Annual Report 2020

Instituto de Astrofísica
Facultad de Física
Pontificia Universidad Católica de Chile

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Abstract

The Institute of Astrophysics (IA) at the *Pontificia Universidad Católica de Chile* (PUC) has, as of December 31st, 2020, 15 active faculty members, one emeritus professor, 22 postdoctoral researchers, and about 30 graduate students. IA members published together 194 refereed articles in peer-review journals during 2020. In the academic year 2020, 15 students received their *Licenciatura* degree, 7 obtained a M.Sc., and one a PhD degree.

1 Introduction

The *Instituto de Astrofísica* (Institute of Astrophysics, IA) is one of the two academic divisions of the Faculty of Physics of *Pontificia Universidad Católica de Chile* (PUC). The Institute offers an undergraduate (Licenciatura) degree in Astronomy, and PhD and Master's programmes in Astrophysics.

The IA is becoming an international center of excellence for studies in the field of Astrophysics, covering a broad range of topics in observational and theoretical astrophysics, and is preparing the next generations of students that will benefit from the superb observational facilities available to astronomers working in Chilean institutions and their collaborators. In addition, the IA together with the associated Center for Astro-Engineering (AIUC) are engaged in innovative telescope instrumentation projects and high-performance computing programs for astrophysical simulations data mining. In this report, we review the main activities at IA from January 1st 2020 until December 31st 2020. The IA activities and details can be reached at the web page `http://www.astro.uc.cl`.

2 Personnel Changes in 2020

2.1 Faculty

- Prof. Dr. Jorge Cuadra left the Institute on February 2020.
- Prof. Dr. Patricia Tissera arrived at the Institute on September 2020
- Prof. Dr. Cristóbal Petrovic arrived at the Institute on October 2020.

2.2 Postdoc Arrivals

- Dr. Elizabeth Artur de la Villarmois, from University of Copenhagen, Dinamarca
- Dr. Francisco Cesar De Gerónimo, from Universidad Nacional de La Plata (UNLP), Argentina
- Dr. Carolina Elizabeth Finlez Ruiz, from Universidad de Concepción, Chile

2.3 Postdoc Departures

- Dr. Rafael Andrés Brahm Scott, left to take a position as Academic, Universidad Adolfo Ibañez, Santiago, Chile
- Dr. Julio Alberto Carballo Bello, left to take a position as Researcher, Universidad de Tarapacá, Chile
- Dr. Nicolás Cuello, left to take a position as Marie Curie Postdoc Fellow, France
- Dr. Holger Drass, lives in Chile
- Dr. Evelyn Joanne Johnston, left to take a faculty position at Universidad Diego Portales, Chile
- Dr. Andrea Kulier, lives in Netherlands
- Dr. Boris Alejandro Panes Saavedra, lives in Chile
- Dr. Athanasios Papageorgiou, lives in Greece
- Dr. Roberto Puddu, lives in Italy.
- Dr. Federica Ricci, took a position in Bologna, Italy
- Dr. Christopher Michael Post Russell, took a position as postdoc, University of Delaware, USA
- Dr. Fabio Vito, took a postdoc position in Pisa, Italy.

3 IA Members

3.1 Faculty

List of faculty members at the IA as of late 2020.

- Dr. Felipe Barrientos, Associate Professor, IA Director since August 2020 (PhD University of Toronto, Canada, 1999) – *Galaxy evolution and morphology. Elliptical galaxies. Clusters of galaxies. Observational cosmology.*

- Dr. Franz E. Bauer, Associate Professor, Head of the Computing Area (PhD University of Virginia, USA, 2001) – *AGN Demographics, Feeding, and Evolution. Coeval Growth of Galaxies and Super-Massive Black Holes. Deep Blank-field Surveys (Radio through X-ray). Nearby Supernovae and X-ray Binaries. Structure Formation and Galaxy Cluster Evolution.*

- Dr. Márcio Catelan, Full Professor (PhD Universidade de São Paulo, Brazil, 1996) – *Stellar structure and evolution. Globular clusters. Variable stars. Stellar Populations. Galaxy formation and evolution.*

- Dr. Julio Chanamé, Assistant Professor, Head of the Graduate Office (PhD The Ohio State University, USA, 2005) – *Stellar dynamics. The Milky Way and the Local Group. Stellar structure and evolution.*

- Dr. Alejandro Clocchiatti, Full Professor (PhD University of Texas at Austin, USA, 1995) – *Supernovae, near and far. Radiative Transfer. Galaxy Clusters. Cosmology.*

- Dr. Rolando Dünner, Associate Professor, IA Academic Secretary (PhD PUC, 2009) – *Large scale structure and cosmology. Astronomical instrumentation. Experiments to measure the Cosmic Microwave Background fluctuations.*

- Dr. Gaspar Galaz, Full Professor, Director of the UC Observatory (PhD Université de Paris, France, 1998) – *Stellar populations in galaxies. Galaxy evolution. Low surface brightness galaxies. Statistical properties of the galaxy distribution.*

- Dr. Viviana Guzmán, Assistant Professor, Head of Seminars and Colloquia (PhD Université Pierre et Marie Curie, France, 2013) – *Astrophysics of Star and Planet formation. Astrochemistry. Protoplanetary disks. Sub-millimeter astronomy.*

- Dr. Leopoldo Infante, Full Professor, on leave as Director of Las Campanas Observatory, Carnegie Institution for Science. (PhD University of Victoria, Canada, 1990) – *Galaxy and structure evolution. Pairs, groups and clusters of galaxies. LSB, dwarf and star forming galaxies in relation to environment. High-z QSOs. Correlation functions. The very high redshift universe.*

- Dr. Nelson Padilla, Full Professor, CATA-UC Director (PhD Universidad Nacional de Córdoba, Argentina, 2001) – *Numerical astrophysics. Galaxy and Structure Formation. Cosmology.*

- Dr. Cristóbal Petrovich, Assistant Professor (PhD Princeton University, USA, 2015) – *Planet formation and evolution. Orbital dynamics. Exoplanet demographics. Gravitational wave sources.*

- Dr. Thomas H. Puzia, Associate Professor, Head of the Outreach Office and Head of Infrastructure (PhD Ludwig-Maximilians-Universität München, Germany, 2003) – *Large-Area Surveys of Baryonic Structures of nearby Galaxy Clusters and Groups. Hierarchical Structure Formation. Mass Assembly of Clusters and Galaxies. Star clusters and Star Cluster Systems. Chemical evolution and enrichment histories of galaxies. Galaxy formation and evolution. Stellar dynamics. Stellar populations. Population synthesis models. Stellar abundances.*

- Dr. Hernán Quintana, Professor Emeritus (PhD Cambridge University, UK, 1973) – *Observational astrophysics. Clusters of galaxies. Interacting galaxies. Large scale structure.*

- Dr. Patricia Tissera, Associate Professor (PhD Universidad de Córdoba, 1995) – *Formation and evolution of galaxies; Numerical simulations; The Milky Way*

- Dr. Ezequiel Treister, Associate Professor, Head of the Research and Postdoctoral Offices (PhD Universidad de Chile, Chile, 2005) – *Extragalactic astronomy, active galactic nuclei, galaxy evolution, black holes.*

- Dr. Manuela Zoccali, Full Professor (PhD Università degli Studi di Padova, Italy, 2000) – *Stellar Populations in the Milky Way. The Galactic Bulge. Star Clusters. Chemical Abundances.*

3.2 Postdoctoral Researchers

List of postdoctoral researchers at the IA as of late 2020:

- Dr. Elizabeth Artur de la Villarmois (PhD. University of Copenhagen, Dinamarca, 2019)– *REVEALING THE PHYSICAL AND CHEMICAL EVOLUTION OF PLANET-FORMING DISKS*

- Dr. Laura Marcela Becerra Bayona (PhD. Sapienza University of Rome, Italia, 2018)– *The Stability of the Magnetic Field in Stratified Stars*

- Dr. Francisco Javier Castillo Andahur (PhD. Universidad de Chile, Chile, 2017)– *MAGNETIC FIELD EVOLUTION IN NEUTRON STAR CORES*

- Dr. Rodrigo Andrés Contreras Ramos (PhD. Universidad de Bologna, Italia, 2010)– *Variable stars, proper motions, milky way*
- Dr. Giuseppe D'Ago (PhD. Università degli Studi di Salerno, Italia, 2015)– *Automatic Analysis of Large Spectroscopic Databases*
- Dr. Demetra De Cicco (PhD. University of Naples - Federico II, Italia, 2017)– *Variable AGN Science for New-Generation Surveys*
- Dr. Francisco Cesar De Gerónimo (PhD. Universidad Nacional de La Plata (UNLP), Argentina, 2019)– *Estudio Teórico de Enanas Blancas Ultramasivas Pulsantes y Sus Aplicaciones*
- Dr. Luciano Noé Del Valle Bertoni (PhD. Universidad de Chile, Chile, 2016)– *Water delivery to terrestrial planets*
- Dr. Paul Eigenthaler (PhD. University of Vienna, Austria, 2011)– *Chasing Ghosts in the Nearby Universe -An unprecedented Study of the Dwarf Galaxy Populations in the Centaurus A Group and the Formax Galaxy Cluster*
- Dr. Carolina Elizabeth Finlez Ruiz (PhD. Universidad de Concepción, Chile, 2019)– *Analysis of MUSE data for nearby AGN*
- Dr. Timothy Paul Hewlett (PhD. University of St Andrews, Reino Unido de Gran Bretaña e Irlanda del Norte (el), 2019)– *CONICYT Anillo PIA. Morphological Study of AGN host galaxies*
- Dr. Melissa Janice Hobson (PhD. Aix-Marseille University, Francia, 2019)– *Warm giant exoplanets through photometry and radial velocities*
- Dr. Sam Kim (PhD. University of California, Estados Unidos de América (los), 2012)– *-ALMA observations for Gamma-ray Burst Afterglow of Binary Neutron Star Merger. Gravitationally Lensed Extended Lyman Alpha Emission behind the Hubble Frontier Field.*
- Dr. Regis Lachaume (PhD. Université Joseph Fourier, Francia, 2003)– *Optical/IR long-baseline interferometry*
- Dr. Juan Aldebarán Magaña Zapata (PhD. Universidad Nacional Autónoma de México (UNAM), México, 2013)– *Modelos alternativos de materia oscura*
- Dr. Marcelo Daniel Mora Genskowsky (PhD. Universität Ludwing-Maximilian U, Alemania, 2008)– *Star forming regions in distorted galaxies and Star clusters*
- Dr. Álvaro Alonso Rojas Arriagada (PhD. Université de Nice, Francia, 2016)– *Milky Way y Local Group*
- Dr. María Paula Ronco (PhD. Universidad Nacional de La Plata (UNLP), Argentina, 2018)– *Planet formation in binary systems: linking different formation stages*
- Dr. Yu Rong (PhD. University of Chinese Academy of Sciences, China, 2016)– *The Study of Properties And Formation of Ultra-diffuse Galaxies*
- Dr. Paula Andrea Sánchez Sáez (PhD. Universidad de Chile, Chile, 2019)– *AGN variability studies in the context of the ALeRCE project*
- Dr. Chelsea Elizabeth Spengler (PhD. University of Victoria, Canadá, 2018)– *The Origins and Growth of Nuclear Star Clusters*
- Dr. Giacomo Venturi (PhD. Università degli Studi di Firenze, Italia, 2019)– *Exploring outflows and feedback from active galactic nuclei through integral field spectroscopy*

Support for the postdoctoral fellows comes mostly from the national FONDECYT program, grants from the Joint ESO–Chile Committee for the Development of Astronomy in Chile, the ALMA–CONICYT and Gemini–CONICYT funds, the Millennium Scientific Initiative, and the Basal program (see § 7).

