Federica Tarsitano

> Observational astrophysicist investigating the co-evolution of galaxies and supermassive black holes through next-generation astronomical surveys and multi-messenger astrophysics.

Galaxy Evolution • AGN and dual AGN • Large-scale surveys • Machine Learning

Federica Tarsitano develops data-driven methodologies for the identification and characterization of AGN and dual AGN systems, aiming at advancing our understanding of the co-evolutionary path of SMBH and their host galaxies and investigating the link of dual supermassive black-holes to theoretical models for LISA-detectable gravitational waves. Her research currently bridges major international collaborations. She co-leads the *Euclid* AGN morphology working group and serves as co-leader of a new medium-band survey with the Subaru telescope (HSC-Niji). She is an active member of the Roman Science Community and the LISA Consortium. She also contributes to the Euclid photometric redshift and cosmic shear pipelines.

Current Position

2026 - Present Postdoctoral Researcher

Kobayashi-Maskawa Institute, Nagoya University, Japan

Previous Appointments

2025–2026 Senior Researcher

ETH Zürich, Institute of Particle Physics and Astrophysics, Switzerland

2022–2025 Postdoctoral Researcher

University of Geneva, Department of Astronomy, Switzerland

2021–2022 Research Assistant

ETH Zürich, Institute of Particle Physics and Astrophysics, Switzerland

Leadership and Major Scientific Responsibilities

- Co-leader of the development of a new set of 16 medium-band filters for the Subaru telescope, and the design of the new HSC-Niji survey using these filters
- Co-leader of the *Euclid* AGN morphology working group
- Leading the reconstruction of galaxy SEDs in the *Euclid* photo-z pipeline
- Co-I of the first Subaru intensive program with the HSC-Niji survey
- Co-I of a NASA Roman proposal targeting the Euclid Deep Fields

International Collaborations

Euclid Consortium • Subaru HSC • Roman Science Community • LISA Consortium • Rubin LSST • Dark Energy Survey

Research Methodology

Data Analysis: Large-scale astronomical surveys, Bayesian inference, template fitting, statistical inference.

Computational Methods: machine learning, deep learning, variational autoencoders, probabilistic random forest, UMAP

Image Analysis: galaxy morphology, PSF, SED reconstruction, image simulations

Software: Python, C++, software development for image decomposition, SExtractor, PSFEx

Education

2015 - 2022 PhD in Physics

ETH Zürich, Institute for Particle Physics and Astrophysics, Switzerland

Galaxy morphology and cosmological predictions for wide-field survey analyses.

Advisors: Prof. A. Refregier, Prof. A. Amara

- December 2019: Visiting student at Stanford University
- March - July 2017: Internship in nuclear and particle physics, ETH Zürich, Institute for Particle Physics and Astrophysics, Switzerland
- 2012 - 2014: MSc in Nuclear, Subnuclear and Biomedical Physics, University of Turin, Italy
- July - August 2013: CERN Summer student, CERN, Geneva, Switzerland
- 2009 - 2012: BSc in Physics, University of Turin, Italy
- 2004 - 2009: High school Diploma, Liceo Classico C. Cavour, Turin, Italy

Student Supervision and Mentoring

2024 - 2025 Supervisor of Dóra Takács' Semester Project

Dual and Binary supermassive black holes in the Euclid Survey

2020

- Supervisor of Silvan Fishbacher's Semester Project
  Constraining Cosmological Parameters with PyCosmo using KiDS+VIKING-450
- Supervisor of Paul Moser Röggla's Bachelor Thesis
  The effect of Intrinsic Alignment on cosmological parameter constraints

2019

- Supervisor of Imelda Romero's Semester Project: *Testing PyCosmo on JupyterHub*
- Supervisor of Beatrice Moser's Master Thesis: *Neutrino Cosmology*

