Luca Ighina

PhD in Astrophysics

Milano (Italy), 18/09/1996 @ luca.ighina@inaf.it +39 3389360502

RESEARCH EXPERIENCE

Post-doctoral Research Fellow

Center for Astrophysics | Harvard & Smithsonian, Cambridge, MA, USA November 2024 – on

Studying the properties of $z > 6$ quasars by focusing on the impact of relativistic jets on the growth of supermassive black holes in the early stages of their evolution.

Post-doc

INAF-Brera, Milano March 2024 – October 2024

Working on the evolution of high-redshift quasars and relativistic jets from the observational point of view using telescopes across the entire electromagnetic spectrum (radio+optical/NIR+X-rays).

EDUCATION

PhD in Astrophysics

Università degli Studi dell'Insubria – INAF-Brera – ICRAR-Curtin Nov 2020 – Jan 2024

- Title: 'Relativistic jets from QSOs in the early Universe'
- Subject: Finding and characterising radio-powerful quasars at high redshift ($z > 5$) to study the combined evolution of supermassive black holes together with their relativistic jets in the early Universe.
- Supervisors: A. Caccianiga and A. Moretti, National Institute for Astrophysics (INAF), Milano–Brera, Italy
- One year spent at the International Centre for Radio Astronomy Research (ICRAR), Perth, Western Australia. Hosted by N. Seymour and J. W. Broderick.

Master's degree in Astrophysics and Physics of Space

Università degli Studi di Milano-Bicocca (Italy) 2018 – 2020

- One semester spent at: *Université d'Aix-Marseille* (France, autumn 2019)
- *'The impact of the CMB on the spatial density of high-z blazars'*, at the INAF-Brera observatory (12 months) Supervisors: A. Caccianiga, A. Moretti and M. Dotti. Final grade: 110 *cum laude* / 110

Undergraduate degree in Physics

Università degli Studi di Milano-Bicocca (Italy) 2015 – 2018

- One semester spent at: *Université de Bordeaux* (France, spring 2018)
- *'X-ray analysis of high-redshift blazars'*, at the INAF-Brera observatory (6 months) Supervisors: A. Caccianiga, A. Moretti and M. Dotti. Final grade: 104 / 110

LANGUAGES

Italian	***English***	***French***	***Spanish***	***Portuguese***
Mother tongue	Fluent (band 8/C1) IELTS certification	Fluent (C1) Univ. Bordeaux/OLS certification	Advanced (B2)	Beginner (A2)

COMPUTER SKILLS

Operating Systems	***Programming Languages***	***Astro. Softwares***
Linux, MacOS	Python, C/C++	Xspec, CIAO, Marx, Sherpa, IRAF, TopCat, CASA, MIRIAD, AIPS

GRANTS AND AWARDS

- **Chandra proposal 26700199** "X-ray observations of four radio-bright $z > 2$ kpc-scale jets" PI L. Ighina, $US46k.
- **Grant from INAF** for the project "Testing the obscuration in the Early Universe" (PI A. Caccianiga), €49k in total, in order to analyse the observations obtained during 2022 with L. Ighina as PI.
- **Grant from INAF** for the project "QSO jets in the early Universe" (PI A. Moretti), €24k in total, in order to analyse the observations obtained during 2021 with L. Ighina as PI.
- Honorable mention in the first edition of the national *Geppina Coppola* prize (2021) for the best master thesis in physics and astrophysics. Organised by the Capodimonte Observatory and the Geppina Coppola Association (Naples, Italy). Invited for a talk. Newspaper article (in Italian) *here*.
- **PhD scholarship** awarded for three years and three months after a competitive selection. €51k in total.

INVITED SEMINARS

- High energy seminar, Center for Astrophysics, Cambridge, MA, US (02 April 2025), invited seminar: *X-ray view on blazars and relativistic jets at high redshift.*
- Radio, Sub-Millimiter (RMS) seminar, Center for Astrophysics, Cambridge, MA, US (15 November 2024), invited seminar: *Radio Quasars and their relativistic jets in the early Universe.*
- Institute of Astrophysics and Space Sciences, Lisbon, Portugal (7 June 2024), invited seminar: *Relativistic jets from QSOs in the early Universe.*
- Osservatorio Astoronomico di Brera, Merate, Italy (16 April 2024), invited seminar: *Relativistic jets from QSOs in the eraly Universe.*
- Hypatia Colloquium (14 June 2022), organised by ESO, Garching. Invited after a competitive selection. Online seminar: YouTube recording and Proceedings available.

