 October 2023
152. **Paulo Maurício de Carvalho**, Um Universo de Informação - A Luz (Online), Escola Básica de Alverca, Vila Franca de Xira, 24 October 2023
153. **Paulo Maurício de Carvalho**, Da Idade da Magia a Galileu (Presencial), Escola Básica 2/3 de Pevidém, Guimarães, 23 October 2023
154. **Paulo Maurício de Carvalho**, Um Universo de Informação - A Luz (Presencial), Escola Básica e Secundária de Águas Santas, Maia, 25 October 2023
155. **Paulo Maurício de Carvalho**, Da Idade da Magia a Galileu (Presencial), Escola Básica de Outeiro, Gondomar, 26 October 2023
156. **Paulo Maurício de Carvalho**, Um Universo de Informação - A Luz (Presencial), Jardim de Infância n.º 1 de Portelinha, Fânzeres, Gondomar, 26 October 2023
157. **Paulo Maurício de Carvalho**, Um Universo de Informação - A Luz (Presencial), Escola Básica Gualdim Pais, Pombal, 26 October 2023
158. **Paulo Maurício de Carvalho**, Um Universo de Informação - A Luz (Presencial), Escola Básica de Fonte Nova, Pombal, 26 October 2023
159. **Paulo Maurício de Carvalho**, Da Idade da Magia a Galileu (Presencial), Escola Básica de Vouzela, Vouzela, 27 October 2023
160. **Paulo Maurício de Carvalho**, Da Idade da Magia a Galileu (Online), Escola Secundária do Arco-Íris, Portela, Loures, 30 October 2023
161. **Paulo Maurício de Carvalho**, Um Universo de Informação - A Luz (Presencial), Escola Básica n.º 1 de Junqueira, Vila do Conde, 30 October 2023
162. **Paulo Maurício de Carvalho**, Da Idade da Magia a Galileu (Presencial), Escola Secundária Filipa de Vilhena, Porto, 30 October 2023
163. **Paulo Maurício de Carvalho**, Um Universo de Informação - A Luz (Online), Escola Básica Guilherme Stephens, Marinha Grande, 31 October 2023
164. **Paulo Maurício de Carvalho**, Um Universo de Informação - A Luz (Online), Escola Secundária Rainha Dona Leonor, Lisboa, 2 November 2023
165. **Paulo Maurício de Carvalho**, Um Universo de Informação - A Luz (Online), Escola Básica Engenheiro Duarte Pacheco, Lisboa, 2 November 2023
166. **Paulo Maurício de Carvalho**, Da Idade da Magia a Galileu (Online), Escola Básica Engenheiro Duarte Pacheco, Lisboa, 2 November 2023
167. **Paulo Maurício de Carvalho**, Da Idade da Magia a Galileu (Online), Escola Portuguesa de Cabo Verde, Cidade da Praia, Cabo Verde, 3 November 2023
168. **Paulo Maurício de Carvalho**, Um Universo de Informação - A Luz (Presencial), Escola Básica de São João da Foz, Porto, 3 November 2023
169. **Paulo Maurício de Carvalho**, Da Idade da Magia a Galileu (Presencial), Jardim Escola João De Deus; Salreu, Estarreja, 7 November 2023
170. **Paulo Maurício de Carvalho**, Um Universo de Informação - A Luz (Presencial), Escola Secundária de São Pedro do Sul, S. Pedro do Sul, 9 November 2023
171. **Paulo Maurício de Carvalho**, Um Universo de Informação - A Luz (Presencial), Escola Básica de Pombal, Pombal, 9 November 2023
172. **Paulo Maurício de Carvalho**, Um Universo de Informação - A Luz (Presencial), Escola Secundária de Santa Comba Dão, Santa Comba Dão, 10 November 2023
173. **Paulo Maurício de Carvalho**, Um Universo de Informação - A Luz (Presencial), Escola Básica e Secundária de Sever do Vouga, Sever do Vouga, 14 November 2023
174. **Paulo Maurício de Carvalho**, Da Idade da Magia a Galileu (Presencial), Escola Básica de Ponte das Três Entradas, S. Sebastião da Feira; Oliveira do Hospital, 16 November 2023
175. **Paulo Maurício de Carvalho**, Da Idade da Magia a Galileu (Presencial), Escola Básica de Ponte das Três Entradas, S. Sebastião da Feira; Oliveira do Hospital, 16 November 2023
176. **Paulo Maurício de Carvalho**, Da Idade da Magia a Galileu (Presencial), Escola Básica de Ponte das Três Entradas, S. Sebastião da Feira; Oliveira do Hospital, 16 November 2023