2018 Supervisor of Ralf Aeberhard's Semester Project: *Semesterproject in Cosmology*

Teaching

Fall Semester 2020	Physics III, ETH Zürich
Spring Semester 2020	Astrophysics II, ETH Zürich
Spring Semester 2019	Astrophysics II, ETH Zürich
Fall Semester 2018	Astrophysics I, ETH Zürich
Fall Semester 2018	Statistical Methods in Astrophysics, ETH Zürich
Spring Semester 2018	Astrophysics II, ETH Zürich
Fall Semester 2016	Physics I, ETH Zürich

Spring Semester 2016	Physics II, ETH Zürich
Fall Semester 2015	Physics I, ETH Zürich

Selected Conferences and Seminars

Coordinating Roles

- **LOC** of the 4th HSC medium band workshop, 29 June-1 July, University of Nagoya, Japan
- **SOC** of the IAU symposium *Innovative Research and Techniques in Astronomy Communication*, 2-6 November 2026, NAOJ, Tokyo
- Third HSC medium band workshop, 6-8 August 2025, University of Nagoya, Japan: **Co-leader of the new HSC-Niji survey and co-chair (LOC) of the workshop:** https://sites.google.com/view/hsc-mb-survey3/
- Second HSC medium band workshop, 27-28 November 2024, University of Nagoya, Japan: **Co-leader of the new HSC-Niji survey and co-chair (LOC) of the workshop:** https://sites.google.com/view/hsc-mb-workshop/home

Invited Talks

- **Invited talk** at the *12th Galaxy Evolution Workshop,* SNU, South Korea, August 2026
- **Invited to the workshop** *Settling the Dust: Obscured AGN in Galaxy Evolution,* Lorentz Center, the Netherlands, scheduled for July 2026
- **Invited talk** at *Astromeeting*, Osservatorio di Capodimonte, Naples, 3 June 2026
- **Invited online talk** at OPINAS, Max-Planck for Extraterrestrial Physics, to be scheduled in March 2026
- **Invited talk** at Tokyo IPMU, 4 August : *Dual and Binary Supermassive Black Holes in Stage IV surveys: Pathways to LISA-detected Gravitational Waves.*
- **Invited Seminar** at the Nagoya University, Japan, 30 August 2025
- ESLAB/EC meeting, Leiden, 24-28 April 2025 - **Invited plenary talk:** *Euclid Quick Data Release (Q1): First study of red quasars selection*
- **Invited talk** at the Japanese Euclid Meeting, 25-26 November 2024, University of Kyoto, Japan: *Euclid photometric redshift*
- Euclid Collaboration Meeting, Rome, June 2024 - **Invited plenary talk:** *Euclid OU-PHZ:* https://youtu.be/7lxD48__iiU?si=uiIAw4m2KLaQzD6e&t=2985
- *First* HSC medium band workshop, University of Nagoya, Japan, 28 August- 1 September 2023. **Invited talk:** *Accurate SED Reconstruction in the Euclid Survey*
- **Invited Seminar** at the Nagoya University, Japan, 30 August 2023
- **Invited Seminar** at the University of Turin, Italy, 30 July 2023
- Kinetic Field Theory (*KFT*) Workshop, 3-6 April, Heidelberg University
  Invited talk: *KFT in PyCosmo*

Selected Talks

- **Accepted talk** at *New Frontiers in Cosmology 2026,* La Coruña, Spain, August 2026
- **Accepted talk** at *Evolution Near and Far*, Osservatorio di Capodimonte, Naples, 8-12 June 2026

- Cosmic Cartography with Roman, 14-18 July 2025, STScI Baltimore - **Selected talk:** *Dual AGN and the status of photo-z: synergies across Euclid, Roman and a new HSC medium band survey*
- *AGN workshop* in Bologna, February 2024 - **Selected Talk:** *AGN-host decomposition with Euclid first light*
- Python in Astronomy, 20-24 April 2020, virtual conference
  Selected talk: *Cosmological predictions with PyCosmo*
- Cosmology on Safari, South Africa, 3-9 March 2019 - **Selected talk:** *Cosmological observables with PyCosmo*
- Cosmo-18, Daejeon, South Korea, 27-31 August 2019 - **Selected poster:** *Precision cosmology with PyCosmo*

