

Alejandra Melo Melo

Contact information

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Professional Status PhD in Astrophysics
Nationality Chilean
Spanish Mothertongue
English Expert

Research interest strong gravitational lensing, machine learning, black hole masses, galaxy evolution, observational reduction, microlensing analysis, lens finding

Education and Career

Current Position

Postdoc fellow at the Max Planck Institute for Astrophysics
06/2022 - Present

Education

UNIVERSIDAD DE VALPARAÍSO, Valparaíso, Chile.

PhD in Astrophysics, April 2022

Title: "Probing the source structure in lensed AGNs"

Advisor: Dr. Verónica Motta

UNIVERSIDAD DE CONCEPCIÓN, Concepción, Chile.

Professional degree : Astrónoma, 08/2016

Bachelor's degree in Astronomy : Licenciado en Ciencias Mención Astronomía, 12/2014

Bachelor in Astronomy, 2010-2014

Employment history

PhD fellowship / PUENTE, UVA20993 / Instituto de Física y Astronomía / Universida de Valparaíso / Chile / 09-2021 - 12-2021.

PhD fellowship / CONICYT (ANID) / Instituto de Física y Astronomía / Universida de Valparaíso / Chile / 03-2017 - 01-2022

Collaboration membership

2022 - present Highly Optimised Lensing Investigations of Supernovae, Microlensing Objects, and Kinematics of Ellipticals and Spirals (**HOLISMOKES**)
2023 - present **Euclid consortium**; Euclid Strong Lensing Science Working Group
2022 - present Vera C. Rubin Observatory (**LSST**) consortium.
2022 - present German Center for Cosmological Lensing (**GCCL**) Rubin group of Strong Lensing.
2022 - present Time-delay Cosmography (**TDCOSMO**) kinematics analysis subgroup.

List of Publications

- 2024 **Melo, A.**; Canameras, R.; Suyu, S.; et al.: "Strong-lens search through deep learning with both ground- and space-based imaging data"
2024, in prep.
- 2024 **Melo, A.**; Caminha, G.; Suyu, S.; et al.: "Filament features in the quadruple lensed system WGD2038-4008"
2024, in prep.
- 2024 **Melo, A.**; Motta, V.; et al.: "Accretion disk size estimation for four double lensed systems"
2024, in prep.
- 2023 **Melo, A.**; Motta, V.; et al.: "Black Hole masses for 14 gravitational lensed quasars"
2023, A&A 680, A51.
- 2021 **Melo, A.**; Motta, V.; Godoy, N. et al.: "First black hole mass estimation for the quadruple lensed system WGD2038-4008"
2021, A&A, 656, A108.

As co-author

- 2023 Canameras, R., et al.: "HOLISMOKES – XI. Evaluation of supervised neural networks for strong-lens searches in ground-based imaging surveys"
eprint arXiv:2306.03136
- 2023 Taufik Andika, Irham., et al.: "Streamlined Lensed Quasar Identification in Multiband Images via Ensemble Networks"
A&A, 678 (2023) A103
- 2023 Rojas, K., et al.: "The impact of human expert visual inspection on the discovery of strong gravitational lenses"
MNRAS, Volume 523, Issue 3, pp.4413-4430
- 2020 Millon, M., et al.: "TDCOSMO. II. Six new time delays in lensed quasars from high-cadence monitoring at the MPIA 2.2 m telescope"
2020A&A...642A.193M
- 2020 Lemon, C., et al.: "The STRong lensing Insights into the Dark Energy Survey (STRIDES) 2017/2018 follow-up campaign: discovery of 10 lensed quasars and 10 quasar pairs "
2020MNRAS.494.3491L
- 2017 Lansbury, G. B., et al.: "THE *NuSTAR* SERENDIPITOUS SURVEY: THE 40 MONTH CATALOG AND THE PROPERTIES OF THE DISTANT HIGH ENERGY X-RAY SOURCE POPULATION "
2017ApJ...836...99L
- 2014 Faundez C.; Bravo A.; **Melo A.** & Astudillo H.: "Laboratorio Virtual para la Unidad Tierra y Universo como parte de la Formación Universitaria de Docentes de Ciencias"
Formación Universitaria, 2014, 7(3) 33-40.