177. **Paulo Maurício de Carvalho**, Um Universo de Informação - A Luz (Presencial), Escola Básica do Sudeste de Baião, Stª. Marinha do Zêzere, Baião, 17 November 2023
178. **Paulo Maurício de Carvalho**, Um Universo de Informação - A Luz (Presencial), Escola Básica e Secundária de Fajões, Fajões, Oliveira de Azeméis, 28 November 2023
179. **Ricardo Reis**, “Como produzir uma sessão de planetário?”, Planetários/PT 2023 - 2º Encontro nacional de Planetários, 20 February 2023
180. **Sérgio Sousa**, “À descoberta de Exoplanetas com o CHEOPS e o ESPRESSO”, Escola Básica Dr. Carlos Pinto Ferreira, Junqueira, Vila do Conde 11 October 2023
181. **Sérgio Sousa**, “À descoberta de Exoplanetas com o CHEOPS e o ESPRESSO”, Escola Secundária Filipa de Vilhena, Porto, 17 October 2023
182. **Sérgio Sousa**, “À descoberta de Exoplanetas com o CHEOPS e o ESPRESSO”, Escola Secundária Aurélia de Sousa, Porto, 30 October 2023
183. **Sérgio Sousa**, “À descoberta de Exoplanetas com o CHEOPS e o ESPRESSO”, Escola Básica de Milheirós de Poiares, Santa Maria da Feira, 31 October 2023
184. **Sérgio Sousa**, “À descoberta de Exoplanetas com o CHEOPS e o ESPRESSO”, Colégio da Trofa, 08 November 2023
185. **Sérgio Sousa**, “Tirar as medidas a exoplanetas”, Ignite IAstro, Vizela, 30 May 2023
186. **Sérgio Sousa**, “Tirar as medidas a exoplanetas”, Ignite IAstro, Marco de Canaveses, 11 November 2023
187. **Tomás de Azevedo Silva**, Astronomy On Tap: Unveiling the atmospheres of distant planets, 03 May 2023
188. **Tomás de Azevedo Silva**, Espaço vai à Escola: "Em busca de planetas distantes, e como desvendar suas atmosferas!" Total of >20 talks during 2023
189. **Tomás de Azevedo Silva**, “Desvendar as atmosferas de planetas distantes “, Ignite IAstro, Marco de Canaveses, 11 November 2023
190. **Tomás de Azevedo Silva**, “Desvendar as atmosferas de planetas distantes “, Ignite IAstro, Vizela, 20 May 2023

CONTAS

Balanço individual em 31 de Dezembro de 2023, valores em euro:

