

# Francesco M. C. Belfiore

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## Employment & Education

2024-present	INAF – Arcetri Astrophysical Observatory, Florence, Italy SENIOR RESEARCH SCIENTIST (“Primo Ricercatore”, Associate Professor level)
2020-2023	INAF – Arcetri Astrophysical Observatory, Florence, Italy STAFF RESEARCHER (“Ricercatore”, Assistant Professor level, with tenure)
2018-2020	European Southern Observatory, Garching bei München, Germany ESO FELLOW
2017-2018	University of California Observatories, University of California Santa Cruz, USA POSTDOCTORAL RESEARCHER
2013-2017	University of Cambridge (St John's College), Cambridge, UK PHD in PHYSICS, Cavendish Laboratory & Kavli Institute for Cosmology, Advisor: Prof. R. Maiolino.
2012-2013	University of Cambridge (St John's College), Cambridge, UK MASTERS DEGREE (MSci) in Experimental and Theoretical Physics, First Class.
2009-2012	University of Cambridge (St John's College), Cambridge, UK UNDERGRADUATE DEGREE (BA) in Natural Sciences (Physics), First Class.
2007-2009	United World College of the Adriatic, Duino (Trieste), Italy INTERNATIONAL BACCALAUREATE (IB).

## Research Interests

### Galaxy evolution and the baryon cycle

- Star formation, the ISM and stellar feedback in galaxies at high resolution.
- Star formation and chemical enrichment at Cosmic Noon.
- The quenching of star formation.

### Big Data and Machine Learning for Astronomy

- Large spectroscopic galaxy surveys.
- Machine Learning applications to 3D data.
- Parameter estimation, probabilistic models.

## Refereed journal publication statistics (from Nasa/ADS)

Author of 130 refereed publications (12 first author).

Total number of citing papers 6525 (975 first author). *h*-index 49. Last updated 09/02/2025.

Link to ADS Public Library: [https://ui.adsabs.harvard.edu/public-libraries/H\\_MunpSNRJqwlo6zgISD-A](https://ui.adsabs.harvard.edu/public-libraries/H_MunpSNRJqwlo6zgISD-A)

## Projects Leadership roles

- **Team leader** at INAF-Arcetri, currently supervising three PhD students and one postdoc.
- Core team member of the **PHANGS collaboration**, targeting nearby galaxies at cloud-scale resolution. Lead of the “Ionised ISM and stellar feedback” science working group.
- Lead of the **ERIS GTO program** targeting galaxies at Cosmic Noon, with a total allocation of 115 hr (observations 2023-2028).
- Co-lead of **Extragalactic Science Working Group for WST** (Wide-Field Spectroscopic Telescope), funded by Horizon Europe for a feasibility study (2025-2028).
- Member of the Management Team of SDSS-IV MaNGA, integral field spectroscopy survey of 10000 nearby galaxies (2015-2021). Representative for Early Career scientists (2015-2019).

## Participation in International Teams (selected)

- Member of the **MOONRISE** survey, a large spectroscopic survey of galaxies with the MOONS instrument on the VLT (planned start of observations early 2025).
- Members of the **4MOST-StePS** community survey, aiming to obtain deep spectroscopy of galaxies at  $0.3 < z < 0.7$ , with the 4MOST instrument.

## Participation in the Organising Committee of International Conferences

2025	Member of the SOC for the ESO Workshop “Galactic ecosystems under the microscope: lessons from highly resolved studies”, to take place in Garching bei München in July 2025.
2025	SOC member for the “Third International School on the ISM of galaxies” to take place in Banyuls-sur-mer in July 2025.
2022	Organizer and Co-chair of the LOC with responsibility for the budget (~20 k€) of the Joint Kavli-INAF workshop “Charting the metallicity evolution history of the Universe”, Catania, Italy.
2022	Member of the SOC of the special session 16 “Connecting stellar sources and the ionised ISM” for EAS 2022, Valencia, Spain.
2019	Co-chair of the LOC/SOC, “Metals in galaxies near and far, looking ahead”, Lorentz Centre Workshop, Leiden, the Netherlands.

## Referee and Editorial Roles

2016-present	Regular service as referee for MNRAS, ApJ, A&A.
2024	Expert reviewer for the STFC (English research council).
2023	Expert reviewer for JWST cycle 2.
2023	Expert reviewer for the French National Research Agency (ANR).
2021-present	Member of the Italian TAC at large for TNG and LBT telescopes.
2017-present	Expert reviewer for HST Cycle 25 proposals.

