CENTRO DE ASTROFÍSICA UNIVERSIDADE DO PORTO

RELATÓRIO DE GESTÃO E CONTAS

Centro de Astrofísica
da Universidade do Porto

U.PORTO

ANO 2020

RELATÓRIO DE GESTÃO

Versão aprovada pela Assembleia Geral em 2021/04/28

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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 objeto 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/Astrofisica através de projetos nele desenvolvidos, bem como a aquisição de conhecimentos básicos de caráter interdisciplinar, que abram novas perspetivas à investigação aplicada;*
- *A Astronomia/Astrofisica 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/Astrofisica, nomeadamente a nível de licenciatura e pós-graduação;*
- *A divulgação científica na área de Astronomia/Astrofisica.*

Órgãos Sociais

Os elementos que estiveram em funções em 2020 foram:

- **Mesa da Assembleia Geral**:

  Presidente – Universidade do Porto (José António Sarsfield Pereira Cabral)

  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 (João Carlos Ferreira Ribeiro)

  Vogal – Jorge Filipe S. Gameiro

Os membros do Conselho Consultivo em 2020 foram:

- **Conselho Consultivo**:

  Vogal - Moira Jardine (University of St Andrews)

  Vogal - Mark McCaughrean (European Space Agency)

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

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

Os Associados do CAUP a 31 de dezembro de 2020 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 utiliza instalações que são propriedade da U.Porto após a extinção da Fundação para a Ciência e o Desenvolvimento (FCD) em 2013. As instalações, que têm uma área total útil de 3580 m2. são partilhadas com o *Planetário do Porto*, também propriedade da U.Porto após a extinção da FCD . O espaço atribuído ao CAUP resulta do financiamento atribuído pelo Ministério da Ciência e Tecnologia para a construção do edifício, que foi planeado de raiz para albergar o CAUP e o Planetário do Porto.

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

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

Recursos Humanos

O CAUP tem recursos humanos próprios que, no final de 2020, correspondiam a um total de 37 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 2020):

Contratos sem termo (total de 8):

- Divulgação:
  - (**1**) Filipe A. L. Pires - *especialista*
  - (**2**) Paulo J. T. Pereira - *assessor gráfico*
  - (**3**) Ricardo S. S. C. Reis - *técnico*
- Informática:
  - (**4**) Manuel A. S. Monteiro - *especialista*
- Administração e Serviços:
  - (**5**) Argentina M. T. Pereira - *técnico*
  - (**6**) Elsa M. P. P. Silva - *técnico*
  - (**7**) Fernando M. S. Soares - *porteiro*
  - (**8**) Carlos A. G. Gonçalves - *porteiro*

Contratos a termo (total de 28):

- Investigação:
  - (**1**) Vardan Zh. Adibekyan - *investigador auxiliar*
  - (**2**) Susana C. C. Barros - *investigador júnior*
  - (**3**) Diego Bossini - *investigador júnior*
  - (**4**) Jarle Brinchmann - *investigador*
  - (**5**) Tiago J. L. C. E. Campante - *investigador auxiliar*
  - (**6**) Margarida M. S. Cunha - *investigador principal*
  - (**7**) Morgan Deal - *investigador júnior*
  - (**8**) Olivier D. S. Demangeon - *investigador júnior*
  - (**9**) João Faria - *investigador júnior*
  - (**10**) Charlotte Gehan - *investigador júnior*
  - (**11**) Jean Michel Gomes - *investigador júnior*
  - (**12**) João N. T. Gomes da Silva - *investigador júnior*
  - (**13**) Andrew Humphrey - *investigador júnior*
  - (**14**) M. S. Nanda Kumar - *investigador principal*
  - (**15**) Patricio Lagos - *investigador júnior*
  - (**16**) Carlos J. A. P. Martins - *investigador júnior*
  - (**17**) Jorge H. C. Martins - *investigador júnior*
  - (**18**) Elisa Delgado Mena - *investigador auxiliar*
  - (**19**) Ivan Rybak - *investigador júnior*
  - (**20**) Tom C. Scott - *investigador júnior*
  - (**21**) Lara G. Sousa - *investigador júnior*
  - (**22**) Sérgio A. G. Sousa - *investigador principal*
  - (**23**) Hugo M. Tabernero Guzmán - *investigador junior*
- Divulgação :
  - (**24**) Hilberto M. S. Silva - *técnico*
  - (25) Elsa M. P. S. Moreira - *técnico*
- Administração e Serviços:
  - (**26**) Mariana P. Júlio - *técnico*
  - (**27**) L. Marlene R. da Cruz - *técnico*
  - (**28**) Ernesto J. Silva - *porteiro*

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

Síntese da Atividade em 2020

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): coordenar 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 cuja Instituição de Gestão Principal é a FCiências.ID - Associação para a Investigação e Desenvolvimento de Ciências (sendo a outra o CAUP), as competências da UnI do CAUP passaram a ser delegadas na Coordenação do IA, onde têm assento dois elementos do CAUP em paridade com dois elementos do pólo de Lisboa.
- **Unidade de Formação** (UnF): coordenar ou apoiar todas as atividades de formação organizadas pelo CAUP ou que têm a sua participação/colaboração. Nomeadamente a formação universitária (licenciatura, mestrado e doutoramento), formação contínua, cursos avançados e organização de eventos que visam reforçar a qualidade da formação oferecida no CAUP.
- **Núcleo de Divulgação** (ND): organiza todas as atividades de divulgação e promoção da cultura científica, incluindo o 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 2020 no âmbito de cada uma destas unidades é apresentada na componente de relatório de atividades.

Situação Económico-Financeira

A situação económico-financeira no final de 2020 representa as dificuldades vividas ao longo do ano, em consequência da pandemia causada pela COVID-19. O resultado líquido do exercício foi negativo.

O montante global de gastos desceu em relação a 2019, situando-se abaixo de um milhão e setecentos mil euros. Os rendimentos também decresceram significativamente, sendo este ano inferiores aos gastos, como se ilustra na Figura 1. O capital próprio teve uma ligeira diminuição enquanto as disponibilidades no final do ano também desceram significativamente, situando-se agora abaixo de quinhentos mil euros.

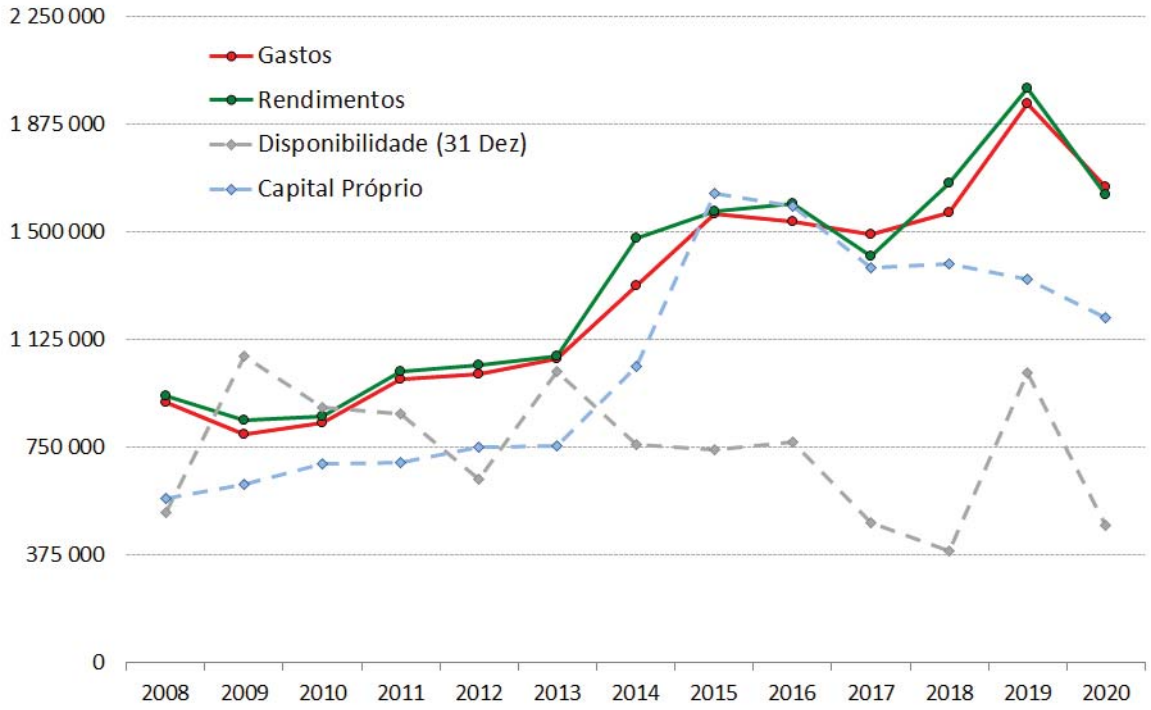


Figure 1: Evolução dos *Gastos* (linha vermelha) e dos *Rendimentos* (linha verde), para o exercício por ano fiscal, desde 2008. Os valores dados estão em euros. Também se indica as *disponibilidades* (linha cinzenta) existentes a 31 de Dezembro de cada ano e o *capital próprio* (linha azul).

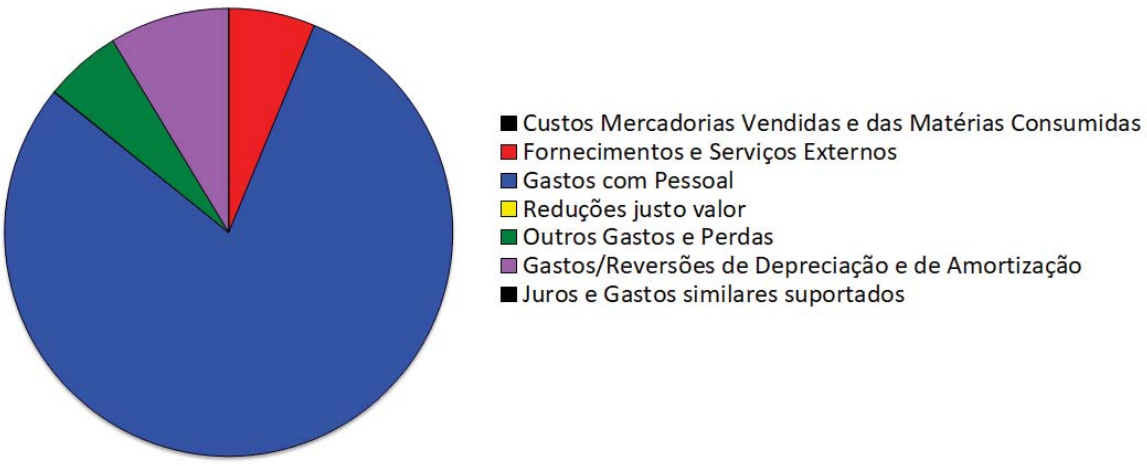


Figure 2: Distribuição dos Gastos do exercício de 2020, correspondendo a um total de 1 659 043,99 euros.

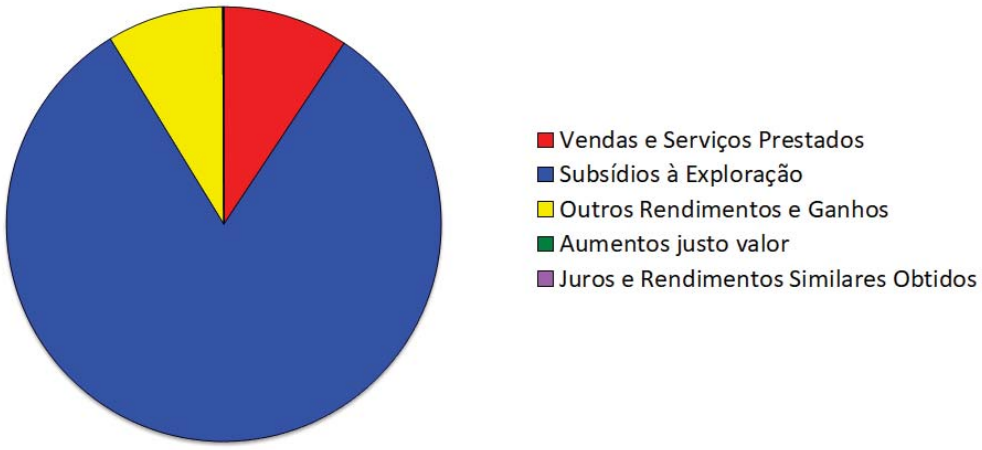


Figure 3: Distribuição dos Rendimentos do exercício de 2020, correspondendo a um total de 1 631 584,20 euros.

A fração dos custos com recursos humanos, quer através de despesas com o pessoal, quer através da contratação de bolseiros, foi este ano ainda mais significativa do que em anos anteriores, consequência do abrandamento das restantes atividades. A Figura 2 ilustra o peso relativo das diferentes componentes de *Gastos* nas contas em 2020. 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).

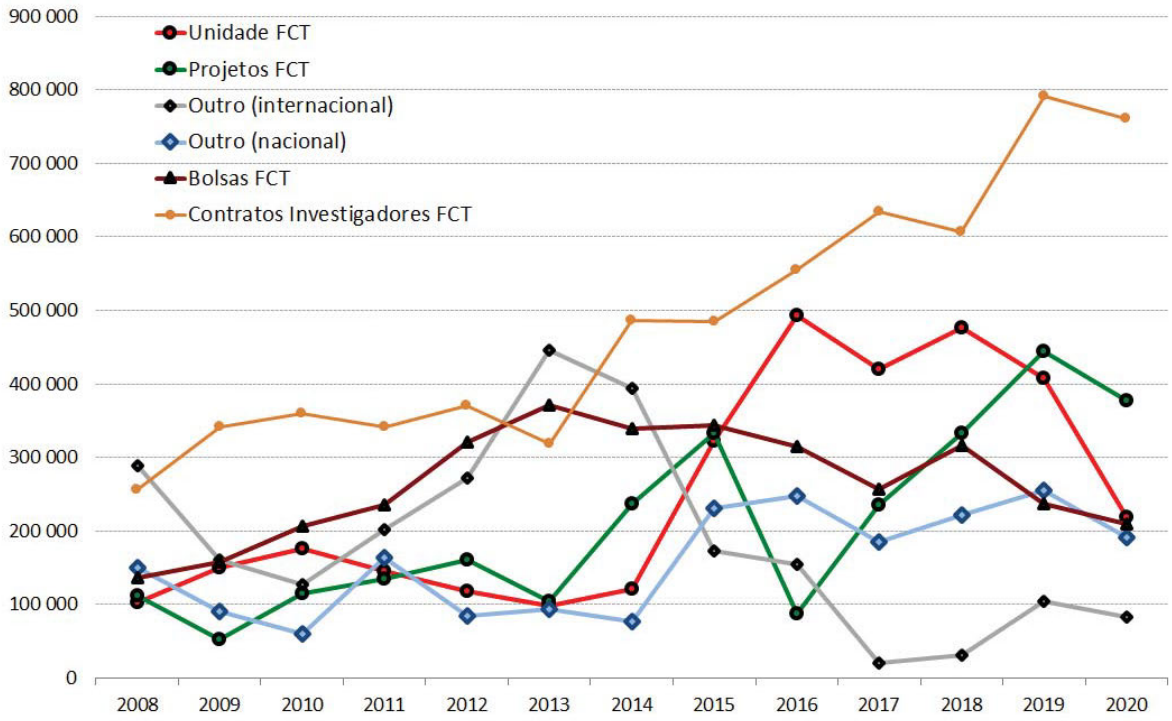


Figure 4: Distribuição das fontes de financiamento para o exercício por ano fiscal, desde 2008.

O financiamento da Unidade I&D, proveniente da FCT, diminuiu consideravelmente em 2020, sobretudo devido ao início do novo programa de financiamento para 2020-2023.

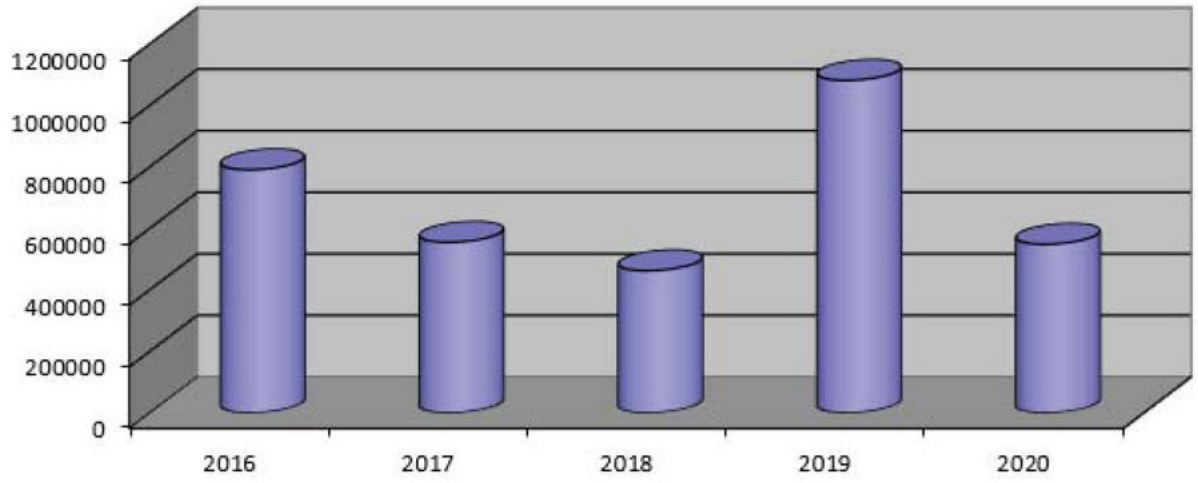
Quanto ao financiamento de projetos FCT, registou-se uma descida reflexo do abrandamento da atividade nos projetos de I&D em curso. No financiamento nacional, proveniente de outras fontes, registou-se uma descida considerável devido sobretudo ao abrandamento da atividade económica global em consequência da COVID-19. No que respeita a outros fundos internacionais verificou-se também uma descida, resultante do fim de uma bolsa Marie Curie individual. A dificuldade que o CAUP tem tido nos últimos anos em ver aprovadas candidaturas suas a projetos financiados pela Comissão Europeia continua. Esta dificuldade está intimamente ligada à clara redução dos instrumentos que permitem financiar ciência fundamental.

O financiamento correspondente aos contratos FCT registou uma ligeira descida devido ao término de alguns contratos Investigador FCT. No ano de 2020, esta componente correspondeu a um total de 761 036 euros (19 investigadores envolvidos). Uma outra fonte de financiamento indireto provém das bolsas de investigação atribuídas diretamente pela FCT cujo valor global teve uma ligeira descida relativamente a 2019, consequência das novas políticas de apoio à contratação de doutorados. 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 2020, esta componente correspondeu a um total de 209 509 euros (1 investigador, 15 alunos de doutoramento e 2 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, mostrando que o valor anual global é consideravelmente superior ao financiamento anual da Unidade de Investigação. À semelhança do que acontece com os salários dos docentes, os montantes das bolsas FCT não são incluídos nas contas do CAUP.

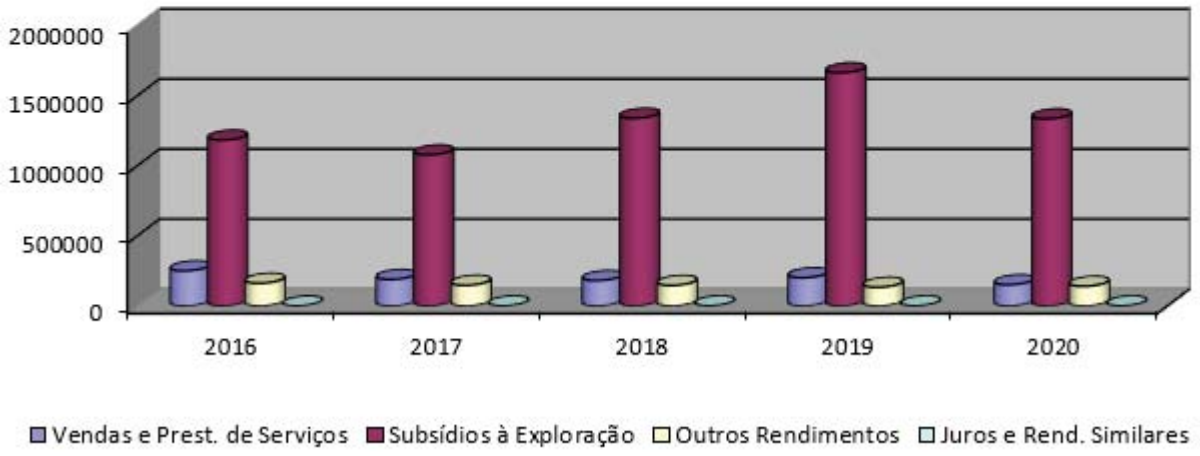
Indicadores Económico-Financeiros

Nesta seção fornecem-se alguns dos indicadores económico-financeiros das contas de 2020, em comparação com os 4 anos anteriores.

