

DR. PAOLA REBUSCO

MIT Experimental Study Group, 24-608 | (617) 324-7773 | pao@mit.edu |

EDUCATION

International Max Planck Research School 2007
Ludwig Maximilian University, München, Germany
PhD in Astronomy. Magna cum Laude (1.0/1.0) Thesis title: Impact of supermassive black holes in clusters and elliptical galaxies
Awards: EARA Marie Curie Fellowship

University of Trieste, Trieste, Italy 2003
MSc in theoretical physics graduated with distinction (110/110)
Thesis title: *QPOs in nearly geodesic orbits in strong gravity*
Awards: Collegio Luciano Fonda Fellowship

RESEARCH EXPERIENCE

MIT, Pappalardo Postdoctoral Fellow 2007-2010
Research on theory of accretions disks and clusters of galaxies

MIT, Research Scientist 2010-2011
Working in Bruno Coppi's group at the Laboratory for Nuclear Science, contributed to modeling accretion disks plasma structures

TEACHING

MIT Experimental Study Group, Cambridge, MA January 2011 – present day
Physics senior lecturer (since September 2023)

- I regularly teach ES.801, ES.8012, ES.802, ES.8022 (equivalent to 8.01, 8.02, 8.012, 8.022) at ESG.
- In each subject above I introduced innovations, such as: new problems related to astrophysics and to current scientific advancements, project enhanced learning components, computational thinking components, use of simulations (in Python and Mathematica)
- I developed and taught the material for ES.S601 and ES.S602 (equivalent to 6.100A and 16.C20, but specifically designed for first year students that are taking mechanics and electromagnetism). ES.S601 turned into the discovery subject 8.0006 (offered by physics)
- I designed and taught interdisciplinary seminars: "Speak Italian with your mouth full" (also on OCW), "There is more to physics than Newton" (on modern physics and careers)

in science), "Where is everybody?" (on the search for extraterrestrial life), "Programming Physics: E&M with Python", "It's dangerous to take mechanics alone. Take Python too!", "Podcast Power" (from the physics of sound, to storytelling and audio editing), "Hack Yourself" (now turned into a Computer Science elective)

- I constantly generate new ways to engage our students by organizing Fermi Problems Competitions, Physics Tea Time, tours of MIT labs related to what we are studying.
- Member of the 2024-2025 Gen AI Faculty Learning Community organized by Office of Open Learning

MIT Physics Department, Cambridge, MA

Fall 2007 - present

Physics lecturer (from 2010, as needed on a semester basis)

- 8.01 section leader (Fall 2025)
- 8.022 recitation leader (Spring 2025)
- 8.02 section leader (Spring 2016, 2019, 2022, 2024, Fall 2023)
- 8.012 recitation leader (Fall 2018)
- 8.011 section leader (Spring 2020)
- 8.033 recitation leader (Fall 2010)
- Designed and lead TEAL workshops on the landing of the Rosetta mission (2015)
- Spring 2024 served in the committee to review the physics introductory major sequence

MIT Interphase Program, Cambridge, MA

Summer 2012, 2013, 2015

Head Lecturer

- I taught and coordinated the two-month summer physics session for incoming students in the Interphase Program
- Traditionally physics was taught to a single cohort of students. In 2013 I lead the effort to divide the material for three separate cohorts in order to address the whole spectrum of incoming students

Singapore University of Technology and Design, Singapore

Summer 2014

Visiting Physics Lecturer

Munich International School, Starnberg (Germany)

Substitute teacher, mostly for mathematics, chemistry, physics and computer science.

2006 -2007

Ludwig Maximilian University, München, Germany

Teaching Assistant in Electrodynamics

2005

LEADERSHIP and MENTORING

MIT Experimental Study Group, Cambridge, MA

2011 – present day

- As ESG head physics lecturer (2021 – present day) I coordinate our team of four lecturers. I lead us to keep changing how we teach and what we teach, based on current research in physics education and on the evolving needs of our students
- Supervised eight UROP (Undergraduate Research Opportunities Program) students
- Supervised three postdocs that were temporary hired to develop and teach course material
- Co-supervised a PhD student in Physics Education Research at the University of Ferrara (Italy) and a master student at the University of **Bologna** (Italy)
- Each semester I supervise 5 to 15 undergraduate teaching assistants and developers
- Each semester I advise 6-10 first year undergraduates.
- 2017-2018 Awarded the *MIT Creative Advising Activity Award*

OUTREACH

European Southern Observatory, Garching bei München (Germany) 2007- present
Media and Outreach Representative in North America

- As part of the ESO Science Outreach Network I promote ESO's missions and achievements locally

MIT Blossoms, Cambridge, MA 2009-2010

- Author of two learning video modules on the science of soap bubbles

Italian national radio (Radio 24), Milan, Italy 2007-2022

- Radio commentator. Reporting on scientific news for the Italian national radio program *Moebius* (2007-2010)

CONSULTING

MIT Physics Department, Cambridge, MA 2012-present

- Scientific editor for MIT research projects. I have been editing papers that have been published in *Science* and *Nature* and I have written the relative press releases.