3.3 Administrative and Technical Staff

- Ricardo Acevedo – *Journalist*
- Luis Mauricio Barz – *Caretaker*
- Mario Castro – *Telescope Engineer at PUC Observatory at Santa Martina*
- Karina Charris – *Postdoctoral Office Coordinator*
- Carmen Gloria Cordovez – *Administrative Assistant*
- Daniela Fernández (B.Sc. PUC, 2014) – *Resident Astronomer at PUC Observatory at Santa Martina*
- Lilena Montenegro – *Administrative Assistant of Center for Astro-Engineering, AIUC*
- Carolina Muñoz – *Research analist*
- Carol Rojas (M.Sc. PUC, 2016) – *Communication and Outreach manager.* Carol left the Instituto in late 2020 to join Las Campanas outreach department.

- Juan Véliz – *IT Systems Manager and Software Specialist*
- Mariela Villanueva – *IT Systems Assistant Manager*

3.4 Recognitions, Awards, Sabbaticals, others

Two professors finished a one year sabbatical leave. Alejandro Clocchiatti returned in June 2020 and Manuela Zoccali in August 2020.
Prof. N. Padilla was a Fellow of the Institute for Advanced Studies at Durham University, UK, in 2020.

4 Academic Programmes and Teaching

The IA offers graduate and undergraduate programmes in Astrophysics, as detailed below. Our faculty members are in charge of all Astrophysics courses, both for our programmes and for students from other majors, plus some courses on Physics.

During 2020, we taught 27 semester-long courses, which can be categorized as follows:

- Astrophysics undergrad core courses (7)
- Astrophysics graduate core courses (3)
- Astrophysics elective courses (5)
- Sections of Astronomy/Physics courses for non-majors (8)
- Physics service courses (4)

4.1 Graduate Programme

The IA offers PhD and Master programmes in Astrophysics. They include core courses on Physical Processes in Astrophysics, Advanced Stellar Astrophysics, and Advanced Extragalactic Astrophysics. The programmes are completed with elective courses, supervised research, and a thesis. Students typically start research projects during their first year.

4.1.1 Degrees obtained

- César Jorge Calderón Galaz obtained his degree in Magíster en Astrofísica defending his thesis titled "Identifying the best candidates for indirect dark matter detection among dwarf spheroidal galaxies" supervised by Nelson Padilla
- Manuel Hernán Barrientos Laurence obtained his degree in Magíster en Astrofísica defending his thesis titled "New Constraints for the Initial-to-Final Mass Relation of White Dwarfs" supervised by Julio Chanamé
- Julio Ariel Olivares Carvajal obtained his degree in Magíster en Astrofísica defending his thesis titled "MUSE Spectroscopy in Dense Stellar Fields: A Pilot Study for VVV-CL001 Cluster" supervised by Manuela Zoccali
- Jonathan Sebastián Gómez Uribe obtained his degree in Magíster en Astrofísica defending his thesis titled "Merger Tree Comparison: Impact on the Semi-Analytic Model GALFORM" supervised by Nelson Padilla
- Carolina Paz Andonie Bahamondes obtained his degree in Magíster en Astrofísica defending her thesis titled "Characterizing the Fe Kα line variability in a large sample of AGN" supervised by Franz Bauer
- Karen Ximena Ribbeck Valenzuela obtained his degree in Magíster en Astrofísica defending her thesis titled "Characterization of the Dwarf Galaxy Population in the Centaurus A Environment" supervised by Thomas Puzia
- Felipe Sebastián Zepeda González obtained his degree in Magíster en Astrofísica defending his thesis titled "Fast Radio Bursts: Constraining possible astrophysical scenarios from a particle acceleration model" supervised by Andreas Reisenegger
- Dr. Marco Alfonso San Martín Hormazábal obtained his degree in Doctorado en Astrofísica defending his thesis titled "Observational constraints in Delta Gravity: CMB and supernovas" supervised by Jorge Alfaro

4.1.2 New students

During 2020, 9 students were admitted to our PhD programme:

- Sergio André Best Reyes
- Ernesto Antonio Camacho Iñiguez
- Álvaro Enrique Hernán Valenzuela Navarro
- Julio Ariel Olivares Carvajal
- Catalina Isabel Casanueva Villarreal
- Carolina Maritza Cenzano Silva
- Catalina Francisca Labayru Fernandez
- Cristóbal Andrés Moya Sierralta
- Priscilla Behar Jorge

Also, 5 students were admitted to our MSc programme:

- Víctor Manuel Moraga Mejías

- Francisca Macarena Espinoza Rojas
- Juan Manuel Garrido Deutelmoser
- Jaime Patricio Castillo Lara
- Javiera Katalina Díaz Berríos
- Almendra Paz del Moral Lobos

4.2 Undergraduate Programme

The programme has 186 students as of late 2020, who are consistently drawn from the top 3% of the high school seniors who take the nationally administered entrance examination (PDT) each year.

A group of 33 new students registered in the programme through the regular admission process started in March 2020. The last admitted student got a weighted average 721.85 points at the PDT. Additionally, 9 students registered through various special programs.

Undergraduate students work full time during the last semester of the program on a research project under the supervision of a faculty member.

During 2020, 15 students obtained a Bachelor degree. The students, their research subjects and supervisors were the following:

- Juan Ignacio Espinoza Retamal, *Estudio de la viabilidad de descubrir planetas como los del Sistema Solar con TESS* (Rafael Brahm)
- Avelyn Fernanda García Araya, *Photometric analysis of low mass ratio contact binary stars* (Marcio Catelan)
- Ariel Andres Gonzalez Carrasco, *Desempeño de estrategias de observación en el LSST: AGNs a $z \geq 5.6$ desde LF bolométrica y variabilidad según pares de visitas* (Franz Bauer)
- Claudio Andrés Hernández Vera, *Complex organic molecules in the Horsehead PDR* (Viviana Guzman)
- Carlos Iván Quezada Zurita, *Implementación de un algoritmo de Random Forest para la clasificación automática de estrellas variables en el survey VVV* (Manuela Zoccali)
- Vania Carolina Rodriguez Santana, *Experimentos de Astronomía para la Enseñanza en Colegios* (Felipe Barrientos)
- Nicolás Alejandro Rodríguez Segovia, *Period Change Rates in LMC Classical Cepheids* (Marcio Catelan)
- Manuel Antonio Solimano Gambardella, *Formación estelar en el Mediodía Cósmico: una mirada multibanda a través de lentes gravitacionales fuertes* (Felipe Barrientos)
- Álvaro Hernán Toro Ibarra, *The distribution of H2CO in the HD163296 protoplanetary disk* (Viviana Guzman)
- David Alejandro Flores Cabrera, *Analysis of Eclipsing Binary Stars in the ALeRCE Late Classifier* (Marcio Catelan)
- Lucas Vladimir Soazo Parra, *Diferenciación química entre núcleos pre-estelares y proto-estelares* (Viviana Guzman)
- Camila Andrea Varas Hernando, *Contaminación de señal de Sunyaev Zel'dovich producto de emisión de galaxias miembro detectada en la banda de 220 GHz de Atacama Cosmology Telescope* (Rolando Dunner)
- Jorge Andrés Riveros Vergara, *The excitation of CN in the HD163296 protoplanetary disk* (Viviana Guzman)
- Hector Sebastian Cabrera Vielma, *Modelling atmospheric emissions at Cerro Toco* (Rolando Dunner)
- Erick Antonio Cárdenas Hernández, *Una nueva mirada a las diferentes tecnicas de obtencion de imagenes* (Marcio Catelan)

5 Interdisciplinary Center: The UC Center for Astro-Engineering, AIUC

5.1 Overview

Since its creation in 2009 as a joint venture between the IA and the Faculty of Engineering, the AIUC Center, strategically located on the 6th floor of the Innovation Center at Universidad Católica, led by L. Infante, has assembled a unique combination of staff, facilities and alliances to provide state-of- the-art research in astronomy and engineering applied to astronomy, building collaborations between academia, industry and government, and engaging with students to stimulate applied science education and innovation.

5.2 Achievements during 2020

During 2020, the AIUC laboratory activities had to be significantly reduced due to COVID related restrictions, maintaining only those tasks considered critical for the ongoing research. Instead, most of the activity was refocused towards studies that could be performed remotely, such as simulations, modeling and data reduction.

In the area of CMB experiments, we continued participating in the international collaborations ACT, Polarbear, CLASS, Simons Observatory and CCAT-prime. Our contributions included big-data processing for ACT, optical characterization and alignment for ACT, Polarbear and CLASS, technical and logistical developments

for Simons Observatory, optical alignment planning for CCAT-prime, and on-site support for ACT, Polarbear and CLASS.

We continued the development of a drone-based polarized calibration source for CMB experiments. The system must provide better than 0.1 degrees in polarization angle accuracy, requiring a precise on-board metrology system to provide exact position and orientation information of the source while in flight. This year we made significant progress demonstrating the performance of our video-based photogrammetry for this, assembled the mm-wave source in a 3D printed frame, characterized the RF signal and its antenna properties and presented our results in two international meetings ("SPIE: Astronomical Telescopes and Instrumentation", and "CMB Calibration and Systematics Focus Workshop").

6 Colloquia, seminars and science activities

Colloquia and seminars in the IA started early in 1990. However, since 2012, under the leading role of J. Chanamé, the Institute organizes each year an aggressive series of astronomy colloquia that, modeled after similar programs with long traditions at major astronomical institutions in the world, targets outstanding speakers selected not only for their scientific achievements but also for their ability to communicate them well to a diverse audience. Among the obvious advantages of a Colloquium series of such characteristics, this plan is part of an integral effort by our Institute to improve the quality of our Graduate program, adding even more stimulating experiences to our daily scientific atmosphere.