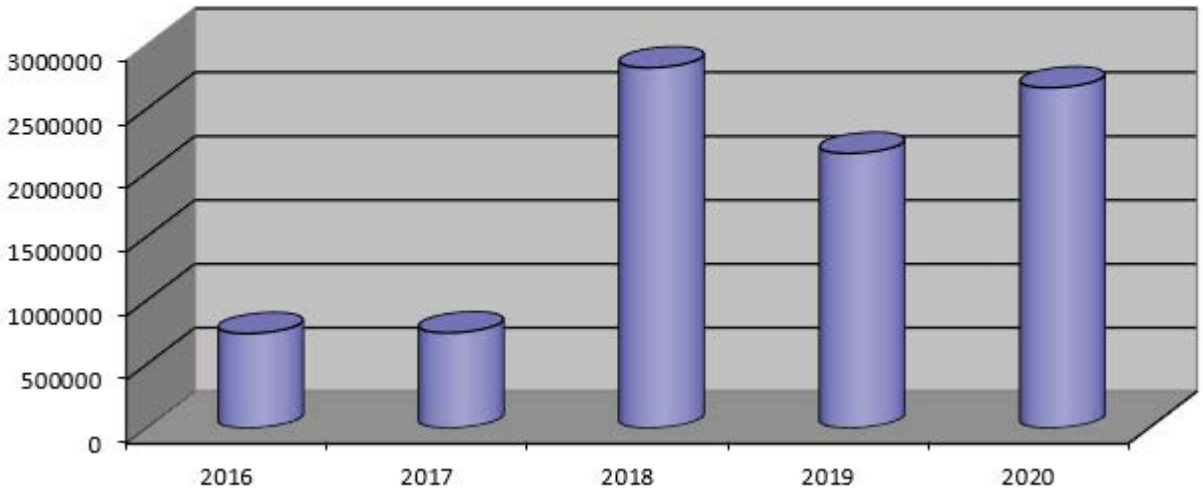
Meios Financeiros Liquidos					
	2016	2017	2018	2019	2020
Caixa	50	50	35	35	35
Depósitos Bancários	770290	485471	389606	1009156	477264
Outros Instrumentos Financ.	20000	69000	72435	71803	70824
TOTAIS	790340	554521	462076	1080994	548123



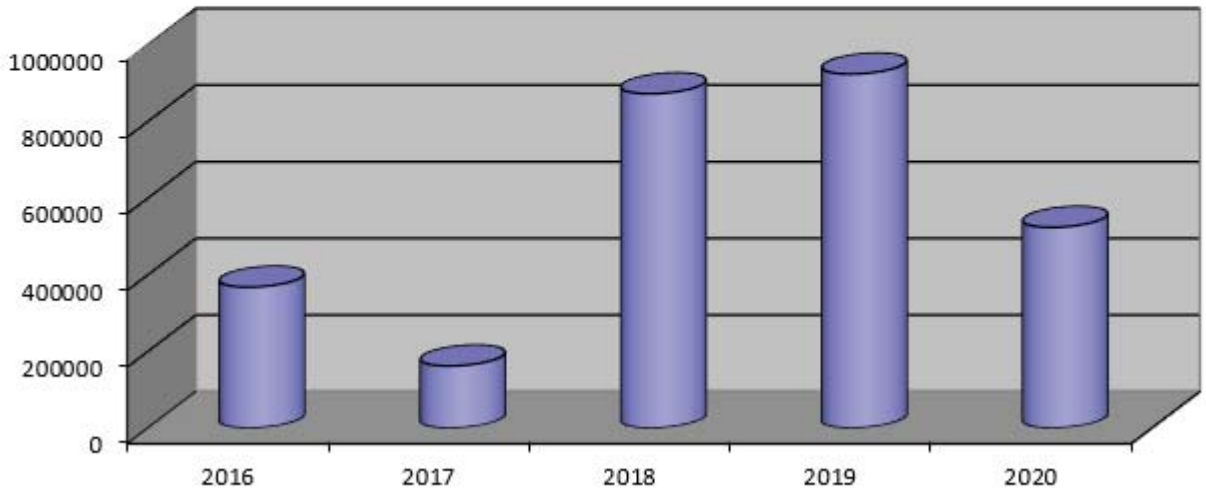
Evolução dos Rendimentos					
	2016	2017	2018	2019	2020
Vendas e Prest. de Serviços	251657	189794	182041	202436	152362
Subsídios à Exploração	1184708	1079412	1340581	1665765	1336622
Outros Rendimentos	162795	148367	147359	134182	141325
Juros e Rend. Similares	372	910	1271	1271	1275
TOTAIS	1599532	1418483	1671252	2003654	1631584



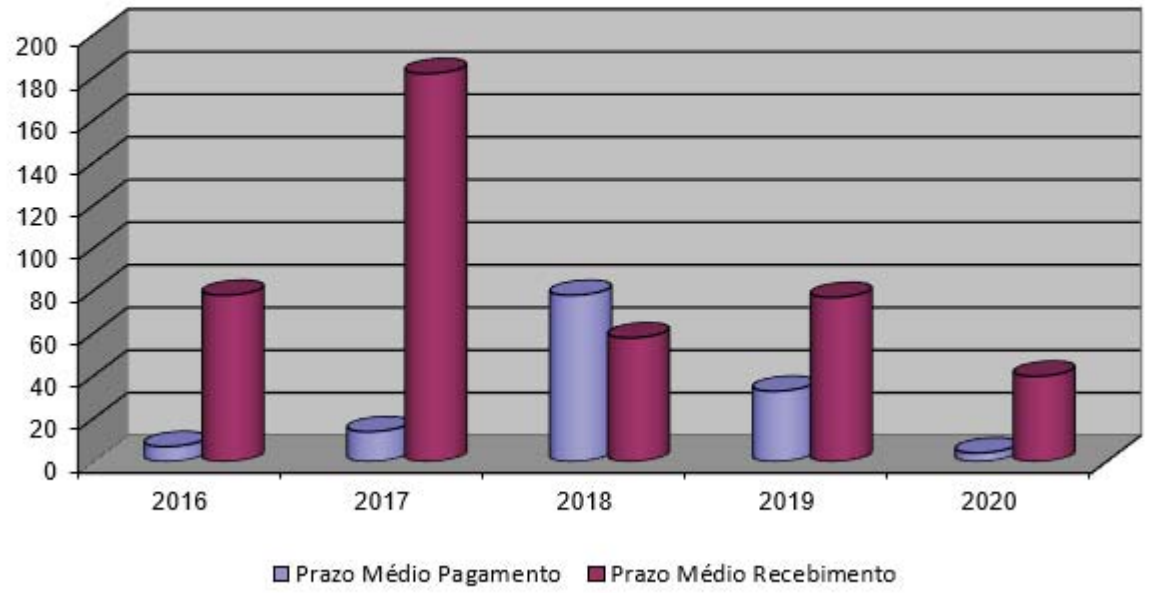
Créditos a Receber e Outros Ativos Correntes					
	2016	2017	2018	2019	2020
Créditos a Receber	347	467	28563	43216	16988
Outros Ativos Correntes	739210	745008	2791945	2107206	2646897
TOTAIS	739557	745475	2820508	2150422	2663885



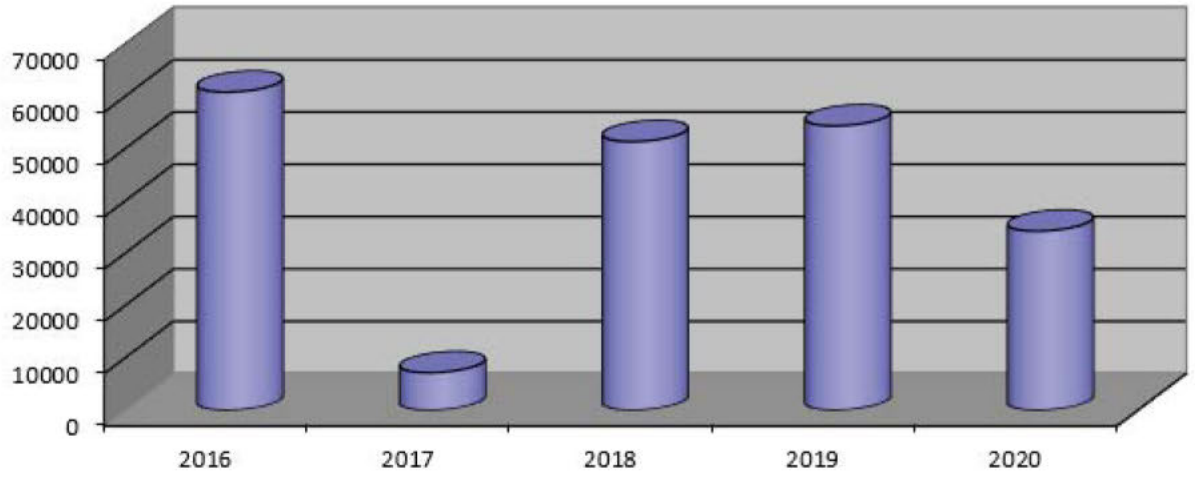
Fornecedores e Outros Passivos Correntes					
	2016	2017	2018	2019	2020
Fornecedores	0	0	64888	18351	886
Outros Passivos Correntes	367584	161933	807441	905431	522785
TOTAIS	367584	161933	872329	923782	523671



Tesouraria					
	2016	2017	2018	2019	2020
Prazo Médio Pagamento	7	14	78	33	4
Prazo Médio Recebimento	78	182	58	77	40



	Activo Fixo				
	2016	2017	2018	2019	2020
Aquisições	60819	7183	51380	54382	34248
TOTAIS	60819	7183	51380	54382	34248



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

O CAUP conta com uma percentagem baixa de financiamento da Comissão Europeia. É fundamental o aumento desta percentagem para valores verdadeiramente significativos.

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 terá um impacto significativo no desenrolar das atividades do CAUP. Adicionalmente, a pandemia de COVID-19 e a forte descida da receita do Planetário dela resultantes, teve, também, um impacto bastante negativo nas nossas atividades em 2020, e que continua a fazer-se sentir em 2021, provavelmente durante todo o ano. Dos projetos financiados pela FCT destaca-se, para além da continuação de dois projetos exploratórios associados a Investigadores FCT e dos sete projetos de investigação iniciados em 2018, a conclusão dos projetos exploratórios "*Resolving galaxy evolution*" e "*Towards the characterization of Earth-like exoplanets*". Para 2021 esperamos uma descida no número de projetos FCT em execução, consequência do fim dos dois projetos exploratórios e de alguns projetos de investigação. Em contrapartida, apenas um projeto FCT novo começará: "*Dark matter and metals in galaxies (DarkMAGE)*". Em 2020 tivemos a conclusão do projeto "*Detecting and characterization of exoplanets around evolved stars with NASA 's TESS mission",* financiado pela União Europeia. Tivemos também quatro projetos financiados pela Ciência Viva - Agência Nacional para a Cultura Científica e Tecnológica na área da divulgação (outreach).

Ao nível do 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, e o COST action "*Revealing the Milky Way with Gaia*", iniciado em 2019.

Na componente de bolsas externas, o CAUP, no âmbito da Unidade de Investigação 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. Com vista ao recrutamento mais estratégico de recursos humanos, o CAUP vai apresentar uma candidatura à segunda edição do Concurso Estímulo ao Emprego Científico - Institucional da FCT e celebrar um contrato de trabalho ligado à computação no âmbito do projeto para a missão PLATO financiado pelo programa PRODEX.

De referir a continuação do contrato celebrado com a DEIMOS-Engenharia para desenvolvimento e manutenção de software para o CHEOPS (ESA small mission). Este satélite foi lançado com sucesso em 18 de dezembro de 2019 e os primeiros dados foram analisados em 2020.

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 investigação científica e 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.

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 2020 se apurou um Resultado Líquido do Exercício negativo, no montante de 27 459,79 euros (vinte e sete mil quatrocentos e cinquenta e nove euros e setenta e nove cêntimos), a Direção propõe:

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

[redacted]

Doutor Jarle Brinchmann

(Presidente)

[redacted]

Prof. Doutora Catarina G. G. Lobo

(Vogal)

[redacted]

Prof. Doutor Daniel F. M. Folha

(Vogal)

Porto, 14 de abril de 2021.

REPORT OF ACTIVITIES

This component of the report describes the main initiatives and results obtained during the year of 2020.

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

At the end of 2020 the team included:

- **38 Researchers** - corresponding to
  - *12 Lecturers* (4.9 FTE): Ilídio André P. M. Costa (AE Santa Bárbara[1]), Vítor M. M. Costa (ISEP), J. Paulo Maurício de Carvalho (FCUP), Pedro P. Avelino (FCUP), Daniel F. M. Folha (ISCS-Norte), 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)
  - *25 Research Positions* (23.45 FTE): Vardan Zh. Adibekyan, Susana C. C. Barros, Diego Bossini, Jarle Brinchmann, Tiago J. L. C. E. Campante, Margarida S. Cunha, António C. da Silva (FCUL), Morgan Deal, Elisa Delgado Mena, Olivier D. S. Demangeon, João P. S. Faria, Pedro Figueira (ESO), Charlotte Gehan, Jean Michel Gomes, João N. T. Gomes da Silva, Andrew J. Humphrey, M. S. Nanda Kumar, Patricio Lagos, Carlos J. A. P. Martins, Jorge H. C. Martins, Ivan Rybak, Tom C. Scott, Lara G. Sousa, Sérgio A. G. Sousa, Hugo M. Tabernero Guzmán
  - *1 Postdoctoral Researcher* (1.0 FTE): Pedro M. Palmeirim

- **22 PhD students**
  - Babatunde Akinsanmi, Alexandros Antoniadis Karnavas, Rui P. L. Azevedo, Thibault Boulet, João D. R. Camacho, Abhishek Chougule, Miguel Clara, José Ricardo Correia, Eduardo Cristo, Tomás de Azevedo Silva, Vasco M. C. Ferreira, David Grüber, Saeed Hojjatpanah, Ana C. O. Leite, Nuno A. M. Moedas, Sandy G. Morais, L. Filipe Pereira, José Rodrigues, Nuno M. Rosário, André Miguel A. C. V. Silva, Bachar Wehbe, Paulina M. Zaworska

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

- **8 Supporting staff** (6,6 FTE)
  - Carlos A. G. Gonçalves, Mariana P. Júlio, L. Marlene R. da Cruz, Manuel A. S. Monteiro, Argentina M. T. Pereira, 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.

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

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

The major changes in the team (researchers with a PhD) during 2020 were:

Ricardo Caldeira Costa	-	ended his grant in April
Iris P. Breda	-	ended her grant in June
Doris Arzoumaniam	-	ended her grant in July
Ilídio André P. M. Costa	-	joined the team in September

UnI – Research Unit

Research in CAUP is structured according to the organization of the research unit *Instituto de Astrofisica e Ciências do Espaço*, into four thematic lines (TLs). Each of these groups focuses on a few well defined and strategic thematic lines. In the interest of saving space, the presentation here does not aim to distinguish between efforts in the groups and the thematic lines.

Report from the Thematic Line - Towards the detection and characterisation of other Earths

In 2020, Planetary System research at IA continued the activities around the two major branches, namely Exoplanet research and Solar System atmospheres.

Exoplanet research focused on multiple complementary aspects, mostly observationally driven: 1) the search and characterization of exoplanets using state-of-the-art radial velocity data, including the detection and mass measurement of planets previously detected by the transit method (e.g. with missions such as TESS); 2) the study of astrophysical sources of noise for the detection and characterization of planets as well as methods to correct/model them; 3) the study of planet-host stars as a way to characterize planets as well as their properties and formation processes; 4) the statistical study of planet characteristics as well as the relation with the properties of the host stars; 5) the study of exoplanet atmospheres using broad-band photometry and high-resolution spectroscopy.

Our team is a major participant/player (e.g. Co-PIship and Board membership) in current (e.g. ESPRESSO@VLT and SPIROU@CFHT) and future (NIRPS@ ESO's 3.6m and HIRES@ESO's ELT) state-of-the-art ground based facilities, as well as space missions (CHEOPS, ESA - launched December 2019; Plato, ESA, 2026; ARIEL, ESA, 2028). For all of those, we are responsible for scientific tasks as well as part of the data reduction/analysis pipelines. This is complemented by other hardware (HW) and software (SW) participations responsibility of the Instrumentation team in IA. As such, the strategy of the team is develop taking advantage of our privileged position to make use of the data from these facilities.

in 2020 we can highlight the strong effort done by the team in the analysis of data from the ESPRESSO spectrograph (Guaranteed Time Observations). The IA team has a strong contribution to all three working-groups of the ESPRESSO consortium: blind radial velocity search for planets in the habitable zone of solar type stars, transit follow-up to derive masses for rocky planets, and study of exoplanet atmospheres using high resolution spectroscopy. Several papers led by IA researchers have been published and others are in preparation.

Also of relevance was the analysis of the first data obtained by the CHEOPS mission. The scientific acquisition and analysis of CHEOPS data started in March 2020, and several team members have been very active in preparing and analysing the scientific observations (including leading roles in some working groups within the CHEOPS Science Team). The team was therefore involved in all the papers published by the CHEOPS consortium, and in 2021 we expect to have several results led by IA-team members.

ESPRESSO and CHEOPS will be major references for the team in the next 2-4 years, since our leading participation in these projects allows us to be in a privileged position inside the respective consortia to exploit the valuable data obtained in the 273 guaranteed nights of observations (GTO) with ESPRESSO at the VLT (until 2022) and the 80% of the time of the CHEOPS ESA mission (until 2024). To this we should add the 725 nights of GTO for the NIRPS consortium (first light expected in late 2021). Our participation in these projects will reinforce the existing strategy and allow the team to be in the forefront of exoplanet detection and characterization. Further ahead, our secured participation in the ESA-PLATO, ESA-ARIEL, and ESO-HIRES (ELT) projects guarantee our international leadership role beyond 2026.

On the Solar System side, research mainly focused on solar-system planet atmospheres, with clear synergies with the exoplanet side. The recent adoption by ESA of the space mission ARIEL, with a relevant IA participation, shows that the adopted strategy was correct.

Furthermore, the team continued different studies of the atmospheres of Venus, Mars, Saturn, and Jupiter. We can highlight here the use of space-based observations (from the missions Akatsuki for Venus, and from Cassini for Jupiter and Saturn) to perform dynamical studies based on cloud tracking techniques (UV and IR) and for the detection and characterization of atmospheric waves. Also of relevance was the use of sophisticated 3D models to evaluate the strong impact of those waves on the atmospheric circulation of Mars and Venus. In addition, ground-based observations (VLT/UVES for Saturn, HARPSN/TNG and CFHT/ESPaDOnS for Venus) and their related high-resolution spectra provided wind velocities using our Doppler velocimetry method.

Scientific Highlights for 2020

In 2020, a total of 13 IA Press-releases were published announcing scientific or science-related results with a leading or major participation of the team. Most of them were done in an international context. The list of highlights below is based on some of these.

From the nearest planetary system to the atmospheres of distant giants: the first ESPRESSO results

Following a long effort to design and build the ESPRESSO spectrograph for the VLT, in 2020 the IA team saw the dawn of the first scientific results obtained by this revolutionary instrument. From the detection and characterization of very low mass planets to the study of exoplanet atmospheres in unique detail, 7 refereed papers in total were published by the team. These results are just a glimpse of what ESPRESSO still has to offer.

The first ESPRESSO result (published in Nature) revealed an extreme planet where iron is raining (Ehrenreich et al. 2020). The ultra-hot giant exoplanet WASP-76b has a day side where temperatures climb above 2400 degrees Celsius, high enough to vaporise metals. Strong winds carry iron vapour to the cooler night side where it condenses into iron droplets. Using the transmission spectroscopy technique, the observations show that iron vapour is abundant in the atmosphere of the hot day side of WASP-76b. A fraction of this iron is injected into the night side owing to the planet's rotation and atmospheric winds. There, the iron encounters much cooler environments, condenses and rains down. This result had a strong contribution from our team.

Among other results, in a separate study, IA researchers also led the detection of the broad band spectrum of another exoplanet, HD209458b (Santos et al. 2020). The results show hints of absorbers such as TiO and Na, confirming previous results obtained using the Hubble Space Telescope. Evidence for atmospheric variability was also discussed.

ESPRESSO data was also used to measure the mass of several transiting planets detected by space missions such as TESS. Also, data was used to confirm and refine the mass of the planet orbiting the closest star to our Sun: Proxima Centauri (Suarez-Mascareno, Faria, et al. 2020). Detected about 4 years ago using the radial-velocity method, the so called "Proxima b" was suspected to have a mass similar to that of the Earth and orbiting at a distance from its how star that was close to the habitable zone of the system. However, given that the detection was at the limit of previous instrumentation capacity, an independent confirmation was mandatory. Now, using ESPRESSO, the planet signal was detected without any ambiguity. Furthermore, the exquisite precision of the ESPRESSO data allowed to take into account the noise introduced by stellar activity. Altogether, the analysis allowed to confirm that the planet exist, and to measure its mass with unprecedented precision.

Figure 5: This illustration shows a night-side view of the exoplanet WASP-76b. The ultra-hot giant exoplanet has a day side where temperatures climb above 2400 degrees Celsius, high enough to vaporise metals. Strong winds carry iron vapour to the cooler night side where it condenses into iron droplets. To the left of the image, we see the evening border of the exoplanet, where it transitions from day to night. Credit: ESO/M. Kornmesser.

CHEOPS satellite opens its eye

Like for ESPRESSO, the CHEOPS mission also published its first science results in 2020. Launched in December 2019, the early months of 2020 were spent in commissioning studies. In the end of January the first image was obtained, and in March the science program started with a strong participation of our team in different working groups (including at leadership level). Furthermore, our team kept its very relevant activities related with the data reduction pipeline, a fundamental piece to the success of the mission.

One of the first observations of CHEOPS was of the transit and occultation of the planet WASP-189b, gas giant more than 1.5 times the size of Jupiter (Lendl et al. 2020). It is about 20 times closer to its host star than the Earth to the Sun. WASP-189 b is one of the hottest exoplanets known: CHEOPS occultation data suggest its temperature to be approximately 3200 degrees Celsius. The host star itself is a massive blue star 322 light years away from Earth, and it is wider at its equator than at its poles as it is spinning so fast that it is pulled outwards around its equator. This leads to "strange" photometric transit shapes, whose details can only be seen with the very precise CHEOPS data.

The new and high-precision CHEOPS observations enable a substantial revision of the planetary parameters, as well as the geometry of the planet's orbit: by combining updated parameters of the star with the transit data, scientists have found that the planet is 15% larger than previously thought, and so less dense; they have also revealed that the planet's orbit is tilted away from the stellar equator, with the planet passing over the star's poles as it circles the star.

Several other papers are now being prepared from CHEOPS observations, including with leadership of IA researchers.

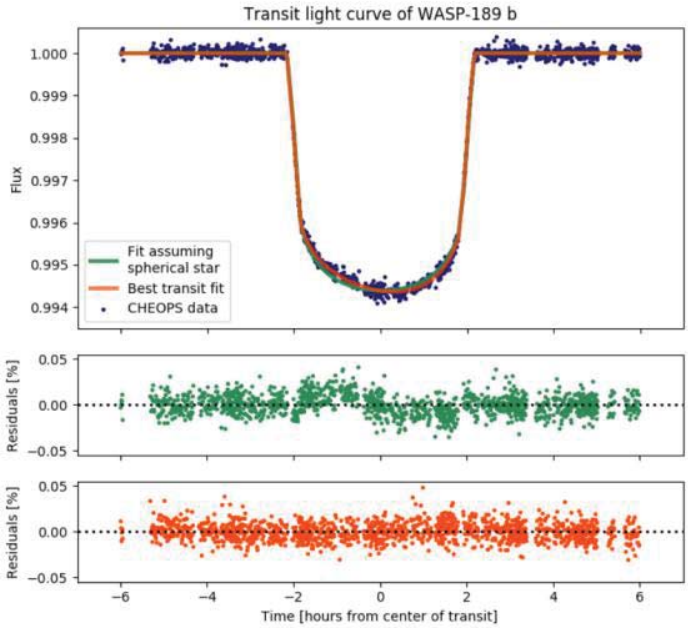


Figure 6: Transit of WASP-189 as observed by CHEOPS. Two different fits were done to the data: using a spherical star model and taking into account a more realistic model taking into account the effects of stellar rotation. From Lendl et al. 2020.

A cotton candy planet, or the first exoplanetary ring?

The detection of a growing population of exoplanets does not stop surprizing astronomers. One of the recent examples is the planetary system orbiting the bright solar-type star HIP41378. The system is comprised of at least 5 planets with masses that go from about 4 times the mass of the Earth, up to about the mass of Neptune. More importantly, the outer planet in this system (planet "f", with an orbital period of 542 days) was found to have a radius (throught transit photometry) similar to the one of Saturn, but its mass, as measured using radial velocities, is lower that of Neptune. This makes this planet the lowest density planet ever detected.

There is actually no simple explanation for the formation of such a low-density planet. Can such a "cotton candy" world be formed by the traditional planet formation models? Or is there another explanation for the observed low-density? To understand this, an international team led by IA's PhD student Babatunde Akinsanmi explored different explanations for the observed density. Using an in-house developed code to model the system, the results have shown that the observations can be easily explained if HIP41378f is actually a normal Neptune-like planet with a large system of rings similar in shape to the ones we see in Saturn. Absorbing ring particles can explain why the measured radius is equivalent to the one of a Saturn-like world while its mass is "small" and compatible with the one of Neptune.

Rings are ubiquitous in solar system giant planets, but they have never been unambiguously detected in an exoplanet. While other explanations are not discarded, the results that were obtained by the team show that this planet is the best exoplanet candidate so far for the presence of rings.

ARIEL mission adopted by ESA: into the strategy of IA

Ariel, the Atmospheric Remote-sensing Infrared Exoplanet Large-survey, was recently selected as the fourth medium-class mission in ESA's Cosmic Vision programme. During its 4-year mission, Ariel will study what exoplanets are made of, how they formed and how they evolve, by surveying a diverse sample of about 1000 extrasolar planets, simultaneously in visible and infrared wavelengths. It is the first mission dedicated to measuring the chemical composition and thermal structures of the atmospheres of hundreds of transiting exoplanets, enabling planetary science far beyond the boundaries of the Solar System.

The Portuguese participation in the Ariel is highly based in IA's contribution. In particular, the participation in several scientific work packages of the ARIEL space mission is secured by IA's researchers. Besides the scientific activities the role of IA is also in the focus of funding procurement and related projects applications (namely Prodex) and coordination with our industry and instrumentation partners regarding the ARIEL's Telescope Baffle construction in Portugal, the Payload (namely in the Optical Ground Support Equipment - OGSE) by IA's instrumentation group.