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ACTIVO			
Activo não corrente			
Activos fixos tangíveis	5	91,258.12	52,110.41
Activos intangíveis	4	14,275.42	4,240.23
Investimentos financeiros	15.2	15,953.20	16,342.35
		121,486.74	72,692.99
Activo corrente			
Inventários	6	4,161.55	4,191.08
Créditos a receber	8	9,806.06	18,889.45
Estado e Outros Entes Públicos	8	5,035.54	1,436.98
Diferimentos	8	3,084.95	5,716.08
Outros ativos correntes	8/15.1	2,987,325.64	2,457,138.35
Caixa e depósitos bancários	15.3	2,075,083.52	2,343,432.01
		5,084,497.26	4,830,803.95
Total do activo		5,205,984.00	4,903,496.94
FUNDOS PATRIMONIAIS E PASSIVO			
Fundos Patrimoniais			
Resultados transitados	8	1,092,400.94	1,045,095.83
Ajustamentos/Outras variações nos fundos patrimoniais	8	38,993.07	39,349.75
		1,131,394.01	1,084,445.58
Resultado líquido do período	8	-13,186.93	61,675.80
Total dos fundos patrimoniais		1,118,207.08	1,146,121.38
Passivo			
Passivo corrente			
Fornecedores	8	3,761.22	2,663.02
Estado e outros entes públicos	8	53,064.45	27,261.89
Diferimentos	8	3,498,764.68	3,283,303.56
Outros passivos correntes	8	532,186.57	444,147.09
		4,087,776.92	3,757,375.56
Total do passivo		4,087,776.92	3,757,375.56
Total dos fundos patrimoniais e do passivo		5,205,984.00	4,903,496.94

Demonstrações Financeiras

Alterações no capital

Demonstração individual das alterações nos fundos patrimoniais no período de 2022

DESCRIÇÃO		NOTAS	Fundos Patrimoniais atribuídos aos instituidores da entidade-mãe								Interesses que não controlam	Total dos fundos patrimoniais
			Fundos	Eccedentes Técnicos	Reservas	Resultados Transitados	Eccedentes de revalorização	Ajustamentos/Ditas variações nos fundos patrimoniais	Resultado líquido do período	Total		
POSIÇÃO NO INÍCIO DO PERÍODO 2022	1					998773,50		93721,80	46322,33	1138817,63		1138817,63
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 eccedente de revalorização												
Eccedentes de revalorização												
Ajustamentos por impostos diferidos												
Outras alterações reconhecidas nos fundos patrimoniais						46322,33	-54372,05	-46322,33	-54372,05			-54372,05
	2					46322,33	-54372,05	-46322,33	-54372,05			-54372,05
RESULTADO LÍQUIDO DO PERÍODO	3								61675,80	61675,80		61675,80
RESULTADO INTEGRAL	4=2+3								15353,47	7303,75		7303,75
OPERAÇÕES COM INSTITUIDORES NO PERÍODO												
Fundos												
Subsídios, dotações e legados												
Distribuições												
Outras operações												
	5											0,00
POSIÇÃO NO FIM DO PERÍODO 2022	6=1+2+3+5					1045095,83		39349,75	61675,80	1146121,38		1146121,38

Demonstração individual das alterações nos fundos patrimoniais no período de 2023

DESCRIÇÃO		NOTAS	Fundos Patrimoniais atribuídos aos instituidores da entidade-mãe								Interesses que não controlam	Total dos fundos patrimoniais
			Fundos	Ecedentes Técnicos	Reservas	Resultados Transitados	Excedentes de revalorização	Outras variações nos fundos patrimoniais	Resultado líquido do período	Total		
POSIÇÃO NO INÍCIO DO PERÍODO 2023	6	2				1045095,83		39349,75	-61675,80	1146121,38		1146121,38
ALTERAÇÕES NO PERÍODO												
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												
Otras alterações reconhecidas nos fundos patrimoniais						47305,11		-356,68	-61675,80	-14727,37		-14727,37
	7					47305,11		-356,68	-61675,80	-14727,37		-14727,37
RESULTADO LÍQUIDO DO PERÍODO	8								-13186,93	-13186,93		-13186,93
RESULTADO INTEGRAL	9=7+8								-74862,73	-27914,30		-27914,30
OPERAÇÕES COM INSTITUIDORES NO PERÍODO		10										
Fundos												
Subsídios, doações e legados												
Distribuições												
Otras operações												
												0,00
POSIÇÃO NO FIM DO PERÍODO 2023	6+7+8+10					1092400,94		38993,07	-13186,93	1118207,08		1118207,08