6.1 Colloquia during 2020

- Marios Karouzos (Nature Astronomy) *How to publish (and write) an impactful paper in Nature Astronomy and beyond* (March 3)
- Cristobal Petrovich (Steward Observatory, University of Arizona) *Dynamics and Astrophysics of Dark Objects: from planetary systems to merging black holes* (March 4)
- Macarena Lagos (Kavli Institute for Cosmological Physics, University of Chicago, US) *Multi-messenger cosmology* (March 24)
- Evelyn Johnston (PUC) *Understanding Galaxy Mass Assembly and the Role of Nuclear Star Clusters* (March 31)
- Stefano Cavuoti (University of Naples, Federico II) *Machine Learning in Astrophysics - photo-z as a template case* (April 21)
- Marcelo Mora (PUC) *An interacting view of NGC 1427A* (April 28)
- Octavio Guilera (PUC/ Instituto de Astrofísica de La Plata) *Global models of planet formation* (May 19)
- Alejandro Clocchiatti (PUC) *ATLAS-4: The second Southern ATLAS telescope comes to Chile* (June 2)
- Luca Izzo (DARK/NBI, Copenhagen, Denmark) *Jet-cocoon signatures in broad-line supernovae associated with gamma-ray bursts* (June 16)
- Julian Onions (University of Nottingham, UK) *The Far Side of the Moon, is it full of Aliens?* (June 23)
- Bruno Dias (Universidad Andrés Bello) *The VISCACHA survey - deep and resolved photometry of star clusters in the Magellanic Clouds* (August 11)
- Gordon Richard (Drexel University, Pennsylvania, USA) *A Modern View of Quasars in the LSST Era* (August 18)
- Ana Maria Aron (Escuela de Psicología, PUC) *Imposter Syndrome* (August 25)
- Maren Hempel (Universidad Andrés Bello) *10 years of VVV & VVVX : Time to say 'Good bye'* (September 8)
- Chris Conselice (University of Nottingham, UK) *The Astrobiological Copernican Limit for Intelligent Life* (September 15)
- Sebastian Ramirez (University of Antofagasta) *Open clusters, high-mass stars and the VVV/VVVX survey* (September 29)
- Anthony Brown (Leiden Observatory, Netherlands) *Gaia: mission status and results from the second data release* (October 6)
- Kevin Schawinski (Co-founder & CEO — Modulos AG) *Bringing Machine Learning to the Right Level of Abstraction* (October 13)
- Simon Casassus (Universidad de Chile) *Warps in protoplanetary disks* (October 20)
- Søren Larsen (Radbound University (Netherlands)) *Chemical abundances of extragalactic globular clusters: new results and a surprise* (October 27)
- Ariana Cortesi (Observatorio de Valongo, Universidade Federal do Rio de Janeiro, Brazil) *Galaxies' morphologies in multi band surveys: the narcisms of little differences* (November 3)

- Nathan Leigh (Universidad de Concepcion) *Chaos in the Gravitational Three-Body Problem* (November 10)
- Alan Fitzsimmons (Queens University Belfast, UK) *The DART and Hera missions, our first Planetary Defence test* (November 17)
- Paul Strøm (Wilson) (University of Warwick, UK) *Exocomets from a Solar System perspective* (November 24)
- Andre Izidoro (UNESP/Houston) *The Solar System and the Exoplanet Zoo: Making Sense of Planet Formation* (December 1)

6.2 Seminars and talks

6.3 Golden Webinars in Astrophysics

Thanks to monetary support from CATA, we launched our program of Golden Webinars in Astrophysics. The speakers include Nobel laureates and scientist at the bleeding edge of research. They are oriented to the astronomical community worldwide and are hosted via zoom by Thomas Puzia and Evelyn Johnston, with Daniela Fernández, Ricardo Acevedo and Carol Rojas as Q&A support. The talks also include several IA members and astronomers abroad as panel members. These talks have an average of around 300 assistants in the zoom webinar, with a total of several thousands of assistants for the 28 talks conducted in 2020. Talks are given in English with simultaneous translation to Spanish.

6.3.1 List of 2020 Golden Webinars

1. James Peebles: *The Expanding Universe - Discovery and Evidence* (Jun 8)
2. Volker Springel: *Hydrodynamical Simulations of Galaxy Formation* (Jun 9)
3. Sandra Faber: *Galaxy Formation: What is Simple and What remains Outstanding* (Jun 10)
4. Stephen Wolfram: *A New Fundamental Theory of Physics and its implications for Astrophysics & Cosmology* (Jun 11)
5. Didier Queloz: *Exoplanets, Earth Twins, Pathways for the Origins of Life* (Jun 12)
6. Brent Tully: *Galaxy Flows and the Formation of Large Scale Structure* (Jun 19)
7. Mike Brown: *How the Icy Asteroids of the outer Solar System point our Way to Planet Nine* (Jun 30)
8. William Borucki: *Kepler Space Mission; A Step in the Journey to Find Our Place in the Universe* (Jul 10)
9. Jill Tarter: *Searching for Aliens; Finding Ourselves* (Jul 27)
10. Jocelyn Bell Burnell: *The Discovery of Pulsars - a Graduate Student's Story* (Jul 27)
11. Roger Blandford: *Black Holes Astrophysics: The Role of Rotation* (Aug 7)
12. Mike Nolan: *Twenty Years of Bennu: From Arecibo to Orbit (and Home Again)* (Aug 14)
13. Chris Lintott: *Surprises in Big Data: Adventures in the Zooniverse* (Aug 27)
14. Sara Saeger: *Mapping the Nearest Stars for Habitable or Inhabited Worlds: Exoplanets and the Search for Atmospheric Biosignature Gases* (Sep 4)
15. Michael Merrifield: *Observations of Nearby Galaxies – Not Just Beautiful But Also A Key To Their Formation* (Sep 11)
16. Simon White: *Dark Matter Halos: their structure and its consequences over 20 orders of magnitude in mass, from that of rich galaxy clusters down to that of the Earth* (Sep 17)
17. Adam Riess: *New Measurements of the Expansion Rate of the Universe, Hints of New Physics?* (Sep 25)
18. Joe Silk: *The Future of Cosmology* (Oct 2)
19. Makoto Yoshikawa: *The Challenges of the Asteroid Sample-Return Mission Hayabusa2* (Oct 9)
20. Rob Kennicutt: *The Cosmic Ecosystem: Star Formation and Galaxy Evolution Through the Lens of a Scaling Law - "Isn't Star Formation a Bit Like the Weather?"* (Oct 16)
21. Suzanne Staggs: *Charting the Trajectory of the Universe with the Atacama Cosmology Telescope — from Initial Conditions through Structure Formation to the Era of Dark Energy Domination* (Oct 23)
22. Paul Hoyningen-Huene: *What makes Science special? Why is Science so reliable?* (Oct 30)
23. Alexey Vikhlinin: *Lynx: a Revolutionary X-ray Observatory with the Power to Transform our Understanding of the Cosmos through Unprecedented X-ray Vision into the otherwise Invisible Universe* (Nov 6)

24. Bob Williams: *Probing the Distant Universe with the Hubble Space Telescope* (Nov 13)

25. Carlos Frenk: *Cosmology at the Crossroads: a Definitive Test of the Identity of Dark Matter* (Nov 20)

26. Alvio Renzini: *Galaxy Scaling Relations and the Role of Angular Momentum in Galaxy Evolution* (Nov 27)

27. William H. Press: *A Quick Dive into Computational Finance* (Dec 4)

28. Jay Pasachoff: *Solar Eclipses: Science and Monday's Spectacle* (Dec 12)

7 Grants

7.1 Institute Grants

The Basal Centre for Astrophysics and Associated Technologies (CATA) is a large institutional grant from CONICYT, Chile, awarded to the IA, the Astronomy Department of Universidad de Chile, and the Astrophysics Department of Universidad de Concepción. This Centre supports research in astrophysics, national and international academic exchange, and collaborations with the Observatories in Chile, providing funds for research, graduate student fellowships, organisation of workshops and conferences, and travel. The PIs in the UC node are Nelson Padilla (Director of the node), Ezequiel Treister and Felipe Barrientos. The focus of the UC node is currently incrementing its efforts in astronomical instrumentation and large databases and computing for future observing facilities, in association with the IA and the Center for Astro-Engineering.

7.2 Group Grants

7.2.1 Instituto Milenio

The Millennium Institute of Astrophysics (MAS) is funded by the Millennium Scientific Initiative. It is dedicated to the study of stellar populations, supernovae, transients, exoplanets, and the observation of the central regions of the Milky Way. In 2020 MAS was led by A. Jordan. During 2020, the associate members of MAS at Universidad Católica included Márcio Catelan, Alejandro Clocchiatti, Franz Bauer, and Manuela Zoccali; roughly half of MAS associates belong to the Institute of Astrophysics. One of the main characteristics of MAS is the multidisciplinary approach, because the team is composed not only by astronomers but also by statisticians, who would help to handle and exploit large observational databases becoming available.

7.2.2 Núcleos Milenio

7.2.3 Anillos

Anillo project: Formation and Growth of Supermassive Black Holes is a CONICYT grant awarded to a team of astronomers from Universidad de Concepcion, Universidad de Valparaiso and PUC (associate researcher: Prof. Ezequiel Treister). This project carries out high-level internationally competitive research exploring supermassive black holes as astrophysical objects. Specifically, they work on three particularly relevant science questions: 1)How do supermassive black holes initially form? 2) How do supermassive black holes accrete on the smallest scales, ranging from a few to a few hundred Schwarzschild radii? 3) How can we probe supermassive black hole growth through X-ray observations, both for nearby AGN and as a function of cosmic time?

8 Exchange Agreements and International Networks

8.1 Bilateral agreements

The IA has agreements with several institutions with the goal of strengthening its research activity and its graduate program. These agreements allow exchange visits of researchers and students. In some cases, the thesis is recognised by both institutions, resulting in a double PhD degree. Currently, we have agreements with the Universities of Heidelberg (see § 8.4), Johns Hopkins, Maryland, Padova, and Princeton.

8.2 UMI-FCA

The French–Chilean Joint International Astronomy Unit (UMI-FCA) was established by agreement between the CNRS and PUC, U. de Chile and U. de Concepción. This "Joint International Unit" facilitates collaborations between astronomers of the participating institutions, and allows them to use the facilities of their counterpart.

8.3 Collaboration with the University of Notre Dame

In the last 3 years we have boosted a collaboration between the Astronomy group at University of Notre Dame (UND) and the IA. Prof. Cris Howk and Tim Beers visited the IA several times, and in particular Prof. Howk spend one sabbatical year in Chile, working with Prof. Galaz. This collaboration is supported by PUC, UND and Fundación Luksic.

8.4 Heidelberg University–PUC Agreement

The Heidelberg University–PUC exchange program was established in 2010 and the agreement for astronomy, funded by the German DAAD, was extended until 2024. The activities of the program consist of a joint doctoral program, an academic exchange, the organiza-

tion of summer schools, and a strong outreach program focused on school teacher workshops that is becoming a highly sought-after program in Chile, attracting every year more than 40 teachers.

8.5 Horizons 2020 LACEGAL Network

The number of mobility months that have benefited the IA until 2020 are 56, for a total of 112,000 euros of benefit that helped several postgraduate students, postdocs and professors to participate in this exchange program. In early 2020 Joaquín Sureda and Juan Magaña visited the University of Durham thanks to this exchange program.

9 Office, Computing and Teaching facilities

The IA occupies 1,887 m^2 in a building at the San Joaquín Campus of PUC, to the south of downtown Santiago. This includes offices for faculty, postdocs, graduate students and administrative and technical staff, a special room for our super-computers, and multimedia conference rooms. The same building also hosts the "Ninoslav Bralić" auditorium, shared with Physics and Mathematics, which seats 100 people. Since October 2015, some of the IA members who are also affiliated to the Centre for Astro-Engineering (§ 5) are housed in the newly-built UC Innovation Center, also in the San Joaquín Campus.

Next to the IA building, the "Gauss" Physics and Math library has a collection of ∼30,000 books and journal volumes. Staff members, students and visitors also have access to the University library system with more than 300,000 books and hundreds of periodical publications, including around 60 titles in different branches of physics. The University supports, in addition, on-line access to all major astrophysics journals. Finally, the IA hosts since 1998 the first Latin-American mirror of NASA's Astrophysical Data System (ADS).

The IA has a computer network maintained by a full-time software engineer and two assistants. It includes a cluster, managed by the AIUC, consisting of 64 nodes with a total of 128 Intel Xeon Quad-Core CPUs (512 cores), 1024 GB of RAM, 40 TB of disk space (iSCSI), and a Linux system for 64-bit architecture running over a 10 Gbps ethernet network (a 10 fold increase with respect to the previous year). Development and execution tools include Intel Fortran and Intel C compilers (ifort, icc), mpich2, Distributed Resource Management (DRM) software SGE (Sun Grid Engine), and other standard tools (gcc, g++, gfortran, etc). In early 2013, this cluster was complemented by a brand-new 520-core CPU cluster, with 18 Tflops, and 3 TB of memory. In 2015 we installed the 64-core CPUs with 1TB of ram memory corresponding to the participation of the IA in the National Lab for High Performance Computing (NLHPC). In 2017 we installed additional CPU nodes with 1.5Tb ram and 120 cores from the Newton-CONICYT DPI20140114 (PI N. Padilla), and in 2018 additional 120 cores with 1.6Tb ram were financed by Basal CATA and Newton-CONICYT DPI20140114 (PI N. Padilla). To the original 30 TB of disk space we have added 350TB of normal access disks and 45 TB of fast I/O disks, using funds provided by QUIMAL 130008 (PI N. Padilla). We also house a GPU cluster with 1792 NVidia Tesla Cores, with 96 GB of memory. Users at IA have access to the cluster via personal accounts and get access to the cluster resources by the DRM system that defines use and priority of each user to the total resources. Research Assistant Roberto González dedicates a fraction of their time to help manage the use of the computing cluster.