Contributed Talks

- Contributed talk at the Euclid Consortium Meeting, Barcelona 2026
- *OU-PHZ workshop in Garching,* Münich, May 2024
- Euclid Collaboration Meeting, Copenhagen, 19-23 June 2023
- Euclid Collaboration Meeting (online participation) Oslo, 25-29 April 2022
- Scipy 2020, 6-12 July 2020, virtual conference
- Dark Energy Survey (DES) Collaboration Meeting, Penn State University, 17-21 June 2019
- DES Collaboration Meeting, SLAC/Stanford University, 9-13 May 2016
- DES Collaboration Meeting, University of Michigan, 11-14 May 2015

Scientific Community Service

Referee for A&A (Astronomy and Astrophysics), MNRAS (Monthly Notices for the Royal Astronomical Society), and for the Euclid Consortium (EC).

Post-graduate training

- Django Girls workshop, online, CERN, Geneva, 22-24 April 2021
- Deep learning meets (Astro)Physics, workshop on Tensor Flow 2.0, 22 Jan. 2020, ETH Zürich
- Advanced Machine Learning lectures, 16/09/2019 - 20/12/2019 , ETH Zürich
- AICosmo2019 workshop, Ascona, Switzerland, 9-12 June 2019
- Machine Learning for High Energy Physics workshop, University of Zürich, 4-5 February 2019
- Advanced C++ for HPC - CSCS Supercomputing Centre, Lugano, Switzerland, 26-30 September 2016
- Observer for DES at Blanco Telescope, Cerro Tololo CTIO, Chile 27/08/2016 - 06/09/2016.

Publications

Selected Research Highlights

(P15) *Galaxy SED reconstruction in the PHZ processing function: impact on the PSF and the role of medium-band filters*

Tarsitano et al., 2026, arXiv:2601.10795, A&A (in press)

(P14) Multi-wavelength galaxy ellipticity with the HSC-Niji survey
F. Tarsitano, S. Fishbacher, A. Refregier et al., in prep.

(P13) *Euclid Quick Data Release (Q1) First study of red quasars selection*
F. Tarsitano et al., 2025, arXiv:2503.15319
A&A accepted, special issue *Euclid Q1*

(P12) *Near-infrared selection and physical properties of dual red quasars*
F. Tarsitano, F. Shankar, D. Roberts, H. Fu, S. Amy et al., in prep.

(P11) *ERO meets AI: advanced AGN-host decomposition with Euclid first light*
F. Tarsitano, J.C. Cuillandre et al., in prep.

(P10) *Euclid Quick Data Release (Q1). Photometric redshifts and physical properties of galaxies through the PHZ processing function*
M. Tucci, S. Paltani, W. G. Hartley, F. Dubath, N. Morisset, M. Bolzonella, S.Fotopoulou, **F. Tarsitano,** Saulder, C., et al., arXiv:250315306E*,* A&A accepted, special issue *Euclid Q1*

(P9) *Assessing theoretical uncertainties for cosmological constraints from weak lensing surveys*
T. Tan, D. Zürcher, I. Fluri, A. Refregier, **F. Tarsitano**, T. Kacprzak, MNRAS 522, 3766–3783 (2023)

(P8) *Image feature extraction and galaxy classification: a novel and efficient approach with automated machine learning*
F. Tarsitano et al., 2022, MNRAS 511, 3330–3338 (2022)

(P7) *Symbolic implementation of extensions of the PyCosmo Boltzmann solver*
B. Moser, C.S. Lorenz, U. Schmitt, A. Réfrégier, J. Fluri, R. Sgier, **F. Tarsitano,** L.Heisenberg, 2022 Astronomy and Computing 40 (2022) 100603

(P6) *Predicting cosmological observables with PyCosmo*
F. Tarsitano et al., 2021, Astronomy and Computing 36 (2021) 100484