Fluxos de Caixa

RUBRICAS	NOTAS	PERÍODOS	
		31-12-2023	31-12-2022
Fluxos de Caixa das actividades operacionais-método directo			
Recebimento de Clientes e Utentes		249 664,52	193 904,98
Pagamentos de subsídios			
Pagamentos de apoios			
Pagamentos de bolsas		-77 298,40	-62 941,92
Pagamento a fornecedores		-294 836,32	-204 280,52
Pagamentos ao pessoal		-1 259 949,09	-1 321 198,86
Caixa gerada pelas operações		-1 382 419,29	-1 394 516,32
Pagamento/recebimento do imposto s/rendimento			
Outros recebimentos/pagamentos		1 134 898,27	2 969 733,22
FLUXO DE CAIXA DAS ACTIVIDADES OPERACIONAIS		-247 521,02	1 575 216,90
Fluxos de caixa das actividades de investimento			
Pagamentos respeitantes a :			
Activos fixos tangíveis		-49 391,73	-49 326,49
Activos intangíveis		-13 611,99	
Investimentos financeiros		-1 631,39	-6 969,64
Outros activos			
Recebimentos provenientes de:			
Activos fixos tangíveis			
Activos intangíveis			
Investimentos financeiros		2 020,54	9 835,64
Outros activos			
Subsídios ao investimento		41 789,96	32 939,91
Juros e rendimentos similares		10,15	672,69
Dividendos			
FLUXO DE CAIXA DAS ACTIVIDADES DE INVESTIMENTO		-20 814,46	-12 847,89
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		-13,01	
Dividendos			
Redução de fundos			
Outras operações de financiamento			
FLUXO DE CAIXA DAS ACTIVIDADES DE FINANCIAMENTO		-13,01	0,00
VARIAÇÃO DE CAIXA E SEUS EQUIVALENTES		-268 348,49	1 562 369,01
EFEITO DAS DIFERENÇAS CÂMBIO			
CAIXA E SEUS EQUIVALENTES NO INICIO PERÍODO		2 343 432,01	781 063,00
CAIXA E SEUS EQUIVALENTES NO FIM PERÍODO		2 075 083,52	2 343 432,01

Resultados por natureza

RENDIMENTOS E GASTOS	NOTAS	PERÍODOS	
		31/12/2023	31/12/2022
Vendas e serviços prestados	9	240 581,13	195 424,11
Subsídios, doações e legados à exploração	7	1 428 903,63	1 444 064,49
Custo das mercadorias vendidas e das matérias consumidas	6	-1,80	-1,35
Fornecimentos e serviços externos	10	-307 010,26	-204 122,18
Gastos com o pessoal	11	-1 280 303,04	-1 300 900,19
Aumentos/reduções justo valor	15.2		
Outros rendimentos	12	44 522,90	144 238,64
Outros gastos	13	-89 971,44	-121 230,00
Resultado antes de depreciações, gastos de financiamento e impostos		36 721,12	157 473,52
Gastos/reversões de depreciação e de amortização	5/6	-49 905,19	-96 470,41
Resultado operacional (antes de gastos de financiamento e impostos)		-13 184,07	61 003,11
Juros e rendimentos similares obtidos	9/14	10,15	672,69
Juros e gastos similares suportados	14	-13,01	
Resultado antes de impostos		-13 186,93	61 675,80
Resultado líquido do período		-13 186,93	61 675,80

Anexo

Anexo às demonstrações financeiras do período findo em 31 de Dezembro de 2023.
(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.

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

- a investigação científica;
- 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) n.º 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 ASTROFÍSICA 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 reflecta 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 - Ativos 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 à 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 2023, 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 2022.