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Refereed and Accepted
publications

<https://ui.adsabs.harvard.edu/public-libraries/CLZI3DNgToKx7m4HWM3mKQ>

Telescope runs/skills

Observing proposals

- 2021 109.23A0.001/P108, Very Large Telescope, XSHOOTER, 12.0 hours (PI).
- 2021 108.22BQ.001/P108, Very Large Telescope, XSHOOTER, 15.0 hours (PI).
- 2020 106.21DC.001/P106, Very Large Telescope, XSHOOTER, 16.0 hours (PI).
- 2019 0103.B-0566(A)/P103, Very Large Telescope, XSHOOTER, 10.5 hours (PI).

- 2023 Core run: 7E7H39JG 3, Las Campanas Observatory / Magellan Telescope / 3 nights (Col).
- 2021 106.216P.002/P107, VLT Survey Telescope (VST) / OMEGACAM / 291.5.0 hours (Col).
- 2020 106.216P.001/P106, VLT Survey Telescope (VST) / OMEGACAM / 315.0 hours (Col).
- 2019 1103.A-0801/P103, VLT Survey Telescope (VST) / OMEGACAM / 182.0 hours (Col).
- 2018 0102.A-0335(A)/P101, Very Large Telescope, XSHOOTER, 12.0 hours (Col).

Observing nights

- 2023 Clay/Magellan telescope at Las Campanas Observatory, SDSS3 instrument, one night. This run was part of PhDc Felipe Ávila to measure black hole masses and study microlensing analysis.
- 2021 2.2m ESO/MPG 2.2m telescope at La Silla Observatory, WFI, FEROS and GROND instruments, 11 nights. This run was part of the COSMological MONitoring of GRAvitational Lenses (COSMOGRAIL) program for the observation of gravitational lenses.
- 2019 The Southern Astrophysical Research (SOAR) Telescope, SOAR Optical Imager (SOI), 3 nights. This run was part of the STRong-lensing Insights into Dark Energy Survey (STRIDES) in the search and confirmation of gravitational lenses.
- 2018 2.2m ESO/MPG 2.2m telescope at La Silla Observatory, WFI, FEROS and GROND instruments, 9 nights. This run was part of the COSMOGRAIL program.
- 2018 The ESO New Technology Telescope (NTT) at La Silla Observatory, SofI instrument, 3 nights. This run was part of the ESO/NEON Observing School at La Silla to obtain black holes masses of quasars.
- 2018 2.2m ESO/MPG 2.2m telescope at La Silla Observatory, WFI, FEROS and GROND instruments, 3 nights. This run was part of the COSMOGRAIL program.
- 2017 The Southern Astrophysical Research (SOAR) Telescope, SOAR Optical Imager (SOI), 6 nights. This run was part of STRIDES.
- 2016 The Swope Telescope, Las Campanas Observatory, CCD camera, E2V 4kx4k, 2 nights.
- 2016 2.2m ESO/MPG 2.2m telescope at La Silla Observatory, GROND instrument, 3 nights.
- 2016 Henrietta Swope telescope at Las Campanas Observatory, Direct CCD camera, 4 nights.
- 2015 Smarts 0.9-m telescope in cerro Tololo, 2048x2046 Tek2K CCD detector, 2 nights.

Data reduction

X-shooter pipeline/Esoreflex workflow and R software (Python) for reduction

I use X-shooter pipeline of Esoreflex to reduce the data obtained from my observing programs. The observing block (OB) for the first program was made using a 3 arcsec nodding per individual frame for a proper reduction, which caused a self-subtraction flux from the lensed quasar spectra. To correct this problem, I used the X-shooter pipeline changing the mode from nodding to stare mode so that I reduced each OB (flat field, dark current, wavelength calibration, among others) without nodding and subtraction of the sky emission. Then, a sky emission correction was designed using R software based on Principal Component Analysis (PCA) for the NIR arm. Finally, flux calibration was done using the response curve from the end-products of the X-shooter pipeline. For my second program, we used the nodding mode. The R program was moved to python.