(P5) *PyCosmo: Multi-purpose cosmology calculation tool*
F. Tarsitano et al., 2021, ASCL Code Record: http://ascl.net/2004.007

(P4) *Combined 13×2-point analysis of the Cosmic Microwave Background and Large-Scale Structure: implications for the S8-tension and neutrino mass constraints*
R. Sgier, C. Lorenz, A. Refregier, J. Fluri, D., Zürcher, **F. Tarsitano**, 2021 arXiv:2110.03815

(P3) *Monte Carlo control loops for cosmic shear cosmology with DES Year 1 data*
T. Kacprzak, J. Herbel, A., Nicola, R. Sgier, **F. Tarsitano,** C. Bruderer, A., Amara, A., Refregier, S. L. Bridle et al., 2020, Phys. Rev. D 101, 082003

(P2) *A catalogue of structural and morphological measurements for DES Y1*
F. Tarsitano et al., 2018, MNRAS 481, 2018–2040 (2018)

(P1) *Evidence for Dynamically Driven Formation of the GW170817 Neutron Star Binary in NGC 4993*
A. Palmese, W. Hartley, **F. Tarsitano,** C. Conselice et al., 2017, ApJL 849L34

Book chapters

The Dark Energy Survey: The Story of a Cosmological Experiment - O. Lahav, L. Calder, J. Mayers, J. Friedman, World Scientific Connect, September 2020

The work I presented in *A catalogue of structural and morphological measurements for DES Y1*

(**F.Tarsitano et al.,** 2018) was featured in Chapter 17, as one of the most important research outputs in galaxy evolution conducted with the Dark Energy Survey.

Other selected publications

- currently not under Euclid internal review

(P16) *Euclid. Discovery of 31 new quasars at 6.6 < z < 7.8*
D. Yang et al., 2026, submitted to A&A

(P15) *Euclid Quick Data Release (Q1): AGN and host galaxy physical properties*
EC: B. Laloux, A. Bongiorno, M. Salvato, V. Allevato, M. Mezcua, W. Roster, T. Matamoro Zatarain, S. Paltani, R. Shirley, **F. Tarsitano** et al., 2026, submitted to A&A

(P14) *Euclid Q1: Euclid spectroscopy of QSOs. I. Identification and redshift determination of ~3500 bright quasar*
EC: Y. Fu et al., 2025, arXiv:2512.08803, A&A accepted, special issue *Euclid Q1*

(P13) *Euclid: Early Release Observations. Weak gravitational lensing analysis of Abell 2390*
Schrabback et al., 2025, arXiv: 250707629S, submitted to A&A

(P12) *Dark Energy Survey Year 3: Blue Shear*
McCullough et al., 2024, arXiv:2410.22272

(P11) *Euclid Q1. Exploring galaxy morphology across cosmic time through Sersic fits*
Quilley et al., 2025, arXiv:2503.15309, A&A accepted, special issue *Euclid Q1*

(P10) *Euclid Quick Data Release (Q1). Extending the quest for little red dots to z<4*
Bisigello et al., 2025, arXiv:2503.15323, A&A accepted, special issue *Euclid Q1*

(P9) Euclid Quick Data Release (Q1). The active galaxies of Euclid
Matamoro Zatarain et al., 2025, arXiv:2503.15320, A&A accepted, special issue *Euclid Q1*

(P8) *Euclid: Early Release Observations – A preview of the Euclid era through a galaxy cluster magnifying lens* Atek et al., 2025, A&A, 697, A15 (2025)

(P7) *Euclid: Early Release Observations – Overview of the Perseus cluster and analysis of its luminosity and stellar mass functions*
Cuillandre et al., A&A, 697, A11 (2025)

(P6) *Weak lensing combined with the kinetic Sunyaev-Zel'dovich effect: a study of baryonic feedback,* Bigwood et al., 2924, MNRAS 534**,** 655–682 (2024)

(P5) *Dark Energy Survey Year 3 Results: Deep Field optical + near-infrared images and catalogue,* G. W. Hartley et al., 2022, MNRAS 509, 3547–3579 (2022)

(P4) *Dark Energy Survey Y3 results: blending shear and redshift biases in image simulations*
N. MacCrann et al., 2022, MNRAS 509, 3371–3394 (2022)

(P3) *Pushing automated morphological classifications to their limits with the Dark Energy Survey,* Vega-Ferrero et al., 2021, MNRAS 506, 1927–1943 (2021)

(P2) *Dark energy survey operations: years 4 and 5*
H. T. Diehl et al., 2018, Proceedings of the SPIE, Volume 10704, id. 107040D 18 pp. (2018).