## Granted Observing Time and Observing Experience

**Main techniques:** optical and IR integral field spectroscopy, sub-mm single dish observations.

**Optical/IR:** VLT/MUSE, VLT/KMOS, Keck/KCWI, Keck/ESI, JWST/NIRSpec, NIRCam, MIRI.

**Sub-mm:** APEX, ALMA, IRAM 30m, Arizona Radio Observatory.

**Observing Experience:** Support astronomer for the APEX telescope (2018-2020), observing experience of several hundred hours. Observing experience at the IRAM-30m telescope, Arizona Radio Observatory. Experience with planning and executing visitor-mode observations with ERIS as part of the GTO team.

## Professional and Institutional responsibilities

2021-2025	Member & Chair of the Colloquium Organising Committee, INAF-Arcetri.
2019-2020	Member of the PhD student selection committee at ESO, Garching.

## Supervision and mentoring

2025-present	<b>Francesco Chiti Tegli</b> ( <i>Master Student</i> , co-supervised with Dr. Lucia Armillota), INAF-Arcetri & UniFI. Thesis title: “The multi-phase ISM in local galaxies compared with high-resolution hydrodynamical simulations”.
2023-present	<b>Avinanda Chakraborty</b> ( <i>postdoc</i> ), INAF-Arcetri.
2024-present	<b>Bianca Moreschini</b> ( <i>PhD student</i> , co-supervised with Prof. A Marconi), INAF-Arcetri and UniFI. Thesis topic “Photoionization models for high-redshift galaxies in the JWST era”. Previously supervised as Master thesis student.
2024-present	<b>Caterina Bracci</b> ( <i>PhD student</i> , co-supervised with Dr. M. Ginolfi), INAF-Arcetri and UniFI. Thesis topic “Machine learning for astrophysical spectroscopy”. Previously supervised as Master thesis student.
2023-present	<b>Elisa Cataldi</b> ( <i>PhD student</i> , co-supervised with Dr. M. Ginolfi), INAF-Arcetri and UniFI. Thesis title “Chemical abundances at Cosmic Noon with ultra-deep JWST spectroscopy”.
2023-present	<b>Nils Candebat</b> ( <i>post-bac research assistant</i> , co-supervised as part of a collaborative research program, PI: Dr. G. Sacco), INAF- Arcetri.
2023	<b>Matilde Brazzini</b> ( <i>Master student</i> ), INAF- Arcetri & UniFI. Thesis title: “Towards precision chemical abundances with auroral lines in the local universe”, published in <a href="#">Brazzini et al., 2024</a> .
2021-2023	<b>Amirhossein Khoram</b> ( <i>Master Student</i> ), University of Padova, supervised as part of an independent reasearch project: “Metallicity Gradients in Nearby Galaxies From Auroral Lines with SDSS IV MaNGA”, published in <a href="#">Khoram et al. 2024</a> .
2021	<b>Nicole Orientale</b> ( <i>Bachelor Thesis</i> ), UniFI. Thesis title: “Ionised gas properties in the starburst dwarf galaxy NGC 5253”.
2019-2020	<b>Sim Brownson</b> ( <i>PhD student</i> ), University of Cambridge, supervised informally for a project published as part of <a href="#">Brownson et al., 2020</a> .
2018-2019	<b>Matilde Mingozi</b> ( <i>PhD student</i> ), University of Bologna, supervised informally for a year while visiting the University of California Santa Cruz. Results of the project published as part of <a href="#">Mingozi et al., 2020</a> .

## Grants and prizes

2025-2028	Horizon Europe infrastructure grant “The wide-field spectroscopic telescope” (113k€ personal share, PI: Bacon).
2022-2025	INAF Travel Mini-Grant (20k€).
2022-2025	INAF Large Grant : “The Metal cycle” (100k€ personal share, PI: Cresci).
2022-2025	INAF Collaborative Grant: “Machine Learning for Astrophysical Spectroscopy” (100k€, PI: Sacco).
2022	Habilitation (Abilitazione Scientifica Nazionale) for the rank of Associate Professor.
2020	Astro3D travel grant (~2.5k€), supporting an extended visiting period in Australia.
2018-2020	ESO Fellowship (independent research fellowship), ESO Headquarters, Germany.
2013	Master’s Thesis excellence award (best Master thesis in the physics department): BP-Neville Mott Prize for outstanding achievements in the Natural Sciences Tripos in Cavendish Laboratory, Cambridge, UK.
2009-2017	Undergraduate prizes for academic excellence: St John's College (Cambridge, UK): 2014-15 (College Scholarship Prize), 2012 (United Steel, Hughes and Hockin Prizes), 2011 (United Steel, Earle, Hockin and Quass Prizes), 2010 (United Steel and Wrigh Prizes).