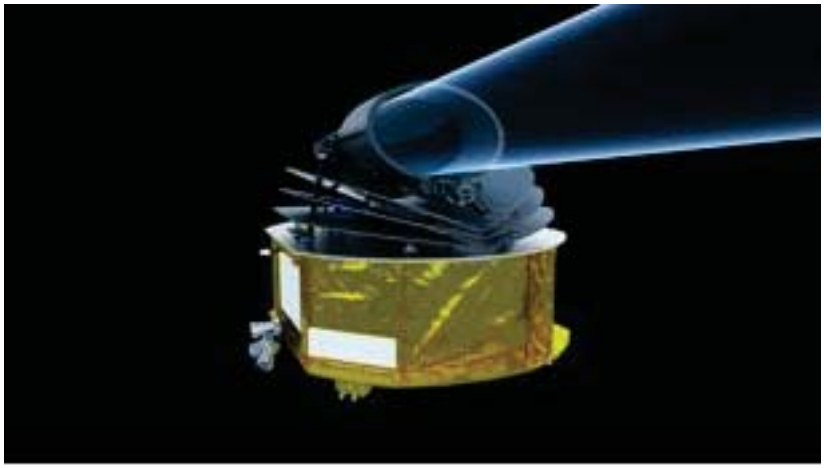


Figure 7: Artist's impression of Ariel. Image Credit: ESA/STFC RAL Space/UCL/UK Space Agency/ ATG Medialab

An overview about the plan of activities concerning the strong IA's participation in this mission involves the several Science Working Groups (WG) that the Portuguese consortium is leading (or co-leading), which comprises the synergy between the study of the atmospheres of the planets in the Solar System and the exoplanets. IA is also involved in other objectives such as support calculations of the radial velocities of the exoplanets or the connection between the exoplanets and their parent star.

Together with ESA'S CHEOPS and PLATO, as well as ground based instrumentation for ESO such as ESPRESSO, NIRPS, and HIRES@ELT, ARIEL completes the instrumentation set related with planetary system's research that support the long term strategic science plan of IA.

Thematic line meetings, Journal Clubs and other activities

In 2020, as for the previous years, the IA-planet line maintained a regular journal club and team meeting agenda. Team meetings and journal clubs are organized every two weeks. Meetings include a presentation of "general information", as well as a short presentation of the work being carried out by one PhD student, followed by discussion. This format helps the whole team to be acquainted about the research that is being carried out and helps the students to develop presentation skills and identify potential problems and solutions in his/her research project. Journal clubs include the presentation of one paper, followed by discussions. A journal club more specific about solar system research is also organised.

Due to the covid-19 situation, since March 2020 all regular team meetings and journal clubs were done via Zoom. The regular contact helped to minimize the impact of the confinements and decreased human contact in the team's activities.

We also organised our annual team meeting (called "2-DEMOC", this time using Zoom, where the team strategy and plans (both scientific and organisational) were discussed.

Team members actively participated in different public outreach activities, including "IAstro Junior" (co-organized with the magazine Visão), as well as with public talks and debates in schools and other outreach events.

In 2020, 3 PhD thesis were successfully finished:

- "Atmospheric correction for high resolution near infrared spectroscopy" by Solene Ulmer-Moll,
- "From ESPRESSO to Plato: detecting and characterizing Earthlike planets in the presence of stellar noise", by Luisa Maria Serrano, and

- "Towards a comprehensive understanding of tiny stars in the near-infrared domain -Determining stellar parameters of FGK and M dwarfs from their APOGEE spectra using the spectral synthesis method" by Pedro Sarmento.

Three undergraduate students (Francisco Pimenta, Mafalda Matos, and Ana Barboza) did short research work/internships with team members.
Team funding comes mostly from IA "strategic funding" as well as from 3 FCT projects. Furthermore, funding for our participation in the PLATO mission was secured through PRODEX. We also guaranteed the continuation of this funding for the period 2020-2022, as well as a similar funding package for the ARIEL mission. We note, however, the PRODEX funding covers only the "project level activities".
In 2020, the team was organizing a large international conference on exoplanets ("Towards other Earths III: from Solar System to Exoplanets"). Unfortunately, the conference had to be cancelled due to the pandemic crisis.

Nuno Santos
Thematic Line Leader

Report from the Thematic Line - Towards a comprehensive study of stars

The main goal of this thematic line is to understand the details of the structure and evolution of stars of low and intermediate masses, from the early stages of star formation to late stages of evolution. It also covers the study of rotation and activity both in Young Stellar Objects (YSOs) and in main-sequence stars, as well as to the modeling of star-disk interactions in the former.

In 2020, the team continued the extensive exploitation of asteroseismic data from the NASA satellite TESS (launched in 2018), in relation to which the team leads one of the working groups established by the Tess Asteroseismic Science Consortium (TASC). Following the adoption by ESA (in 2017) of the mission PLATO, the team is actively participating in the implementation of the work in the stellar part of the mission. In particular the team is leading work packages on seismic diagnostics and calculation of stellar models for the pipeline, a working group on spectroscopic characterization of the PLATO targets, a working package on the scientific validation of the PLATO as well as participates in several others. The team is also involved (leading some sub-WGs) in the preparation of the ARIEL/ESA (2028) mission through stellar characterization with asteroseismology and determination of atmospheric stellar parameters and chemical abundances. The team also continued its participation to the Gaia- ESO survey by providing stellar parameters and chemical abundances for the final data release of the survey.

On the star formation side, the team is involved in the ongoing JCMT projects, the ESO-VISTA VVVx survey, and also intensively uses the ALMA and Herschel high-quality data. The team members are also involved in the upcoming JWST (James Webb Space Telescope, scheduled march 2021). Additionally, the team is involved in SPIRou consortium work packages focusing on the study of accretion and outflow processes in the T Tauri stars. All these efforts are aimed at understanding the complete picture of star formation by connecting the smaller scale of individual cores/YSOs (for the whole spectrum of mass low- and high-mass) to the large galactic scale of the ISM.

Scientific Highlights for 2020

Unifying low- and high-mass star formation

Star formation takes place in giant molecular clouds, resulting in mass-segregated young stellar clusters composed of Sun-like stars, brown dwarfs, and massive O-type (50-100 $M_{\odot}$) stars. In 2020, the team continued its efforts in understanding the role of molecular filaments and hub-filament systems in the formation of stars of different masses.

The team (Kumar et al.) applied the DisPerSE algorithm on the Herschel data to detect filamentary skeletons. Then a hub was defined as a junction of three or more filaments. Based on their results, it was concluded that all high-

mass stars preferentially form in the density-enhanced hubs of hub-filament systems. Then, a "filaments to clusters" unified paradigm for star formation was proposed, with the following salient features: (a) low-intermediate-mass stars form slowly (10^6 yr) in the filaments and massive stars form quickly (10^5 yr) in the hub, (b) the initial mass function is the sum of stars continuously created in the hub-filament systems with all massive stars formed in the hub, (c) feedback dissipation and mass segregation arise naturally due to hub-filament systems properties, and explain the (d) age spreads within bound clusters and the formation of isolated OB associations.

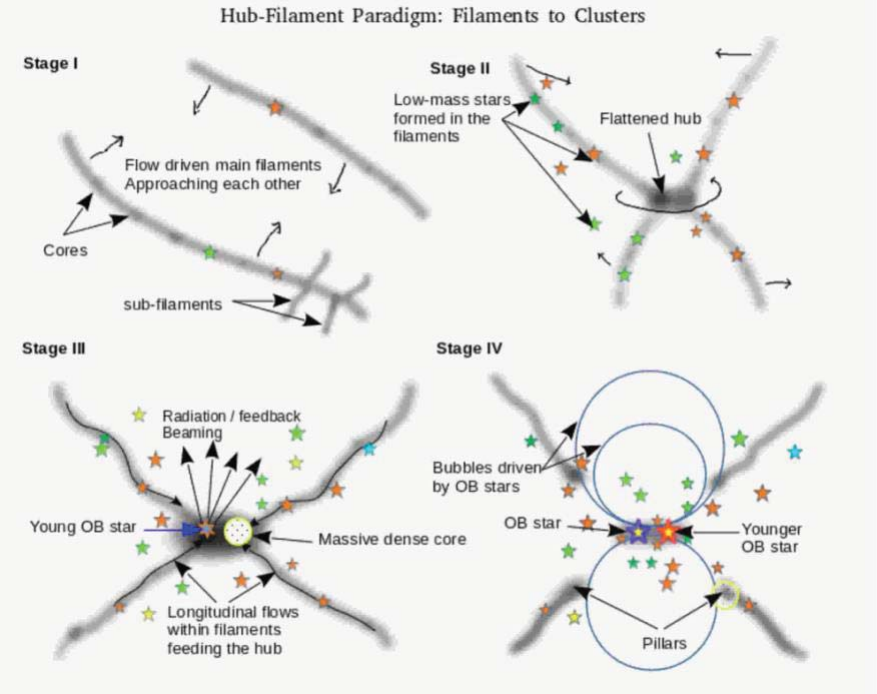


Figure 8: Schematic illustration of the filaments-to-clusters paradigm for star formation. Kumar et al. 2020, A&A, 642, A87.

Stellar pulsators in the presence of stochastic noise

As in the previous years, studying and understanding the pulsations in stars at different evolutionary stages is one of the main focuses of the team. In this context, in 2020 the team (Cunha et al) addressed a long-standing question concerning the driving of pulsations in Asymptotic Giant Branch stars. The authors proposed a new model that provides a unifying description for the driving of low-mass star pulsations throughout stellar evolution, all the way from the main sequence to the Asymptotic Giant Branch. According to the model, in the most general case the driving incorporates two sources, a stochastic and a coherent one. The model predictions concerning pulsation amplitude and phase variability, power spectrum properties, amplitude scaling with pulsation period, and mode life time scaling with effective temperature, are all consistent with evidence provided by the analyses of space-based and ground-based data.

Stellar parameters of FGK and M stars

One of the main interest and internationally recognized expertise of the team is the spectroscopic characterization of cool stars. In 2020, the team led and contributed to several articles which aimed at improving our ability to determine precise stellar parameters of FGK and M-type stars. Of these articles, two led by the IA students can be highlighted: a machine learning tool to derive effective temperature and metallicity for M dwarf stars (Antoniadis-Karnavas et al.) and Derivation of parameters for 3748 FGK stars using H-band spectra from APOGEE Data Release 14 (Sarmento et al. 2020).

In Antoniadis-Karnavas et al. (2020) an automatic computational tool was developed which can quickly and reliably derive the effective temperature and metallicity of M dwarfs using optical spectra obtained by different spectrographs with different resolutions. Development of this tool - ODUSSEAS (Observing Dwarfs Using Stellar Spectroscopic Energy-Absorption Shapes) - was very important since the derivation of spectroscopic parameters for M dwarf stars is a very difficult task, but is very important in the fields of stellar and exoplanet characterization.

In Sarmento et al. (2020) an alternative method to the standard APOGEE pipeline (APOGEE Stellar Parameter and Chemical Abundances Pipeline, ASPCAP) was developed to derive parameters in the near-infrared for FGK dwarfs. With this method, spectroscopic parameters for a sample of 3748 main-sequence and subgiant FGK stars have been derived from the APOGEE H-band spectra. A good agreement, within the expected uncertainties, was found when comparing these parameters with the ones obtained with ASPCAP for the same stellar spectrum. The most promising next step is to move towards colder stars and derive parameters for M dwarfs. Another paper exploring stars in this parameter space is currently in preparation.

Chemical mixing in low mass stars.

Studying and characterizing the interiors of stars with asteroseismology is one of the hottest research fields of stellar physics, and one of the main focuses of the team.

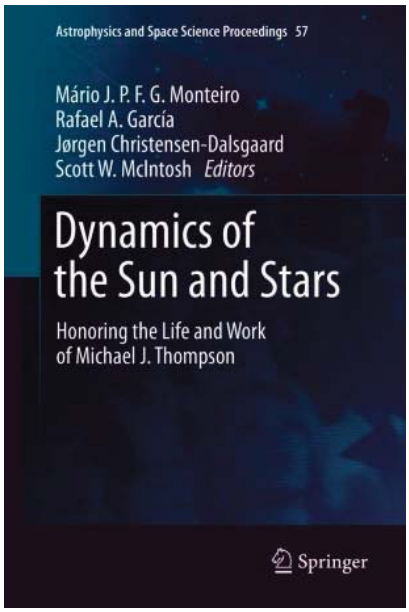
The team (Deal et al.) led a study aimed at quantifying the opposite or conjugated effects of atomic diffusion (including radiative acceleration) and rotationally induced mixing in stellar models of low mass stars, and to assess whether rotational mixing is able to prevent the strong abundance variations induced by atomic diffusion in F-type stars. The goal of the work was to estimate the impact of neglecting (which is very often done in the literature) both rotational mixing and atomic diffusion in stellar parameter inferences for stars with masses higher than 1.3 $M_{\odot}$.

The results showed that for masses lower than 1.3 $M_{\odot}$, rotation dominates the transport of chemical elements and strongly reduces the effect of atomic diffusion, with net surface abundance modifications similar to solar values. At higher mass, atomic diffusion and rotation are competing equally. Above 1.44 $M_{\odot}$, atomic diffusion dominates in stellar models with initial rotation lower than 80 km s^{-1} producing a chemical peculiarity which is not observed in Kepler Legacy stars.

The general conclusion of the work is that atomic diffusion and rotational mixing should be taken into account in stellar models in order to determine accurate stellar parameters. When atomic diffusion and shellular rotation are both included, they enable stellar evolution codes to reproduce the observed metal and helium surface abundances for stars with masses up to 1.4 $M_{\odot}$ at solar metallicity. However, if rotation is actually uniform for these stars (as observations seem to indicate), then an additional chemical mixing process is needed together with a revised formulation of rotational mixing. For higher masses, an additional mixing process is needed in any case.

Dynamics of the Sun and Stars

The team edited a volume published by Springer in 2020. The volume is a collection of 47 original articles resulting from the contributions presented at the conference on "DYNAMICS OF THE SUN AND STARS: HONOURING THE LIFE AND WORK OF MICHAEL J. THOMPSON". The conference was focussed on dynamical aspects of the Sun and stars, based on the large amount of data available on solar and stellar oscillations, and the extensive and detailed modelling that is becoming feasible. Several of these articles are authored or co-authored by the members of the team. The book can be accessed at https://www.springer.com/gp/book/9783030553357



Thematic line meetings, Journal Clubs and other activities

Complementary to the many publications produced, the team also participated in several international conferences where the results of the project have been presented and discussed. We maintained an active participation in the large projects of ESA and ESO (also NASA's TESS mission) related to the Thematic Line selected as the backbone of IA under its strategic plan.

The team includes several PhD and MSc students working on topics related to the main goals of the thematic line. During 2020 one MSc student (Gaëtan Devillers - University of Strasbourg/Engineering School Télécom Physique) and five PhD students (Benard Nsamba, Raquel Albuquerque, Pedro Sarmento (also linked to the planets TL), Guilherme Teixeira, and Ilidio Costa (also linked to the science communication group) - U.P.), successfully finished their thesis in the team.

In 2020 the team continued the organization of regular (bi-weekly) journal clubs on topics related to the research interests and the monthly team meetings. In addition, regular bi-weekly meetings have been organized focused on 'stellar physics' where all the team members were invited to participate and contribute. Participation in outreach activities covering topics on stars is also frequent, including several talks and manuscripts in the National Geographic Portugal that cover topics related to this thematic line.

Vardan Adibekyan
Thematic Line Leader

Report from the Thematic Line - The assembly history of galaxies resolved in space and time

The adverse conditions created by the COVID19 pandemic have led to significant challenges for the Thematic Line (TL) and greatly impacted its scientific work during 2020. Notwithstanding this fact, the TL has continued the implementation of its strategic plan, intensifying its efforts toward the exploration of the formation history of galaxies and their structural components, of the genesis and growth of super-massive black holes (SMBHs) in galactic nuclei and their influence on the assembly history of galaxies, the mechanisms triggering and regulating starburst activity and its role on the galaxy stellar mass growth, and the influence of the environment on galaxy evolution.

These science goals which are being pursued by a team of 14 researchers, 7 collaborators and 6 PhD students, are served by the participation of IA with leadership roles in the instrument consortia of MOONS@VLT and MOSAIC@ELT of ESO, and ESA missions with key relevance to the strategy of the TL (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 TL 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 that recently permitted team members 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 TL is developing new observational discriminators for the detection of proto-AGN at the Epoch of Reionization (EoR). It also acts as a strong driver in the development of the future ASKAP's Evolutionary Map of the Universe survey, through the IA-lead Key Science Project "Radio AGN in the EoR" and is represented at the Board and Science team level in ESA's future X-ray mission, Athena.

At low and intermediate redshift (z), the AGN phenomenon is being studied using the currently most powerful telescopes and instruments, most notably the Multi Unit Spectroscopic Explorer (MUSE) at ESO-VLT. Special emphasis is being laid on the study of quasars surrounded by gigantic Lyman-α halos and the definition of new diagnostics for constraining the physical conditions and excitation mechanisms in the nebular component of these extreme environments. This line of research is further supported by a comparative analysis of gas kinematics and excitation properties obtained from integral field spectroscopy (IFS) with predictions from cosmological simulations incorporating AGN feedback, and through the ongoing further development of IA's spectral synthesis code FADO with the capability of self-consistently modeling stellar and nebular emission jointly with an AGN power-law component. FADO, together with other tools developed at IA, 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 observations in 2022.
During 2020, 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 field of the activities of the TL centers on spatially resolved investigations of galaxies with IFS and deep multi-band photometry. Using MUSE and the CALIFA and MaNGA IFS galaxy surveys, team members are investigating a wide range of fundamental issues in extragalactic research, including the build-up history of galaxy bulges and the physical drivers of their inside-out star formation quenching, age and metallicity patterns in spiral and elliptical galaxies, cooling flows and ram pressure stripping effects in galaxy clusters, gas kinematics and excitation mechanisms in elliptical galaxies, the evolution of the ionizing photon efficiency across cosmic time, massive Wolf-Rayet stars and the diffuse ionized gas in star-forming galaxies, and the nature of ultra-faint galaxies. Furthermore, using ALMA, MUSE and FADO the team is also studying the action of starbursts on the molecular gas phase in extremely metal-poor dwarf galaxies, which may be considered the best local analogs of the first proto-galactic units that emerged at the EoR. The activities of the team also encompass detailed photometric decomposition studies and the recent development of a conceptually novel tool for the robust structural characterization of galaxies via the Sérsic law. The latter publicly available tool has significant potential for an automated application to the Euclid Galaxy Legacy Survey, which is co-led by IA.

The team's expertise in current state-of-the-art telescopes and instruments is well worth stressing. Not only the team is nuclear to the activities of the Portuguese ALMA Centre of Expertise (PACE), providing manpower and expertise to support the national use of the facility and helping ESO validating its data, but during 2020 the team has shown a remarkable level of proficiency in the use of one of the most revolutionary and complex optical spectrographs currently in operation — MUSE — as detailed below.

Scientific Highlights for 2020

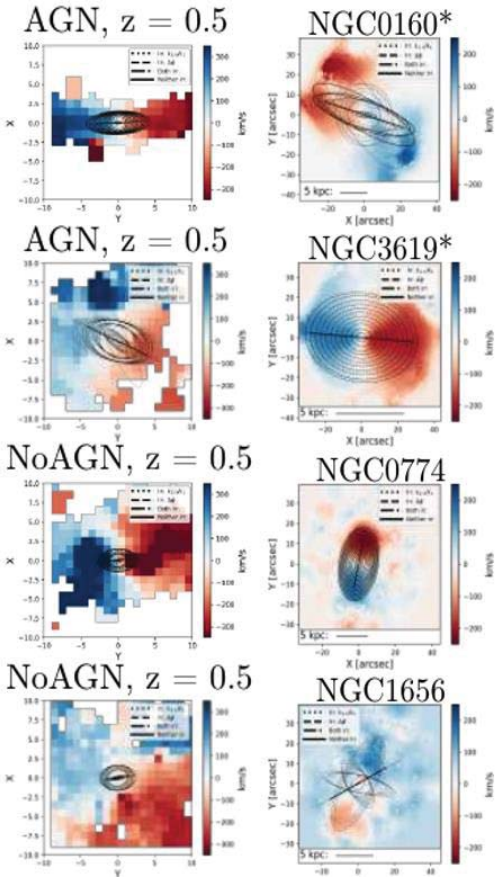


Figure 9: From Florian et al (2020) – see text for details

Towards a better understanding of the regulatory role of AGN on galaxy evolution

The TL has participated in a study (Florian, Ziegler, Hirschmann, Papaderos … Gomes et al. 2020, A&A 635, A41) that examined the difference between observed gas velocity fields in massive early-type galaxies (ETGs) with those predicted by cosmological SPHgal simulations (figure on the left, r.h.s and l.h.s., respectively) for galaxies with and without an AGN. The primary goal of this project was to infer the visibility timescale and nature of kinematical perturbations in the gas being induced by an AGN. This analysis included an extended sample of 123 ETGs from the CALIFA survey that was processed with the IA-developed IFS modeling interface Porto3D. This study finds that even if the general disturbance of the gas is not a unique indicator for AGN feedback, certain kinematical irregularity parameters documented both in observations and simulations can only be reproduced through AGN feedback. Specifically, an elevated value for the deviation from simple ordered motion is a strong sign for previous episodes of AGN activity and feedback.

Silva, Humphrey, Lagos & Morais (2020, MNRAS 495, 4707) studied UV emission-line ratios of 145 type II quasars (QSO2s) from SDSS, and compared them against a grid of AGN photoionization models with a relevant range in gas density, gas chemical abundances, and ionization parameter. Most of the quasars were found to be 'carbon-loud', with C IV/He II ratios that are unusually high for the narrow-line region,

implying higher than expected gas density (>106 cm−3) and/or significantly supersolar-relative carbon abundance.

Stellar age gradients in bulges

Breda et al. (2020a; A&A 635, 177) used spatially resolved IFS data and spectral synthesis models to study for the first time systematically and on the basis of a representative sample of 135 galaxies stellar age gradients in the bulge component of spiral galaxies. They found that an inversion of positive to negative age gradients occurs at $\log(M^*/M_\odot) \sim 10$, which roughly coincides with the transition from lower-mass bulges whose gas excitation is powered by star formation to bulges classified as Composite, LINER, or Seyfert. From age gradients they infer for massive bulges a low mean velocity of ~2 km/s for the inside-out star formation quenching process, which suggests that, on the statistical average, AGN evacuate the bulge from gas and shut off star formation on a timescale of ~2 Gyr. This in turn suggests that negative AGN driven feedback is highly directional and places new observational constraints to models.

Development and applications of spectral modeling tools

In preparation for a detailed exploration of the galaxy assembly history with MOONS@VLT, BlueMUSE@VLT, MOSAIC@ELT and NIRSpec@JWST our team has further refined spectral modeling tools that it has developed over the past few years and deepened its expertise in the processing and interpretation of multi-wavelength data.

In parallel to the ongoing development of an upgraded version of the spectral synthesis code FADO (Gomes & Papaderos 2017) with the capability of self-consistently fitting Seyfert 2 galaxy spectra, the TL has continued spectral modeling studies of synthetic and observed spectra for star-forming galaxies in order to quantitatively address the ability of FADO and other widely used codes of retrieving key physical and evolutionary properties of galaxies. An analysis of the dependence of the fitting result on the signal-to-noise ratio (SNR) by Pappalardo et al. (A&A, submitted; see figure below, left) has demonstrated that FADO can retrieve the mass- and light-weighted age and metallicity of galaxies even down to a SNR~10. This line of activities has been supplemented by a study of the dependence of the spectral synthesis output on the spectral coverage of the input data. To this end, Breda et al. (2021, in prep.) have compared the output from different codes (FADO, STARLIGHT, STECKMAP) for a selected sample of star-forming and passive galaxies with available single-fiber SDSS spectra and IFS data from CALIFA, MaNGA and MUSE.

The team has continued the processing of the entire SDSS DR7 (about one million galaxies) with FADO, with several publications by TL members and collaborators being in preparation. These will focus on the origin and timescales of star formation quenching, the difference between the stellar and gas-phase extinction, and the nature of the star formation main sequence.

A new spectral fitting concept allowing for consistent modeling of Wolf-Rayet features and the Paschen discontinuity was presented in Gunawardhana, Brinchmann et al. (2020; see figure below, upper panel). Additionally, spectral modeling concepts were used to investigate the role of star formation on the UV properties of MUSE-detected Lyα emitters (LAEs) in the Hubble Deep Field Survey at $2.9<z<4.6$ (Feltre … Brinchmann et al. (2020, A&A 641, 11). Moreover, Nanayakkara, Brinchmann et al. (2020, ApJ 889, 180) and Maseda … Brinchmann et al. (2020, MNRAS 493, 5120) studied the ionizing photon production efficiency at higher redshift with, respectively, stellar population models and by contrasting the observed Hα and UV magnitude in a selected sample of 35 LAEs. In the course of this project, the spatially resolved properties of the Lyα halos were studied in detail with MUSE in Leclercq … Brinchmann et al. (2020, A&A 635, 82).