CONFERENCE PARTICIPATION

- 25 Years of Science with Chandra, (03 – 06 December 2024), Boston, US. Talk contribution: The most distant relativistic jet resolved by Chandra.
- Deep24: Beyond the Edge of the Universes, (21 – 25 October 2024), Sintra, Portugal. Talk contribution: Relativistic jets from QSOs in the early Universe.
- The First Gigayear(s), (30 Sept. – 4 Oct. 2024), Hilo, Hawaii, US. Talk and poster contribution: Relativistic Jets from quasars in the early Universe.
- XVth Italian meeting on Active Galactic Nuclei: from the present-day Universe to the Dark Ages, (20-27 September 2024), Padova, Italy. Talk contribution: *The most extreme radio QSOs at* $z > 5$.
- SPARCS XII: Pushing Toward the Final Frontier, (6-10 May 2024), Bologna, Italy. Talk contribution: *The most extreme z>5 AGN uncovered by RACS.*
- Exploring the Unknown with Radio Surveys: A Celebration of the Career of Ray Norris, (15-18 May 2023), Uluru, NT, Australia. Talk contribution: *Exploring the Radio-Loud AGN population at high redshift with RACS.*
- IAU Symposia: The multimessenger chakra of blazar jets, (5-9 December 2022), Kathmandu, Nepal. Talk contribution: *Multi-wavelength properties of the kpc-scale jet in the highest-redshift blazar*.
- IAUGA 2022 XXXI General Assembly International Astronomical Union, Focus Meeting 1 'Physics of Relativistic Jets on All Scales' (2-11 August 2022), Busan, Republic of Korea and Online Platform. E-talk: *Direct observation of an extended X-ray jet at z=6.1*; e-poster: *Cosmic evolution of the Blazar population*.
- AGN XIV: The Renaissance of Black Holes and Galaxies (23-27 May 2022), Florence, Italy. Two posters contribution.
- The Third National Workshop on the SKA Project - The Italian Route to the SKAO Revolution (4–8 October 2021), organised by the Italian National Institute for Astrophysics (INAF). Online event, talk contribution: Exploring the population of Radio-Loud AGNs at high redshift with the RACS survey.
- X-ray Astronomy 2019: current challenges and new frontiers in the next decade (8–13 September 2019), Bologna, Italy. *Poster contribution*: X-ray properties of z>4 blazars.
- AGN XIII: Beauty and the Beast: The 13th Italian meeting on Active Galactic Nuclei (9-12 October 2018), Milano, Italy. *Poster contribution*: An X-ray analysis of high-z blazar candidates.

SUMMER SCHOOLS AND WORKSHOPS PARTICIPATION

- ERIS 2022, ninth European Radio Interferometry School (19–23 September 2022), sponsored by the OPTICON-RadioNET Pilot and hosted by JIVE, Joint Institute for VLBI ERIC, & ASTRON, Netherlands Institute for Radio Astronomy, Dwingeloo, The Netherlands.
- 2nd IAA-CSIC Severo Ochoa School on Statistics, Data Mining and Machine Learning (29–3 December 2021), organised by the Instituto de Astrofísica de Andalucía, Granada.
- GROWTH Astronomy School 2020 (17–21 August 2020), online summer school on multi-wavelength observations, organised by Caltech and the GROWTH collaboration.
- School on High Energy Astrophysics (5–16 August 2019), International Center for Theoretical Astrophysics South American Institute for Fundamental Research (ICTP-SAIFR), São Paulo, Brazil (poster contribution).
- Astrosoma, summer school on modern astrophysics, Cosmology (1–12 July 2019), Moscow Institute of Physics and Technology and P. N. Lebedev Physical Institute, Moscow, Russia (with talk contribution).
- Observational Astrophysics: from proposals to publication (17–27 June 2019), Astronomical Institute of Slovak Academy of Sciences (SAS), Tatranská Lomnica, Slovak Republic. Organised by Opticon and Erasmus+.