## Teaching

2024-2025	“Machine Learning for Astrophysics”, Postgraduate (PhD-level) Course (duration: 16 hr), UniFI.
2022-2024	“Scientific Writing for the Physical Sciences”, Postgraduate (PhD-level) Course, workshop format (duration: 12 hrs in 2022, 15 hr in 2023, 15 hr in 2024), UniFI.
2023	“Scientific Writing for the Astronomers”, Postgraduate (PhD-level) Course, workshop format (duration: 10 hrs), University of Cambridge.
2021-2022	Guest lecture on galaxy evolution (1 lecture) during the Introduction to Astronomy undergraduate-level course at the UniFI.

2020	Lecturer (1 lecture) at the ESO undergraduate summer school.
2018	“Introduction to Research in Astronomy”, undergraduate-level course, hand-on research experience (regular meetings for one semester), UC Santa Cruz.
2017	Tutor for the Master-level astronomy course “Formation of Structure in the Universe” (regular meetings for one semester), University of Cambridge. Tutorials (known as supervisions in Cambridge) are small-group meetings that complement lectures.
2013-2015	Tutor for first year Mathematics and Physics courses, University of Cambridge (regular meetings over several semesters).

## Conferences and Seminars

### Invited talks at international conferences

2022/09/06	The Epoch of Galaxy Quenching, Kavli Workshop, Cambridge, UK. Talk Title: “Probing the timescales of galaxy evolution via chemical abundances”.
2021/05/26	III Workshop on Chemical Abundances in Gaseous Nebulae: from the Milky Way to the Early Universe, Sao José dos Campos (virtual). Talk title: “A MUSE view of H II regions in nearby galaxies the era of “cloud-scale” surveys”.
2020/09/09	The epoch of galaxy quenching, KICC workshop, virtual meeting. Talk title: “Connecting chemical abundances with star formation histories in large galaxy surveys”.
2019/03/19	The life and death of star forming galaxies, Perth, Australia. Talk Title: “The role of bulges on star formation: an observational perspective”.
2018/08/29	Focus Meeting of the International Astronomical Union (IAU), FM7: Radial Metallicity gradients in star forming galaxies, Vienna, Austria. Talk title: “Metallicity gradients from surveys of nearby galaxies”.
2017/06/11	The Physics of Quenching of Massive Galaxies at High Redshift, Lorentz Workshop, Leiden, the Netherlands. Talk title: “Do galaxies quench inside-out?”.

### Contributed talks at international conferences

2024/11/21	A decade of discovery with MUSE and beyond, ESO Garching, Talk Title: “Machine Learning for the analysis of IFU data in the MUSE era”.
2024/07/08	Machine Learning for Astrophysics, Catania, Italy, Talk Title: “Classifying ionized nebulae in nearby galaxies with ML”.
2024/04/22	Raising the Veil on Star Formation Near and Far, Cambridge, UK. Talk title: “The JWST view of embedded star formation in nearby galaxies”.
2023/11/03	Illuminating the dusty Universe, A tribute to the work of Bruce Draine, Florence, Italy. Talk Title: “A cloud-scale view of dust-obscured star formation in nearby galaxies with JWST”.
2023/06/24	EAS 2023, Cracow, Poland. Talk Title: “Star formation in the extragalactic context: and integral field spectroscopy view”.
2023/06/24	Science with the future Wide Field Spectroscopic Telescope, Vienna, Austria. Talk Title: “Linking the build-up of galaxies to the small-scale matter cycle”.
2022/12/14	Theory Meets Observations: star formation physics probed in nearby galaxies, Heidelberg, Germany. Talk Title: “The ionisation sources of diffuse ionised gas in local galaxies”.