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 ocorreram 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 ativos 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 à 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 2023 e 31 de dezembro de 2022, 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			13.611,99			13.611,99
	Revalorizações						
	Transferências						
	Alienações						
	Sinistros						
	Abates						
	Saldo Final		4.077,14	31.104,89			35.182,03

	Activos intangíveis: amortizações	Projectos de desenvolvimento	Programas de computador			Activos intangíveis em curso	Totais
		Outros		Marcas comerciais			
	Saldo Inicial		4.077,14	13.252,67			17.329,81
	Reforços			3.576,80			3.576,80
	Reversões						
	Alienações						
	Sinistros						
	Abates						
	Saldo Final		4.077,14	16.829,47			20.906,61

5. ACTIVOS FIXOS TANGÍVEIS

Durante os períodos findos em 31 de dezembro de 2023 e 31 de dezembro de 2022, 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	1.055.115,10	35.400,00	794.949,74	45.181,08		1.930.645,92
Adições	59.052,30		2.396,05	24.950,04		86.398,39
Revalorizações						
Alienações						
Transferências						
Abates				-17.707,77		-17.707,77
Saldo Final	1.114.167,40	35.400,00	797.345,79	52.423,35		1.999.336,54

Activos fixos tangíveis: depreciações	Equipamento básico	Equipamento de transporte	Equipamento administrativo	Outros activos fixos tangíveis	Activos fixos tangíveis em curso	Totais
Saldo Inicial	1.008.004,17	35.400,00	791.444,19	43.687,15		1.878.535,51
Reforços	40.735,84		3.511,51	2.081,04		46.328,39
Reversões						
Alienações						
Abates				-16.785,48		-16.785,48
Saldo Final	1.048.740,01	35.400,00	794.955,70	28.982,71		1.908.078,42

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 2023 e em 31 de dezembro de 2022 é detalhado conforme segue:

CMVMC		Mercadorias	TOTAIS
Em 31.12.2023	Saldo Inicial	4.191,08	4.191,08
	Compras		
	Regularizações (+/-)	-27,73	-27,73
	Saldo Final	4.161,55	4.161,55
	CMVMC	1,80	1,80
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

7. SUBSÍDIOS E OUTROS APOIOS

O montante dos subsídios, reconhecidos nos períodos findos em 31 de dezembro de 2023 e em 31 de dezembro de 2022, é detalhado como se segue:

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

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

Relação dos subsídios obtidos e outros apoios			Quantias Concedidas	
			2023	2022
Não reembolsáveis	Subsídios relacionados com activos	Estado e Outros Entes Públicos	31.049,83	32.939,91
		Outras Entidades	10.740,13	
		Subtotais	41,789,96	32.939,91
	Subsídios à exploração	Estado e Outros Entes Públicos	1.304.411,19	1.295.363,27
		Outras Entidades	124.492,44	148.701,22
		Subtotais	1.428.903.63	1.444.064,49
Totais			1.470.693.59	1.477.004,40

8. INSTRUMENTOS FINANCEIROS

CRÉDITOS A RECEBER						
	Quantia Nominal		Imparidade		Valor Líquido	
	2023	2022	2023	2022	2023	2022
Clientes Correntes	9.806,06	18.889,45			9.806,06	18.889,45
Clientes Cob. Duvidosa						
Totais	9.806,06	18.889,45	0	0	9.806,06	18.889,45

	OUTROS ATIVOS CORRENTES	
	2023	2022
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
Outros acréscimos de rendimentos	81.967,68	77.270,27
Outros devedores	2.905.357,96	2.371.876,61
Totais	2.987.325,64	2.457.138,35

	ESTADO E OUTROS ENTES PÚBLICOS	
	2023	2022
Finanças	22.339,80	18.162,93
Segurança Social e Fundo de Compensação	25.689,11	7.661,98
Totais	48.028,91	25.824,91
Saldos Devedores		
Retenção Imp. s/ Rendimento		
Iva Restituição	5.035,54	1.436,98
Iva a recuperar		
Restantes impostos		
Totais	5.035,54	1.436,98
Saldos Credores		
Corrente		
Retenção Imp. s/ Rendimento	16.105,00	14.357,00
Iva a pagar	11.270,34	5.242,91
Contribuições seg. social	25.689,11	7.083,16
Outras Tributações (Fundo de Compensação)		578,82
Totais	53.064,45	27.261,89