Molecfit software

To correct by telluric absorptions in the VIS and NIR arm of X-shooter. I used a median combined spectra of the targeted object of each frame to use in molecfit as the input spectra, and when we obtained the best-fit, it was applied it to all the frames row-by-row.

IRAF (Image Reduction and Analysis Facility)

I used IRAF to reduced the data from the Smarts 0.9-m and Swope telescope. I know how to use the libraries and do the steps of reduction (flat field, dark current, sky correction, wavelength calibration, flux calibration, among others) for FITS images. To this date, I still use IRAF for several telescope reductions or programs that needs it.

SINFONI pipeline/Esoreflex workflow

SINFONI pipeline was employed to reduce data of gravitational lensed quasar from the ESO archive.

MOPEX (MOsaicker and Point source EXtractor)

Spitzer images using IRAC instrument in Channel 1 and 2 (3.551 and 4.493 μm respectively) was reduced using MOPEX. After the reduction, SExtractor program was used for the photometry of each quasar.

THELI GUI

For the reduction of the 2.2m telescope using GROND instrument (run of 2016), the THELI tool was used to reduce J, H, K, u, g, r i, z images.

Coding/Programming experience

Python: Most used for programming.

R software

Lensmodel: Package used to model a gravitational lens and obtain the lens parameters to get the magnification of each image.

Low Resolution Template (LRT): Package for creating an Spectral Energy Distribution (SED) for AGNs.

Fellowships and grants

2017-2021 BECA DE DOCTORADO NACIONAL CONICYT (ANID) (Folio: 21171499) at Universidad de Valparaíso

A scholarship that covers the cost of a PhD at the university you apply to while pursuing one.

2019 Gastos operacionales (Folio: 24190202), CONICYT (ANID), \$2.400.000

Award that supports doctoral studies.

Talks and Seminars

2024 Rubin Strong Lensing 2024, Oxford, UK. Talk contribution.

2024 Euclid Strong Lensing Science Working Group meeting, Bologna, Italy. Online talk contribution.

2023 LARIM 2023: XVII Reunión Regional Latinoamericana De La UAI, Montevideo, Uruguay. **Invited speaker:** "Strong-lens search through deep learning with both ground- and space-based imaging data"

2023 Astrophysic seminar at Universidad de Valparaíso, Valparaíso, Chile. Talk contribution.

2023 MIAPbP 2023, Garching Bei Munchen, Germany, The Extragalactic Distance Scale and Cosmic Expansion in the Era of Large Surveys and the James Webb Telescope. Contributed talk.

2023 Strong Gravitational Lensing in the era of big data, Otranto Castle, Italy, Poster presentation: "Strong-lens search through deep learning with both ground- and space-based imaging data"

2022 LENSING ODYSSEY 2022, Kouremenos, Crete, Oral presentation: "Black hole mass estimation of 14 gravitational lensed quasars."

2020 Seminar at Universidad de Valparaíso, Oral presentation: "Supermassive black hole mass estimation of gravitational lensed quasars."

2019 LARIM 2019: XVI Latim American Regional IAU Meeting, Antofagasta, Chile, Oral presentation: "Supermassive Black Hole mass estimations using gravitational lensed quasars."

2019 PANORAMAS 2019, Valparaíso, Chile, Oral presentation: "Supermassive Black Hole mass estimations for 13 gravitational lensed quasars."

2018 PANORAMAS 2018, Valparaíso, Chile, Oral presentation: "Probing the source structure in lensed AGNs."

2016 XII Annual Meeting Sociedad Chilena de Astronomía (SOCHIAS), Puerto Varas, Chile, Oral presentation: "Infrared properties of hard X-ray emitters detected in the NuSTAR Serendipitous Survey."