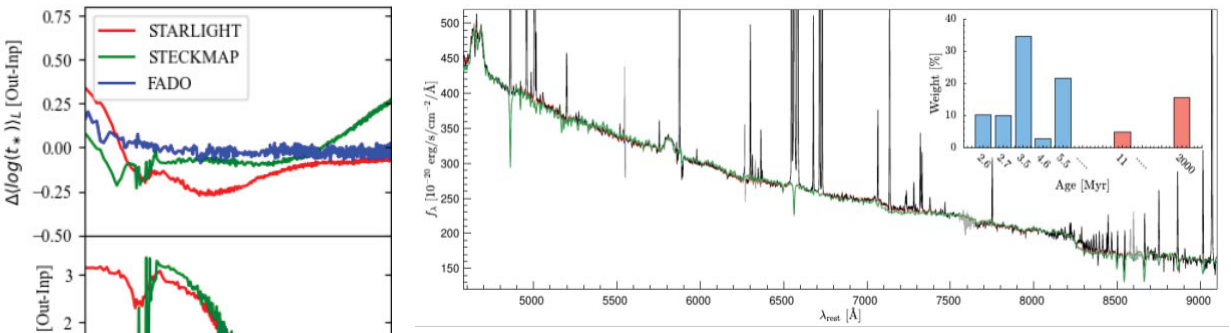


Figure 10: Left: Comparison between the purely stellar population spectral synthesis (PSS) codes STARLIGHT (red) and STECKMAP (green) with the conceptually novel IA-developed PSS code FADO (blue). The latter is the currently only publicly available PSS tool that takes both stellar and nebular emission into account and ensures consistency between the retrieved star formation history (SFH) and nebular characteristics of a galaxy. Logarithmic representation of the difference between the retrieved and input light- and mass-weighted stellar age (a&b) and metallicity (c&d) as a function of age for an input SFH model assuming continuous star formation at a constant rate. It is apparent that, whereas STARLIGHT and STECKMAP severely overestimate (underestimate) the age (metallicity) in early stages of galaxy evolution (<1 Gyr), FADO in all cases recovers the input age and metallicity within 0.15 dex (from Pappalardo et al. 2020, A&A submitted). Above: An example of the spectral modeling concept developed by Gunawardhana, Brinchmann et al. (2020, MNRAS 497, 3860) for the simultaneous modeling of Wolf-Rayet features together with the Paschen jump. This tool, combining STARBURST99 with CLOUDY was successfully applied to MUSE data for the Antennae galaxy.

The IA-developed IFS spectral modeling pipeline Porto3D was upgraded with the capability of modelling MUSE IFS data with FADO. This new version of the pipeline is being intensively applied to the exploration of the SFH of ALMA-observed metal-poor starburst galaxies and the inside-out growth of spiral galaxies from the MUSE Atlas of Disks (MAD) survey.

Structural and morphological characterization of galaxies

The TL has presented in dos Reis et al. (2020, A&A 634, 11) a detailed structural and colour analysis of 17 massive galaxies at z~0.5 using multi-band imaging data with the HST. Quite importantly, this project has for the first time investigated whether radial colour profiles implied by 2D bulge-disk decomposition with GALFIT are sensible from the evolutionary point of view. This was not found to be the case for about one half of the analysed galaxy sample, which points to a fundamental conceptual shortcoming of state-of-the-art 2D photometry tools. Overcoming this problem with new surface photometry concepts (e.g., the code presented by our team in Breda et al. 2019 for a robust determination of Sérsic model parameters) appears to be of paramount importance for a reliable automated structural analysis of large galaxy samples with, e.g., Euclid.

It should be noted that Galaxy Legacy Science with Euclid is at the core of the mid-term strategy of the TL, and preparatory work in this regard is being carried by several of its members. In particular, team members have developed and successfully tested advanced Machine Learning (ML) concepts that allow for the detection of quiescent/passive galaxies at 1.5<z<2 with Euclid & LSST at a rate that is twice as high as that of previous ML tools (Humphrey et al., in prep.).

A novel spectrophotometric bulge-disk decomposition method presented in Breda, Papaderos & Gomes (2020b; A&A 640, 20) was applied to IFS data for 135 galaxies from the CALIFA survey. The main finding from this study was that in 1/3 of local spiral galaxies the disk's radial stellar surface density shows a central flattening or down-bending inside the radius of the bulge. This theoretically predicted central depletion of galactic disks, now observationally demonstrated, has far-reaching implications for our understanding of the joint evolution of bulge and disk since the early epoch of galaxy formation, and potentially also for the slope of the bulge vs. SMBH mass relation.

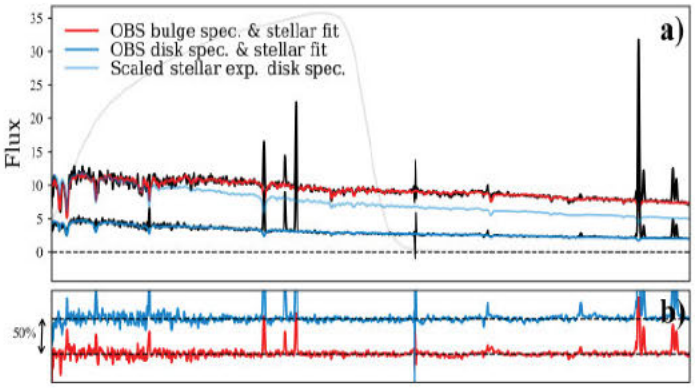


Figure 11: Illustration of the methodology devised by Breda et al. (2020b) for the extraction of the net spectrum of the bulge through subtraction of the scaled spectrum of the disk (light-blue) from the integrated spectrum within the radius of the bulge (red). The residuals between the observed and modeled spectrum for the bulge and disk are shown in the lower panel.

Dwarf Galaxies: the smallest galaxy building blocks

Extending a previous study in Zoutendijk, Brinchmann et al. (2020a; A&A 635, 107), our team has used stellar line-of-sight velocities obtained with MUSE for individual stars to constrain the dark matter density profile of the ultra-faint dwarf galaxy Eridanus 2. This project provided substantial evidence for a cuspy DM halo (Zoutendijk, Brinchmann et al., A&A submitted, arXiv:2101.00253).

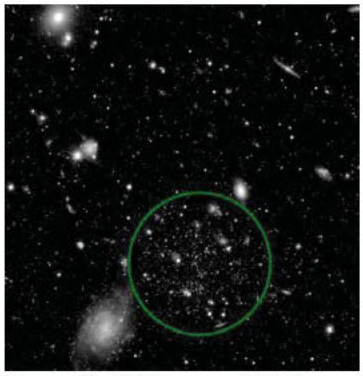


Figure 12: HST image of Eridanus 2 (from Zoutendijk et al. 2020a, A&A 635, 107).

Deep IFS data with MUSE were also used for a detailed study of the SFH, metallicity and stellar velocity dispersion σ in the dwarf galaxy Leo T (Vaz, Brinchmann et al. in prep). An intriguing discovery from this project is the presence of an old higher-σ and a young lower-σ stellar component matching, respectively, the kinematics of the cold and warm HI gas in the galaxy.

Since mid 2020, the team is using the upgraded version of the pipeline Porto3D to the study of several low-metallicity starburst dwarf galaxies observed both with MUSE and ALMA. Topics to be addressed in various publications in preparation include the connection between star formation- and CO surface density, and metallicity, extinction and gas kinematics patterns.

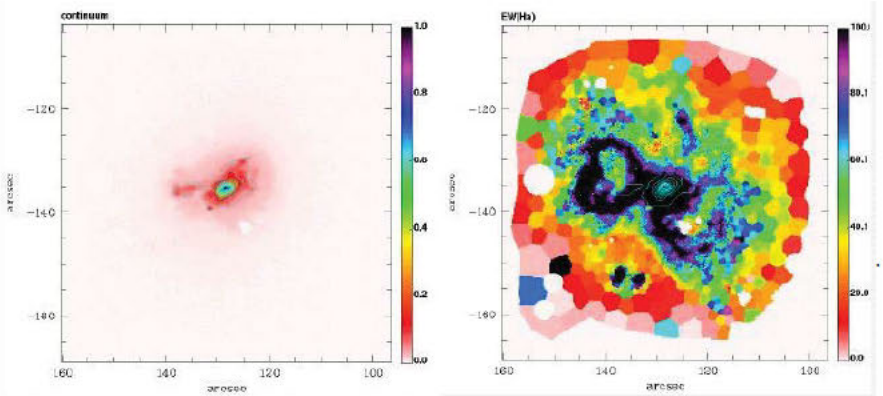


Figure 13: Example of the analysis with Porto3D of MUSE IFS data for the starburst dwarf galaxy He 2-10. left) stellar continuum, right) Hα equivalent width map, revealing a spectacular network of starburst-driven super-shells.

Thematic line meetings, Journal Clubs and other activities

The emergence of the COVID19 pandemic has forced the team to base almost its entire internal communication on video conferences and email, and resulted in various technical challenges related to the remote processing of large data sets being centrally stored at IA's servers. Despite these conditions, the team could largely maintain its productivity, further intensify internal synergy and establish new collaborations. Throughout 2020, the team maintained a busy schedule of weekly Briefings in which the team's scientific work is discussed. Additionally, regular weekly journal clubs were also continued, for the discussion of recent, mostly non-IA, scientific results.

It is also worth pointing out that team members actively participate in IA public outreach activities, not only providing frequent public talks on galaxies and the Universe, but also in major institutional initiatives such as IAstro Junior or Ignite IAstro.

Finally, during 2020, the team organized the three-day online workshop "Exploiting Archives for Radio Astronomy in the SKA-era" with 70 participants and co-organized the online national conference "30th Encontro Nacional de Astronomia e Astrofísica" with 152 participants.

Polychronis Papaderos (Lisbon)
Thematic Line Leader

Report from the Thematic Line - Unveiling the dynamics of the Universe

This report focuses on the Thematic Line (TL) scientific highlights activity throughout 2020, with ongoing projects, new projects, highlight contributions to the IA and the TL strategic plan and vision for 2021+. We focus essentially on the ESPRESSO, Euclid and LISA missions.

We emphasize that the ESPRESSO GTO (Guaranteed Time Observations) program was significantly affected by the COVID pandemic, since ESO observatories were closed for the entire Period 105 (1 April 2020 – 30 September 2020) and the early part of Period 106 ((1 October 2020 – 31 March 2021)). Nevertheless, preparatory work continued on data analysis pipelines, which are now ready and fully optimized for ESPRESSO fundamental physics data.

Relative to LISA, unfortunately, due to the coronavirus pandemic, several projects were temporarily put on hold due to a restructuring and redefining of the Consortium's internal rules. However, in 2020, the first official LISA paper (i.e., a publication carrying the official seal of the Cosmology WG) about cosmic strings was published, where an IA-Cosmology team member was a first-tier author (JCAP 04 (2020) 034). The publication is the culmination of more than two years of work within the LISA Cosmology WG and it studies in detail the capability of LISA to probe cosmic strings. Amongst other issues, the analysis has shown that the stochastic gravitational wave background is one of the more relevant cosmological backgrounds that LISA can probe, thus reinforcing the mission's interest in this area. Relative to the Working Group "Fundamental Physics" with LISA, a white paper (Gen.Rel.Grav. 52 (2020) 8, 81) was also published where the aim was to further delineate and sharpen the future potential of the LISA mission in the area of fundamental physics. Furthermore, several team members have also been actively contributing to the LISA Cosmology White Paper (to be published soon).

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 various science working groups (SWG), and in the Survey Design. The national participation in the mission is coordinated by members of IA's Cosmology TL. The activities of Survey Design, even though coordinated by members of the Cosmology TL, have a strong component of software development, and are reported in the Instrumentation and Systems TL section. In 2020, these activities led to the award of a STAR prize, as reported elsewhere. The participation in SWGs include members of both Cosmology and Galaxies TLs. Concerning the Cosmology TL, the participation in the various Euclid SWGs where team members have responsibilities continued as planned and was reinforced with active presence in additional work packages. A selection of these activities include: leadership of the high-order weak lensing statistics key project; participation in analyses of the impact of shear measurement biases in cosmological forecasts; leadership in the cosmic distance

duality standard paper (published), leadership in the forecasts of extended cosmological models standard paper (submitted), co-authorship in 10 Euclid papers (published in 2020) plus various others (to be published in 2021).

Scientific Highlights for 2020

The following scientific highlights provide an overview of our activity during the past year:

Leadership of Euclid Standard Project Paper:

"Euclid: Forecast constraints on the cosmic distance duality relation", Martinelli et al. Astronomy and Astrophysics, vol. 644, 2020 [doi:10.1051/0004-6361/202039078]
Several team members contributed to this paper, where it was shown that in metric theories of gravity with photon number conservation, the luminosity and angular diameter distances are related via the Etherington relation, also known as the distance duality relation (DDR). A violation of this relation would rule out the standard cosmological paradigm and point to the presence of new physics. The authors quantified the ability of Euclid, in combination with contemporary surveys, to improve the current constraints on deviations from the DDR in the redshift range $0 < z < 1.6$. It was found that for parametric methods Euclid can (in combination with external probes) improve current constraints by approximately a factor of six, while for non-parametric methods Euclid can improve current constraints by a factor of three.

Participation in Euclid Standard Project Paper:

"Euclid: Reconstruction of weak-lensing mass maps for non-Gaussianity studies", Pires et al , Astronomy & Astrophysics 638, 141, doi:10.1051/0004-6361/201936865

Within the context of full-sky weak-lensing surveys such as Euclid, convergence maps (mass maps) offer an important advantage over the more studied shear fields in terms of cosmological exploitation. While it carries the same information, the lensing signal is more compressed in the convergence maps than in the shear field, which simplifies otherwise computationally expensive analyses, such as the ones required for non-Gaussianity studies. The HOWLS project, co-led by a team member, aims at optimizing the cosmological non-Gaussian information that can be extracted from future Euclid lensing data, and for that it needs to rely on accurate mass maps. In preparation of that project, this study presents a new mass-inversion method that aims to reduce the information loss during the mass inversion process used in producing mass maps. This analysis shows that the errors introduced by the mass inversion on high-order moments are reduced by factors of up to 10, when compared to conventional methods.

Full analytical approximation to the stochastic gravitational wave background generated by cosmic string networks

Lara Sousa, Pedro P. Avelino, Guilherme S.F. Guedes, Phys.Rev.D 101 (2020) 10, 103508 (doi: 10.1103/PhysRevD.101.103508)

Team members derived a full analytical approximation to the stochastic gravitational wave background generated by the loops that are produced throughout the cosmological evolution of cosmic string networks. It was shown that this approximation not only predicts the amplitude of the radiation-era plateau exactly, but also provides a good fit to the high-frequency cutoff and to the low-frequency peak generated by the loops that decay during the matter era, irrespective of cosmic string tension and of the length of loops created. It was then found that it provides a good quantitative description of the full stochastic gravitational wave background across the relevant frequency range.

Thematic line meetings and journal clubs

The Thematic Line (TL) "Unveiling the Dynamics of the Universe" carried out journal clubs and seminars on a weekly basis, and TL meetings once every month. All the relevant information can be found in the following link: http://ia-cosmoclub.wikidot.com/

The themes discussed during the approximately 30 journal clubs (http://ia-cosmoclub.wikidot.com/previous-meetings-2020) ranged from theoretical aspects to observational topics. Approximately forty-five papers were discussed throughout 2020.

Francisco Lobo (Lisbon)
Thematic Line Leader

Report from the Thematic Line – Instrumentation and Systems

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

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

Due to the pandemic situation that affected everyone, 2020 was a very hard year for the Instrumentation and Systems Thematic Line (ISTL). If, on the one hand, several observatories were closed and several project related international activities were cancelled, on the other hand, new projects started and the pressure to keep the pace on the instrument design, assembly, integration and test was considerable.

During 2020, the following instruments had engineering and implementation activities at IA, all of which researchers at CAUP are involved in:

- For the European Southern Observatory (ESO): NIRPS, MOONS and HIRES
- For the European Space Agency (ESA): EUCLID, CHEOPS, PLATO, ARIEL and ATHENA.

Currently the ISTL 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.

The ISTL was composed of 18 people. 9 researchers (with PhD) 4 engineers and 5 PhD students. Some researchers are also part of the other two scientific thematic lines and PhD students are mainly focused on their thesis work, leading to a man power availability to the running project of about 10 FTE.

During 2020, the following and PhD Students terminated the participation in the instrumentation and systems thematic line at CAUP:

Solène C. Ulmer-Moll* (PhD student) concluded the PhD thesis, titled "Atmospheric Correction for High Resolution Near Infrared Spectroscopy", in 15/05/2020.

There were no arrivals in 2020, neither in terms of researchers nor PhD students. Therefore, the current composition of the Instrumentation and Systems Thematic Line is:

Researchers (PhDs)	**Others**
Alexandre Cabral	António Joaquim Marques de Oliveira
Elena Duarte	Inês Leite
Ismael Tereno*	**Manuel Monteiro**
João Dinis	Pedro Manuel Fonseca Nunes dos Santos
João Coelho	
José M. Rebordão	**André Miguel Silva*** (PhD student since 01/10/2019)
Manuel Abreu	**Bachar Wehbe** (PhD student since 17/10/2016)
Sérgio A. G. Sousa*	Cédric Pereira (PhD student since 01/10/2019)

Researchers that work in more than one group are marked with (*). Researchers in bold are based at CAUP

In terms of new themes of research, somehow supported by background expertise in Astronomy Instruments / Space missions, are consolidated by the work of three PhD students supervised by TIL researchers:

a) Development of tools/models for Atmospheric Dispersion Compensators, resulting from the work done/projected on different instruments such as Espresso, NIRPS and HIRES. This work will be concluded at the beginning of next year.

b) Stabilization 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 stabilization levels of few ppm are required over long periods of observation.

c) 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.

Details on running projects

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

2020 was programmed to be the year where the ADC would be commissioned in the ESO 3.6 m telescope in La Silla and that the instrument would see its first light. Unfortunately, due to the confinement, the activities in the observatory were postponed, expected to happen after April 2021, and therefore the activities were reduced to the preparation of the commissioning mission (planning and development of data analysis tools).

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 2020 the activities focused on integration of the large structure that will interface with the telescope and on the test of all the mechanisms that the RFE will comprise. It is expected that the fully integrated RFE is transferred during the second half of 2021 to UKATC in Edinburgh for Preliminary tests in Europe before its integration in Chile.

Figure 14: Current Status of the MOONS (ESO) Field Corrector lenses at Officina Stellare where they are being manufactured and integrated in the Field Corrector barrel.

Figure 15: The MOONS (ESO) Rotating Front End during integration and tests of the retraction and screen mechanisms.

HIRES (ESO)

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

After the finishing of the Phase A studies in 2017, during 2020 the work was focused on the Pre-phase B activities, namely on the consortium definition, on the preliminary re-design of the instrument, on the consolidation of cost estimates, on the consolidation of science cases and plans for GTO program.
Phase B is foreseen to start mid 2021.

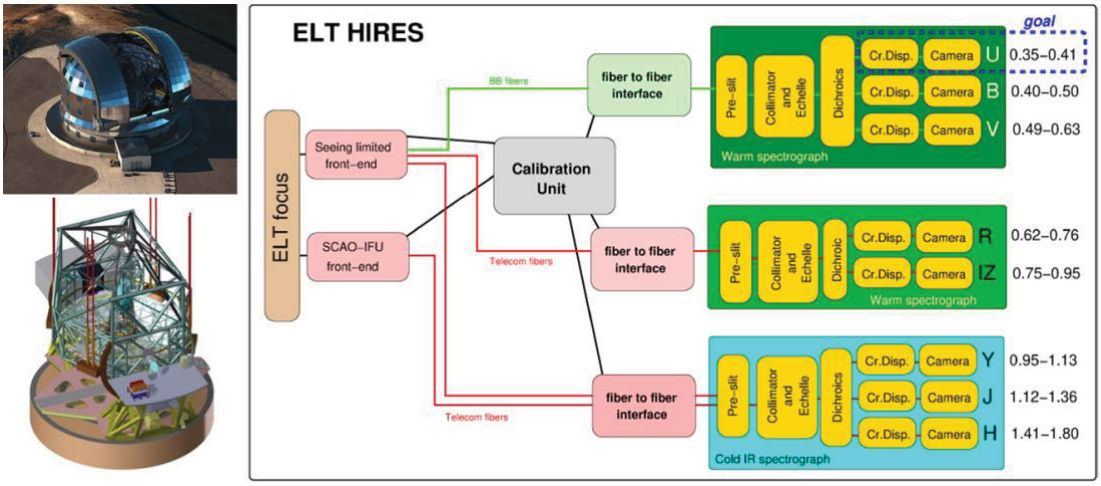


Figure 16: HIRES (ESO) at the ELT and instrument architectural design, outlining the instrument subsystems: Front End (seeing-limited and AO assisted with SCAO unit), Fibre Link, Calibration Unit, VIS-Blue, VIS-Red and NIR (cold spectrograph).

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 various science working groups, and in the Survey Design, which is an activity of support to the Euclid Consortium Lead.

In 2020, 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, compliant with all constraints and requirements.

This year there were considerable improvements in the generated surveys, and we produced four reference surveys. The major improvements were the new patch scheduling algorithm which ensures thermal variations of the telescope to be minimised, improving the temporal stability of the PSF. A re-designed calibration schedule was also developed.A reference survey that included all these improvements was delivered, on September 2020, as part of the delivery pack for the Survey and Calibrations Operations Mid-Term Review (SCOMT). The delivery also included the new document Mission Operations Concept Document part C, under IA's custody. Part of the SCOMT objectives were to assess the feasibility of the reference survey produced, within the constraints of the mission. The work presented by ECSURV passed the review, with no raised issues.

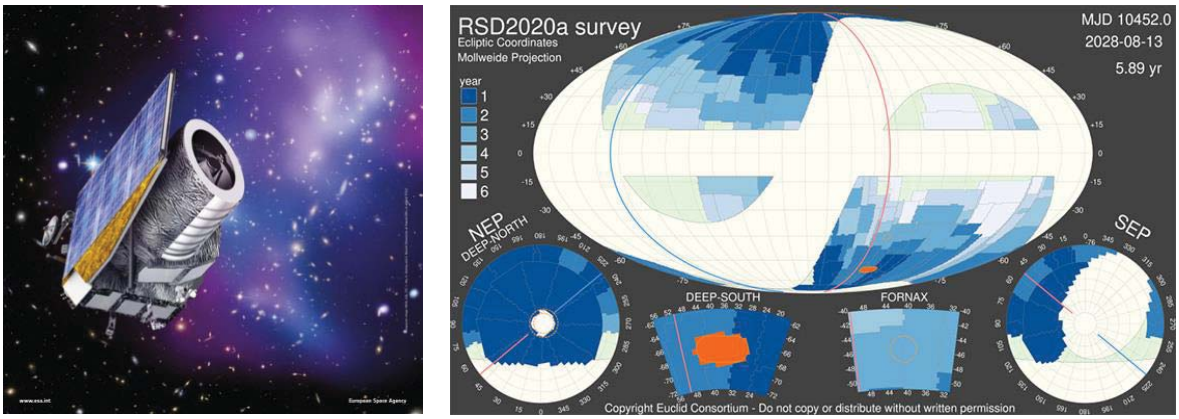


Figure 17: Euclid ESA's mission (left) and the mosaic of the regions that will have been covered by Euclid after its six years of expected lifetime, on a Mollweide projection of the celestial sphere in ecliptic coordinates. Credits: Euclid Consortium/ECSURV (right).

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 relation with the Portuguese industry in the area of scientific related software.

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

In 2020, after its successful launch we were involved in the in orbit commissioning (IOC) to check the status of the instrument. The IOC review was successful, CHEOPS is running well and has started scientific observations. IA will continue to give maintenance support to the data reduction pipeline during the CHEOPS mission.

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 the PLATO cameras on the ground.