TEACHING AND SUPERVISION EXPERIENCE

- **Supervision** of the student *Will Kinley* for the SAO-NSF Research Experience for Undergraduates internship, June-August 2025: *Tracing the evolution of the most extreme Black Holes*.
- **Co-supervision** of the student *Gabrielle Oliva* for the SAO-NSF Research Experience for Undergraduates internship, June-August 2025: *Hurting down the most extreme jetted quasars at* $z > 4$.
- **Supervision** of the student *Luca Palmieri* for his undergraduate thesis project in physics at the Università degli Studi di Milano Statale (2024): *Hurting down the most extreme jetted quasars at* $z > 4$.
- **Teaching: Introduction to Statistics and Informatics** at the Università degli Studi di Milano Statale (2021–2022): 20 hours of practical exercises for second year undergraduate students. Head professor: V. Cotroneo.

OBSERVING EXPERIENCE

Observation preparation for all the radio, optical and near-infrared proposals listed in the next section. This includes: instrument setup, target-calibrators scheduling and finding charts preparation.

First-hand observing experience:

- **Anglo-Australian Telescope**: 3 nights of optical/NIR observations with the KOALA instrument;
- **Telescopio Nazionale Galileo**: 3 nights of optical/NIR observations with the DOLORES instrument;
- **Certified ATCA observer**: 65 hours of setup and monitoring of ATCA radio observations experience;
- **Certified Parkes observer**: 24 hours of setup and monitoring of Parkes radio observations in VLBI mode;
- **Certified LBA observer**: 26 hours of setup and monitoring of ATCA, Parkes and MOPRA as part of VLBI observations.

OBSERVING TIME AWARDED AS P.I.

X-rays:

- **Swift–XRT**, 2024-2025 year, 80 ksec allocated:
  Identifying $z > 5$ *blazars with Swift-XRT*.
- **Chandra telescope**, Cycle 26, project 700199, 120 ksec allocated:
  X-ray observations of four radio-bright $z > 2$ *kpc-scale jets*.
- **Chandra telescope**, Cycle 25, project 704960, 250 ksec allocated:
  Deep observation of the highest-redshift X-ray jet.
- **Swift–XRT**, 2022-2023 year, 125 ksec allocated:
  Uncovering the X-ray properties of ten $4 < z < 6$ *blazars*.
- **Chandra telescope**, Cycle 24, project 704630, 150 ksec allocated:
  X-ray properties of two new $z > 6$ *jetted Quasars*.
- **Chandra telescope**, Cycle 23, project 704300, 70 ksec allocated:
  Uncovering the X-ray Properties of a $z \sim 6.5$ *Radio-Powerful Quasar*.

Optical/NIR:

- **ESO New Technology Telescope (NTT)**, P115 semester, project 115.28BJ.001, 3 nights allocated:
  Identifying the most extreme blazars at $z > 4$.
- **Telescopio Nazionale Galileo (TNG)**, 2024-2025 year, project AOT50_46, 3 nights allocated:
  Identifying the most extreme X-ray and radio QSOs at $z > 4$.
- **Large Binocular Telescope (LBT)**, 2024-2025 year, project 2024B_39, 9 hours allocated:
  Identifying the most extreme X-ray and radio QSOs at $z > 4$.
- **Large Binocular Telescope (LBT)**, 2023-2024 year, project 2023B_22, 15.6 hours allocated:
  Hunting down radio-loud QSOs at $z > 5$.
- **Gemini-South telescope, GMOS**, DDT time, project GS-2023-DD-108, 2 hours allocated:
  Spectroscopic confirmation of a $z \sim 5.7$ *blazar*.
- **Anglo-Australian Telescope, AAT**, OPTICON-radionet 2023B, project 23B005, 3 nights allocated:
  Hunting Down Radio-Loud QSOs at $z > 5$.
- **Very Large Telescope (VLT), FORS2**, semester 111, project 111.24Q5, 28 hours allocated:
  Hunting Down Radio-Loud Quasars at $z > 5$.
- **Telescopio Nazionale Galileo (TNG)**, 2022-2023, project AOT47_3, 20.5 hours allocated:
  Hunting Down $z > 5$ *Radio-Loud Quasars*.
- **Very Large Telescope (VLT), X-Shooter**, semester 110, project 110.23YF, 6 hours allocated:
  Uncovering the accretion process around two new $z > 6$ *jetted SMBHs*.
- **Large Binocular Telescope (LBT)**, 2022-2023 year, project 2022B_37, 20 hours allocated:
  Hunting down the radio-loud QSO population at $z > 5$.
- **Gemini-South telescope, GMOS**, DDT time, project GS-2021-DD-112, 3.9 hours allocated:
  Spectroscopic confirmation of two $z > 6$ *Radio-Loud Quasar candidates*.