2016 LARIM 2016: XV Latim American Regional IAU Meeting, Cartagena de Indias, Colombia, Poster presentation: "Physical Properties of hard X-ray NuSTAR in the NuSTAR Serendipitous Sourvey."

- 2015 SOCHIAS, Poster presentation: "Near IR Properties of NuSTAR hard X-ray Emitters Observed by Spitzer."
- 2015 Unveiling the AGN - Galaxy Evolution Connection, Puerto Varas, Chile, Poster presentation: "Near IR Properties of NuSTAR hard X-ray Emitters Observed by Spitzer."
- 2014 XIX Simposio Chileno de Física 2014, Concepción, Chile, Poster Presentation: "Utilización de Tecnologías de la Información en la Enseñanza de la Astronomía."

Summer schools and trainings

February 18 - March 2, 2018 ESO/NEON Observing School at La Silla, Santiago and La Silla Observatory

In the two week school, we were separated in groups to work in an astronomical research. The objective of my group was to obtain black hole mass from quasars using SofI instrument from the ESO New Technology Telescope (NTT) at La Silla Observatory. The first few days was to prepare ourselves to go to La Silla observatory and obtain the data. We came back to Santiago, reduce and analyse the data and finally present it to the audience. I got to learn how to use a new instrument, how to work with the data and obtain the black hole mass.

Scientific visit

Visit collaborator from ESO (PhD Julian Mejía-Restrepo) at ESO headquarters in Santiago, Chile, 2018 . He taught me to use his program to obtain black hole mass of AGNs.

Visit collaborator from Universidad Diego Portales (Astronomy Professor Roberto Assef) at Universidad de Valparaíso, Chile, 2019. Collaboration together for MMIRS and LUCIFER data.

Lectures given

Images reduction using Python, Universidad de Valparaíso, 2023.

Night observation at the 2.2m telescope at La Silla at Universidad de Valparaíso, 2021.

Mentoring

- 2024/present Duy Anh Hoang (Undergraduate student at Technical University of Munich)
- 2022/2023 Felipe Ávila Vera (PhDc at Universidad de Valparaíso)

Scientific community work

- 02-July-2019 Went to Cachiyuyo, Chile, to be part of the monitoring of the telescope group of Universidad de Valparaíso for the eclipse 2019
- 2019–Present **Telescope instructor in Toki-Kura**, CASABLANCA, Chile.
Observations open to the community.
- 2019 Reñaca, Chile: Talk for the community about eclipses.
- 2014–2017 **Telescope instructor**, UNIVERSIDAD DE CONCEPCIÓN, Chile.
Observations open to the community.
Every 5 and 20 of every month the telescope of the department was open to the community.
Being to Isla Santa María, San Nicolás, Chile Val Pinto, San Nicolás.
Talk in Parque Pedro del Río Zañartu and Parque Alessandri, Concepción, Chile.
- 2013–2016 **Part of Equipo de Divulgación Astronómica (E.D.A.)**, UNIVERSIDAD DE CONCEPCIÓN, Chile.
Workshops and talks for all audiences within the south of Chile.
- In Conferences Unveiling the AGN - Galaxy Evolution Connection, Puerto Varas, Chile in the reception and along the conference.

Teaching experience

- 2022/Present FOPRA Experiment 85: Colour-Magnitude Diagrams of Star Clusters: Determining Their Relative Ages, Technical University of Munich.
- 2016/First semester Módulos Complementarios, Universidad de Concepción.

2015/Second semester Programación Astronómica, Universidad de Concepción.
 2015/Second semester Ciencia y Tecnología, Universidad de Concepción.
 2015/First semester Física II: Fundamentos de Mecánica, Universidad de Concepción.
 2015/First semester Módulos Complementarios, Universidad de Concepción.
 2014/First semester Proyecto de Física II, Universidad de Concepción.
 2014/First semester Módulos Complementarios, Universidad de Concepción.
 2013/Second semester Proyecto de Física II, Universidad de Concepción.

Interests

- Crochet/knitting
- Reading
- Series/movies
- Plants
- Photography
- Running
- Watercolor (sometimes)

References

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