MIT Teaching and Learning Lab, Cambridge, MA 2011

- I have been hired as a consultant in order to assess changes made to the Interphase program.

PUBLICATIONS

Refereed journal publications:

1. *Non-Linear Resonance in Nearly Geodesic Motion in Low-Mass X-Ray Binaries* by M.A. Abramowicz, V. Karas, W. Kluzniak, W.H. Lee, P. Rebusco: in Publications of the Astronomical Society of Japan, 2003, vol.55, pp. 467-466 (astro-ph/0302183)
2. *Twin Peaks kHz QPOs: Mathematics of the 3:2 Orbital Resonance* by P. Rebusco: in

- Publications of the Astronomical Society of Japan, 2004, vol. 56, pp. 553-557 (astro-ph/0403341)
3. *Impact of stochastic gas motions on galaxy cluster abundance profiles* by P. Rebusco, E. Churazov, H. Böhringer, W. Forman: in Monthly Notices of the Royal Astronomical Society, 2005, vol. 359, pp. 1041-1048 (astro-ph/0501141)
 4. *Resonance conditions* by P. Rebusco: in Astronomische Nachrichten, 2005, vol. 326, pp. 830-834 (astro-ph/0510419)
 5. *The correlations and anticorrelations in QPO data* by M.A. Abramowicz, D. Barret, M. Bursa, J. Horak, W. Kluzniak, P. Rebusco, G. Torok: in Astronomische Nachrichten, 2005, vol. 326, pp. 864-866 (astro-ph/0510419)
 6. *Stochastic modelling of kHz QPOs light curves* by R. Vio, P. Rebusco, P. Andreani, Madsen H., R.V. Overgaard: in Astronomy & Astrophysics, 2006, vol. 452, pp. 383-386 (astro-ph/0602200)
 7. *Epicyclic oscillations of fluid bodies Paper II. Strong gravity* by M.A. Abramowicz, O. Blaes, J. Horak, W. Kluzniak, P. Rebusco: in Classical and Quantum Gravity, 2006, vol. 23, pp. 1689 (astro-ph/0511375)
 8. *Effect of turbulent diffusion on iron abundance profiles* by P. Rebusco, E. Churazov, H. Böhringer, W. Forman: in Monthly Notices of the Royal Astronomical Society, 2006, vol. 372, pp. 1840-1850 (astro-ph/0608491)
 9. *Metal mixing by buoyant bubbles in galaxy clusters* by E. Roediger, M. Bruggen, P. Rebusco, H. Böhringer, E. Churazov: in Monthly Notices of the Royal Astronomical Society, 2007, vol. 375, pp. 15-28 (astro-ph/0611531)
 10. *The twin peak QPO in neutron star and black hole sources: what is explained and what is not* by M.A. Abramowicz, W. Kluzniak, M. Bursa, J. Horak, P. Rebusco, G. Torok: in Revista Mexicana de Astronomia y Astrofisica (Serie de Conferencias), 2007, vol. 27, pp. 8-17
 11. *Width of X-ray lines in cooling flows* by P. Rebusco, E. Churazov, Sunyaev R.A., H. Böhringer, W. Forman: in Monthly Notices of the Royal Astronomical Society, 2008, vol. 384, pp. 1511-1518 (astro-ph/0711.4110)
 12. *Difficulties with the QPOs resonance model* by P. Rebusco: in New Astronomy Review, 2008, vol. 51, pp. 855-859 (astro-ph/0801.3658)
 13. *Galaxy Clusters in the Swift/BAT era* by M. Ajello, P. Rebusco, N. Cappelluti et al.: in Astrophysical Journal, 2009, vol. 690, pp. 367-388 (astro-ph/0809.0006)
 14. *A candidate tidal disruption event in the Galaxy cluster Abell 3571* by N. Cappelluti, M. Ajello, P. Rebusco et al.: in Astronomy & Astrophysics Letter 2009, vol. 495, pp. 9-12 (astro-ph/0901.3357)
 15. *Internal resonance in non-linear disk oscillations and the amplitude evolution of neutron star kilohertz QPOs* by: J. Horak, M. Abramowicz, W. Kluzniak, P. Rebusco, G. Torok: in Astronomy & Astrophysics 2009, vol. 499, pp. 535-540 (astro-ph/0901.3076)
 16. *Global transient dynamics of three-dimensional hydrodynamical disturbances in a thin viscous accretion disk* by: P. Rebusco, O. Regev, O.M. Umurhan, W. Kluzniak, in Physics of Fluids, 2009, vol. 21, Issue 7, pp. 076601-20 (astro-ph/0906.0004)
 17. *Galaxy clusters in the Swift/BAT era II: 10 more clusters detected above 15 keV* by M. Ajello, P. Rebusco, N. Cappelluti et al.: in Astrophysical Journal, 2010, vol. 725, pp. 1688-1706 (astro-ph/1009.4699)
 18. *Stability of radiation-pressure dominated disks. I. The dispersion relation for a delayed heating alpha-viscosity prescription* by Adam Ciesielski, Maciej Wielgus, Wlodek Kluzniak, Aleksander Sadowski, Marek Abramowicz, Jean-Pierre Lasota, Paola Rebusco, A&A 538, A148, 10.1051/0004-6361/201117478 2012
 19. *Period doubling and non-linear resonance in the black hole candidate IGR J17091-3624?* by P. Rebusco, P. Moskalik, W. Kluzniak, M.A. Abramowicz, in Astronomy &