9.1 UC Observatory at Santa Martina

The IA maintains a small Observatory (ODUC) in the eastern outskirts of Santiago at an altitude of 1450 m, some 60-minute drive from Campus, mostly dedicated to teaching and astronomy laboratories for our undergraduate students. Permanently installed in a joint dome are a 50 cm telescope (the old ESO 50 cm), and a 40 cm telescope (one of the two old CTIO 16-inch telescopes) and, in a separate dome, a commercial Meade 40 cm used with a CCD camera for basic teaching. The two professional telescopes have locally-upgraded control systems and new instrumentation, including CCD and IR cameras, spectrographs and a built in-house fiber spectrograph at the 50 cm. All three are controlled from a common control room when needed. The two professional telescopes are partly used for testing and developing instrumentation and for some advanced student research programs. A Meade 30 cm is available for visual observations by students and visitors. Besides, the site hosts the dome of one of the SLOOH world network telescopes, remotely controlled via the Web. In addition to the optical telescopes, two radio telescopes were installed in the Observatory to teach radioastronomy. They are 2.5 and 3 meters in diameter and are equipped to observe at 21 cm wavelength in both single dish and interferometric configurations. A small planetarium is also available to teach students the celestial coordinate systems. Current *in situ* activities are suspended due to the COVID-19 pandemic, but during the whole year there were online star parties for general public, broadcasted as webinars from Zoom and YouTube. The full list is included below

- 7 Abril: Superluna -Trilogía de Superlunas (Episodio II)
- 6 de Mayo: Superluna -Trilogía de Superlunas (Episodio III)
- 16 de Junio: Star Party ODUC "Nebulosas"

- 23 de Junio: Star Party ODUC "Cúmulos de estrellas"
- 30 de Junio: Star Party ODUC "Planetas"
- 7 de Julio: Star Party ODUC "Galaxias"
- 13 de Julio: ODUC Star Party - Júpiter en oposición
- 20 de Julio: ODUC Star Party - Saturno en oposición
- 23 de Julio: Star Party IA-ODUC Misión Lunar 1/8 "Luna Creciente"
- 27 de julio: Star Party IA-ODUC Misión Lunar 2/8 "Luna Cuarto Creciente"
- 30 de Julio: Star Party IA-ODUC Misión Lunar 3/8 "Luna Gibosa Creciente"
- 3 de Agosto: Star Party IA-ODUC Misión Lunar 4/8 "Luna Llena"
- 7 de Agosto: Star Party IA-ODUC Misión Lunar 5/8 "Luna Gibosa Menguante"
- 11 de Agosto: Star Party IA-ODUC Misión Lunar 6/8 "Luna Cuarto Menguante"
- 14 de Agosto: Star Party IA-ODUC Misión Lunar 7/8 "Luna Creciente Menguante"
- 21 de Agosto: Star Party IA-ODUC Misión Lunar 8/8 "Afterparty"
- 16 de Septiembre: Star Party IA-ODUC Edición Planetaria "Fosfina en Venus"
- 8 de Octubre: Star Party IA-ODUC Edición Planetaria "Neptuno Ultra Caliente"13 de Octubre: Star Party IA-ODUC Edición Planetaria "Marte en Oposición"
- 21 de Diciembre: Star Party IA-ODUC "La Gran Conjunción" (en directo desde el ODUC)

9.2 Manuel Foster Historical Observatory

The IA also maintains this historical observatory in the Metropolitan Park on San Cristóbal hill near downtown Santiago. It was established in 1903 by an expedition from the Lick Observatory of the University of California, and purchased and donated to PUC in 1929 by the lawyer, politician, and PUC professor Manuel Foster, in this way starting astronomical activities at the University. It was used on and off until the early 1990s, but is now no longer useful for research because of the strong light pollution. In 2010, it was declared a National Historic Monument. It is being opened to the public on selected days. Due to the COVID-19 pandemic the observatory wasn't opened for Día del Patrimonio or Día de la Astronomía, but remote activities were performed (see §11)

10 Meetings supported

11 Outreach

The members of the IA participated in numerous outreach activities during 2020:

- The IA, through Carol Rojas and later Ricardo Acevedo, organizes the ongoing series of weekly articles on astronomy for the general public "Tendencias de la Astronomía", in the online version of the national newspaper "El Mercurio". All these articles are written by professors of the Institute.
- Various professors of the Institute are also contributing to the "Que pasa" newsletter, by "La Tercera". This is organized by Ricardo Acevedo.
- IA shared continually astronomical information and information about its IA members and activities for general public on social networks on Facebook, Twitter and Instagram.
- During January, IA organised the second version of the outreach talks "Astronomía para las tardes de verano", organized by IA. Each of the five talks had about 300 attendees, exceeding the capacity of the rooms in which they were held (Casa Central and Centro de Extensión UC). These talks were given by the Alvaro Rojas and Profs. Thomas Puzia, Gaspar Galaz and Viviana Guzmán.
- The *anillo* project *Formation and Growth of Supermassive Black Holes* organised a series of talks called "Astronomía en tu casa", broadcast live via YouTube. Ezequiel Treister contributed two talks, including the opening one, and Gaspar Galaz contributed one. EMOL also broadcasted the first four talks of the cycle.
- The IA and ODUC team engaged in activities related to *Día del Patrimonio* on May 2020, all centered around Observatorio Manuel Foster. Activities included an interview with Bárbara Silva, writer of *Estrellas desde el San Cristobal*; a theatre play presented by Tryo Teatro Banda company, and a conversation about Foster's history with several important astronomers of the Chilean community, like Hernán Quintana and Leopoldo Infante. Andres Couve, minister of science, was also a participant. The full playlist is in the YouTube channel of the institute: `https://www.youtube.com/playlist?list=PLnuCZ3n0pWSE7ecGNsejjs9LLJ_kvMS-q`
- Several IA professors gave talks at teacher workshops organized in the framework of the Heidelberg–PUC exchange program at the Heidelberg Center in Santiago in January 2020 (see § 8.4).

- The YouTube channel "*Astrofísica UC*". continued to output material. In particular, Thomas Puzia and Carol Rojas created the monthly webseries "Cielos del Sur" which highlights the relevant astronomical events of the month.

- IA researchers were invited many times to speak about astronomical topics on radio and television programs and contributed numerous times to written press contributions and articles.

- The institute's outreach team, led by Thomas Puzia, traveled to the Villarica Volcano at Pucón, Región de la Araucanía, to stream the total solar eclipse 2020 (Dec 14) from the path of totality. This livestream was followed by more than a hundred thousand people worldwide. In addition, the UC team filmed the event together with the Media UC team, a project of the University's Faculty of Communications, and the musician Sadór in order to put together a documentary film about the event.

12 Refereed Publications

Members of the IA, including students and postdocs, participated in 89 peer-reviewed articles published in 2020. The full list is given below.

1. Aguilera-Gómez, Chanamé, and Pinsonneault, On Lithium-6 as a Diagnostic of the Lithium-enrichment Mechanism in Red Giants, ApJ897, L20, https://ui.adsabs.harvard.edu/abs/2020ApJ...897L..20A

2. Ahumada, Prieto, Almeida *et al.*, The 16th Data Release of the Sloan Digital Sky Surveys: First Release from the APOGEE-2 Southern Survey and Full Release of eBOSS Spectra, ApJS249, 3, https://ui.adsabs.harvard.edu/abs/2020ApJS..249....3A

3. Aiola, Calabrese, Maurin *et al.*, The Atacama Cosmology Telescope: DR4 maps and cosmological parameters, JCAP 2020, 047, https://ui.adsabs.harvard.edu/abs/2020JCAP...12..047A

4. Amante, Magaña, Motta *et al.*, Testing dark energy models with a new sample of strong-lensing systems, MNRAS498, 6013, https://ui.adsabs.harvard.edu/abs/2020MNRAS.498.6013A

5. Ananna, Treister, Urry *et al.*, Accretion History of AGNs. II. Constraints on AGN Spectral Parameters Using the Cosmic X-Ray Background, ApJ889, 17, https://ui.adsabs.harvard.edu/abs/2020ApJ...889...17A

6. Ananna, Urry, Treister *et al.*, Accretion History of AGNs. III. Radiative Efficiency and AGN Contribution to Reionization, ApJ903, 85, https://ui.adsabs.harvard.edu/abs/2020ApJ...903...85A

7. Annuar, Alexander, Gandhi *et al.*, NuSTAR observations of four nearby X-ray faint AGNs: low luminosity or heavy obscuration?, MNRAS497, 229, https://ui.adsabs.harvard.edu/abs/2020MNRAS.497..229A

8. Antoja, Ramos, Mateu *et al.*, An all-sky proper-motion map of the Sagittarius stream using Gaia DR2, A&A635, L3, https://ui.adsabs.harvard.edu/abs/2020A&A...635L...3A

9. Aravena, Boogaard, Gónzalez-López *et al.*, The ALMA Spectroscopic Survey in the Hubble Ultra Deep Field: The Nature of the Faintest Dusty Star-forming Galaxies, ApJ901, 79, https://ui.adsabs.harvard.edu/abs/2020ApJ...901...79A

10. Artola, Beroiz, Cabral *et al.*, TOROS optical follow-up of the advanced LIGO-VIRGO O2 second observational campaign, MNRAS493, 2207, https://ui.adsabs.harvard.edu/abs/2020MNRAS.493.2207A

11. Assef, Brightman, Walton *et al.*, Hot Dust-obscured Galaxies with Excess Blue Light, ApJ897, 112, https://ui.adsabs.harvard.edu/abs/2020ApJ...897..112A

12. Astudillo-Defru, Cloutier, Wang *et al.*, A hot terrestrial planet orbiting the bright M dwarf L 168-9 unveiled by TESS, A&A636, A58, https://ui.adsabs.harvard.edu/abs/2020A&A...636A..58A

13. Astudillo, Protopapas, Pichara Huijse *et al.*, An Information Theory Approach on Deciding Spectroscopic Follow-ups, AJ159, 16, https://ui.adsabs.harvard.edu/abs/2020AJ....159...16A

14. Bakos, Bayliss, Bento *et al.*, HATS-71b: A Giant Planet Transiting an M3 Dwarf Star in TESS Sector 1, AJ159, 267, https://ui.adsabs.harvard.edu/abs/2020AJ....159..267B

15. Baronchelli, Nandra, and Buchner, Relativistic accretion disc reflection in AGN X-ray spectra at $z = 0.5 - 4$: a study of four Chandra Deep Fields, MNRAS498, 5284, https://ui.adsabs.harvard.edu/abs/2020MNRAS.498.5284B

16. Battistelli, Ade, Alberro *et al.*, QUBIC: The Q & U Bolometric Interferometer for Cosmology, Journal of Low Temperature Physics 199, 482, https://ui.adsabs.harvard.edu/abs/2020JLTP..199..482B