(P1) Euclid Q1: The Metallicity of the ICL
Euclid Collaboration: J. B. Golden-Marx et al., 2025, under EC review

Description of selected publications

Euclid Quick Data Release (Q1) First study of red quasars selection
F. Tarsitano et al., 2025, arXiv:2503.15319, A&A accepted, special issue *Euclid Q1*
In this work, I developed a selection method based on multidimensional colour analysis, refined through probabilistic Random Forest classification and UMAP, achieving 98% completeness and 88% purity. I also showed that the *Euclid* resolution and coverage improve the identification of the reddest sources and identified a sample of candidate dual AGN, which is the focus of my current research. Notably, Euclid's exquisite resolution in the VIS filter unveils the presence of dual AGN systems and lensed sources. This work provides a first census of candidate red quasars in Euclid and sets the groundwork for future studies in the Euclid Wide Survey (EWS), including spectra and host morphology. My work was selected as a plenary talk showcasing the first *Euclid* results at the 56th ESLAB symposium in Leiden, on 24-26 March 2025, and for an interview series by ESA (available here).

> **Scientific impact:** first census of *Euclid* red quasars and foundation for spectroscopic follow-up and current dual AGN searches.

Galaxy SED reconstruction in the PHZ processing function: impact on the PSF and the role of medium-band filters
Tarsitano et al., 2026, arXiv:2601.10795, submitted to A&A
In this work I lead the implementation of galaxy SED reconstruction in the Euclid processing function, using a combination of template-fitting and ML-based approaches. Accurate SED are mission-key for Stage IV survey, such as Euclid, to model the chromatic PSF and minimise the bias propagated in weak-lensing analyses. Therefore, the deliverables of my research are functional not only for the Euclid photo-z pipeline, but also for the cosmic shear pipeline. Notably, this paper showcases that using a new set of 16 MB filters, providing a quasi-spectroscopic resolution of the Euclid, VIS window, yields to significant improvements in the accuracy of galaxy SED reconstruction. This new set of filters has been evolved in a new MB survey, HSC-Niji, which I have been co-designing in the collaboration with Prof. Hironao Miyatake and Prof. Atsushi Nishizawa: https://sites.google.com/view/hsc-mb-survey3/ .

> **Scientific impact:** methodology for Euclid galaxy SEDs reconstruction and pilot study for the new HSC-MB survey with the Subaru telescope.

Predicting cosmological observables with PyCosmo
F. Tarsitano et al., 2021, Astronomy and Computing 36 (2021) 100484
In this work I developed a user-intuitive python-based framework to predict cosmological observables for wide field surveys. It includes a choice of fitting functions both for linear and nonlinear power spectra, and sets the first python implementation of the non-linear power spectrum using the Mead Model (A. Mead et al., 2025), including baryonic effects. The code is public. A non-yet-published developer version implements the computation of the linear power spectrum using the Effective Field Theory (KFT; M. Bartelmann et al, 2019).

> **Scientific impact:** first python-based framework for the prediction of cosmological observables, employed in cosmic-shear analyses using the Dark Energy Survey dataset.