Radio:

- **Very Large Array (VLA)**, DDT time, project 24B–504, 4.5 hours allocated:
  Illuminating the COSMOS: characterising the radio jet of a $z \sim 8$ *AGN*.
- **e-MERLIN**, cycle 18, project CY18014, 96 h allocated:
  Resolving kpc-scale relativistic jets at high redshift.
- **Australia Telescope Compact Array (ATCA)**, semester 2024APR, project C3601, 12 hours allocated:
  ATCA view on a $z \sim 5.2$ *kpc-scale radio jet*.
- **MeerKAT telescope**, DDT time, project DDT-20231128-LI-01, 4.5 h allocated:
  Characterisation of a $z \sim 5.2$ *kpc-scale radio jet*.
- **e-MERLIN**, cycle 17, project CY17015, 24 h allocated:
  High-resolution view on a kilo-parsec scale radio jet at $z = 6.1$.
- **Australia Telescope Compact Array (ATCA)**, semester 2023APR, project C3535, 24 hours allocated:
  Identifying Blazars in the Primordial Universe.
- **Australian Large Baseline Array (LBA)**, semester 2022OCT, project V619, 24h allocated:
  Zooming in on the innermost regions of two $z > 6$ *relativistic jets*.
- **upgraded Giant Metrewave Telescope (uGMRT)**, Cycle 42, project 42_001, 14 hours allocated:
  Low-frequency Radio Properties of Three New $z > 6$ *Jetted QSOs*.
- **Australia Telescope Compact Array (ATCA)**, semester 2022APR, project C3477, 36 hours allocated:
  High-frequency Radio Properties of Three New $z > 6$ *Jetted QSOs*.
- **Very Large Array (VLA)**, Cycle 22A, project 22A–305, 4 hours allocated:
  Characterising the kpc structure and emission of a powerful radio jet at $z > 6$.

SCIENTIFIC PUBLICATIONS

First Author

High-z radio Quasars in RACS I: Selection, identification, and multi-wavelength properties.
L. Ighina, A. Caccianiga, A. Moretti, J. W. Broderick, J. K. Leung, F. Rigamonti, N. Seymour, J. Afonso, T. Connor, C. Vignali, Z. Wnag, T. An, B. Arsioli, S. Bisogni, D. Dallacasa, R. Della Ceca, Y. Liu, I. Matute, C. Reynolds, A. Rossi, C. Spingola, P. Severgnini and F. Tavcecchio, 2025, A&A, accepted.

Multi-wavelength properties of three new radio-powerful $z \sim 5.6$ QSOs discovered from RACS.
L. Ighina, A. Caccianiga, A. Moretti, J. W. Broderick, J. K. Leung, A. R. López-Sánchez, F. Rigamonti, N. Seymour, T. An, S. Belladitta, S. Bisogni, R. Della Ceca, G. Drouart, A. Gargiulo and Y. Liu, 2024, A&A, 692, A241.

Comprehensive view on a $z \sim 6.5$ radio-loud QSO: from the radio to the optical/NIR to the X-ray band.
L. Ighina, A. Caccianiga, A. Moretti,, J. W. Broderick, J. K. Leung, S. Paterson, F. Rigamonti, N. Seymour, S. Belladitta, G. Drouart, T. J. Galvin and N. Hurley-Walker, 2024, A&A, 687, A242.

New Radio-Loud QSOs at the end of the Re-ionisation Epoch.
L. Ighina, A. Caccianiga, A. Moretti, S. Belladitta, J. W. Broderick, G. Drouart, J. K. Leung and N. Seymour, 2023, MNRAS, 519, 2060.