17. Becker, Pichara, Catelan *et al.*, Scalable end-to-end recurrent neural network for variable star classification, MNRAS493, 2981, https://ui.adsabs.harvard.edu/abs/2020MNRAS.493.2981B

18. Bergner, Öberg, Bergin *et al.*, An Evolutionary Study of Volatile Chemistry in Protoplanetary Disks, ApJ898, 97, https://ui.adsabs.harvard.edu/abs/2020ApJ...898...97B

19. Boardman, Zasowski, Seth *et al.*, Milky Way analogues in MaNGA: multiparameter homogeneity and comparison to the Milky Way, MNRAS491, 3672, https://ui.adsabs.harvard.edu/abs/2020MNRAS.491.3672B

20. Boardman, Zasowski, Newman *et al.*, Are the Milky Way and Andromeda unusual? A comparison with Milky Way and Andromeda analogues, MNRAS498, 4943, https://ui.adsabs.harvard.edu/abs/2020MNRAS.498.4943B

21. Boogaard, van der Werf, Weiss *et al.*, The ALMA Spectroscopic Survey in the Hubble Ultra Deep Field: CO Excitation and Atomic Carbon in Star-forming Galaxies at $z = 1 - 3$, ApJ902, 109, https://ui.adsabs.harvard.edu/abs/2020ApJ...902..109B

22. Brahm, Nielsen, Wittenmyer *et al.*, TOI-481 b and TOI-892 b: Two Long-period Hot Jupiters from the Transiting Exoplanet Survey Satellite, AJ160, 235, https://ui.adsabs.harvard.edu/abs/2020AJ....160..235B

23. Bulla, Miller, Yao *et al.*, ZTF Early Observations of Type Ia Supernovae. III. Early-time Colors As a Test for Explosion Models and Multiple Populations, ApJ902, 48, https://ui.adsabs.harvard.edu/abs/2020ApJ...902...48B

24. Calderón, Cuadra, Schartmann *et al.*, Three-dimensional simulations of clump formation in stellar wind collisions, MNRAS493, 447, https://ui.adsabs.harvard.edu/abs/2020MNRAS.493..447C

25. Calderón, Cuadra, Schartmann *et al.*, Stellar Winds Pump the Heart of the Milky Way, ApJ888, L2, https://ui.adsabs.harvard.edu/abs/2020ApJ...888L...2C

26. Carmo, Ferreira Lopes, Papageorgiou *et al.*, Recovering variable stars in large surveys: EA_{up} Algol-type class in the Catalina Survey, MNRAS498, 2833, https://ui.adsabs.harvard.edu/abs/2020MNRAS.498.2833C

27. Carvajal, Bauer, Bouwens *et al.*, The ALMA Frontier Fields Survey. V. ALMA Stacking of Lyman-Break Galaxies in Abell 2744, Abell 370, Abell S1063, MACSJ0416.1-2403 and MACSJ1149.5+2223, A&A633, A160, https://ui.adsabs.harvard.edu/abs/2020A&A...633A.160C

28. Castillo *et al.*, Two-fluid simulations of the magnetic field evolution in neutron star cores in the weak-coupling regime, MNRAS498, 3000, https://ui.adsabs.harvard.edu/abs/2020MNRAS.498.3000C

29. Cheng, Anguiano, Majewski *et al.*, Exploring the Galactic Warp through Asymmetries in the Kinematics of the Galactic Disk, ApJ905, 49, https://ui.adsabs.harvard.edu/abs/2020ApJ...905...49C

30. Choi, Hasselfield, Ho *et al.*, The Atacama Cosmology Telescope: a measurement of the Cosmic Microwave Background power spectra at 98 and 150 GHz, JCAP 2020, 045, https://ui.adsabs.harvard.edu/abs/2020JCAP...12..045C

31. Clerc, Kirkpatrick, Finoguenov *et al.*, SPIDERS: overview of the X-ray galaxy cluster follow-up and the final spectroscopic data release, MNRAS497, 3976, https://ui.adsabs.harvard.edu/abs/2020MNRAS.497.3976C

32. Coccato, Jaffé, Cortesi *et al.*, Formation of S0s in extreme environments I: clues from kinematics and stellar populations, MNRAS492, 2955, https://ui.adsabs.harvard.edu/abs/2020MNRAS.492.2955C

33. Cohen, Goudfrooij, Correnti *et al.*, The Strikingly Metal-rich Halo of the Sombrero Galaxy, ApJ890, 52, https://ui.adsabs.harvard.edu/abs/2020ApJ...890...52C

34. Contreras, Rincón, Panotopoulos *et al.*, Black hole shadow of a rotating scale-dependent black hole, Phys.Rev.D101, 064053, https://ui.adsabs.harvard.edu/abs/2020PhRvD.101f4053C

35. Cooke, Pollacco, Almleaky *et al.*, Two Transiting Hot Jupiters from the WASP Survey: WASP-150b and WASP-176b, AJ159, 255, https://ui.adsabs.harvard.edu/abs/2020AJ....159..255C

36. Cortes-Rangel, Zapata, Toalá *et al.*, ALMA Observations of the Extraordinary Carina Pillars: HH 901/902, AJ159, 62, https://ui.adsabs.harvard.edu/abs/2020AJ....159...62C

37. Cowie, Barger, Bauer González-López *et al.*, On the Absence of High-redshift AGNs: Little Growth in the Supermassive Black Hole Population at

High Redshifts, ApJ891, 69, https://ui.adsabs.harvard.edu/abs/2020ApJ...891...69C

38. Cuello, Louvet, Mentiplay *et al.*, Flybys in protoplanetary discs - II. Observational signatures, MNRAS491, 504, https://ui.adsabs.harvard.edu/abs/2020MNRAS.491..504C

39. Cúneo, Muñoz-Darias, Sánchez-Sierras *et al.*, Discovery of optical outflows and inflows in the black hole candidate GRS 1716-249, MNRAS498, 25, https://ui.adsabs.harvard.edu/abs/2020MNRAS.498...25C

40. D'Amato, Gilli, Vignali *et al.*, Dust and gas content of high-redshift galaxies hosting obscured AGN in the Chandra Deep Field-South, A&A636, A37, https://ui.adsabs.harvard.edu/abs/2020A&A...636A..37D

41. de La Vieuville, Pelló, Richard *et al.*, MUSE observations towards the lensing cluster A2744: Intersection between the LBG and LAE populations at $z \sim 3$–7, A&A644, A39, https://ui.adsabs.harvard.edu/abs/2020A&A...644A..39D

42. de Menezes, Amaya-Almazán, Marchesini *et al.*, Optical spectroscopic observations of gamma-ray blazar candidates. X. Results from the 2018-2019 SOAR and OAN-SPM observations of blazar candidates of uncertain type, Ap&SS365, 12, https://ui.adsabs.harvard.edu/abs/2020Ap&SS.365...12D

43. Delvecchio, Daddi, Aird *et al.*, The Evolving AGN Duty Cycle in Galaxies Since $z \sim 3$ as Encoded in the X-Ray Luminosity Function, ApJ892, 17, https://ui.adsabs.harvard.edu/abs/2020ApJ...892...17D

44. Diaz, Arévalo, Hernández-García *et al.*, Constraining X-ray reflection in the low-luminosity AGN NGC 3718 using NuSTAR and XMM-Newton, MNRAS496, 5399, https://ui.adsabs.harvard.edu/abs/2020MNRAS.496.5399D

45. Donor, Frinchaboy, Cunha *et al.*, The Open Cluster Chemical Abundances and Mapping Survey. IV. Abundances for 128 Open Clusters Using SDSS/APOGEE DR16, AJ159, 199, https://ui.adsabs.harvard.edu/abs/2020AJ....159..199D

46. Dorval, Talens, Otten *et al.*, MASCARA-4 b/bRing-1 b: A retrograde hot Jupiter around a bright A-type star, A&A635, A60, https://ui.adsabs.harvard.edu/abs/2020A&A...635A..60D

47. Duras, Bongiorno, Ricci *et al.*, Universal bolometric corrections for active galactic nuclei over seven luminosity decades, A&A636, A73, https://ui.adsabs.harvard.edu/abs/2020A&A...636A..73D

48. Echiburú, Guillot, Zhao *et al.*, Spectral analysis of the quiescent low-mass X-ray binary in the globular cluster M30, MNRAS495, 4508, https://ui.adsabs.harvard.edu/abs/2020MNRAS.495.4508E

49. Ernandes, Barbuy, Friaça *et al.*, Cobalt and copper abundances in 56 Galactic bulge red giants, A&A640, A89, https://ui.adsabs.harvard.edu/abs/2020A&A...640A..89E

50. Espinoza, Brahm, Henning *et al.*, HD 213885b: a transiting 1-d-period super-Earth with an Earth-like composition around a bright ($V = 7.9$) star unveiled by TESS, MNRAS491, 2982, https://ui.adsabs.harvard.edu/abs/2020MNRAS.491.2982E

51. Farias, Clocchiatti, Woods Rest *et al.*, Supersoft X-ray nebulae in the Large Magellanic Cloud, MNRAS497, 3234, https://ui.adsabs.harvard.edu/abs/2020MNRAS.497.3234F

52. Favole, Gonzalez-Perez, Stoppacher *et al.*, [O II] emitters in MultiDark-Galaxies and DEEP2, MNRAS497, 5432, https://ui.adsabs.harvard.edu/abs/2020MNRAS.497.5432F

53. Ferrarese, Côté, MacArthur *et al.*, The Next Generation Virgo Cluster Survey (NGVS). XIV. The Discovery of Low-mass Galaxies and a New Galaxy Catalog in the Core of the Virgo Cluster, ApJ890, 128, https://ui.adsabs.harvard.edu/abs/2020ApJ...890..128F

54. Ferreira Lopes, Cross, Catelan *et al.*, The VISTA Variables in the Vía Láctea infrared variability catalogue (VIVA-I), MNRAS496, 1730, https://ui.adsabs.harvard.edu/abs/2020MNRAS.496.1730F

55. Fluxá, Brewer, and Dünner, Pixel space convolution for cosmic microwave background experiments, JCAP 2020, 030, https://ui.adsabs.harvard.edu/abs/2020JCAP...02..030F

56. Flörs, Spyromilio, Taubenberger *et al.*, Sub-Chandrasekhar progenitors favoured for Type Ia supernovae: evidence from late-time spectroscopy, MNRAS491, 2902, https://ui.adsabs.harvard.edu/abs/2020MNRAS.491.2902F

57. Fontecilla, Lodato, and Cuadra, The effect of cooling on the accretion of circumprimary discs in merging supermassive black hole binaries, MNRAS499, 2836, https://ui.adsabs.harvard.edu/abs/2020MNRAS.499.2836F

58. Garcia, Morgan, Herner *et al.*, A DESGW Search for the Electromagnetic Counterpart to the LIGO/Virgo Gravitational-wave Binary Neutron Star Merger Candidate S190510g, ApJ903, 75, https://ui.adsabs.harvard.edu/abs/2020ApJ...903...75G

59. Gill, Wheatley, Cooke *et al.*, NGTS-11 b (TOI-1847 b): A Transiting Warm Saturn Recovered from a TESS Single-transit Event, ApJ898, L11, https://ui.adsabs.harvard.edu/abs/2020ApJ...898L..11G

60. González-López, Novak, Decarli *et al.*, The ALMA Spectroscopic Survey in the HUDF: Deep 1.2 mm Continuum Number Counts, ApJ897, 91, https://ui.adsabs.harvard.edu/abs/2020ApJ...897...91G