Regarding the contribution to the OGSE, in August 2020 the Instrumentation group delivered the first unit of the Room Temperature Collimator to CSL (Belgium).The performance and calibration report produced showed full compliance of the developed equipment with the CSL initial requirements.

The second collimator is now on the stage of integration. The delivery date for this second unit to CSL is foreseen to May 2020.

Second funding phase by Prodex is now being finalized, which shall allow the procurement of the light source required for integration on the 2nd collimator unit.

The activities regarding other workpackages associated to instrumentation, namely with SW work, in Star Centroids and Target Position, our team continued to produce documentation and supporting algorithms, in the scope of the activities led by LESIA group.

Figure 18: The PLATO (ESA) White light collimator during integration. Detail of the fibre holder (left) and mirror gimbal (right).

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 in ARIEL and with the OGSE team regarded the elaboration of an OGSE concept design report, integrating the Portuguese - IA contribution associated to the VIS-NIR optical source and modulator.

To this date and with a continuous activity throughout the whole year of 2020, there have been a series of activities and contributions regarding the definition of the System Requirements, in preparation of the SRR milestone in beginning 2021.

In terms of funding of the activities, the LoE issued by the Portuguese delegation was delivered to the Prodex Office and the official grant is now available for pursuing ARIEL OGSE activities.

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.
This activity will focus on the development of the engineering model of the metrology system that is responsible for measuring the telescope internal pointing, activity that will have a 24 month duration. The current work is now focusing on the definition of the system and user requirements that will define the design of the metrology solution.

Highlights for 2020

1. The Special Talent And Recognition (STAR) award, acknowledges annually, since 2017, exceptional contributions to the mission made by groups and individual members of the Euclid consortium. Every year, all the roughly 2000 Euclid members have the opportunity to indicate nominees for the 6 categories of the prize. A jury then selects a winner per category among all the nominees. The Euclid Consortium Survey group (ECSURV) was awarded the STAR award of 2020 in the Team category. The ECSURV team has 14 members from Italy, France and Portugal, including 4 researchers from IA.

2. All the parts for the MOONS Rotating Front End Structure, after manufacturing by CUNHOL (Portugal), are now at the IA (Lisbon) MOONS integration room and the entire main structure, including its retraction and screen mechanisms, have been fully integrated and successfully tested. The system includes a powerful retractor mechanism that is in charge of retracting the entire fibre positioning support structure for metrology purposes and to provide the required distance from the calibration screen during instrument calibrations.

3. Our participation in the ESA PLATO project accomplished the delivery of the first unit of the ambient collimator to CSL. Starting integration of 2nd collimator with an expected delivery date of mid 2021.

4. For the ESA ARIEL project. The Prodex funding was approved (200 keuros) for the development of the VIS-NIR OGSE. Conceptual design was approved and a preliminary design is on course.

5. IA led a proposal for an international consortium for the development of the onboard metrology system for the ESA Athena mission. This activity, resulting from an ESA tender with 900keuros funding for a 24 month project duration, was granted to our consortium and the work started in mid 2020.

6. HIRES restart activities following a positive answer from ESO to prepare the beginning of the phase B in mid-2021. The IST has a very relevant participation on this consortium, with the responsibility of one of the major work package (the instrument front end that interfaces with the telescope) and has several key persons in the project management and systems engineering team

Alexandre Cabral (Lisbon)
Group Leader

Research projects/programmes

During 2020 there were 16 funded projects in CAUP, which provided most of the funds available for research related expenses (of those projects, 4 finished during 2020), as well as for outreach and basic expenses. The research projects that in 2020 were supported by national and European funds are:

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

Detecting and characterizing exoplanets around evolved stars with NASA's TESS mission (PULSATION) (MSCA-IF-EF-ST-792848)
PI: Tiago Campante
[start date: 1st November 2018 – end date: 31st October 2020]

Revealing the Milky Way with Gaia (MW-GAIA) (COST ACTION CA18104)
PI: Vardan Adibekyan & Nuno Santos
[start date: 14th March 2019 – end date: 13th March 2023]

(ii) Projects funded by the Fundação para a Ciência e a Tecnologia (FCT):

Resolving galaxy evolution (IF/01654/2014/CP1215/CT003)
PI: Jarle Brinchmann
[start date: 30th June 2015 – end date: 29th June 2020]

Towards characterization of Earth-like exoplanets (IF/00028/2014/CP1215/CT0002)
PI: Sérgio Sousa
[start date: 1st May 2015 – end date: 30th April 2020]

Zoom-In ON hIgh-mass Star forMation (IF/00956/2015/CP1273/CT0002)
PI: Nanda Kumar
[start date: 15th December 2016 – end date: 14h December 2021]

Characterizing the smallest planet hosts (IF/00849/2015/CP1276/CT0003)
PI: Elisa Delgado Mena
[start date: 1st January 2017 – end date: 31st December 2021]

Breaking through outstanding problems in stellar evolution with ultra-precise space-based photometry (BreakStarS) (POCI-01-0145-FEDER-030389 & PTDC/FIS-AST/30389/2017)
PI: Margarida Cunha
[start date: 1st May 2018 - end date: 30th April 2022]

Cosmology and Fundamental Physics with ESPRESSO (CosmoESPRESSO) (POCI-01-0145-FEDER-028987 & PTDC/FIS-AST/28987/2017
PI: Carlos Martins
[start date: 1st June 2018 - end date: 31st May 2022]

Exploring exoPlanets wIth CHEOPS (EPIC) (POCI-01-0145-FEDER-028953 & PTDC/FIS-AST/28953/2017)
PI: Sérgio Sousa
[start date: 1st June 2018 - end date: 31st December 2021]

a Generation of Earth-ANalogs Exploration Spectrographs (G.EANES) (POCI-01-0145-FEDER-032113 & PTDC/FIS-AST/32113/2017)
PI: Nuno Santos
[start date: 1st August 2018 - end date: 31st December 2021]

Identifying the Earliest Supermassive Black Holes with ALMA (IdEaS with ALMA) (PTDC/FIS-AST/29245)
PI: José Afonso
[start date: 3rd September 2018 - end date: 2nd September 2021]

Planets - Towards Understanding their General circulation Atmospheres (P-TUGA) (PTDC/FIS-AST/29942/2017)
PI: Pedro Machado
[start date: 3rd September 2018 - end date: 2nd September 2021]

Probing cosmic strings and other topological defects with gravitational waves (Gwstrings) (POCI-01-0145-FEDER-031938 & PTDC/FIS-PAR/31938/2017)
PI: Lara Sousa
[start date: 15th October 2018 - end date: 14th October 2022]

(iii) Infrastructure projects (FCT):

R&D Units: Instituto de Astrofísica e Ciências do Espaço (UIDB/04434/2020 & UIDP/04434/2020)
PI: José Afonso
[start date: 1st January 2020 – end date: 31st December 2023]

(v) Cooperation projects funded by Departamento das Relações Internacionais (FCT) and by Conselho de Reitores das Universidades Portuguesas (CRUP):

Strategic partnership in astrophysics Portugal-Brazil: the connection between black holes and galaxies using powerful new instrumentation and theoretical insights (Cooperação Cientifica e Tecnológica FCT/CAPES - 2018/2019)
PI: Andrew Humphrey
[start date: 1st May 2018 – end date: 31st May 2021]

(vi) Other international projects:

PLATO OGSE and PDC Phase B
PI: Nuno Santos
[start date: 1st January 2018 - end date: 31st December 2020]

Outreach projects

During 2020, there were 2 funded outreach projects in CAUP, which provide funds available for outreach related expenses. These were:

Ciência Viva no Verão em Rede 2020 (CV: 44-2020/446)

PI: Filipe Pires
[start date: 1st July 2020 – end date: 30th September 2020]

Formação ESERO - Conhecer a Terra através do Espaço - 2ª Edição
PI: Filipe Pires
[start date: 1st September 2019 - end date: 31st December 2020]

Research grants

Several grants have been active in 2020 with financial support of CAUP or with CAUP as the host institution.

Ongoing Post-Doctoral grants:

1. Pedro M. Palmeirim, Postdoctoral grant (SFRH/BPD/110176/2015), Fundação para a Ciência e a Tecnologia, 01 September 2016

Completed Post-doctoral grants in 2020:

1. Ricardo Caldeira Costa, Research assistantship grant - Ph.D. (CIAAUP-20/2019-BID), CAUP, 01 September 2019 to 30 April 2020
2. Iris Breda, Research assistantship grant - Ph.D. (CIAAUP-30/2019-BID), CAUP, 01 January to 30 June 2020
3. Doris Arzoumanian, Research assistantship grant - Ph.D. (CIAAUP-12/2019-BID), CAUP, 15 April 2019 to 15 July 2020

Ongoing PhD grants:

1. David Grüber, PhD grant (2020.07632.BD), Fundação para a Ciência e a Tecnologia, 01 October 2020
2. Miguel Tavares Clara, PhD grant (2020.07530.BD), Fundação para a Ciência e a Tecnologia, 01 October 2020
3. Abhishek Chougule, PhD grant (PD/BD/150439/2019), Fundação para a Ciência e a Tecnologia, 01 October 2019
4. Thibault Boulet, PhD grant (PD/BD/150426/2019), Fundação para a Ciência e a Tecnologia, 01 October 2019
5. Tomás de Azevedo Silva, PhD grant (PD/BD/150416/2019), Fundação para a Ciência e a Tecnologia, 01 October 2019
6. Rui P. L. Azevedo, PhD grant (SFRH/DB/132546/2017), Fundação para a Ciência e a Tecnologia, 01 January 2018
7. Babatunde Akinsanmi, PhD grant (PD/BD/135226/2017), Fundação para a Ciência e a Tecnologia, 01 October 2017
8. Bachar Wehbe, PhD grant (PD/BD/135225/2017), Fundação para a Ciência e a Tecnologia, 01 October 2017
9. L. Filipe Pereira, PhD grant (PD/BD/135227/2017), Fundação para a Ciência e a Tecnologia, 01 October 2017
10. Sandy G. Morais, PhD grant (PD/BD/135228/2017), Fundação para a Ciência e a Tecnologia, 01 October 2017
11. Vasco M. C. Ferreira, PhD grant (PD/BD/135229/2017), Fundação para a Ciência e a Tecnologia, 01 October 2017
12. José Ricardo Correia, PhD grant (SFRH/BD/130445/2017), Fundação para a Ciência e a Tecnologia, 01 September 2017

Completed PhD grants in 2020:

1. Saeed Hojjatpanah, PhD grant (PD/BD/128119/2016), Fundação para a Ciência e a Tecnologia, 01 October 2016 to 30 September 2020
2. Pedro I. T. K. Sarmento, PhD grant (PD/BD/128050/2016), Fundação para a Ciência e a Tecnologia, 01 October 2016 to 31 May 2020
3. Luisa M. Serrano, PhD grant (SFRH/BD/120518/2016), Fundação para a Ciência e a Tecnologia, 01 March 2017 to 16 April 2020

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

1. Sergei Mukovnikov, Research assistantship grant - MSc (CIAAUP-11/2020-BIM), CAUP, 05 November 2020 to 04 October 2021
2. José Rodrigues, Research assistantship grant - MSc (CIAAUP-09/2020-BID), CAUP, 01 November 2020
3. Alexandros Antoniadis Karnavas, Research assistantship grant - MSc (CIAAUP-22/2019-BIM), CAUP, 01 October 2019

Completed research grants (PhD students, master students or graduates) in 2020 were:

1. André Miguel A. C. V. Silva, Research assistantship grant - MSc (CIAAUP-10/2020-BIB), CAUP, 15 November to 31 December 2020
2. João D. R. Camacho, Research assistantship grant - MSc (CIAAUP-05/2020-BIM), CAUP, 01 July to 31 December 2020
3. André Miguel A. C. V. Silva, Research assistantship grant - MSc (CIAAUP-28/2019-BIM), CAUP, 15 November 2019 to 14 November 2020
4. Miguel T. Clara, Research assistantship grant - BSc (CIAAUP-29/2019-BIL), CAUP, 01 January to 30 June 2020
5. João D. R. Camacho, Research assistantship grant - MSc (CIAAUP-31/2019-BIM), CAUP, 01 January to 30 April 2020
6. Solène C. Ulmer-Moll, Research assistantship grant - MSc (CIAAUP-32/2019-BIM), CAUP, 01 January to 30 April 2020
7. Raquel M. G. Albuquerque, Research assistantship grant - MSc (CIAAUP-23/2019-BIM), CAUP, 07 October 2019 to 25 February 2020
8. Ana C. O. Leite, Research assistantship grant - MSc (CIAAUP-25/2019-BIM), CAUP, 21 October 2019 to 20 January 2020

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

The completed Science and Technology Management Grants in 2020 were:

1. Elsa M. P. S. Moreira, Science and Technology Management Grant (SFRH/BGCT/135479/2018), Fundação para a Ciência e a Tecnologia, 01 January 2018 to 28 February 2020

Scientific Output and Activities

The scientific output of CAUP in 2020 was (see below):

Books	2
Papers in refereed journals	143
Papers in proceedings	11
Communications in international meetings	27
Communications in national meetings	34
Observing runs	21

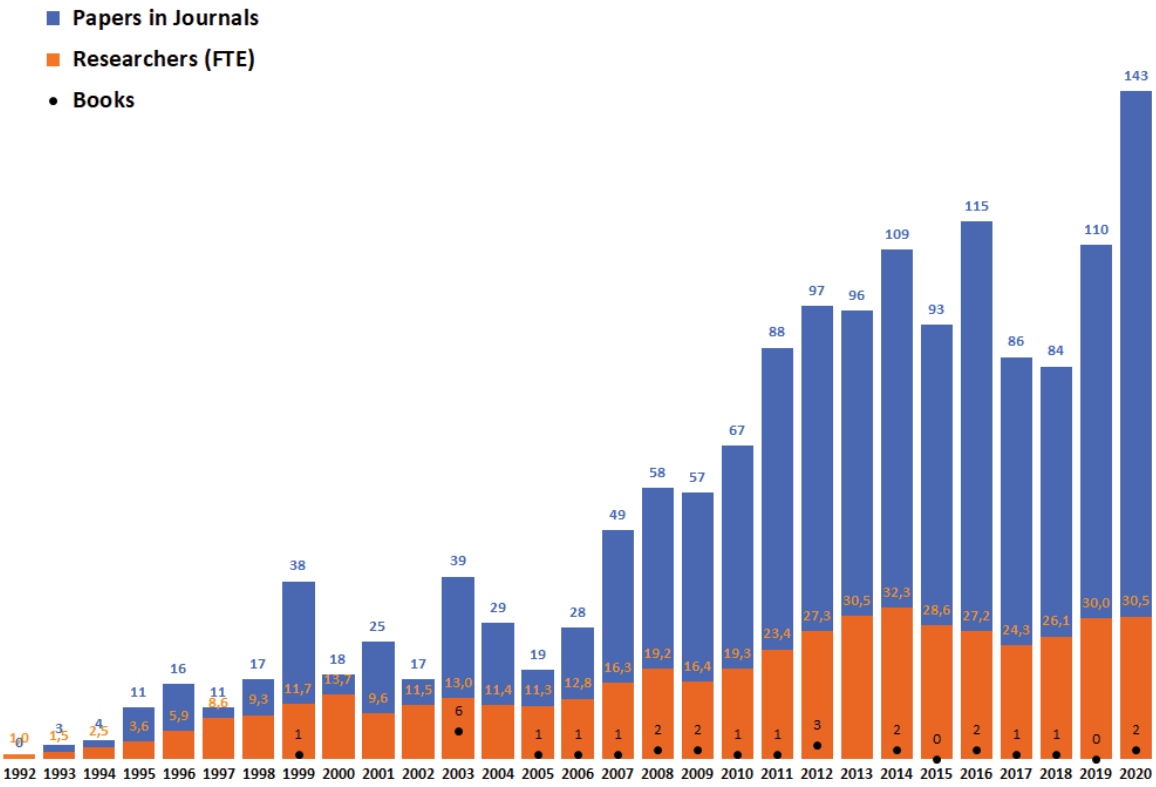


Figure 19: Blue bars - CAUP Publications in refereed journals per year; Orange bars - number of researchers with a PhD in full-time-equivalent (FTE) units; dots - books edited/published per year.

The h-index of CAUP is 125 (for a total of 85 481 accumulated citations).

If only refereed papers - as defined by ISI - are considered, the average number of citations per article is close to 55. The evolution of this number over the years can be seen in Figure 21. The curve shows that the quality of the papers produced by CAUP (as measured by the average number of citations) continues to increase steadily as is natural as time goes on.

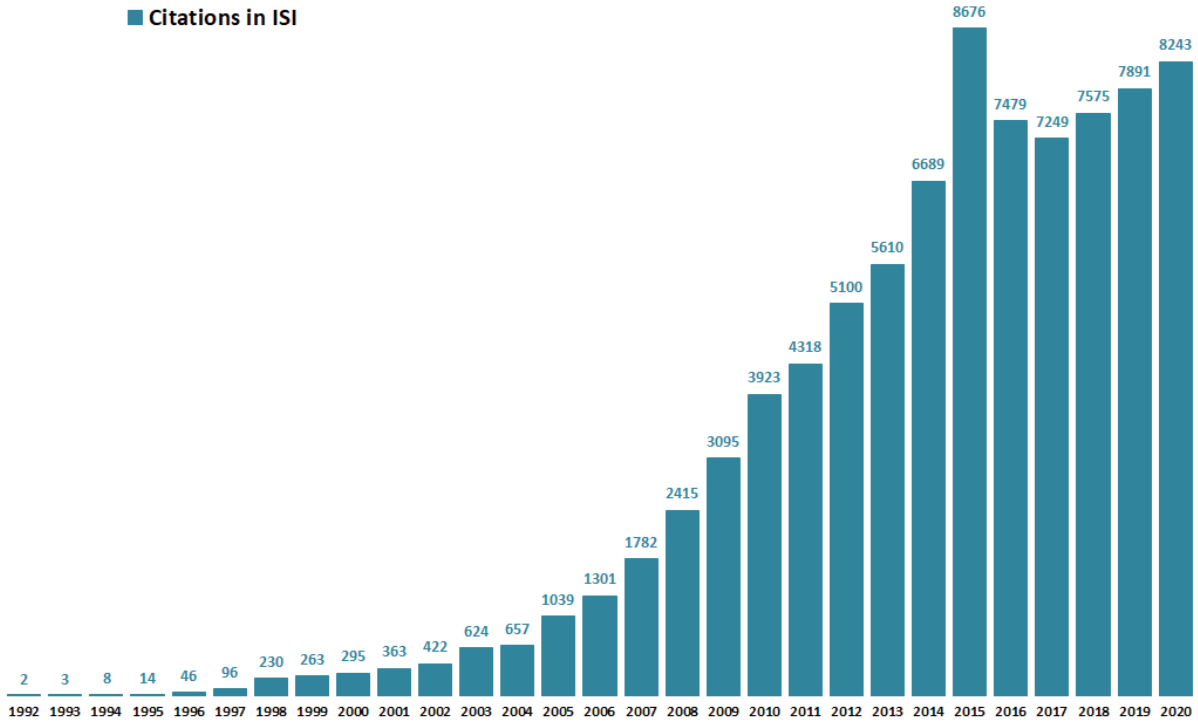


Figure 20: Citations per year from ISI using all entries in the database with CAUP/IA Porto in the affiliation.

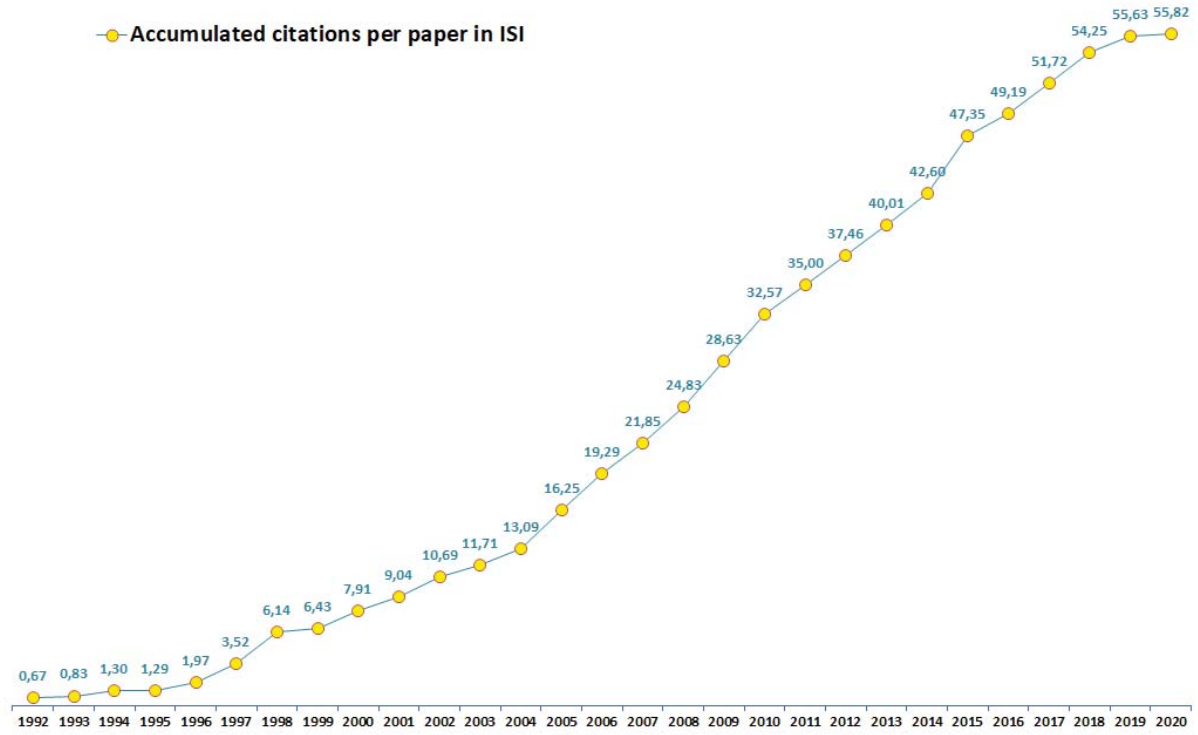


Figure 21: Accumulated citations per paper in ISI using all entries in the database with CAUP in the affiliation.

During 2020 CAUP organized, or co-organized, the following conferences, workshops, meetings or schools:

- IA-ON7; Instituto de Astrofísica e Ciências do Espaço 7th internal workshop; 19 to 22 October 2020; online, Portugal

- 30th Encontro Nacional de Astronomia e Astrofísica; 9 to 11 September 2020, online, Portugal

- JWST master class workshop; 14 to 15 May 2020; online, Portugal

Several team members also integrated the scientific organizing 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 2020 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 members of the FCT scientific council, as evaluators for FCT panels (projects and/or grants) and in panels of several European programmes.

In 2020, due to travel restrictions CAUP received only 8 visitors to develop collaborative work with team members, most of them being supported under the ongoing exchange programmes and projects, and organized 24 scientific seminars, as well as frequent journal clubs in the various thematic lines, mostly held online.