- 2022/07/01 EAS 2022, Valencia, Spain. Talk Title: “The ionisation sources of the diffuse ionised gas (DIG) in local galaxies”.
- 2022/06/30 EAS 2022, Valencia, Spain. Talk Title: “PHANGS-MUSE: A cloud-scale view of the ionised ISM in nearby galaxies”.
- 2021/05/11 ISM 2021: structure, characteristic scales, and star formation, Beirut (virtual). Talk title: “PHANGS-MUSE, a cloud-scale view of the ionised ISM in nearby galaxies”.
- 2021/03/02 Ringberg Meeting, virtual. Talk title: “Hot stars and diffuse gas”.
- 2021/02/22 Double-peaked emission-line galaxies, Paris Observatory, virtual. Talk title: “Spatially resolved excitation diagnostic diagrams at kpc scales”.
- 2020/07/01 European Astronomical Society Annual Meeting, S3- Linking gas and star formation throughout cosmic time, Leiden, virtual meeting. Talk title: “HII regions and the diffuse interstellar medium in nearby galaxies”.
- 2020/02/18 The 2nd Australia-ESO joint Conference: the build-up of galaxies through multiple tracers and facilities, Perth, Australia. Talk title: “Chemical enrichment in local disc galaxies”.
- 2018/08/08 2018 Santa Cruz Galaxy Workshop, Santa Cruz, USA. Talk title: “The star formation histories of main sequence galaxies”.
- 2017/08/08 2017 Santa Cruz Galaxy Workshop, Santa Cruz, USA. Talk title: “The spatially resolved transition from star formation to quiescence”.
- 2017/07/26 The Galaxy Ecosystem. Flows of Baryons through Galaxies, ESO, Germany. Talk title: “Metallicity gradients in the nearby Universe: shedding new light on the role of gas flows in galaxies”.
- 2017/06/26 European Week of Astronomy and Space Science 2017, SS11 Star formation, metals, and feedback in galaxies: Combining the latest observations and models, Prague, Czech Republic. Talk title: “Metallicity gradients in nearby galaxies”.
- 2016/09/09 Crossing the Rubicon. The fate of gas flows in galaxies, Santarcangelo, Italy. Talk Title: “Understanding gas flows in galaxies using chemical abundances”.
- 2016/07/06 European Week of Astronomy and Space Science 2016, S5 How galaxies live and die: the onset and end of star formation across cosmic time, Athens, Greece. Talk title: “Spatially resolving the transition from star formation to quiescence”.
- 2016/01/07 227<sup>th</sup> Meeting of the American Astronomical Society (AAS), Orlando, Florida. Talk title: “Emission line diagnostics and LI(N)ER galaxies”.

### **Departmental seminars (selected)**

- 2024/05/29 Seminar, as part of a Symposium on Extragalactic Astrophysics, University of Heidelberg, Heidelberg Germany. Talk title: “A multi-scale view of star formation in galaxies”.
- 2024/03/07 Seminar, Max Planck Institute for Extraterrestrial Physics (MPE), Garching bei München, Germany. Talk title: “The JWST view of star formation in nearby galaxies”.
- 2024/01/29 Seminar, Institute of Science and Technology Austria, Klosterneuburg, Austria. Talk Title: “The cosmic cycle of matter in galaxies: Star formation, stellar feedback, and Big Data”.
- 2023/02/03 Galaxy Talk, Kavli Institute for Cosmology, University of Cambridge, Cambridge, UK. Talk title: “The JWST view of star formation in nearby galaxies”.

- 2021/09/15 Space Telescope Science Institute Colloquium, USA (virtual). Talk title: “A cloud-scale view of the ISM in nearby galaxies”.
- 2021/04/16 The Königstuhl Colloquium, MPIA, Germany (virtual). Talk title: “Mapping the assembly of discs via their chemical abundances”.

## Outreach

- 2021-present Astrophysics-themed lessons in high schools in the Florence area (Liceo Gobetti, Liceo Santa Marta), internationally (Ecole Privè Fieldgen, Luxembourg) and online.
- 2023 Public lectures on the use of Artificial Intelligence in Astronomy (e.g. Prato, Livorno, Florence).
- 2021-2024 Guided visits to the observatory site at INAF-Arcetri for the public and for schools, including night visits and observing (on average one visit per month).
- 2021-present Active participant and speaker in the “Notti d’estate” (Open Summer Nights) at the Arcetri Observatory, the Observatory’s main summer outreach event series.
- 2021 Teacher training session at the HERAEUS summer school.
- 2018-2020 Content developer and presenter for the ESO Supernova Planetarium.
- 2020 Skype a Scientist: remote teaching to high-school students.
- 2014-2015 Widening participation initiatives for high-school students in Cambridge, UK (Physics at Work, 2014, Cambridge, UK; Magdalene Science Residential, 2014-2015).

## Language skills

English (native level), Italian (native), French (intermediate, level A2), German (intermediate, level A2).