61. Gralla, Marriage, Addison *et al.*, Atacama Cosmology Telescope: Dusty Star-forming Galaxies and Active Galactic Nuclei in the Equatorial Survey, ApJ893, 104, https://ui.adsabs.harvard.edu/abs/2020ApJ...893..104G

62. Gramajo, Palma, Minniti *et al.*, A hundred new eclipsing binary system candidates studied in a near-infrared window in the VVV survey, PASA 37, e054, https://ui.adsabs.harvard.edu/abs/2020PASA...37...54G

63. Guaita, Pompei, Castellano *et al.*, The VANDELS survey: Discovery of massive overdensities of galaxies at $z > 2$. Location of Lyα-emitting galaxies with respect to environment, A&A640, A107, https://ui.adsabs.harvard.edu/abs/2020A&A...640A.107G

64. Guilera, Sándor, Ronco *et al.*, Giant planet formation at the pressure maxima of protoplanetary disks. II. A hybrid accretion scenario, A&A642, A140, https://ui.adsabs.harvard.edu/abs/2020A&A...642A.140G

65. Gurung-López, Orsi, Bonoli *et al.*, Ly α emitters in a cosmological volume II: the impact of the intergalactic medium, MNRAS491, 3266, https://ui.adsabs.harvard.edu/abs/2020MNRAS.491.3266G

66. Gómez-Vargas, López-Fogliani, Muñoz Perez *et al.*, MeV-GeV γ-ray telescopes probing axino LSP/gravitino NLSP as dark matter in the $\mu\nu$SSM, JCAP 2020, 058, https://ui.adsabs.harvard.edu/abs/2020JCAP...01..058G

67. Hajdu, Dékány, Catelan Grebel *et al.*, On the optimal calibration of VVV photometry, Experimental Astronomy 49, 217, https://ui.adsabs.harvard.edu/abs/2020ExA....49..217H

68. Hara, Bouchy, Stalport *et al.*, The SOPHIE search for northern extrasolar planets. XVI. HD 158259: A compact planetary system in a near-3:2 mean motion resonance chain, A&A636, L6, https://ui.adsabs.harvard.edu/abs/2020A&A...636L...6H

69. Hartman, Jordán, Bayliss *et al.*, HATS-47b, HATS-48Ab, HATS-49b, and HATS-72b: Four Warm Giant Planets Transiting K Dwarfs, AJ159, 173, https://ui.adsabs.harvard.edu/abs/2020AJ...159..173H

70. Hasselquist, Zasowski, Feuillet *et al.*, Exploring the Stellar Age Distribution of the Milky Way Bulge Using APOGEE, ApJ901, 109, https://ui.adsabs.harvard.edu/abs/2020ApJ...901..109H

71. Hernández-Almada, Leon, Magaña *et al.*, Generalized emergent dark energy: observational Hubble data constraints and stability analysis, MNRAS497, 1590, https://ui.adsabs.harvard.edu/abs/2020MNRAS.497.1590H

72. Hernández-Almada, García-Aspeitia, Magaña Motta *et al.*, Stability analysis and constraints on interacting viscous cosmology, Phys.Rev.D101, 063516, https://ui.adsabs.harvard.edu/abs/2020PhRvD.101f3516H

73. Hirao, Bennett, Ryu *et al.*, OGLE-2017-BLG-0406: Spitzer Microlens Parallax Reveals Saturn-mass Planet Orbiting M-dwarf Host in the Inner Galactic Disk, AJ160, 74, https://ui.adsabs.harvard.edu/abs/2020AJ....160...74H

74. Horta, Schiavon, Mackereth *et al.*, The chemical compositions of accreted and in situ galactic globular clusters according to SDSS/APOGEE, MNRAS493, 3363, https://ui.adsabs.harvard.edu/abs/2020MNRAS.493.3363H

75. Huang, Andrews, Dullemond *et al.*, Erratum: "The Disk Substructures at High Angular Resolution Project (DSHARP). II. Characteristics of Annular Substructures" (2018, ApJL, 869, L42), ApJ898, L57, https://ui.adsabs.harvard.edu/abs/2020ApJ...898L..57H

76. Inami, Decarli, Walter *et al.*, The ALMA Spectroscopic Survey in the Hubble Ultra Deep Field: Constraining the Molecular Content at $\log(M_\star/M_\odot) \sim 9.5$ with CO Stacking of MUSE-detected $z \sim 1.5$ Galaxies, ApJ902, 113, https://ui.adsabs.harvard.edu/abs/2020ApJ...902..113I

77. Iodice, Cantiello, Hilker *et al.*, The first detection of ultra-diffuse galaxies in the Hydra I cluster from

the VEGAS survey, A&A642, A48, https://ui.adsabs.harvard.edu/abs/2020A&A...642A..48I

78. Iodice, Spavone, Cattapan *et al.*, VEGAS: a VST Early-type GAlaxy Survey. V. IC 1459 group: Mass assembly history in low-density environments, A&A635, A3, https://ui.adsabs.harvard.edu/abs/2020A&A...635A...3I

79. Jenkins, Díaz, Kurtovic *et al.*, An ultrahot Neptune in the Neptune desert, Nature Astronomy 4, 1148, https://ui.adsabs.harvard.edu/abs/2020NatAs...4.1148J

80. Jimenez-Gallardo, Massaro, Prieto *et al.*, Completing the 3CR Chandra Snapshot Survey: Extragalactic Radio Sources at High Redshift, ApJS250, 7, https://ui.adsabs.harvard.edu/abs/2020ApJS..250....7J

81. Johnston, Puzia, D'Ago *et al.*, The Next Generation Fornax Survey (NGFS): VII. A MUSE view of the nuclear star clusters in Fornax dwarf galaxies, MNRAS495, 2247, https://ui.adsabs.harvard.edu/abs/2020MNRAS.495.2247J

82. Jordán, Brahm, Espinoza *et al.*, TOI-677b: A Warm Jupiter ($P = 11.2$ days) on an Eccentric Orbit Transiting a Late F-type Star, AJ159, 145, https://ui.adsabs.harvard.edu/abs/2020AJ....159..145J

83. Jun, Assef, Bauer *et al.*, Spectral Classification and Ionized Gas Outflows in $z \sim 2$ WISE-selected Hot Dust-obscured Galaxies, ApJ888, 110, https://ui.adsabs.harvard.edu/abs/2020ApJ...888..110J

84. Khostovan, Malhotra, Rhoads *et al.*, A large, deep 3 deg^2 survey of Hα, [O III], and [O II] emitters from LAGER: constraining luminosity functions, MNRAS493, 3966, https://ui.adsabs.harvard.edu/abs/2020MNRAS.493.3966K

85. Kirkpatrick, Urry, Brewster *et al.*, The Accretion History of AGN: A Newly Defined Population of Cold Quasars, ApJ900, 5, https://ui.adsabs.harvard.edu/abs/2020ApJ...900....5K

86. Kluska, Berger, Malbet *et al.*, A family portrait of disk inner rims around Herbig Ae/Be stars. Hunting for warps, rings, self shadowing, and misalignments in the inner astronomical units, A&A636, A116, https://ui.adsabs.harvard.edu/abs/2020A&A...636A.116K

87. Kulier, Galaz, Padilla Trayford *et al.*, Massive low-surface-brightness galaxies in the EAGLE simulation, MNRAS496, 3996, https://ui.adsabs.harvard.edu/abs/2020MNRAS.496.3996K

88. Lagos, Schreiber, Parsons *et al.*, The White Dwarf Binary Pathways Survey -III. Contamination from hierarchical triples containing a white dwarf, MNRAS494, 915, https://ui.adsabs.harvard.edu/abs/2020MNRAS.494..915L

89. Lagos, Schreiber, Parsons *et al.*, Erratum: The White Dwarf Binary Pathways Survey - III. Contamination from hierarchical triples containing a white dwarf, MNRAS498, 2662, https://ui.adsabs.harvard.edu/abs/2020MNRAS.498.2662L

90. Lalounta, Papageorgiou, Christopoulou Catelan *et al.*, An investigation of low-mass-ratio EW systems from the Catalina Sky Survey, Contributions of the Astronomical Observatory Skalnate Pleso 50, 409, https://ui.adsabs.harvard.edu/abs/2020CoSka..50..409L

91. Lambrides, Chiaberge, Heckman *et al.*, A Large Population of Obscured AGN in Disguise as Low-luminosity AGN in Chandra Deep Field South, ApJ897, 160, https://ui.adsabs.harvard.edu/abs/2020ApJ...897..160L

92. Lamperti, Saintonge, Koss *et al.*, The CO(3-2)/CO(1-0) Luminosity Line Ratio in Nearby Star-forming Galaxies and Active Galactic Nuclei from xCOLD GASS, BASS, and SLUGS, ApJ889, 103, https://ui.adsabs.harvard.edu/abs/2020ApJ...889..103L

93. Lendl, Bouchy, Gill *et al.*, TOI-222: a single-transit TESS candidate revealed to be a 34-d eclipsing binary with CORALIE, EulerCam, and NGTS, MNRAS492, 1761, https://ui.adsabs.harvard.edu/abs/2020MNRAS.492.1761L

94. Li, Xue, Sun *et al.*, Piercing through Highly Obscured and Compton-thick AGNs in the Chandra Deep Fields. II. Are Highly Obscured AGNs the Missing Link in the Merger-triggered AGN-Galaxy Coevolution Models?, ApJ903, 49, https://ui.adsabs.harvard.edu/abs/2020ApJ...903...49L

95. Lian, Thomas, Maraston *et al.*, The age-chemical abundance structure of the Galactic disc - II. α-dichotomy and thick disc formation, MNRAS497, 2371, https://ui.adsabs.harvard.edu/abs/2020MNRAS.497.2371L

96. Lian, Zasowski, Hasselquist *et al.*, The Milky Way's bulge star formation history as constrained from its bimodal chemical abundance distribution, MNRAS497, 3557, https://ui.adsabs.harvard.edu/abs/2020MNRAS.497.3557L

97. Lim, Côté, Peng *et al.*, The Next Generation Virgo Cluster Survey (NGVS). XXX. Ultra-diffuse Galaxies and Their Globular Cluster Systems, ApJ899, 69, https://ui.adsabs.harvard.edu/abs/2020ApJ...899...69L

98. Liu, Côté, Peng *et al.*, The Next Generation Virgo Cluster Survey. XXXIV. Ultracompact Dwarf Galaxies in the Virgo Cluster, ApJS250, 17, https://ui.adsabs.harvard.edu/abs/2020ApJS..250...17L

99. Liu, Deng, Fan *et al.*, Variability and transient search in the SUDARE-VOICE field: a new method to extract the light curves, MNRAS493, 3825, https://ui.adsabs.harvard.edu/abs/2020MNRAS.493.3825L

100. Liu, Koss, Blecha *et al.*, The BAT AGN Spectroscopic Survey. XVIII. Searching for Supermassive Black Hole Binaries in X-Rays, ApJ896, 122, https://ui.adsabs.harvard.edu/abs/2020ApJ...896..122L

101. Longeard, Martin, Starkenburg *et al.*, The Pristine Dwarf-Galaxy survey - II. In-depth observational study of the faint Milky Way satellite Sagittarius II, MNRAS491, 356, https://ui.adsabs.harvard.edu/abs/2020MNRAS.491..356L

102. Lopez, Tejos, Barrientos *et al.*, Slicing the cool circumgalactic medium along the major axis of a star-forming galaxy at $z = 0.7$, MNRAS491, 4442, https://ui.adsabs.harvard.edu/abs/2020MNRAS.491.4442L