Constraining the Radio Properties of the z=6.44 QSO VIK J2318−3113.
L. Ighina, J. K. Leung, J. W. Broderick, G. Drouart, N. Seymour, S. Belladitta, A. Caccianiga, E. Lenc, A. Moretti, T. An and T. J. Galvin, et al., 2022, A&A, 663, 73.

Direct observation of an extended X-ray jet at z=6.1.
L. Ighina, A. Moretti, F. Tavecchio, A. Caccianiga, S. Belladitta, D. Dallacasa, R. Della Ceca, T. Sbarrato and C. Spingola, 2022, A&A 659, A93.

The Impact of the CMB on the Evolution of high-z Blazars.
L. Ighina, A. Caccianiga, A. Moretti, S. Belladitta, R. Della Ceca and A. Diana, 2021, MNRAS, 505, 4120.

Radio Detection of VIK J2318−3113, the Most Distant Radio Loud Quasar (z=6.44).
L. Ighina, S. Belladitta, A. Caccianiga, J. W. Broderick, G. Drouart, A. Moretti and N. Seymour, 2021, A&A, 647, L11.

X-ray properties of z>4 blazars. **L. Ighina**, A. Caccianiga, A. Moretti, S. Belladitta, R. Della Ceca, L. Ballo and D. Dallacasa, 2019, MNRAS, 489, 2732.

Co-Author

ESPRESSO reveals a single but perturbed broad-line region in the supermassive black hole binary candidate PG 1302−102.
F. Rigamonti, P. Severgnini, E. Sottocorno, M. Dotti, S. Covino, M. Landoni, L. Bertassi, V. Braito, C. Cicone, G. Cupani, A. De Rosa, R. Della Ceca, **L. Ighina**, J. Singh and C. Vignali, A&A, 693, A117.

Mapping the Cosmic Gamma-ray Horizon: The 1CGH Catalogue of Fermi–LAT detections above 10 GeV.
B. Arsioli, Y. Chang, **L. Ighina**, 2025, MNRAS, 539, 1458.

Obscuration in high-redshift jetted QSO.
A. Caccianiga, **L. Ighina**, A. Moretti, R. Brivio, S. belladitta, D. Dallacasa, C. Spingola, M. J. Marcha, S. Antón, 2024, A&A, 684, A98.

Quasars at High-Redshift: Physics and Cosmology.
G. Risaliti, A. Caccianiga, R. Gilli, et al. (including **L. Ighina**), 2023, Memorie della Società Astronomica Italiana, 2023, Vol. 93, 64

The central engine of the highest redshift blazar. S. Belladitta, A. Caccianiga, A. Diana, A. Moretti, P. Severgnini, M. Pedani, L. P. Cassarà, C. Spingola, **L. Ighina**, A. Rossi, and R. Della Ceca, 2022, A&A, 660, 74.

The evolution of the heaviest super-massive black holes in jetted AGNs. A. Diana, A. Caccianiga, **L. Ighina**, S. Belladitta, A. Moretti and R. Della Ceca, 2022, MNRAS, 511, 5436.

Minute-timescale variability in the X-ray emission of the highest redshift blazar.
A. Moretti, G. Ghisellini, A. Caccianiga, S. Belladitta, R. Della Ceca, **L. Ighina**, T. Sbarrato, P. Severgnini and C. Spingola, 2021, ApJ, 920, 15.

Quest to find Changing Look Quasars. T. Pursimo, **L. Ighina**, N. Ihanec, N. Mandarakas, K. Skillen and

S.Terefe, 2019, CAOSP, 49, 539.

An extremely X–ray weak blazar at z=5.0. S. Belladitta, A. Moretti, A. Caccianiga, G. Ghisellini, C. Cicone, T. Sbarrato, **L. Ighina** and M. Pedani, 2019, A&A., 629, A68.

The space density of z>4 blazars. A. Caccianiga, A. Moretti, S. Belladitta, R. Della Ceca, S. Antón, L. Ballo, C. Cicone, D. Dallacasa, A. Gargiulo, **L. Ighina**, M. J. March$\tilde{a}$ and P. Severgnini, 2019, MNRAS, 484, 204.