A catalogue of structural and morphological measurements for DES Y1
F. Tarsitano et al., 2018, MNRAS 481, 2018–2040 (2018)
Morphology is a powerful tools to understand the physical processes shaping the structure of galaxies. In this work, I led the creation of the largest galaxy structural catalogue existed since then, and I established my expertise in developing pipelines and algorithms to extract

morphological information from galaxy images, validating the measurements through ad-hoc simula/ons and delivering science-driven interpretation of the results. This earned me the promo/on to DES builder member, under the approval of the DES Management Committee and the DES appointed director, Prof. Richard Kron. This work was followed by I*mage feature extraction and galaxy classification: a novel and efficient approach with automated machine learning (***F. Tarsitano** et al., 2022), where I proposed a novel method combining feature engineering and boosted Random Forest to classify the DES galaxies into early-type and late-type, and simultaneously identify sub-structural features such as bars, clumps and shell-like structures. Furthermore, building on my expertise from **F. Tarsitano et al.,** 2018, I contributed to *Evidence for Dynamically Driven Formation of the GW170817 Neutron Star Binary in NGC 4993* (A. Palmese, W. G. Hartley, **F. Tarsitano,** C. Conselice et al., 2017). In this work, I performed a multi-wavelength morphological analysis of NGC 4993, the host galaxy of the GW event detected in 2017 by LIGO/Virgo. I found increasing Sérsic index from the blue to red DES bands, orienta/on twists, and a shell-like structure in the residuals. My analysis suggest the presence of two overlapping stellar populations with different orientations, likely the result of a past minor merger. This interpretation aligns with simulations showing shell structures in post-merger galaxies, and with the co-authors' spectroscopic analyses that reveal no signs of recent star formation. The collected evidences support the scenario where the merger triggered gravitational instabilities that led to the coalescence of the neutron star binary. Beyond marking the dawn of multi-messenger astronomy, NGC 4993 illustrates how galaxy structure offers unique insights into the physical and dynamical processes at play.

> **Scientific impact:** largest structural catalogue produced for DES, comprehensive description of galaxy properties applied to a flagship example in multi messenger astrophysics.

Outreach and awards

ESA interview series: I contributed to a series of interview conducted by ESA to communicate the research by Euclid members. In this interview (available here) I talk about I present my publication on red quasars using the Euclid Q1 data, and talk about the search for dual AGN system using a multi-survey approach, introducing the new HSC-Niji survey that I co-lead with Prof. Hironao Miyatake and Prof. Atsushi Nishizawa.

Science Comics: I wrote two comic books to teach math and physics [1], and I am preparing a new story describing the Universe at different scales, as seen by the Euclid telescope, using my own illustrations and the original Euclid ERO images. The project is currently underway within the domain of the Euclid Consortium, in collaboration with Prof. Jean Charles Cuillandre.

I also made an illustrated short story about the upcoming NASA Roman telescope, following my participation to the Cosmic Cartography with Roman, STScI Baltimore, July 2026.

I made comics for *Treffpunkt Science City*, a public science program by ETH Zürich [2].

Other outreach events: I contributed to *Scientifica*, a biennial scientific outreach event organised by ETH Zürich and the University of Zürich, which welcomes more than 25000 visitors every year.

Guest at the Swiss Radio-television: I am often invited to the Swiss Radio television program *Millevoci*, to discuss topics related to space missions, cosmology and astrophysics, together with the journalist Nicola Colotti and internationally recognised scientists [3].

Awards: invited to see in person the launch of the space shuttle STS-120 in Cape Canaveral, Florida, after winning an ESA science competition [4].

[1] Preview of science comic books: https://www.federicatarsitano.com/outreach-and-awards .
[2] Comics for Treffpunkt Science City: https://static.wixstatic.com/media/dd2a18_c7a3ecb9737b4a10ba8343e61b2c85dc~mv2.jpg .
[3] F. Tarsitano, N. Colotti, *Euclid e le sue prime immagini dell'Universo*, RSI, 2023: https://www.rsi.ch/info/scienza-e-tecnologia/Euclid-e-le-sue-prime-immagini-dell'Universo--1988018.html .
[4] Article on national newspaper La Stampa: https://www.federicatarsitano.com/_files/ugd/dd2a18_d92dd0178bf74bb1b823ed9378480deb.pdf?index=true .