103. Lucas, Minniti, Kamble *et al.*, VVV-WIT-01: highly obscured classical nova or protostellar collision?, MNRAS492, 4847, https://ui.adsabs.harvard.edu/abs/2020MNRAS.492.4847L

104. Madhavacheril, Sifón, Battaglia *et al.*, The Atacama Cosmology Telescope: Weighing Distant Clusters with the Most Ancient Light, ApJ903, L13, https://ui.adsabs.harvard.edu/abs/2020ApJ...903L..13M

105. Madhavacheril, Hill, Næss *et al.*, Atacama Cosmology Telescope: Component-separated maps of CMB temperature and the thermal Sunyaev-Zel'dovich effect, Phys.Rev.D102, 023534, https://ui.adsabs.harvard.edu/abs/2020PhRvD.102b3534M

106. Magnelli, Boogaard, Decarli *et al.*, The ALMA Spectroscopic Survey in the HUDF: The Cosmic Dust and Gas Mass Densities in Galaxies up to $z \sim 3$, ApJ892, 66, https://ui.adsabs.harvard.edu/abs/2020ApJ...892...66M

107. Mancini, Sarkis, Henning *et al.*, The highly inflated giant planet WASP-174b, A&A633, A30, https://ui.adsabs.harvard.edu/abs/2020A&A...633A..30M

108. Marasco, Cresci, Nardini *et al.*, Galaxy-scale ionised winds driven by ultra-fast outflows in two nearby quasars, A&A644, A15, https://ui.adsabs.harvard.edu/abs/2020A&A...644A..15M

109. Millon, Courbin, Bonvin *et al.*, TDCOSMO. II. Six new time delays in lensed quasars from high-cadence monitoring at the MPIA 2.2 m telescope, A&A642, A193, https://ui.adsabs.harvard.edu/abs/2020A&A...642A.193M

110. Minniti, Sbordone, Rojas-Arriagada *et al.*, Using classical Cepheids to study the far side of the Milky Way disk. I. Spectroscopic classification and the metallicity gradient, A&A640, A92, https://ui.adsabs.harvard.edu/abs/2020A&A...640A..92M

111. Miyazaki, Sumi, Bennett *et al.*, OGLE-2013-BLG-0911Lb: A Secondary on the Brown-dwarf Planet Boundary around an M Dwarf, AJ159, 76, https://ui.adsabs.harvard.edu/abs/2020AJ...159...76M

112. Modjaz, Bianco, Siwek *et al.*, Host Galaxies of Type Ic and Broad-lined Type Ic Supernovae from the Palomar Transient Factory: Implications for Jet Production, ApJ892, 153, https://ui.adsabs.harvard.edu/abs/2020ApJ...892..153M

113. Montero-Dorta, Artale, Abramo *et al.*, The manifestation of secondary bias on the galaxy population from IllustrisTNG300, MNRAS496, 1182, https://ui.adsabs.harvard.edu/abs/2020MNRAS.496.1182M

114. Montesinos, Garrido-Deutelmoser, Olofsson *et al.*, Dust trapping around Lagrangian points in protoplanetary disks, A&A642, A224, https://ui.adsabs.harvard.edu/abs/2020A&A...642A.224M

115. Morgan, Soares-Santos, Annis *et al.*, Constraints on the Physical Properties of GW190814 through Simulations Based on DECam Follow-up Observations by the Dark Energy Survey, ApJ901, 83, https://ui.adsabs.harvard.edu/abs/2020ApJ...901...83M

116. Muñoz and Petrovich, Kozai Migration Naturally Explains the White Dwarf Planet WD1856 b, ApJ904, L3, https://ui.adsabs.harvard.edu/abs/2020ApJ...904L...3M

117. Ménard, Cuello, Ginski *et al.*, Ongoing flyby in the young multiple system UX Tauri, A&A639, L1, https://ui.adsabs.harvard.edu/abs/2020A&A...639L...1M

118. Naess, Aiola, Austermann *et al.*, The Atacama Cosmology Telescope: arcminute-resolution maps of 18 000 square degrees of the microwave sky from ACT 2008–2018 data combined with Planck, JCAP 2020, 046, https://ui.adsabs.harvard.edu/abs/2020JCAP...12..046N

119. Namikawa, Guan, Darwish *et al.*, Atacama Cosmology Telescope: Constraints on cosmic birefringence, Phys.Rev.D101, 083527, https://ui.adsabs.harvard.edu/abs/2020PhRvD.101h3527N

120. Nanni, Gilli, Vignali *et al.*, The deep Chandra survey in the SDSS J1030+0524 field, A&A637, A52, https://ui.adsabs.harvard.edu/abs/2020A&A...637A..52N

121. Napolitano, Li, Spiniello *et al.*, Discovery of Two Einstein Crosses from Massive Post-blue Nugget Galaxies at $z > 1$ in KiDS, ApJ904, L31, https://ui.adsabs.harvard.edu/abs/2020ApJ...904L..31N

122. Napolitano, D'Ago, Tortora *et al.*, Central velocity dispersion catalogue of LAMOST-DR7 galaxies, MNRAS498, 5704, https://ui.adsabs.harvard.edu/abs/2020MNRAS.498.5704N

123. Navarro, Minniti, Pullen Ramos *et al.*, VVV Survey Microlensing: The Galactic Latitude Dependence, ApJ889, 56, https://ui.adsabs.harvard.edu/abs/2020ApJ...889...56N

124. Navarro, Contreras Ramos, Minniti *et al.*, VVV Survey Microlensing: Catalog of Best and Forsaken Events, ApJ893, 65, https://ui.adsabs.harvard.edu/abs/2020ApJ...893...65N

125. Navarro, Minniti, and Contreras Ramos, VVV Survey Microlensing: Candidate Events with a Source in the Far Disk, ApJ902, 35, https://ui.adsabs.harvard.edu/abs/2020ApJ...902...35N

126. Nealon, Cuello, and Alexander, Flyby-induced misalignments in planet-hosting discs, MNRAS491, 4108, https://ui.adsabs.harvard.edu/abs/2020MNRAS.491.4108N

127. Nelson, Ford, Buchner *et al.*, Quantifying the Bayesian Evidence for a Planet in Radial Velocity Data, AJ159, 73, https://ui.adsabs.harvard.edu/abs/2020AJ....159...73N

128. Ni, Brandt, Yi *et al.*, An Extreme X-Ray Variability Event of a Weak-line Quasar, ApJ889, L37, https://ui.adsabs.harvard.edu/abs/2020ApJ...889L..37N

129. Nowak, Palle, Gandolfi *et al.*, K2-280 b - a low density warm sub-Saturn around a mildly evolved star, MNRAS497, 4423, https://ui.adsabs.harvard.edu/abs/2020MNRAS.497.4423N

130. Padilla, Eimer, Li *et al.*, Two-year Cosmology Large Angular Scale Surveyor (CLASS) Observations: A Measurement of Circular Polarization at 40 GHz, ApJ889, 105, https://ui.adsabs.harvard.edu/abs/2020ApJ...889..105P

131. Papageorgiou, Christopoulou, Catelan *et al.*, What we can learn from eclipsing binaries in large surveys: The case of EA Catalina systems, Contributions of the Astronomical Observatory Skalnate Pleso 50, 774, https://ui.adsabs.harvard.edu/abs/2020CoSka..50..774P

132. Pegues, Öberg, Bergner *et al.*, An ALMA Survey of H_2CO in Protoplanetary Disks, ApJ890, 142, https://ui.adsabs.harvard.edu/abs/2020ApJ...890..142P

133. Petroff, Eimer, Harrington *et al.*, Two-year Cosmology Large Angular Scale Surveyor (CLASS) Observations: A First Detection of Atmospheric Circular Polarization at Q band, ApJ889, 120, https://ui.adsabs.harvard.edu/abs/2020ApJ...889..120P

134. Petrovich, Muñoz, Kratter Malhotra *et al.*, A Disk-driven Resonance as the Origin of High Inclinations of Close-in Planets, ApJ902, L5, https://ui.adsabs.harvard.edu/abs/2020ApJ...902L...5P

135. Peña-Herazo, Amaya-Almazán, Massaro *et al.*, Optical spectroscopic observations of low-energy counterparts of Fermi-LAT γ-ray sources, A&A643, A103, https://ui.adsabs.harvard.edu/abs/2020A&A...643A.103P

136. Piatti and Carballo-Bello, The tidal tails of Milky Way globular clusters, A&A637, L2, https://ui.adsabs.harvard.edu/abs/2020A&A...637L...2P

137. Piatti, Carballo-Bello, Mora *et al.*, The elusive tidal tails of the Milky Way globular cluster NGC 7099, A&A643, A15, https://ui.adsabs.harvard.edu/abs/2020A&A...643A..15P

138. Poblete, Calcino, Cuello *et al.*, Binary-induced spiral arms inside the disc cavity of AB Aurigae, MNRAS496, 2362, https://ui.adsabs.harvard.edu/abs/2020MNRAS.496.2362P

139. Polarbear Collaboration, Adachi, Aguilar Faúndez *et al.*, A Measurement of the Degree-scale CMB B-mode Angular Power Spectrum with POLARBEAR, ApJ897, 55, https://ui.adsabs.harvard.edu/abs/2020ApJ...897...55P

140. Popping, Walter, Behroozi *et al.*, The ALMA Spectroscopic Survey in the HUDF: A Model to Explain Observed 1.1 and 0.85 mm Dust Continuum Number Counts, ApJ891, 135, https://ui.adsabs.harvard.edu/abs/2020ApJ...891..135P

141. Poulain, Paolillo, De Cicco *et al.*, Extending the variability selection of active galactic nuclei in the W-CDF-S and SERVS/SWIRE region, A&A634, A50, https://ui.adsabs.harvard.edu/abs/2020A&A...634A..50P

142. Price-Jones, Bovy, Webb *et al.*, Strong chemical tagging with APOGEE: 21 candidate star clusters that have dissolved across the Milky Way disc, MNRAS496, 5101, https://ui.adsabs.harvard.edu/abs/2020MNRAS.496.5101P

143. Privon, Ricci, Aalto *et al.*, A Hard X-Ray Test of HCN Enhancements As a Tracer of Embedded Black Hole Growth, ApJ893, 149, https://ui.adsabs.harvard.edu/abs/2020ApJ...893..149P

144. Prudil, Dékány, Smolec *et al.*, Humps and bumps: the effects of shocks on the optical light curves of fundamental-mode RR Lyrae stars, A&A635, A66, https://ui.adsabs.harvard.edu/abs/2020A&A...635A..66P

145. Pérez, Hales, Liu *et al.*, Resolving the FU Orionis System with ALMA: Interacting Twin Disks?, ApJ889, 59, https://ui.adsabs.harvard.edu/abs/2020ApJ...889...59P

146. Queiroz, Anders, Chiappini *et al.*, From the bulge to the outer disc: StarHorse stellar parameters, distances, and extinctions for stars in APOGEE DR16 and other spectroscopic surveys, A&A638, A76, https://ui.adsabs.harvard.edu/abs/2020A&A...638A..76Q

147. Quintana, Proust, Dünner *et al.*, A redshift database towards the Shapley supercluster region, A&A638, A27, https://ui.adsabs.harvard.edu/abs/2020A&A...638A..27Q

148. Rebolledo, Guzmán, Contreras *et al.*, Effect of Feedback of Massive Stars in the Fragmentation, Distribution, and Kinematics of the Gas in Two Star-forming Regions in the Carina Nebula, ApJ891, 113, https://ui.adsabs.harvard.edu/abs/2020ApJ...891..113R