Books in 2020

1. C. J. A. P. Martins, 2020; *The Universe Today. Our Current Understanding and How It Was Achieved*; Springer International Publishing
2. M. J. P. F. G. Monteiro, R. Garcia, J. Christensen-Dalsgaard, S. W. McIntosh, 2020; *Dynamics of the Sun and Stars. Honoring the Life and Work of Michael J. Thompson*; Springer International Publishing

Refereed publications in 2020

1. *Euclid* Collaboration, P. Paykari, T. Kitching, H. Hoekstra, R. Azzollini, V. F. Cardone, M. Cropper, C. A. J. Duncan, A. Kannawadi, L. Miller et al. (*including:* **J. Brinchmann**, **A. C. da Silva**, **I. Tereno**), 2020; *Euclid preparation. VI. Verifying the performance of cosmic shear experiments*; Astronomy and Astrophysics, 635, A139, 18
2. *Euclid* Collaboration, G Desprez, S. Paltani, J. Coupon, I. Almosallam, A. Alvarez-Ayllon, V. Amaro, M. Brescia, M. Brodwin, S. Cavuoti et al. (*including:* **J. Brinchmann**, **C. S. Carvalho**, **A. C. da Silva**, **A. Humphrey**, **I. Tereno**), 2020; *Euclid preparation. X. The Euclid photometric-redshift challenge*; Astronomy and Astrophysics, 644, A31, 24
3. C. Abia, **H. M. Tabernero**, S. A. Korotin, D. Montes, E. Marfil, J. Caballero, O. Straniero, N Prantzos, I. Ribas, A. Reiners, 2020; *The CARMENES search for exoplanets around M dwarfs. Rubidium abundances in nearby cool stars*; Astronomy and Astrophysics, 642, A227, 15
4. **V. Zh. Adibekyan**, **S. G. Sousa**, **N. C. Santos**, **P. Figueira**, C. Allende Prieto, **E. Delgado Mena**, J. I. González Hernández, P. de Laverny, A. Recio-Blanco, **T. L. Campante** et al. (*including:* **J. P. Faria**, **T. Boulet**), 2020; *Benchmark stars, benchmark spectrographs. Detailed spectroscopic comparison of ESPRESSO, PEPSI, and HARPS data for Gaia benchmark stars*; Astronomy and Astrophysics, 642, A182, 16
5. **B. Akinsanmi**, **S. C. C. Barros**, **N. C. Santos**, **M. Oshagh**, L. M. Serrano, 2020; *Constraining the oblateness of transiting planets with photometry and spectroscopy*; Monthly Notices of the Royal Astronomical Society, 497, 3, 3484
6. **B. Akinsanmi**, **N. C. Santos**, **J. P. Faria**, M. Oshagh, **S. C. C. Barros**, A. Santerne, S. Charnoz, 2020; *Can planetary rings explain the extremely low density of HIP 41378 f?*; Astronomy and Astrophysics, 635, L8, 8
7. **R. M. G. Albuquerque**, **J. F. Gameiro**, S. Alencar, **J. J. G. Lima**, C. Sauty, C. Melo, 2020; *Accretion in low-mass members of the Orion Nebula Cluster with young transition disks*; Astronomy and Astrophysics, 636, A86, 16

8. R. Allart, L. Pino, C. Lovis, **S. G. Sousa**, N. Casasayas-Barris, M. R. Zapatero-Osorio, M. Cretignier, E. Palle, F. Pepe, S. Cristiani et al. (*including:* **N. C. Santos**, **O. Demangeon**, **H. M. Tabernero**, **V. Zh. Adibekyan**, **A. Cabral**, **P. Figueira**, **C. J. A. P. Martins**, **N. J. Nunes**), 2020; *WASP-127b: a misaligned planet with a partly cloudy atmosphere and tenuous sodium signature seen by ESPRESSO*; Astronomy and Astrophysics, 644, A155, 18
9. J. Alonso-Santiago, I. Negueruela, A. Marco, **H. M. Tabernero**, N. Castro, 2020; *Three open clusters containing Cepheids: NGC 6649, NGC 6664, and Berkeley 55*; Astronomy and Astrophysics, 644, A136, 22
10. A. Palmese, J. Annis, J. Burgad, A. Farahi, M. Soares-Santos, B. Welch, M. da Silva Pereira, H. Lin, S. Bhargava, D. Hollowood et al. (*including:* **P. T. P. Viana**), 2020; *Stellar mass as a galaxy cluster mass proxy: application to the Dark Energy Survey redMaPPer clusters*; Monthly Notices of the Royal Astronomical Society, 493, 4, 4591
11. **A. Antoniadis-Karnavas**, **S. G. Sousa**, **E. Delgado Mena**, **N. C. Santos**, **G. D. C. Teixeira**, V. Neves, 2020; *ODUSSEAS: a machine learning tool to derive effective temperature and metallicity for M dwarf stars*; Astronomy and Astrophysics, 636, A9, 15
12. D. J. Armstrong, T. A. Lopez, **V. Zh. Adibekyan**, R. A. Booth, E. M. Bryant, K. A. Collins, M. Deleuil, A. Emsenhuber, C. X. Huang, G. W. King et al. (*including:* **N. C. Santos**, **S. G. Sousa**, **S. C. C. Barros**, **E. Delgado Mena**, **O. Demangeon**, **P. Figueira**, **S. Hojjatpanah**), 2020; *A remnant planetary core in the hot-Neptune desert*; Nature, 583, 7814, 39
13. N. Astudillo-Defru, R. Cloutier, S. X. Wang, J. Teske, R. Brahm, C. Hellier, G. R. Ricker, R. K. Vanderspek, D. W. Latham, S. Seager et al. (*including:* **P. Figueira**, **N. C. Santos**), 2020; *A hot terrestrial planet orbiting the bright M dwarf L 168-9 unveiled by TESS*; Astronomy and Astrophysics, 636, A58, 13
14. **P. P. Avelino**, 2020; *Parameter-free velocity-dependent one-scale model for domain walls*; Physical Review D, 101, 2
15. **P. P. Avelino**, **M. S. Cunha**, W. J. Chaplin, 2020; *Modelling stochastic signatures in classical pulsators*; Monthly Notices of the Royal Astronomical Society, 492, 3, 4477
16. **P. P. Avelino**, 2020; *Comparing parametric and non-parametric velocity-dependent one-scale models for domain wall evolution*; Journal of Cosmology and Astroparticle Physics, 2020, 4
17. **P. P. Avelino**, B. F. de Oliveira, R. S. Trintin, 2020; *Performance of weak species in the simplest generalization of the rock-paper-scissors model to four species*; Physical Review E, 101, 6
18. **P. P. Avelino**, **R. P. L. Azevedo**, 2020; *Boltzmann's H-theorem, entropy and the strength of gravity in theories with a nonminimal coupling between matter and geometry*; Physics Letters B, 808
19. **P. P. Avelino**, B. F. de Oliveira, J. V. O. Silva, 2020; *Rock-paper-scissors models with a preferred mobility direction*; Europhysics Letters, 132, 4
20. **P. P. Avelino**, **L. Sousa**, 2020; *Domain walls and other defects in Eddington-inspired Born-Infeld gravity*; Physical Review D, 102, 10
21. **R. P. L. Azevedo**, **P. P. Avelino**, 2020; *Second law of thermodynamics in nonminimally coupled gravity*; Europhysics Letters, 132, 3
22. W. H. Ball, W. J. Chaplin, M. B. Nielsen, L. González-Cuesta, S. Mathur, A. R. G. Santos, R. A. García, D. L. Buzasi, B. Mosser, **M. Deal** et al. (*including:* **B. Nsamba**, **T. L. Campante**, **M. S. Cunha**), 2020; *Robust asteroseismic properties of the bright planet host HD 38529*; Monthly Notices of the Royal Astronomical Society, 499, 4, 6084
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9. **C. Pappalardo**, **P. Papaderos**, **J. M. Gomes**, **L. S. M. Cardoso**, **A. Paulino-Afonso**, **I. Matute**, **S. Amarantidis**; 2020; *Galaxy Evolution through spectral fitting tools: A comparative study between STECKMAP and FADO*; Uncovering Early Galaxy Evolution in the ALMA and JWST Era; (Eds.)Elisabete da Cunha; Jacqueline Hodge; José Afonso; Laura Pentericci; David Sobral, Cambridge University Press, Volume 352, Series Proceedings of the International Astronomical Union, Page 119
10. **C. I. S. A. Rocha**, **C. J. G. N. Pereira**, **M. S. Cunha**, **M. J. P. F. G. Monteiro**, **B. Nsamba**, **T. L. Campante**; 2020; *16 Cygni A: A Testbed for Stellar Core Physics*; Dynamics of the Sun and Stars; (Eds.)Mário J.P.F.G. Monteiro; Rafael A. García; Jørgen Christensen-Dalsgaard; Scott W. McIntosh, Springer, Volume 57, Series Astrophysics and Space Science Proceedings, Page 281

11. **B. Wehbe**, **A. Cabral**, G. Avila; 2020; *A novel method for on-sky measurements of atmospheric dispersion*; Ground-based and Airborne Instrumentation for Astronomy VIII; (Eds.)Christopher J. Evans; Julia J. Bryant; Kentaro Motohara, SPIE, Volume 11447, Series Proceedings of the SPIE

International Scientific Communications in 2020

1. **V. Zh. Adibekyan**; 2020; *Frontiers of Stellar Spectroscopy: the Precision – Accuracy Interface*; Frontiers of Stellar Physics: the Theory-Observation Interface, Zagreb, Croácia
2. **V. Zh. Adibekyan**; 2020; *Stellar flares with ESPRESSO*; ESPRESSO Science Team Meeting, Palermo, Itália
3. **V. Zh. Adibekyan**; 2020; *ESPRESSO's look at fine structures of stellar surfaces using exoplanet transits*; ESPRESSO Science Team Meeting, Palermo, Itália
4. **V. Zh. Adibekyan**; 2020; *Observational evidence of the compositional link between rocky planets and their hosts*; PLATO ESP 2020 - Planetary interiors and system architectures, Online,
5. **B. Akinsanmi**; 2020; *Planet Love-number measurements from transit light curves*; PLATO ESP 2020 - Planetary interiors and system architectures, Online,
6. **B. Akinsanmi**, **N. C. Santos**, **J. P. Faria**, M. Oshagh, **S. C. C. Barros**, A. Santerne, S. Charnoz; 2020; *Possible case of exoplanetary rings around HIP 41378 f*; Europlanet Science Congress 2020, Online,
7. **A. Antoniadis-Karnavas**, **S. G. Sousa**, **E. Delgado Mena**, **N. C. Santos**, **G. D. C. Teixeira**, V. Neves; 2020; *ODUSSEAS: a machine learning tool to derive Teff and [Fe/H] for M dwarf stars*; Exoplanets III, Online, Alemanha
8. **S. C. C. Barros**; 2020; *Improving transit characterisation with Gaussian process modelling of stellar variability*; PLATO ESP 2020 - Planetary interiors and system architectures, Online, Alemanha
9. **S. C. C. Barros**; 2020; *Status of the WG5 Feature characterise*; CHEOPS Science Team Meeting #18, Online, Reino Unido
10. T. Boulet; 2020; *How to best prepare TESS 2-min cadence light curves of solar-type stars for seismic analysis?*; 7th Iberian Meeting on Asteroseismology, Online, Portugal
11. **D. Bossini**; 2020; *PARAM and Gaia parallax: a new constraint for stellar age and mass*; Frontiers of Stellar Physics: the Theory-Observation Interface, Zagreb, Croácia
12. **J. Brinchmann**; 2020; *Large galaxies in Euclid*; Euclid Consortium conference 2020, Online, Espanha
13. **J. Brinchmann**; 2020; *Some thoughts on tiling from a legacy perspective*; Euclid Consortium conference 2020, Online, Espanha
14. **J. Brinchmann**; 2020; *Bounds on Axion-like Dark Matter with MUSE-Faint*; MUSE Consortium Busy Week Spring 2020, Online, Alemanha
15. **J. Brinchmann**; 2020; *Ultra-faint Dwarfs - an Update*; MUSE Consortium Busy Week Spring 2020, Online, Alemanha
16. **J. Brinchmann**; 2020; *An update on MUSE-Faint*; MUSE Consortium Busy Week Spring 2020, Online, Alemanha
17. **I. A. Costa**; 2020; *CoAstro: @n Astrononomy Condo*; Space Talks online series – Ecsite (European Network of Science Centres and Museums) Space Group, Online, Bélgica
18. **I. A. Costa**; 2020; *CoAstro: @n Astronomy Condo – Teachers´Attitudes and Epistemological Beliefs Towards Science in a Citizen Science Project*; International Conference on Education and New Developments 2020, Online, Croácia
19. **I. A. Costa**; 2020; *CoAstro: @n Astronomy Condo – Development of Teachers´Knowledge of Astronomy Trough a Citizen Science Project*; INTED2020 - 14th Annual International Technology, Education and Development Conference, Online, Espanha
20. **M. Deal**; 2020; *Evolution de la composition chimique de surface des étoiles et impact sur l'âge*; ExoSystèmes I, Paris, França
21. **C. Gehan**, B. Mosser, E. Michel, **M. S. Cunha**; 2020; *Automated approach to measure stellar inclinations: validation through large-scale measurements on the red giant branch*; Red Giant Workshop, Graz, Áustria

22. **A. Humphrey**; 2020; *Identifying Passive Galaxies at High-z using a Nonlinear Fusion of Classifiers*; Exploiting Archives for Radio Astronomy in the SKA- era, Online, Portugal
23. **A. Humphrey**; 2020; *Selecting Quiescent Galaxies using Euclid Mock Photometry*; Euclid Galaxies Evolution SWG, Online,
24. J. Lillo Box, T. A. Lopez, A. Santerne, L. D. Nielsen, **S. C. C. Barros**, M. Deleuil, O. Mousis, **S. G. Sousa**, **V. Zh. Adibekyan**, D. J. Armstrong, D. Barrado, D. Bayliss, D. J. A. Brown, **O. Demangeon**, X. Dumusque, **P. Figueira**, **S. Hojjatpanah**, H. P. Osborn, **N. C. Santos**, S. Udry; 2020; *Masses for the seven planets in K2-32 and K2-233. Four diverse planets in resonant chain and the first young rocky worlds*; XIVth Spanish Astronomical Society Meeting, Online, Espanha
25. **A. M. Silva**, **S. G. Sousa**, **N. C. Santos**, **O. Demangeon**, R. A. Matson; 2020; *archi: pipeline for light curve extraction of CHEOPS background stars*; Europlanet Science Congress 2020, Online,
26. **S. Ulmer-Moll**; 2020; *Telluric correction with TAPAS and Molecfit in the near-infrared*; SPIRou Science team meeting, Online, França
27. **B. Wehbe**, **A. Cabral**, G. Avila; 2020; *A novel method for on-sky measurements of atmospheric dispersion*; SPIE Astronomical Telescopes + Instrumentation, Online,

National Scientific Communications in 2020

1. **V. Zh. Adibekyan**; 2020; *Stars TL overview*; IA-ON 7 - 7th internal IA workshop, Online, Portugal
2. **R. P. L. Azevedo**, **P. P. Avelino**; 2020; *Nonminimally coupled gravity and the perfect fluid Lagrangian*; IA-ON 7 - 7th internal IA workshop, Online, Portugal
3. S. A. Berge, **J. R. C. C. C. Correia**, **C. J. A. P. Martins**; 2020; *Measuring Cosmic String Loops One by One*; 30th Encontro Nacional de Astronomia e Astrofísica, Online, Portugal
4. **T. Boulet**, **T. L. Campante**, **V. Zh. Adibekyan**, A. M. Serenelli; 2020; *Galactic archaeology of solar-type stars with the NASA TESS mission*; IA-ON 7 - 7th internal IA workshop, Online, Portugal
5. **J. D. Camacho**; 2020; *Modelling stellar activity signals in radial velocity data with Gaussian processes regression network*; 30th Encontro Nacional de Astronomia e Astrofísica, Online, Portugal
6. **M. T. Clara**; 2020; *Asteroseismology with ESA & PLATO Mission: Testing Modelling Requirements for Subgiant Stars*; IJUP 2020, Porto, Portugal
7. **M. T. Clara**; 2020; *Modelling Stars with Mixed Modes*; 7th Iberian Meeting on Asteroseismology, Online, Portugal
8. **M. T. Clara**, **M. S. Cunha**, **T. L. Campante**; 2020; *Modelling Stars with Mixed Modes*; 30th Encontro Nacional de Astronomia e Astrofísica, Online, Portugal
9. **J. R. C. C. C. Correia**, **C. J. A. P. Martins**; 2020; *Overcooling string simulations*; 30th Encontro Nacional de Astronomia e Astrofísica, Online, Portugal
10. **I. A. Costa**, **E. M. P. S. Moreira**; 2020; *Science communication to research and research for science communication*; IA-ON 7 - 7th internal IA workshop, Online, Portugal
11. **I. A. Costa**, **M. J. P. F. G. Monteiro**, **D. F. M. Folha**, **F. A. L. Pires**; 2020; *Astroteca: a divulgação da astronomia através do seu ensino*; Ciência 2020, Online, Portugal
12. **I. A. Costa**; 2020; *CoAstro: @n Astronomy Condo – research and science communication in a Portuguese citizen science project*; 30th Encontro Nacional de Astronomia e Astrofísica, Online, Portugal
13. **I. A. Costa**; 2020; *CoAstro: um Condomínio de Astronomi@ – uma nova proposta para a ciência cidadã*; Congresso SiComPt 2020, Online, Portugal
14. **M. Deal**; 2020; *Transport processes in solar-like main-sequence stars*; 30th Encontro Nacional de Astronomia e Astrofísica, Online, Portugal
15. **B. Dias**, **J. R. C. C. C. Correia**, **C. J. A. P. Martins**; 2020; *Domain wall evolution in contracting universes*; 30th Encontro Nacional de Astronomia e Astrofísica, Online, Portugal
16. J. Esteves, **C. S. Alves**, **C. J. A. P. Martins**; 2020; *Redshift drift cosmology: Optimizing the differential redshift drift*; 30th Encontro Nacional de Astronomia e Astrofísica, Online, Portugal
17. **M. S. N. Kumar**; 2020; *Filaments to Clusters: A new universal paradigm of star formation*; IA-ON 7 - 7th internal IA workshop, Online, Portugal

18. **C. Leote**, **S. Pereira**, **J. Retrê**, **P. Machado**, **G. Gilli**, **M. Silva**, **R. Gonçalves**, **P. I. T. K. Sarmento**, **A. Cardesín Moinelo**, **P. J. T. Pereira**; 2020; *A Solar System board game in times of a pandemic*; 30th Encontro Nacional de Astronomia e Astrofísica, Online, Portugal
19. **C. Leote**, **S. Pereira**, **J. Retrê**, **P. Machado**, **G. Gilli**, **J. Silva**, **M. Silva**, **R. Gonçalves**, **P. I. T. K. Sarmento**, **P. J. T. Pereira**; 2020; *ET - A Solar System board game in times of a pandemic*; IA-ON 7 - 7th internal IA workshop, Online, Portugal
20. **C. J. A. P. Martins**; 2020; *Constraining the fine-structure constant 13 billion years ago*; 30th Encontro Nacional de Astronomia e Astrofísica, Online, Portugal
21. **C. B. D. Fernandes**, **C. J. A. P. Martins**; 2020; *Constraining gravity with generalized couplings*; 30th Encontro Nacional de Astronomia e Astrofísica, Online, Portugal
22. **B. A. R. Rocha**, **C. J. A. P. Martins**; 2020; *Constraining the scale invariance model at low redshifts*; 30th Encontro Nacional de Astronomia e Astrofísica, Online, Portugal
23. **V. C. Tavares**, **C. J. A. P. Martins**; 2020; *Varying Fine Structure Constant Generalized DBI Models*; 30th Encontro Nacional de Astronomia e Astrofísica, Online, Portugal
24. **J. H. C. Martins**, **N. C. Santos**; 2020; *A Nobel for the discovery of other worlds*; Jornadas da Física do IST, Lisboa, Portugal
25. **C. Pappalardo**, T. İkiz; 2020; *Galaxies Star Formation Histories in spectral synthesis methods*; 30th Encontro Nacional de Astronomia e Astrofísica, Online, Portugal
26. **S. Pereira**, **P. J. T. Pereira**, **J. Retrê**, **F. A. L. Pires**; 2020; *Astronomy in Culture: partnerships with art schools and cultural agents*; 30th Encontro Nacional de Astronomia e Astrofísica, Online, Portugal
27. **R. S. S. C. Reis**, **S. Pereira**; 2020; *Communicating science to the public and the media*; IA-ON 7 - 7th internal IA workshop, Online, Portugal
28. **S. N. Reis**, **F. Buitrago**, **P. Papaderos**, **I. Matute**, **J. Afonso**, **S. Amarantidis**, **I. P. Breda**, **J. M. Gomes**, **A. Humphrey**, **C. Lobo**, **S. Lorenzoni**, **C. Pappalardo**, **A. Paulino-Afonso**; 2020; *Structural analysis of massive galaxies using Hubble Space Telescope deep imaging at $z < 0.5$*; Ciências Research Day 2020, Lisboa, Portugal
29. **M. C. Rosa**, **C. J. A. P. Martins**; 2020; *Evolution of Domain Walls in a Sine-Gordon Potential*; 30th Encontro Nacional de Astronomia e Astrofísica, Online, Portugal
30. **N. C. Santos**; 2020; *Um Nobel à procura de Outras Terras*; FÍSICA 2020, Lisboa, Portugal
31. **N. C. Santos**; 2020; *Portugal in Space for Science and Exploration*; Ciência 2020, Online, Portugal
32. **A. M. Silva**, **J. P. Faria**, **N. C. Santos**, **P. T. P. Viana**, **S. G. Sousa**; 2020; *A Bayesian approach to precise Radial Velocities*; 30th Encontro Nacional de Astronomia e Astrofísica, Online, Portugal
33. **T. A. Silva**; 2020; *A curious planetary system: An Ultra-Dense Hot Super Earth and a Cold Jupiter*; 30th Encontro Nacional de Astronomia e Astrofísica, Online, Portugal
34. **T. A. Silva**; 2020; *M-dwarf stars with planets: towards the characterization of the smaller planet host stars*; IJUP 2020, Porto, Portugal

Visitors

The researchers/lecturers that have visited CAUP in 2020 were:

1. Ana I. Gómez de Castro, Universidad Complutense de Madrid, Spain, 17 February 2020
2. Salvatore Orlando, Osservatorio Astronomico di Palermo, Afghanistan, 17 February 2020
3. Christophe Sauty, Observatoire de Paris, France, 15 - 22 February 2020
4. Sami Dib, Niels Bohr Institute, Astrophysics and Planetary Science, Denmark, 10 - 13 February 0202
5. Eliana Amazo-Gómez, Max-Planck Institute for Solar System Research, Germany, 20 - 30 January 2020
6. M.-J. Goupil, Observatoire de Paris-Meudon (LESIA), France, 16 - 17 January 2020
7. Victor Silva Aguirre, Aarhus University, Denmark, 16 - 17 January 2020
8. René Oudmaijer, Department of Physics and Astronomy, University of Leeds, United Kingdom, 9 - 11 January 2020

Scientific Seminars

1. Amazo-Gómez, E. M.; 2020; *GPS a new method to determine rotation periods*
2. Arzoumanian, D.; 2020; *Understanding the observed properties of interstellar filaments: Insights into the initial conditions of star formation*
3. Brax, P.; 2020; *Charged Dark Matter and the H0 Tension*
4. Buldgen, G.; 2020; *The solar modelling problem: where do we stand, where are we going?*
5. Carvajal, R.; 2020; *Stacking UV-selected Lyman-Break Galaxies in the ALMA Frontier Fields*
6. Casas, S.; 2020; *Measuring Dark Energy with non-linear observables in the Euclid era*
7. Charnay, B.; 2020; *Physics and chemistry of temperate sub-Neptunes*
8. Di Dio, E.; 2020; *The dipole power spectrum induced by relativistic effects*
9. Dib, S.; 2020; *The 1001 modes of Star Formation*
10. Fabbian, G.; 2020; *Precision cosmology with CMB lensing, delensing and cross-correlation with galaxy surveys*
11. Fernandes, J. M.; 2020; *European Solar Telescope: a place in the Sun for Portugal*
12. Gadotti, D. A.; 2020; *Nuclear discs in external galaxies and the Milky Way: building "bulges" without mergers*
13. Gehan, C.; 2020; *Red giant seismology: large-scale measurements of the core rotation and stellar inclination, and new constraints on the angular momentum transport through modelling*
14. Grimm,. N.; 2020; *Galaxy Power Spectrum in General Relativity*
15. Lepori, F.; 2020; *Weak lensing observables in relativistic N-body simulations*
16. Martins, C. J. A. P.; 2020; *CosmoESPRESSO: A Second-year Progress Report*
17. Masoura, V. A.; 2020; *The co-evolution of the AGNs and their host galaxies*
18. Mezcua, M.; 2020; *Feeding and feedback from little monsters: black holes in dwarf galaxies*
19. Millán-Irigoyen, I.; 2020; *Analysis of stellar population properties using new single stellar population templates and stellar population synthesis codes*
20. Oudmaijer, R.; 2020; *High resolution observations of Massive Young Stellar Objects*
21. Renzi, F.; 2020; *Hubble speed from first principles*
22. Sousa-Silva, C.; 2020; *Finding an Alien Biosphere with Computational Chemistry*
23. Vilenkin, A.; 2020; *Black holes from vacuum bubbles*
24. Zumalacárregui, M.; 2020; *Dark Energy, the Hubble Problem and Gravitational-wave Propagation*