	DIFERIMENTOS	
	2023	2022
Gastos a reconhecer		
Seguros	404,23	912,53
Outros gastos diferidos	2.680,72	4.803,55
Totais	3.084,95	5.716,08
Rendimentos a reconhecer		
Subsídios	3.497.786,21	3.281.026,31
Outros rendimentos	978,47	2.277,25
Totais	3.498.764,68	3.283.303,56

	OUTROS PASSIVOS CORRENTES	
	2023	2022
Não correntes		
Clientes (saldos contrários)		
Pessoal		
Fornecedores de investimentos		
Totais	0	0
Correntes		
Clientes (saldos contrários)		
Pessoal		
Fornecedores de investimentos	32.580,24	2.915,60
Credores por acréscimos de gastos		
Remunerações a pagar	186.402,94	172.799,22
Outros acréscimos de gastos	1.782,51	7.591,08
Outros Credores	311.420,88	260.841,19
Totais	532.186,57	444.147,09

	FORNECEDORES	
	2023	2022
Fornecedores, conta corrente	3.761,22	2.663,02
Fornecedores, títulos a pagar		

Fornecedores, faturas em rec. conf.		
Totais	3.761,22	2.663,02

MOVIMENTOS NAS RUBRICAS DE FUNDOS PATRIMONIAIS

	Saldo Inicial	Aumentos	Reduções	Saldo Final
Fundos				
Reservas				
Resultados transitados	1.045.095,83	61.675,80	14 370,69	1.092.400,94
Excedentes de revalorização				
Outras variações nos fundos patrimoniais	39.349,75	41.789,96	42.146,64	38.993,07
Resultado líquido do exercício	61.675,80	-13.186,93	61.675,80	-13.186,93
Totais	1.146.121,38	90.278,83	118.193,13	1.118.207,08

Foi contabilizada na conta Resultados Transitados uma retificação negativa, no montante de 14 370,69, relativa ao exercício anterior.

9. RÉDITO

Em 31 de dezembro de 2023 e em 31 de dezembro de 2022 os réditos apresentavam a seguinte composição:

Quantias dos réditos reconhecidas no período	2023	2022
	Réditos reconhecidos no período	Réditos reconhecidos no período
Venda de bens	6,83	102,73
Prestação de serviços	240.574,30	195.321,38
Juros	10,15	672,69
Royalties		
Dividendos		
Totais	240.591,28	196.096,80

10. FORNECIMENTOS E SERVIÇOS EXTERNOS

A rubrica de “Fornecimentos e serviços externos” em 31 de dezembro de 2023 e 31 de dezembro de 2022 é detalhada conforme se segue:

Fornecimentos e Serviços Externos	2023	2022
Subcontratos	3.150,00	2.680,31
Serviços Especializados:	38.086,44	51.405,29
Trabalhos Especializados	16.886,77	11.525,10
Publicidade e propaganda	619,92	
Vigilância e Segurança	521,83	74,42
Honorários	4.800,00	6.800,00
Conservação e Reparação	14.350,73	31.892,73
Outros Serviços Especializados	907,19	1.113,04
Materiais	35.702,07	14.181,42
Energia e fluídos	1.533,63	1.403,30
Deslocações, Estadas e Transportes	202.890,89	110.524,97
Serviços Diversos:	25.647,23	23.926,89
Rendas e Alugueres	4.866,00	
Comunicação	68,70	217,55
Seguros	3.254,28	3.296,69
Contencioso e notariado	35,00	280,00
Limpeza, higiene e conforto		
Outros Serviços	17.423,25	20.132,65
Totais	307.010,26	204.122,18