149. Rodríguez, Garcia Lambas, Padilla Troncoso-Iribarren *et al.*, Following the crumbs: statistical effects of ram pressure in galaxies, MNRAS492, 413, https://ui.adsabs.harvard.edu/abs/2020MNRAS.492..413R

150. Rodríguez, Pignata, Anderson *et al.*, Luminous Type II supernovae for their low expansion velocities, MNRAS494, 5882, https://ui.adsabs.harvard.edu/abs/2020MNRAS.494.5882R

151. Rojas-Arriagada, Zasowski, Schultheis *et al.*, How many components? Quantifying the complexity of the metallicity distribution in the Milky Way bulge with APOGEE, MNRAS499, 1037, https://ui.adsabs.harvard.edu/abs/2020MNRAS.499.1037R

152. Rojas, Sani, Gavignaud *et al.*, BAT AGN Spectroscopic Survey - XIX. Type 1 versus type 2 AGN dichotomy from the point of view of ionized outflows, MNRAS491, 5867, https://ui.adsabs.harvard.edu/abs/2020MNRAS.491.5867R

153. Rojas, Maurin, Dünner Pichara *et al.*, Classifying CMB time-ordered data through deep neural networks, MNRAS494, 3741, https://ui.adsabs.harvard.edu/abs/2020MNRAS.494.3741R

154. Ronco, Schreiber, Giuppone *et al.*, How Jupiters Save or Destroy Inner Neptunes around Evolved Stars, ApJ898, L23, https://ui.adsabs.harvard.edu/abs/2020ApJ...898L..23R

155. Rong, Dong, Puzia *et al.*, Intrinsic Morphology of Ultra-diffuse Galaxies, ApJ899, 78, https://ui.adsabs.harvard.edu/abs/2020ApJ...899...78R

156. Rong, Zhu, Johnston *et al.*, Lessons on Star-forming Ultra-diffuse Galaxies from the Stacked Spectra of the Sloan Digital Sky Survey, ApJ899, L12, https://ui.adsabs.harvard.edu/abs/2020ApJ...899L..12R

157. Rong, Mancera Piña, Tempel *et al.*, Exploring the origin of ultra-diffuse galaxies in clusters from their primordial alignment, MNRAS498, L72, https://ui.adsabs.harvard.edu/abs/2020MNRAS.498L..72R

158. Satake, Heidarzadeh, Quiroz Cienfuegos *et al.*, History and features of trans-oceanic tsunamis and implications for paleo-tsunami studies, Earth Science Reviews 202, 103112, https://ui.adsabs.harvard.edu/abs/2020ESRv..20203112S

159. Schlecker, Kossakowski, Brahm *et al.*, A Highly Eccentric Warm Jupiter Orbiting TIC 237913194, AJ160, 275, https://ui.adsabs.harvard.edu/abs/2020AJ....160..275S

160. Schultheis, Rojas-Arriagada, Cunha *et al.*, Cool stars in the Galactic center as seen by APOGEE. M giants, AGB stars, and supergiant stars and candidates, A&A642, A81, https://ui.adsabs.harvard.edu/abs/2020A&A...642A..81S

161. Scognamiglio, Tortora, Spavone *et al.*, Building the Largest Spectroscopic Sample of Ultracompact Massive Galaxies with the Kilo Degree Survey, ApJ893, 4, https://ui.adsabs.harvard.edu/abs/2020ApJ...893....4S

162. Shah, Kartaltepe, Magagnoli *et al.*, Investigating the Effect of Galaxy Interactions on the Enhancement of Active Galactic Nuclei at $0.5 < z < 3.0$, ApJ904, 107, https://ui.adsabs.harvard.edu/abs/2020ApJ...904..107S

163. Shangguan, Ho, Bauer *et al.*, AGN Feedback and Star Formation of Quasar Host Galaxies: Insights from the Molecular Gas, ApJ899, 112, https://ui.adsabs.harvard.edu/abs/2020ApJ...899..112S

164. Shangguan, Ho, Bauer *et al.*, An ALMA CO(2-1) Survey of Nearby Palomar-Green Quasars, ApJS247, 15, https://ui.adsabs.harvard.edu/abs/2020ApJS..247...15S

165. Shankar, Weinberg, Marsden *et al.*, Probing black hole accretion tracks, scaling relations, and radiative efficiencies from stacked X-ray active galactic nuclei, MNRAS493, 1500, https://ui.adsabs.harvard.edu/abs/2020MNRAS.493.1500S

166. Shankar, Allevato, Bernardi *et al.*, Constraining black hole-galaxy scaling relations and radiative efficiency from galaxy clustering, Nature Astronomy 4, 282, https://ui.adsabs.harvard.edu/abs/2020NatAs...4..282S

167. Smith, Koss, Mushotzky *et al.*, Significant Suppression of Star Formation in Radio-quiet AGN Host Galaxies with Kiloparsec-scale Radio Structures, ApJ904, 83, https://ui.adsabs.harvard.edu/abs/2020ApJ...904...83S

168. Smith, Mushotzky, Koss *et al.*, BAT AGN spectroscopic survey - XV: the high frequency radio cores of ultra-hard X-ray selected AGN, MNRAS492, 4216, https://ui.adsabs.harvard.edu/abs/2020MNRAS.492.4216S

169. Smith, D'Andrea, Sullivan *et al.*, First Cosmology Results using Supernovae Ia from the Dark Energy Survey: Survey Overview, Performance, and Supernova Spectroscopy, AJ160, 267, https://ui.adsabs.harvard.edu/abs/2020AJ....160..267S

170. Sokolov, Pineda, Buchner Caselli *et al.*, Probabilistic Detection of Spectral Line Components, ApJ892, L32, https://ui.adsabs.harvard.edu/abs/2020ApJ...892L..32S

171. Stevance, Maund, Baade *et al.*, Erratum: Spectropolarimetry of the Type IIb SN 2008aq, MNRAS493, 3996, https://ui.adsabs.harvard.edu/abs/2020MNRAS.493.3996S

172. Stevance, Baade, Bruten *et al.*, The shape of SN 1993J re-analysed, MNRAS494, 885, https://ui.adsabs.harvard.edu/abs/2020MNRAS.494..885S

173. Surot, Valenti, Gonzalez *et al.*, Mapping the stellar age of the Milky Way bulge with the VVV. III. High-resolution reddening map, A&A644, A140, https://ui.adsabs.harvard.edu/abs/2020A&A...644A.140S

174. Taibi, Battaglia, Rejkuba *et al.*, The Tucana dwarf spheroidal galaxy: not such a massive failure after all, A&A635, A152, https://ui.adsabs.harvard.edu/abs/2020A&A...635A.152T

175. Thomas, Pentericci, Le Fevre *et al.*, The intergalactic medium transmission towards $z \gtrsim 4$ galaxies with VANDELS and the impact of dust attenuation, A&A634, A110, https://ui.adsabs.harvard.edu/abs/2020A&A...634A.110T

176. Tortora, Napolitano, Radovich *et al.*, Nature versus nurture: relic nature and environment of the most massive passive galaxies at $z < 0.5$, A&A638, L11, https://ui.adsabs.harvard.edu/abs/2020A&A...638L..11T

177. Treister, Messias, Privon *et al.*, The Molecular Gas in the NGC 6240 Merging Galaxy System at the Highest Spatial Resolution, ApJ890, 149, https://ui.adsabs.harvard.edu/abs/2020ApJ...890..149T

178. Troncoso-Iribarren, Padilla, Santander *et al.*, The better half - asymmetric star formation due to ram pressure in the EAGLE simulations, MNRAS497, 4145, https://ui.adsabs.harvard.edu/abs/2020MNRAS.497.4145T

179. Venturini, Guilera, Haldemann *et al.*, The nature of the radius valley. Hints from formation and evolution models, A&A643, L1, https://ui.adsabs.harvard.edu/abs/2020A&A...643L...1V

180. Venturini, Guilera, Ronco Mordasini *et al.*, Most super-Earths formed by dry pebble accretion are less massive than 5 Earth masses, A&A644, A174, https://ui.adsabs.harvard.edu/abs/2020A&A...644A.174V

181. Venturini, Ronco, and Guilera, Setting the Stage: Planet Formation and Volatile Delivery, Space Sci.Rev.216, 86, https://ui.adsabs.harvard.edu/abs/2020SSRv..216...86V

182. Verdugo, Carrasco, Foëx *et al.*, Dissecting the Strong-lensing Galaxy Cluster MS 0440.5+0204. I. The Mass Density Profile, ApJ897, 4, https://ui.adsabs.harvard.edu/abs/2020ApJ...897....4V

183. Vito, Brandt, Lehmer *et al.*, Chandra reveals a luminous Compton-thick QSO powering a Lyα blob in a $z = 4$ starbursting protocluster, A&A642, A149, https://ui.adsabs.harvard.edu/abs/2020A&A...642A.149V

184. Walter, Carilli, Neeleman *et al.*, The Evolution of the Baryons Associated with Galaxies Averaged over Cosmic Time and Space, ApJ902, 111, https://ui.adsabs.harvard.edu/abs/2020ApJ...902..111W

185. Wang, Li, Russell Cuadra *et al.*, Colliding winds in and around the stellar group IRS 13E at the galactic centre, MNRAS492, 2481, https://ui.adsabs.harvard.edu/abs/2020MNRAS.492.2481W

186. Weaver, López-Morales, Espinoza *et al.*, ACCESS: A Visual to Near-infrared Spectrum of the Hot Jupiter WASP-43b with Evidence of H_2O, but No Evidence of Na or K, AJ159, 13, https://ui.adsabs.harvard.edu/abs/2020AJ....159...13W

187. Wyrzykowski, Mróz, Rybicki *et al.*, Full orbital solution for the binary system in the northern Galactic disc microlensing event Gaia16aye, A&A633, A98, https://ui.adsabs.harvard.edu/abs/2020A&A...633A..98W

188. Xu, Brewer, Rojas *et al.*, Two-year Cosmology Large Angular Scale Surveyor (CLASS) Observations: 40 GHz Telescope Pointing, Beam Profile, Window Function, and Polarization Performance, ApJ891, 134, https://ui.adsabs.harvard.edu/abs/2020ApJ...891..134X

189. Zaino, Bianchi, Marinucci *et al.*, Probing the circumnuclear absorbing medium of the buried AGN in NGC 1068 through NuSTAR observations, MNRAS492, 3872, https://ui.adsabs.harvard.edu/abs/2020MNRAS.492.3872Z

190. Zhang, Paudel, Smith *et al.*, The Blue Compact Dwarf Galaxy VCC 848 Formed by Dwarf-Dwarf Merging, ApJ891, L23, https://ui.adsabs.harvard.edu/abs/2020ApJ...891L..23Z

191. Zhang, Smith, Oh *et al.*, The Blue Compact Dwarf Galaxy VCC 848 Formed by Dwarf-Dwarf Merging: H I Gas, Star Formation, and Numerical Simulations, ApJ900, 152, https://ui.adsabs.harvard.edu/abs/2020ApJ...900..152Z

192. Zorich, Pichara, and Protopapas, Streaming classification of variable stars, MNRAS492, 2897, https://ui.adsabs.harvard.edu/abs/2020MNRAS.492.2897Z

193. Zou, Brandt, Vito *et al.*, X-ray properties of dust-obscured galaxies with broad optical/UV emission lines, MNRAS499, 1823, https://ui.adsabs.harvard.edu/abs/2020MNRAS.499.1823Z

194. Šubjak, Sharma, Carmichael *et al.*, TOI-503: The First Known Brown-dwarf Am-star Binary from the TESS Mission, AJ159, 151, https://ui.adsabs.harvard.edu/abs/2020AJ....159..151S