Observing Runs

1. S. Sousa, A. Mortier, N. Santos, Rojas Ayala, S. Ulmer-Moll, V. Adibekyan, Israelian, J. Camacho, O. Demangeon, S. Barros, A. Antoniadis Karnavas, E. Delgado Mena, P. Figueira, J. Faria, M. Tsantaki, "*Know the star to know the planet: improving SWEET-CAT with homogeneous planet-host parameters*", UVES, UT2@VLT ESO, SM P106
2. S. Sousa, N. Santos, E. Delgado Mena, V. Adybekian, Rojas Ayala, A. Mortier, P. Figueira, O. Demangeon, Israelian, S. Barros, J. Faria, M. Tsantaki, A. Antoniadis Karnavas, "*Know the star to know the planet: improving the catalog of exoplanet host stars with homogeneous parameters*", UVES, UT2@VLT ESO, SM P105
3. T. C. Scott, P. Lagos, E. Brinks, C. Senguputa, "*Searching for evidence of metal poor cold gas infall to low z galaxies*", VLA B and C array HI, 40hrs, 31 January 2020 to 8 August 2020
4. P. Lagos, Anna Saburova, T.C. Scott, S. Paudel, Chandreyee Sengupta, O. Egorov, R. Uklein, "*Low metallicity TDGs*", SCORPIO-2 multi-mode spectrograph on the Special Astrophysical Observatory of the Russian Academy of Sciences (SAO RAS) 6-m Big Telescope Alt-azimuth (BTA) telescope, 19/20 February 2020
5. Kelly Hambleton, Margarida Cunha, Victoria Antoci (3 Co-PIs) and TASC WG41; *TESS high-frequency a-f pulsators: understanding the driving of oscillations in intermediate-mass stars*; DDT/TESS 20-sec cadence mode; Cycle 3 (one year)
6. Samuel Grunblatt et al. (including M. Cunha), *Planetary archaeology: exploring the planet population around evolved stars with TESS*, TESS FFI, Cycle 3 (one year)
7. D. Holdsworth, D. Kurtz, and M. Cunha; *Asteroseismology of TIC 350146296: the shortest oscillating Ap star with a rich pulsation spectrum*; TESS 20-sec cadence mode; sectors 27 to 30

8. D. Holdsworth, D. Kurtz, and M. Cunha; *Testing the Oblique Pulsator Model with*
9. *simultaneous SAAO and TESS photometry*; Holdsworth-2020-05-40-inch-327, SHOC / 40 inch; 23 September 2020 - 20 October 2020
10. L. Maud, A. Ginsburg, R. Galvan-Madrid, F. van der Tak, A. Sanchez-Monge, M. Beltran, R. Cesaroni, C. Goddi, P. Klaassen, M. Hogerheijde, L. Moscadelli, D. Harsono, S. Purser, A. Izquierdo, V. Allen, N. Kumar, H. Beuther, V. M. Rivilla, L. Testi, M. Hoare, K. Johnston, N. Indriolo, "*Disk Stabilty, Grain Growth and Ionization in the proto-O-star*", G17.64+0.16 VLA/20B-099 Karl Jansky Very Large Array
11. J. Yun, P. Palmeirim, D. Arzoumanian; Yebes 40 m telescope; 32hours + 35 hours during the 1st semester 2020 in service mode
12. M. Rainer, E. Delgado Mena, et al.; "*A precise characterisation of the ARIEL stars*", AOT42/20, HARPS-N in TNG (Observatorio Roque de los Muchachos, La Palma), period 2020A and 2020B
13. C. Danielski, E. Delgado Mena et al.; "*A precise characterisation of the ARIEL stars*", 105.20P2, 106.21QS, UVES/VLT; P105-106 service mode
14. J. Faria; HARPS pool of observations, HARPS, ESO 3.6m, 9-15 December
15. V. Adibekyan; ESPRESSO GTO observations; ESPRESSO; 24 Feb -04 March
16. C. Danielski, T. L. Campante, M. Tsantaki, E. Delgado Mena et al.; "*A precise characterisation of the ARIEL stars*"; Program ID: 106.21QS; Ultraviolet and Visual Echelle Spectrograph (UVES) at the Very Large Telescope (VLT); Period 106
17. S. Benatti, T. L. Campante, M. Rainer, N. Sanna, et al.; "*A precise characterisation of the ARIEL stars*"; Program ID: A41TAC_45; High Accuracy Radial Velocity Planet Searcher (HARPS-N) at the Telescopio Nazionale Galileo (TNG); Period AOT41
18. C. Danielski, T. L. Campante, M. Tsantaki, E. Delgado Mena, et al.; "*A precise characterisation of the ARIEL stars*"; Program ID: 105.20P2; Ultraviolet and Visual Echelle Spectrograph (UVES) at the Very Large Telescope (VLT); Period 105
19. S. Ulmer-Moll, P. Figueira, N. Santos, J. Martins, J. Faria; "*Probing micro-tellurics and their impact on radial velocities*"; 106.2166; ESPRESSO VLT; 2020/P106
20. Jarle, Brinchmann, MUSE GTO team; "*A survey of ultra-faint galaxies with MUSE*", 104.D-0199; MUSE on VLT-UT4; 20/02/2020-24/02/2020
21. Manara, J. F. Gameiro et al., *PENELLOPE: the ESO data legacy program to complete the Hubble UV Legacy Library of Young Stars (ULLYSES)*

UnF – Training Unit

Head (for 2012-2020): 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 2020 were as follows:

- Doctoral level:
  - A total of 8 PhD theses were completed in the calendar year 2020: R. Albuquerque, L. B. Bezerra, I. A. Costa, B. Nsamba, P. Sarmento, L. Serrano, G. Teixeira, S. Ulmer-Moll
  - As of 31 December CAUP, was host to 22 PhD research projects.

- Masters level:
  - A total of 3 Masters thesis were completed in the calendar year 2020: M. Rosa, H. Silva, D. Vaz
  - As of 31 December CAUP, was host to 9 Master's thesis projects.

- Undergraduate level:
  - CAUP runs an extremely active program of research internships for undergraduate (and first-year masters) students, most (though not all) in the context of FCUP's PEEC program.

- A total of 14 such internships were completed in 2020. Several 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, 13 new internships were either in progress or scheduled to start in early 2021.

- Future projects: All research projects offered by CAUP researchers for the academic year 2020-21 were compiled and published in a CAUP Projects Booklet, available at the CAUP website (and in printed form at selected events). This list both projects intended for PhD and Masters theses and those intended for undergraduate internships. An updated edition is to be released in the Spring of each year, pertaining to the following academic year.

- Senior training:
  - We organize our own graduate-level courses, mostly responding to the perceived needs of the students in the unit. These can be either 'classical' graduate courses (open to everyone, and mostly theoretical) or 'hands-on' (practical, with limited attendance and primarily for students). In 2020 one such course was organized, jointly with ESA: a JWST masterclass (led by P. Palmeirim and co-organized by N. Kumar and C. Martins)
  - Due to COVID-19 it was not possible to organize soft skills training activities in 2020, since these can not be efficiently organized in an online format.
  - We also organize continuing education courses, mostly aimed at high-school teachers (in association with FCUP's continuing education programme, FOCO) but open to others (undergraduate or high-school students, etc). In 2020 we ran one edition of the course The Physics of Everyday Life (C. Martins, 25h, in February-March and partially online) and one edition of the course History of the Universe (J. Carvalho/C. Martins, 25h, in October-November and fully online).
  - We have also organized one edition of the ESERO course 'New tools for astronomy in secondary education' (C.Martins/J. Carvalho, 25h, in January-April and partially online).
- Junior training:
  - In 2020 we organized the eight edition of the AstroCamp (scientific director C. Martins). This is a 2-week selective residential school/summer camp for highly motivated high-school students (from the 10th, 11th and 12th grades), which took place on 9-23 August, at the CEIA in Paredes de Coura. Camp activities for the students included classes (30h, in English), observations, community service, and other leisure activities. Due to COVID-19 this edition exceptionally had a hybrid format, with the participants living in Portugal (7 students, 3 camp monitors and one teacher) in residence at the camp and the rest (9 students, 3 online tutors and one teacher) participating remotely in all activities where this was feasible. The camp included participants from Croatia, Finland, Germany, Greece, Hungary, Portugal and Spain.
  - We offered to participate in the 2020 edition of Ciência Viva's OCJF project, by hosting virtual internships, but this was refused by .Ciência Viva, who insisted that the internships should maintain the traditional in person format.

- Other activities:
  - Due to COVID-19 the usual 'Astronomy Students Day', aimed at undergraduate and masters students, was not organized; instead the electronic version of the 2020 CAUP Project Booklet was sent via e-mail to all U.Porto students doing relevant undergraduate and masters degrees.
  - In October-November 2020 we participated in the International Space Week's 'Space Goes to School' event, organized by Ciência Viva's ESERO office, giving more than 30 online talks in secondary schools across continental Portugal.
  - In the context of the CosmoESPRESSO FCT project we have organized 2 Job Shadowing days, with project members hosting a total of 6 high school students from various partner schools. We also provided sporadic help with other outreach activities (popular talks at CAUP and elsewhere, talks in schools, etc).

ND – Outreach Unit

Head (for 2009-2020): Filipe A. L. Pires, who is also the Executive Director of the Porto Planetarium.

Context

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

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

During 2020 we continued undertaking efforts to better integrate the Planetarium into the University of Porto Culture structures and Ciência Viva Network, we may for instance mention a series of podcasts made with Casa Comum at the Reitoria of the University of Porto.

The year of 2020 was marked by the COVID-19 Pandemic which deeply affected the activity of the Outreach Unit. Due to the restrictions applied on society most of the in-person initiatives, which are really key to the activities at the Planetarium of Porto, had to be cancelled. Despite this, we were able to quickly adapt and reinforce our online presence, transforming many of the activities into an online format.

Highlights

The activities developed by CAUP´s Outreach Unit during 2020 reached out to more than 22 500 people. The Porto Planetarium CCV received 10 246 visitors and 5 185 at the hands-on laboratories. About 72% of the visitors were students on school visits. The activities taking place at schools had the participation of 1 724 students and we reached more than 7 120 people through other science outreach activities including online events, not counting social media interactions nor news features sent to media outlets.
During 2020 we produced one new exhibit module “Meteoritos” that is already displayed at the planetarium hall.

Human Resources

During 2020, the human resources allocated to the Outreach Unit were:

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

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

• 2 teachers in “Mobilidade Estatutária” (deployed teacher), under a public servant contract with the Ministry of Education, via Ciência Viva national agency, for Planetarium activities, at 1 FTE: Ilídio André Costa and, since September 2020, José Dantas.

Regular Activities at the Porto Planetarium

Educational offer for schools: the offer implemented in 2017, continued to expand in 2020 by adding new didactic sequences.

● Planetarium shows: 10 246 visitors.

● Online presentations: Because of the restrictions caused by the pandemic, we did 3 free online sessions for the general public, engaged around 2 000 people

● Hands-on Laboratories: 5 185 visitors.

● "Mais Perto das Estrelas": Monthly sessions consisting of an introductory planetarium session to the night sky and observations of the night sky with small telescopes. Because of the limitations caused by Covid19 and bad weather conditions, only the January, August, September and October sessions took place. Total number of participants: 76.

Regular Activities at schools

● Portable Planetarium: planetarium sessions presented for a total of 1724 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" and "Cientificamente Provável".

● Workshops and observations in schools for a total of 1068 participants.

Regular activities in collaboration:

- Academia de Robótica - 11 students
- Ültimas notícias do Cosmos: 14 podcasts with Casa Comum
- Conversas Astronómicas: 4 podcasts with Casa Comum

Special events:

Women's and Girls' Day in Astronomy
On the 11 February, IA celebrated the "Women's and Girls' Day in Science", with activities aimed at demystifying the concept of a female scientist, particularly in areas such as physics and mathematics, and encouraging girls to pursue studies and careers in these areas. IA organised a webinar in which five female researchers talked about their journey in Science and answered questions from the public. The event took place online and got 766 views.

Dia Nacional da Cultura Científica 2020
On the 24th of November, the National Day of Scientific Culture is celebrated in Portugal. The IA, the National Reading Plan 2017-2027 (PNL 2027) and Planetário do Porto – Centro Ciência Viva joined efforts to celebrate the date with several online activities especially targeted for schools. These online events got 1522 views.

Dark Matter Day
On the 31st of October, IA and the Planetário do Porto - CCV organized the online public event Dark Matter Day. In this event, an online planetarium session was offered to the public and a panel of researchers answered the questions of the public about the Universe. This event got 467 views.

Conjunctions, occultations and other "stars of Bethlehem": The Great Jupiter and Saturn Conjunction
On the 21st of December 2020, the planets Jupiter and Saturn were so close in the night sky, they appeared to merge in a single "super-star", and this event has not been seen in over 400 years. To mark the event, on the previous day the Instituto de Astrofísica e Ciências do Espaço (IA) and the Porto Planetarium – Ciência Viva Center hosted an online debate, with IA researchers, about these ephemeris and their scientific and historical importance. This event got 464 views.

Especial Dia Mundial da Criança - Reabertura do Planetário do Porto
To celebrate World Children's Day, a rocket building workshop was offered to families, at Planetário do Porto CCV, and also the fulldome movie "O Despertar da Era Espacial". Engaged 12 people.

Training Courses for School Teachers

Organized and implemented the following training courses (TC) and short duration actions (SDA) for school teachers: TC "Compreender a Terra através do espaço" (2 editions), TC "Novas Ferramentas para a Astronomia no ensino secundário (2nd ed)", TC "Astronomia de Bolsa", TC "Ensino das ciências orientado para a resolução de problemas - Rumo à alfabetização científica", SDA "Descobrir o Universo com telescópios escolares". The total number of participants was 190.

Music under the planetarium dome
Organized three music concerts under the planetarium dome, accompanied by special live presentations of astronomical full dome content using SkyExplorer: Concert by Jorge Coelho, Jorge Queijo and Gustavo Costa "Lay Claim to the World as a Sphere Of Your own Agency" (6 February), Concert by Rodrigo Amado, Angélica V Salvi and João Pais Filipe (7 July). Total attendance: 120 people.

50 Anos das Missões Tripuladas Apollo
Organized debates to celebrate the 50th anniversary of the Apollo 13 mission (17 April). (https://up.pt/casacomum/conversas-astronomicas/1-apolo-13/)

Ciência Viva no Verão em Rede
Solar and night sky observations with small telescopes through the activities "Zoo Celeste" and "À Volta do Sol", "Quinta do Covelo" integrating the Ciência Viva no Verão em Rede program. Total number of participants 100.

Night Sky Observations with Small Telescopes - Other
Implemented the observation of the night sky with small telescopes at Parque da Devesa (Vila Nova de Famalicão) and Arouca. Engaged around 90 people.

"À descoberta do Universo"
The Porto planetarium hosted one of the sessions of talks, which included several Ciência Viva Centers, organized by researcher Tiago Campante. Engaged around 20 people.

"Scrolling the Arcane"
The Porto planetarium hosted a project coordinated by the artist Joana Pestana and with the participation of Alice Bucknell, Christina Worner, Daniel Martins, David Benqué, Diogo Tudela, Eva Papamargariti, Ken Hollings, Raquel Peixoto, Nestor Pestana and Tiago Patatas. Engaged around 80 people.

"COSMOS: Uma Nova Odisseia Ilustrada"
Collective art exhibition of illustration. We challenged 13 artists to watch the new season of "Cosmos" and make an illustrated narrative based on one episode. The exhibition could be seen physically at Galeria "Ó! Galeria" or online at http://planetario.up.pt/pt/evento/Cosmos2020

Porto/Post/Doc film festival
Co-organized with Porto/Post/Doc, in the context of the Porto/Post/Doc film festival, sessions of fulldome films, 20 and 27 of November Porto Planetarium. 60 participants

"O dia mais Curto" - 21 December
The planetarium was one of the 8th edition of the film festival hosted locations.

Dias Abertos FCUP
Faculdade de Ciência da U.Porto open days online event, 13-15 February. IA was present with astronomy related activities that reached around 200 participants.

Clubes Ciência Viva nas Escolas
In the context of the Clubes Ciência Viva nas Escolas project, promoted by the Ciência Viva national agency, for the implementation of various A&A activities with schools, protocols were established with 14 schools: AE Padrão da Légua, ES Filipa Vilhena, AE Soares dos Reis, AE Moimenta da Beira, AE Pero Vaz de Caminha, AE Santa Bárbara, AE Serafim Leite, AE Baião Sudeste, AE Rates, AE Rainha Santa Isabel, AE Carolina Michaelis, AE nº 1 de Gondomar, AE Miranda do Douro, Escola Secundária com 3º Ciclo de Paços de Ferreira,

Staff Training:

"Como comunicar ciência… fora da caixa" - 7 to 9 setember, Estremoz [Elsa Moreira]

Contributed/Invited Talks & Posters

Invited Talks:

1. O CoAstro vai à FEUP, Costa, Ilídio André; Faculdade de Engenharia da Faculdade do Porto, Porto, Portugal, 12/02/2020.
2. O CoAstro vai à FCUP, Costa, Ilídio André; Faculdade de Ciências da Faculdade do Porto, Porto, Portugal, 20/11/2020.
3. Um dia muito Especial, ESERO-Portugal – O Espaço vai à Escola, Costa, Ilídio André; Marinha Grande (virtual), Portugal, 30/10/2020.
4. Com a verdade me enganas, ESERO-Portugal – O Espaço vai à Escola, Costa, Ilídio André; Machico (virtual), Portugal, 29/10/2020.
5. Com a verdade me enganas, ESERO-Portugal – O Espaço vai à Escola, Costa, Ilídio André; Machico (virtual), Portugal, 27/10/2020.
6. Um dia muito Especial, ESERO-Portugal – O Espaço vai à Escola, Costa, Ilídio André; Gondomar (virtual), Portugal, 26/10/2020.
7. Com a verdade me enganas, ESERO-Portugal – O Espaço vai à Escola, Costa, Ilídio André; Lisboa (virtual), Portugal, 23/10/2020.
8. Science communication to research and research for science communication; Costa, Ilídio André & Moreira Elsa; IA-ON 7 - 7th internal IA workshop, Porto (virtual), Portugal, 21/10/2020
9. Ótica do Patrono, Costa, Ilídio André; Agrupamento de Escolas Dr. Carlos Pinto Ferreira, Vila do Conde, Portugal, 06/02/2020.

Contributed Talks:

1. Astronomy in Culture: partnerships with art schools and cultural agents, S. Pereira, P. Pereira, J. Retrê, F. Pires (2020), 30º Encontro Nacional de Astronomia e Astrofísica (30º ENAA), 11 setembro 2020, Online.
2. A Solar System game in times of a pandemic, C. Leote, S. Pereira, J. Retrê, P. Machado, G. Gilli, J. Silva, M. Silva, R. Gonçalves, P. Sarmento, A. Cardesín, P. Pereira (2020), 30º Encontro Nacional de Astronomia e Astrofísica (30º ENAA), 11 setembro 2020, Online.
3. A arte como meio para compreender o Universo, S. Rodrigues, 8º Congresso SciComPT 2020, 27 maio 2020, Online.
4. CoAstro: @n Astrononomy Condo, Costa, Ilídio André; Space Talks online series – Ecsite (European Network of Science Centres and Museums) Space Group, Bruxelas (virtual), Bélgica, 2/12/2020.
5. CoAstro: @n Astronomy Condo – research and science communication in a Portuguese citizen science project, Costa, Ilídio André; 30th Encontro Nacional de Astronomia e Astrofísica & Sociedade Portuguesa de Astronomia, Porto (virtual), Portugal, 11/09/2020.
6. CoAstro: @n Astronomy Condo – Teachers´ Attitudes and Epistemological Beliefs Towards Science in a Citizen Science Project, Costa, Ilídio André; International Conference on Education and New Developments 2020, Zagreb (virtual), Croácia, 28/06/2020.
7. CoAstro: um Condomínio de Astronomi@ – uma nova proposta para a ciência cidadã, Costa, Ilídio André; Congresso SiComPt 2020, Lagoa – Açores (virtual), Portugal, 15/05/2020.
8. CoAstro: @n Astronomy Condo – Development of Teachers´ Knowledge of Astronomy Trough a Citizen Science Project, Costa, Ilídio André; INTED2020 - 14th Annual International Technology, Education and Development Conference, Valencia (virtual), Espanha, 04/03/2020.

Invited Workshops:

1. Communicating science to the public and the media, R. Reis, S. Pereira (2020), IA-ON7, 22 October 2020, Online.
2. Ação de formação de curta duração, Costa, Ilídio André; Vila do Conde, Astro…quê?, 15/09/2020.
3. Oficina de formação (30 horas), Costa, Ilídio André; Gondomar, Ensino das Ciências orientado para a resolução de problemas: rumo à alfabetização científica, 03/02/2020 a 03/04/2020
4. Oficina de formação (30 horas), Costa, Ilídio André; Cucujães, Ensino das Ciências orientado para a resolução de problemas: rumo à alfabetização científica, 10/10/2020 a 12/12/2020
5. Oficina de formação (30 horas), Costa, Ilídio André; Loureiro, Ensino das Ciências orientado para a resolução de problemas: rumo à alfabetização científica, 10/10/2020 a 12/12/2020

Publications

1. [2037173] Costa, Ilídio André. 2020. "Ciência cidadã: envolvimento do público na investigação e divulgação em astronomia". Tese de Doutoramento, Universidade do Porto Faculdade de Ciências.
2. [10.36315/2020end025] Costa, Ilídio André; Morais, Carla; Monteiro, Mário João. "CoAstro: @n Astronomy Condo – Teachers´ Attitudes and Epistemological Beliefs Towards Science in a Citizen Science Project". 2020. International Conference on Education and New Developments. WIARS - InScience Press, pp. 113-117.
3. [10.21125/inted.2020.1741] Costa, Ilídio André; Morais, Carla; Monteiro, Mário João. "CoAstro: @n Astronomy Condo – Development of Teachers´ Knowledge of Astronomy Through a Citizen Science Project". 2020. 14th Annual International Technology, Education and Development Conference IATED, pp. 6518-6526 (UID/FIS/04434/2013).
4. [978-989-54815-1-4] Costa, Ilídio André; Morais, Carla; Monteiro, Mário João. "CoAstro: @n Astronomy Condo – Teachers´ Attitudes and Epistemological Beliefs Towards Science in a Citizen Science Project". 2020. International Conference on Education and New Developments. WIARS - InScience Press, pp. 16.

UnAS – Administration and Services Unit

Head (for 2012-2020): Manuel A. S. Monteiro

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

During 2020 the pandemic caused by covid-19 introduced unexpected challenges that required changes to standard working methods and procedures. The productivity and communication were greatly affected by remote work, especially at the beginning. In addition to understanding how work could be done remotely, the IT infrastructure had to be adapted to provide sufficient secure access solutions for the increased number of remote users. Cyber security was also a great concern due to the enormous increase of tailored phishing campaigns.

During this year:

- One staff member continues to be dedicated to support the principal investigators of European and national projects, and as a project manager for IA;
- A new staff member dedicated to public procurement and human resources started;
- Number of allowed simultaneous VPN connections increased;
- Deployment of a new dedicated gateway for SSH tunneling;
- Network security policies hardened to decrease the number of potential attack vectors.

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

- Preparation and submission to FCT of 18 *pedidos de pagamento*;
- Submission to FCT of 13 *pedidos de pagamento* for *Investigador FCT*;
- Preparation and submission to EU of 1 *pedidos de pagamento*;
- Preparation and submission to *Ciência Viva* of 2 *pedidos de pagamento*.