Non-refereed publications and popular science:

1. *Fusion in the Universe: where your jewelry comes from* by P. Rebusco, H.Boffin, D. Pierce-Price: in Science in School, 2007, vol. 5, pp.52-56 (www.scienceinschool.org)
2. *Lo show prosegue* by P. Rebusco: in Nova, September 20th, 2007
3. *Un telescopio è per la vita...* by P. Rebusco: in Nova, February 21st, 2008
4. *La minaccia fantasma* by P.Rebusco: in Newton, February 2010
5. *James Webb Telescope* by P. Rebusco: in Newton, March 2010
6. *O sole nostro* By P.Rebusco and M.L.Stevens: in Newton, April 2010
7. *Il segreto dell'Universo* by P.Rebusco: in Newton, August 2010
8. *Intervista a Marek Abramowicz* by P.Rebusco: in Newton, October 2010
9. *Rivoluzione Universale* by P.Rebusco and A.Silvestri: in Newton, December 2010
10. *Intervista a Joseph Silk*, Newton, October 2011
11. on-line articles at www.moebiusonline.eu (now retired)
12. *Magnetic Field Signature of Super Earths* by: A.M.Piso, P.Rebusco, S. Seager, 2012, American Astronomical Society, AAS Meeting #217, id.343.24;
13. *3D-Spirals emerging from Plasma Disks and High Frequency QPOs* by: American Physical Society, 2009 APS April Meeting, May 2-5, 2009, abstract id. X12.004
14. *Peekaboo... I see through!* 2014 Press release: <https://www.rle.mit.edu/peekaboo-i-see-through/>
15. *Cheers! Maxwell's electromagnetism extended to smaller scales*, 2019 Press release: <https://www.eurekalert.org/news-releases/487528>
16. *How photonics can reshape the spectrum of light, and rehabilitate Edison's light bulb along the way*, 2017 Press Release <https://phys.org/news/2016-01-photonics-reshape-spectrum-edison-bulb.html>
17. MIT Faculty Newsletter, *Python With First Year Physics: What We Taught and What We Learned*: https://web.mit.edu/fnl/volume/302/rebusco_et%20al.html

SELECTED TALKS

- May 2004, "Twin peaks kHz QPOs: mathematics of the 3:2 orbital resonance", Astronomical Institute of Prague (Czech Republic)
- May 2004, "Twin peak kHz QPOs: mathematics of the 3:2 orbital resonance", Rikkyo University, Tokyo (Japan)
- November 2004, "QPOs: Einstein's gravity non-linear resonances", MPE Garching (München, Germany) "Einstein Legacy 2005"
- February 2005, "Nonlinear conditions", Nordita (Copenhagen, Denmark)
- May 2005, "Impact of stochastic gas motions on galaxy cluster abundance profiles", NASA GSFC (Greenbelt, USA)",
- September 2005, "QPOs: the mystery of the slope(s)", Wojnowice Castle (Poland) "Workshop on QPOs in Strong Gravity"
- January 2008, "Measuring turbulence in cool core galaxy clusters" Technion University (Haifa, Israel)

- January 2008, “QPOs and nonlinear pendulums” Weizmann Institute of Science (Rehovot, Israel)
- January 2008, “Measuring turbulence in cool core galaxy clusters” , Hebrew University (Jerusalem, Israel)
- May 2008 “Galaxy clusters in the Swift, BAT era”, Clusters conference at Columbia University (NYC)
- October 2008, “Spirals!”, Nordita (Stockholm, Sweden)
- January 2009 “Cúmulos de galaxias y capuchino”, Pontificia Universidad Católica (Santiago, Chile)
- February 2009, “3D accretion disks: investigation of global transient dynamics ”, APS meeting
- April 2009, “3D accretion disks: analytical investigation of global transient dynamics ”, UCSB (Santa Barbara, USA)
- April 2009, “3D-Spirals Emerging from Plasma Disks and High Frequency QPOs”, APS meeting
- May 2009, “Global Transient Dynamics”, Copernicus Center, Warsaw (Poland)
- November 2010, “Is the ICM non-thermal?”, MKI at MIT
- November 2014 “Active learning” workshop for university professors from different universities across Brazil
- June 2017, “Pedagogical experimentation at MIT”, University of Trieste (Italy)
- July 2019, “Alla scoperta dei buchi neri”, public talk, Saló (Italy)
- April 2021, “Project based and collaborative learning” with C.Trevisoi. MNU Conference for German teachers, Hessen (Germany)
- March 2024, “Strutture e impatto di didattiche alternative: la metodologia TEAL e l’esperienza di ESG” for italian educators (from primary school to college), INFN Ferrara (Italy)