11. GASTOS COM O PESSOAL

A rubrica de “Gastos com o pessoal” em 31 de dezembro de 2023 e em 31 de dezembro de 2022 detalha-se da seguinte forma:

Gastos com o Pessoal	2023	2022
Remunerações do Pessoal	1.048.772,79	1.042.494,19
Encargos sobre Remunerações	223.823,17	209.971,62
Seguro de acidentes de trabalho e doenças profissionais	5.567,68	7.902,02
Outros gastos com Pessoal	2.139,40	40.532,36
Totais	1.280.303,04	1.300.900,19

O nº. médio de pessoas ao serviço em 2022 foi de 36 e em 2023 de 35.

12. OUTROS RENDIMENTOS

A composição da rubrica de “Outros rendimentos e ganhos” em 31 de dezembro de 2023 e 31 de dezembro de 2022 é conforme se segue:

Outros Rendimentos	2023	2022
Descontos de pronto pagamento	0,01	
Rendimentos e ganhos rest. Activos financeiros	8,15	182,68

Rendimentos e ganhos em Inv. não financeiros		229,98
Outros	44.514,74	143.825,98
Totais	44.522,90	144.238,64

13. OUTROS GASTOS

A decomposição da rubrica de “Outros gastos e perdas” em 31 de dezembro de 2023 e em 31 de dezembro de 2022 é conforme se segue:

Outros Gastos	2023	2022
Impostos	56,57	54,39
Perdas em Inventários		
Gastos e Perdas em Investimentos Não Financ.	922,29	380,90
Outros	88.992,58	120.794,71
Totais	89.971,44	121.230,00

14. JUROS E OUTROS RENDIMENTOS E GASTOS SIMILARES

Os gastos e perdas de financiamento em 31 de dezembro de 2023 e 31 de dezembro de 2022 são detalhados conforme se segue:

Juros e Rendimentos Similares Obtidos	2023	2022
Juros Depósitos	10,15	10,15
Outros		662,54
Totais	10,15	672,69

Juros e Gastos Similares Suportados	2023	2022
Juros Suportados	13,01	
Diferenças de câmbio desfavoráveis		
Outros		
Totais	13,01	0

15. OUTRAS INFORMAÇÕES

15.1. Investimentos Financeiros

INVESTIMENTOS FINANCEIROS						
	Quantia Nominal		Imparidade		Valor Liquido	
	2023	2022	2023	2022	2023	2022
Fundo Compensação	15.953,20	16.342,35			15.953,20	16.342,35
Totais	15.953,20	16.342,35	0	0	15.953,20	16.342,35

15.2 Desagregação dos valores inscritos na rubrica caixa e depósitos bancários.

Caixa, Depósitos e Outros Inst. Financeiros	2023	2022
Caixa	35,00	35,00
Depósitos Bancários	2.075.048,52	2.343.397,01
Total	2.075.083,52	2.343.432,01

16. ACONTECIMENTOS APÓS A DATA DO BALANÇO

Não são conhecidos eventos posteriores a 31 de dezembro de 2023 que possam influenciar a apresentação e interpretação das demonstrações financeiras reportadas a esta data.

17. DATA DE AUTORIZAÇÃO PARA EMISSÃO

As demonstrações financeiras do exercício findo em 31 de Dezembro de 2023 foram aprovadas pela Direcção e autorizadas para emissão em 11-04-2023.

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 2023, 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 2023, que compreendem o Balanço (que evidencia um total de 5.205.984 euros e um total dos fundos patrimoniais de 1.118.207,08 euros, incluindo um resultado líquido do período negativo de 13.186,93 euros), a Demonstração dos Resultados por Natureza, a Demonstração das Alterações nos Fundos Patrimoniais, 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 2023, 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 2023.

Porto, 12 de abril de 2024

Presidente,



(Dr. Filipe Pires)

Vogal,



(Prof. Jorge F. Gameiro)

Relator,



(Dra. Marlene Rebelo)