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

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

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

- *Sessão de Informação|Concurso de Projetos de IC&DT em todos os Domínios Científicos 2020 (FCT)*, 7 February - U.Porto (Elsa Silva)
- *Portal BASE - Gestão de Artigos e Faturas - Portaria 284/2019*, 21-21 July - IGAP (Marlene Cruz)
- *Webinar Reporte Financeiro e Auditoria no H2020*, 23 July - PERIN/ANI/FCT (Elsa Silva)
- *III Encontro Formativo da Rede Ciência Viva*, 7-9 September - Centro Ciência Viva de Estremoz (Elsa Silva)
- *3ª reunião do GT IAF*, 17 September - U.Porto (Elsa Silva)
- *Conversa sobre a convocatória aos Laboratórios Associados*, 29 September - Plataforma PIC (Elsa Silva)
- *Sessão de divulgação "Programa Erasmus+/KA2 - Parcerias para a Criatividade"*, 30 September - Agência Nacional Erasmus + Educação e Formação e Centro de Informação Europa Criativa (Elsa Silva)
- *CCP - Elaboração das Peças do Procedimento: convite, programa e caderno de encargos - ATUALIZADO*, 6-9 October - IGAP (Marlene Cruz)
- *Espaço 2030: A Agência Espacial Portuguesa*, 9 December - Abreu Advogados (Elsa Silva)
- *Horizon Europe PERIN-FCT: Info Sessions*, 10 December - FCT/PERIN (Elsa SIlva)
- *Webinar Restituição do IVA p/ Atividades Científicas*, 11 December - U.Porto (Elsa Silva, Argentina Pereira, Manuel Monteiro)

Contas e Relatório e Parecer do Conselho Fiscal

Balanço em 31 de dezembro de 2020

Valores em euro:

RUBRICAS	NOTAS	DATAS	
		31/12/2020	31/12/2019
ACTIVO			
Activo não corrente			
Activos fixos tangíveis	5	216 045.51	324 225.05
Activos intangíveis	4	8 898.29	11 227.32
Investimentos financeiros	15.2	14 921.57	14 379.70
		239 865.37	349 832.07
Activo corrente			
Inventários	6	4 327.37	4 358.22
Créditos a receber	8	16 987.89	43 216.42
Estado e Outros Entes Públicos	8	22 697.89	0.00
Diferimentos	8	9 966.24	3 393.85
Outros ativos correntes	8/15.1	2 646 896.72	2 107 206.08
Caixa e depósitos bancários		477 298.51	1 009 191.35
		3 178 174.62	3 167 365.92
Total do activo		**3 418 039.99**	**3 517 197.99**
FUNDOS PATRIMONIAIS E PASSIVO			
Fundos Patrimoniais			
Resultados transitados	8	1 026 233.29	970 617.63
Ajustamentos/Outras variações nos fundos patrimoniais	8	204 059.44	310 382.02
		1 230 292.73	1 280 999.65
Resultado líquido do período	8	-27 459.79	55 615.66
Total dos fundos patrimoniais		1 202 832.94	1 336 615.31
Passivo			
Passivo corrente			
Fornecedores	8	885.60	18 350.58
Estado e outros entes públicos	8	42 833.41	54 898.92
Diferimentos	8	1 648 703.39	1 201 901.65
Outros passivos correntes	8	522 784.65	905 431.53
		2 215 207.05	2 180 582.68
Total do passivo		2 215 207.05	2 180 582.68
Total dos fundos patrimoniais e do passivo		**3 418 039.99**	**3 517 197.99**

Demonstrações Financeiras

Alterações no capital

Demonstração individual das alterações nos fundos patrimoniais no período de 2019

DESCRIÇÃO		NOTAS	Fundos Patrimoniais atribuídos aos instituidores da entidade-mãe								Interesses que não controlam	Total dos fundos patrimoniais
			Fundos	Encedentes Técnicos	Reservas	Resultados Transitados	Excedentes de revalorização	Ajustamentos/Outras variações nos fundos patrimoniais	Resultado líquido do período	Total		
POSIÇÃO NO INÍCIO DO PERÍODO 2019	1					868217.84		418252.53	102399.79	1388870.16		1388870.16
ALTERAÇÕES NO PERÍODO												
Primeira adopção de novo referencial contabilístico								0.00		0.00		0.00
Alterações de políticas contabilísticas												
Diferenças de conversão de demonstrações financeiras												
Realização de excedente de revalorização												
Excedentes de revalorização												
Ajustamentos por impostos diferidos												
Outras alterações reconhecidas nos fundos patrimoniais						102399.79		-107870.51	-102399.79	-107870.51		-107870.51
	2					102399.79		-107870.51	-102399.79	-107870.51		-107870.51
RESULTADO LÍQUIDO DO PERÍODO	3								55615.66	55615.66		55615.66
RESULTADO INTEGRAL	4=2+3								-46784.13	-52254.85		-52254.85
OPERAÇÕES COM INSTITUIDORES NO PERÍODO												
Fundos												
Subsídios, doações e legados												
Distribuições												
Outras operações												
	5											0.00
POSIÇÃO NO FIM DO PERÍODO 2019	6=1+2+3+5					970617.63		310382.02	55615.66	1336615.31		1336615.31

Demonstração individual das alterações nos fundos patrimoniais no período de 2020

DESCRIÇÃO		NOTAS	Fundos Patrimoniais atribuídos aos instituidores da entidade-mãe								Interesses que não controlam	Total dos fundos patrimoniais
			Fundos	Encedentes Técnicos	Reservas	Resultados Transitados	Excedentes de revalorização	Outras variações nos fundos patrimoniais	Resultado líquido do período	Total		
POSIÇÃO NO INÍCIO DO PERÍODO 2020	6					970617.63		310382.02	55615.66	1336615.31		1336615.31
ALTERAÇÕES NO PERÍODO		2										
Primeira adopção de novo referencial contabilístico												
Alterações de políticas contabilísticas												
Diferenças de conversão de demonstrações financeiras												
Realização de excedente de revalorização												
Excedentes de revalorização												
Ajustamentos por impostos diferidos												
Outras alterações reconhecidas nos fundos patrimoniais						55615.66		-106322.58	-55615.66	-106322.58		-106322.58
	7					55615.66		-106322.58	-55615.66	-106322.58		-106322.58
RESULTADO LÍQUIDO DO PERÍODO	8								-27459.79	-27459.79		-27459.79
RESULTADO INTEGRAL	9=7+8								-83075.45	-133782.37		-133782.37
OPERAÇÕES COM INSTITUIDORES NO PERÍODO												
Fundos												
Subsídios, doações e legados												
Distribuições												
Outras operações												
	10											0.00
POSIÇÃO NO FIM DO PERÍODO 2020	6+7+8+10					1026233.29		204059.44	-27459.79	1202832.94		1202832.94

Fluxos de Caixa

RUBRICAS	NOTAS	PERÍODOS	
		31-12-2020	31-12-2019
Fluxos de Caixa das actividades operacionais-método directo			
Recebimento de Clientes e Utentes		178 892.19	187 782.73
Pagamentos de subsídios			
Pagamentos de apoios			
Pagamentos de bolsas		-83 028.87	-122 042.64
Pagamento a fornecedores		-135 706.45	-296 574.32
Pagamentos ao pessoal		-1 233 145.39	-1 188 755.39
Caixa gerada pelas operações		-1 272 988.52	-1 419 589.62
Pagamento/recebimento do imposto s/ rendimento			
Outros recebimentos/pagamentos		764 088.21	2 068 368.08
FLUXO DE CAIXA DAS ACTIVIDADES OPERACIONAIS		-508 900.31	648 778.46
Fluxos de caixa das actividades de investimento			
Pagamentos respeitantes a :			
Activos fixos tangíveis		-43 730.46	-45 116.63
Activos intangíveis			-6 119.15
Investimentos financeiros		-541.87	-3 251.40
Outros activos			
Recebimentos provenientes de:			
Activos fixos tangíveis			
Activos intangíveis			
Investimentos financeiros			
Outros activos			
Subsídios ao investimento		20 004.95	23 989.34
Juros e rendimentos similares		1 274.85	1 271.40
Dividendos			
FLUXO DE CAIXA DAS ACTIVIDADES DE INVESTIMENTO		-22 992.53	-29 226.44
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			-1.87
Dividendos			
Redução de fundos			
Outras operações de financiamento			
FLUXO DE CAIXA DAS ACTIVIDADES DE FINANCIAMENTO		0.00	-1.87
VARIAÇÃO DE CAIXA E SEUS EQUIVALENTES		-531 892.84	619 550.15
EFEITO DAS DIFERENÇAS CÂMBIO			
CAIXA E SEUS EQUIVALENTES NO INICIO PERIODO		1 009 191.35	389 641.20
CAIXA E SEUS EQUIVALENTES NO FIM PERIODO		477 298.51	1 009 191.35

Resultados por natureza

RENDIMENTOS E GASTOS	NOTAS	PERIODOS	
		31/12/2020	31/12/2019
Vendas e serviços prestados	9	152 361.96	202 436.45
Subsídios, doações e legados á exploração	7	1 336 622.08	1 665 765.52
Custo das mercadorias vendidas e das matérias consumidas	6	-1.95	-2.40
Fornecimentos e serviços externos	10	-103 720.03	-324 978.69
Gastos com o pessoal	11	-1 318 987.25	-1 318 743.65
Aumentos/reduções justo valor	15.2	-979.20	-632.30
Outros rendimentos	12	141 325.31	134 182.35
Outros gastos	13	-91 732.43	-147 547.88
Resultado antes de depreciações, gastos de financiamento e impostos		114 888.49	210 479.40
Gastos/reversões de depreciação e de amortização	5/6	-143 623.13	-156 133.27
Resultado operacional (antes de gastos de financiamento e impostos)		-28 734.64	54 346.13
Juros e rendimentos similares obtidos	9/14	1 274.85	1 271.40
Juros e gastos similares suportados	14	0.00	-1.87
Resultado antes de impostos		-27 459.79	55 615.66
Resultado líquido do período		-27 459.79	55 615.66

Anexo

Anexo às demonstrações financeiras do período findo em 31 de Dezembro de 2020.

(Montantes expressos em euros).

1. NOTA INTRODUTÓRIA

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

É uma associação científica e técnica privada, sem fins lucrativos e reconhecida de utilidade pública. Inscreve entre os seus objectivos apoiar e promover a Astronomia, nomeadamente:

- a investigação cientifica;
- a formação ao nível pós-graduado e universitário;
- o ensino da Astronomia ao nível não universitário (ensino básico e secundário);
- e a divulgação da ciência e promoção da cultura científica.

2. REFERENCIAL CONTABILÍSTICO DE PREPARAÇÃO DAS DEMONSTRAÇÕES FINANCEIRAS

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

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

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

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

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

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

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

3.1- Bases de apresentação

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

3.2 - Rédito

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

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

- O montante do rédito pode ser mensurado com fiabilidade;
- É provável que benefícios económicos futuros associados à transacção fluam para o CENTRO DE ASTROFÍSICA;

3.3 – Subsídios e outros apoios

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

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

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

A contabilização da atribuição dos subsídios a projetos iniciados em 2018, está refletida na conta 278, bem como o saldo ainda a receber relativo ao Projeto Estratégico.

3.4- Ativos fixos tangíveis

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

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

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

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

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

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

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

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

3.5 - Intangíveis

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

3.6 - Imparidade de activos fixos tangíveis e intangíveis

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

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

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

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

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

3.7 - Activos e passivos financeiros

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

Clientes e dívidas de terceiros

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

Caixa e equivalentes a caixa

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

Contas a pagar

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

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

Na preparação das demonstrações financeiras anexas foram efectuados juízos de valor e estimativas e utilizados diversos pressupostos que afectam as quantias relatadas de activos e passivos, assim como as quantias relatadas de rendimentos e gastos do período. Durante o decurso do ano de 2020, 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 2019.

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

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

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

Activos fixos tangíveis / estimativas de vidas úteis

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

3.9 - Acontecimentos subsequentes

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

3.10 - Especialização dos exercícios

As receitas e despesas são registadas de acordo com o princípio da especialização de exercícios, pelo qual estas são reconhecidas á medida em que são geradas, independentemente do momento em que são recebidas ou pagas.

As diferenças entre as receitas e despesas geradas e os correspondentes montantes facturados são registadas nas rubricas de diferimentos.

4. ACTIVOS INTANGÍVEIS

Durante os períodos findos em 31 de Dezembro de 2020 e 31 de Dezembro de 2019, o movimento ocorrido na quantia escriturada dos activos intangíveis, bem como nas respectivas amortizações acumuladas, foi o seguinte:

Activos intangíveis: quantias brutas escrituradas	Projectos de desenvolvimento	Programas de computador			Activos intangíveis em curso	Totais
	Outros		Marcas comerciais			
Saldo Inicial		4.077,14	17.492.90			21.570,04
Adições						
Revalorizações						
Transferências						
Alienações						
Sinistros						
Abates						
Saldo Final		4.077,14	17.492,90			21.570,04

Activos intangíveis: amortizações	Projectos de desenvolvimento	Programas de computador			Activos intangíveis em curso	Totais
	Outros		Marcas comerciais			
Saldo Inicial		4.077,14	6.265,58			10.342,72
Reforços			2.329,03			2.329,03

	Reversões						
	Alienações						
	Sinistros						
	Abates						
	Saldo Final		4.077,14	8.594.61			12.671,75

5. ACTIVOS FIXOS TANGÍVEIS

Durante os períodos findos em 31 de Dezembro de 2020 e 31 de Dezembro de 2019, 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	956.193,86	35.400,00	790.883,44	45.266,88		1.827.744,18
Adições	33.104,27		1.143.62			34.247,89
Revalorizações						
Alienações						
Transferências						
Abates	1.199.99					1.199.99
Saldo Final	988.098.14	35.400,00	792.027,06	45.266,88		1.860.792,08

Activos fixos tangíveis: depreciações	Equipamento básico	Equipamento de transporte	Equipamento administrativo	Outros activos fixos tangíveis	Activos fixos tangíveis em curso	Totais

Saldo Inicial	683.380,02	35.400,00	751.568,54	33.170,57		1.503.519,13
Reforços	115.853,39		21.747,20	3.693,51		141.294,10
Reversões						
Alienações						
Abates	66,66					66,66
Saldo Final	799.166.75	35.400,00	773.315,74	36.864,08		1.644.746,57

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 2020 e em 31 de Dezembro de 2019 é detalhado conforme segue:

CMVMC		Mercadorias	TOTAIS
Em 31.12.2020	Saldo Inicial	4.358,22	4.358,22
	Compras	62,50	62,50
	Regularizações (+/-)	-91,40	-91,40
	Saldo Final	4.327,37	4.327,37

	CMVMC	1,95	1,95
Em 31.12.2019	Saldo Inicial	4.611,12	4.611,12
	Compras		
	Regularizações (+/-)	-250,50	-250,50
	Saldo Final	4.358,22	4.358,22
	CMVMC	2,40	2,40

7. SUBSÍDIOS E OUTROS APOIOS

O montante dos subsídios, reconhecidos nos períodos findos em 31 de Dezembro de 2020 e em 31 de Dezembro de 2019, é detalhado como se segue:

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

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

Relação dos subsídios obtidos			Quantias Concedidas	
			2020	2019
Não reembolsáveis	Subsídios relacionados com activos	Estado e Outros Entes Públicos	11.164,95	23.989,34
		Outras Entidades	8.840,00	
		Subtotais	20.004,95	23.989,34
	Subsídios à exploração	Estado e Outros Entes Públicos	1.246.901.74	1.574.205,05
		Outras Entidades	89.720,34	91.560,47

	Subtotais	1.336.622.08	1.665.765,52
Totais		1.356.627,03	1.689.754,86

8. INSTRUMENTOS FINANCEIROS

CRÉDITOS A RECEBER						
	Quantia Nominal		Imparidade		Valor Liquido	
	2020	2019	2020	2019	2020	2019
Clientes Correntes	16.987,89	43.216,42			16.987,89	43.216,42
Clientes Cob. Duvidosa						
Totais	16.987,89	43.216,42	0	0	16.987,89	43.216,42

	OUTROS ATIVOS CORRENTES	
	2020	2019
Fornecedores (Saldos contrários)		31,74
Adiant. e outras operações c/ pessoal		

Adiant. A foenecedores de investimentos		
Devedores por acréscimo de rendimentos		
Juros a receber		
Subsídios a receber	85.000,00	6.000,00
Outros acréscimos de rendimentos	93.674.21	139.575,85
Outros devedores	2.397.398,51	1.889.795,29
Totais	2.576.072,72	2.035.402,88

	ESTADO E OUTROS ENTES PÚBLICOS	
	2020	2019
Finanças	-5.740,89	30.518,92
Segurança Social e Fundo de Compensação	25.876,41	24.380,00
Totais	20.135,52	54.898,92
Saldos Devedores		
Retenção Imp. s/ Rendimento		
Iva Restituição	2.567,93	
Iva a recuperar	20.129,96	
Restantes impostos		
Totais	22.697,89	0
Saldos Credores		

Corrente		
Retenção Imp. s/ Rendimento	16.957,00	15.655,00
Iva a pagar		14.863,92
Contribuições seg. social	25.242,84	23.731,85
Outras Tributações (Fundo de Compensação)	633,57	648,15
Totais	42.833.41	54.898,92

	DIFERIMENTOS	
	2020	2019
Gastos a reconhecer		
Seguros	904,15	802,84
Outros gastos diferidos	9.062,09	2.591.01
Totais	9.966,24	3.393,85
Rendimentos a reconhecer		
Subsídios	1.648.053,44	1.201.739,05

Outros rendimentos	649.95	162,60
Totais	1.648.703,39	1.201.901,65

	OUTROS PASSIVOS CORRENTES	
	2020	2019
Não correntes		
Clientes (saldos contrários)		
Pessoal		
Fornecedores de investimentos		
Totais	0	0
Correntes		
Clientes (saldos contrários)	301,70	
Pessoal		
Fornecedores de investimentos		
Credores por acréscimos de gastos		
Remunerações a pagar	176.413,09	179.969,74
Outros acréscimos de gastos	2.831.40	7.255,54
Outros Credores	343.238,46	718.206,25
Totais	522.784,65	905.431,53

	FORNECEDORES	
	2020	2019
Fornecedores, conta corrente	885,60	18.350,58
Fornecedores, títulos a pagar		
Fornecedores, faturas em rec. conf.		
Totais	885,60	18.350,58

MOVIMENTOS NAS RUBRICAS DE FUNDOS PATRIMONIAIS

	Saldo Inicial	Aumentos	Reduções	Saldo Final
Fundos				
Reservas				
Resultados transitados	970.617,63	55.615,66		1.026.233,29
Excedentes de revalorização				
Outras variações nos fundos patrimoniais	310.382,02	20.004,95	126.327,53	204.059,44
Resultado liquido do exercício	55.615,66	-27.459,79	55.615,66	-27.459,79
Totais	1.336.615.31	48.160.82	181.943,19	1.202.832,94

9. RÉDITO

Em 31 de Dezembro de 2020 e em 31 de Dezembro de 2019 os réditos apresentavam a seguinte composição:

Quantias dos réditos reconhecidas no período	2020	2019
	Réditos reconhecidos no período	Réditos reconhecidos no período
Venda de bens	7,41	9.12
Prestação de serviços	152.354,55	202.427,33
Juros	1.274,85	1.271,40

Royalties		
Dividendos		
Totais	153.636,81	203.707,85

10. FORNECIMENTOS E SERVIÇOS EXTERNOS

A rubrica de "Fornecimentos e serviços externos" em 31 de Dezembro de 2020 e 31 de Dezembro de 2019 é detalhada conforme se segue:

Fornecimentos e Serviços Externos	2020	2019
Subcontratos	2.385,10	6.367,50
Serviços Especializados:	**42.006,86**	**30.866,50**
Trabalhos Especializados	10.651,80	12.742,80
Publicidade e propaganda	446,64	204,18
Vigilância e Segurança	93,09	
Honorários	13.269,00	5.791,45
Conservação e Reparação	16.806,33	11.120,93
Outros Serviços Especializados	740,00	1.007,14
Materiais	**23.926,27**	**64.403,51**
Energia e fluídos	**135,70**	**442,15**
Deslocações, Estadas e Transportes	**22.857,42**	**188.776,94**

Serviços Diversos:	**12.408,68**	**34.122,09**
Rendas e Alugueres		1.850,00
Comunicação	142,48	291,00
Seguros	2.400,44	2.873,51
Contencioso e notariado	1.786,40	
Limpeza, higiene e conforto		
Outros Serviços	8.079,36	29.107,58
Totais	103.720,03	324.978,69

11. GASTOS COM O PESSOAL

A rubrica de "Gastos com o pessoal" em 31 de Dezembro de 2020 e em 31 de Dezembro de 2019 detalha-se da seguinte forma:

Gastos com o Pessoal	2020	2019
Remunerações do Pessoal	1.083.644,67	1.083.157,41
Encargos sobre Remunerações	225.315,19	225.211,30
Seguro de acidentes de trabalho e doenças profissionais	7.986,75	8.493.06
Outros gastos com Pessoal	2.040,64	1.881,88
Totais	1.318.987,25	1.318.743,65

12. OUTROS RENDIMENTOS

A composição da rubrica de "Outros rendimentos e ganhos" em 31 de Dezembro de 2020 e 31 de Dezembro de 2019 é conforme se segue:

Outros Rendimentos	2020	2019
Descontos de pronto pagamento		74,24
Rendimentos e ganhos rest. Activos financeiros	53,32	162,33
Rendimentos e ganhos em Inv. não financeiros	66,66	
Outros	141.205,33	133.945,78
Totais	141.325,31	134.182,35

13. OUTROS GASTOS

A decomposição da rubrica de "Outros gastos e perdas" em 31 de Dezembro de 2020 e em 31 de Dezembro de 2019 é conforme se segue:

Outros Gastos	2020	2019
Impostos	59,08	54,96
Perdas em Inventários		
Gastos e Perdas em Investimentos Não Financ.		
Outros	91.673,35	147.492,92
Totais	91.732,43	147.547,88

14. JUROS E OUTROS RENDIMENTOS E GASTOS SIMILARES

Os gastos e perdas de financiamento em 31 de Dezembro de 2020 e 31 de Dezembro de 2019 são detalhados conforme se segue:

Juros e Rendimentos Similares Obtidos	2020	2019
Juros Depósitos	10,15	214,59
Outros	1.264,70	1.056,81
Totais	1.274,85	1.271,40

Juros e Gastos Similares Suportados	2020	2019
Juros Suportados		1.87
Diferenças de câmbio desfavoráveis		
Outros		
Totais	0	1.87

15. OUTRAS INFORMAÇÕES

15.1. Outros Ativos Correntes

OUTROS ATIVOS CORRENTES			
	Quantia Nominal	Aum/Red.J.Valor	Valor Liquido

	2020	2019	2020	2019	2020	2019
Obrigações do Tesouro	71.803,20	72.435,50	-979,20	-632,30	70.824,00	71.803,20
Totais	71.803,20	72.435,50	-979,20	-632,30	70.824,00	71.803,20

15.2. Investimentos Financeiros

INVESTIMENTOS FINANCEIROS						
	Quantia Nominal		Imparidade		Valor Liquido	
	2020	2019	2020	2019	2020	2019
Fundo Compensação	14.921,57	14.379,70			14.921,57	14.379,70
Totais	14.921.57	14.379,70	0	0	14.921.57	14.379,70

16. DATA DE AUTORIZAÇÃO PARA EMISSÃO

As demonstrações financeiras do exercício findo em 31 de Dezembro de 2020 foram aprovadas pela Direcção e autorizadas para emissão em 5-04-2021.

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 2020, 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 2020, que compreendem o Balanço (que evidencia um total de 3.418.039,99 euros e um total dos fundos patrimoniais de 1.202.832,94 euros, incluindo um resultado líquido do período negativo de 27.459,79 euros), a Demonstração dos Resultados, a Demonstração dos Fluxos de Caixa e o respetivo Anexo, composto pelas notas explicativas.

A análise dos documentos acima referidos permite concluir pela boa compreensão da situação financeira do CAUP em 31 de dezembro de 2020, 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 2020.

Porto, 19 de abril de 2021.

Presidente,

[redacted]

(Dr. Filipe Pires)

Vogal,

[redacted]

(Prof. Jorge F. Gameiro)

Relator,

[redacted]

(Dr. João Carlos Ribeiro)