

LORENZO SIRONI

Department of Astronomy
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Academic Training

Astronomy Department, Columbia University (USA)
Assistant Professor, July 2016 – present
Adjunct Associate Research Scientist, July 2015 – June 2016
Institute for Theory and Computation (ITC), Harvard University (USA)
ITC Post-Doctoral Fellow, February 2015 – June 2016
NASA Einstein Post-Doctoral Fellow, February 2012 – January 2015
Department of Astrophysical Sciences, Princeton University (USA)
Ph.D., November 2011
Advisor: Prof. Anatoly Spitkovsky
Thesis: *Particle Acceleration and Nonthermal Emission in Relativistic Astrophysical Shocks*
Scuola Normale Superiore, Pisa (Italy)
Diploma di Licenza, 70/70 with honors, September 2006
Physics Department, University of Pisa (Italy)
Laurea Specialistica in Physical Sciences, 110/110 with honors, September 2006
Advisor: Prof. Mario Vietri
Thesis: *On Some Electrodynamical Properties of Binary Pulsars*
Physics Department, University of Pisa (Italy)
Laurea in Physics, 110/110 with honors, September 2004
Advisor: Prof. Mario Vietri
Thesis: *Origin, Acceleration and Propagation of High-Energy Cosmic Rays*

Research Interests

High-Energy Astrophysics:
Collisionless Shocks: particle acceleration and magnetic field generation in relativistic and non-relativistic shocks, emission signatures, transport of accelerated particles.
Magnetic Reconnection: particle heating and acceleration and magnetic dissipation in relativistic and non-relativistic magnetic reconnection, emission signatures.
Turbulence: particle heating and acceleration, magnetic field generation and dissipation in turbulent flows.
Collisionless Accretion Flows: electron heating and acceleration in two-temperature low-luminosity accretion disks.
Galaxy Clusters: electron acceleration in radio relics and radio haloes; generation of magnetic fields in galaxy clusters and inter-galactic voids.
Compact Objects: electrodynamics of pulsars; physics of gamma-ray bursts; particle acceleration and emission signatures in interaction-powered supernovae.
Galaxy Astrophysics: dynamical effects of cosmic ray protons on the evolution of supermassive black holes and their host galaxies; radiative feedback in starburst galaxies; X-ray cooling flows in clusters of galaxies.

Computational Skills

Extensive experience in design, implementation, testing and use of modern numerical methods for plasma (particle-in-cell) simulations. Experience in the use of a wide variety of computational platforms, ranging from shared memory workstations to massively parallel supercomputers. Good experience in GPU (Graphics Processing Unit) programming.

Mentoring

Advisor of Ph.D. student A. Tran **Sept. 2017 – present**
First-year Project: *Electron Heating in non-relativistic shocks*
Advisor of Ph.D. student A. Babul **Sept. 2017 – present**
First-year Project: *The origin of the coherent emission in FRBs*

	Advisor of Bridge Program student Rafael Colon	Sept. 2017 – present
	Project: <i>Explosive Magnetic Reconnection and Crab Nebula Flares</i>	
	Co-advisor of Ph.D. student D. Ball (with F. Özel at Arizona)	Sept. 2016 – present
	Ph.D. Thesis: <i>Non-Thermal Electron Acceleration in Collisionless Accretion Flows</i>	
	Co-advisor of Ph.D. stud. M. Rowan (with R. Narayan at Harvard)	Feb. 2016 – present
	Ph.D. Thesis: <i>Electron and Ion Heating via Reconnection in Collisionless Accretion Flows</i>	
	Advisor of undergraduate student D. Acevedo (at Columbia)	Jan. 2017 – July 2017
	Summer Project: <i>The Structure of Plasmoids in Relativistic Reconnection</i>	
	Co-advisor of Ph.D. stud. X. Guo (with R. Narayan at Harvard)	2012 – 2017
	Ph.D. Thesis: <i>Particle Acceleration and Electron Heating in Low Mach Number Shocks</i>	
	Co-advisor of undergrad. student A. Peck (with A. Spitkovsky at Princeton)	2010 – 2011
	Senior Thesis Project: <i>The Injection Problem in Relativistic Shocks</i>	
	Co-advisor of undergrad. M. Jimenez (with A. Spitkovsky at Princeton)	Summer 2009
	Summer Project: <i>Long-term Evolution of Particle Acceleration in Relativistic Shocks</i>	
Lectures and Summer Schools	<i>International Cargese Summer School on Cosmic Accelerators</i> , Cargese, France, May 2013	
	Summer school <i>Mera-TeV</i> , Astronomical Observatory of Brera, Merate, Italy, October 2011	
Research Grants	PI on the project <i>Birth and Infancy of a Fast Radio Burst</i> , NASA ATP, \$465,764, Sept. 2018 – Aug. 2021	
	PI on the project <i>Improving and extending models of GRB Afterglows</i> , NSF AST, \$457,776, Sept. 2017 – Aug. 2020	
	Co-PI on the project <i>Blazar emission modeling: going beyond spherical cows</i> , NASA ATP, \$245,825, Sept. 2017 – Aug. 2020	
	PI on the project <i>Unveiling the origin of the highest energy particles in the Universe with large-scale first-principle fully-kinetic simulations</i> , NSF ACI - CRII CISE Research Initiation, \$170,680, July 2017 – June 2019	
	Co-PI on the project <i>Explosive reconnection in relativistic magnetically-dominated plasmas</i> , DOE Office of Science, \$147,000, Sept. 2016 – Aug. 2019	
	PI on the project <i>First-Principle Modeling of the Crab GeV Flares</i> , NASA Fermi Cycle 9, \$60,000, Sept. 2016 – Aug. 2017	
	Collaborator on the project <i>Multi-Scale Models of Accreting Black Holes</i> , Theoretical and Computational Astrophysics Networks (TCAN), Sept. 2013 – Aug. 2016	
Awards and Honors	Scientific Habilitation for Assoc. Professorship in Italian Universities	Nov. 2014 - present
	3-year Einstein Fellowship + 2-year Harvard-ITC Fellowship	Feb. 2012 – June 2016
	3-year UC Berkeley Miller Post-Doctoral Fellowship (declined)	2011
	5-year CITA Senior Researcher Fellowship (declined)	2011
	C. E. Procter Honorific Fellowship, Princeton University	Sept. 2010 – Aug. 2011
	Korn Prize, Dept. of Astrophysical Sciences, Princeton	Sept. 2006 – Aug. 2011
	Scuola Normale Superiore (Pisa) Fellowship	Sept. 2001 – July 2006
Selected Recent Invited Talks and Colloquia	Plenary invited talk at the <i>2018 TeV Particle Astrophysics conference (TeVPA 2018)</i> , Berlin, Germany, August 2018	
	Invited talk at the <i>11th Plasma Kinetics Working Group Meeting</i> , Vienna, Austria, July 2018	
	Colloquium in the Physics and Astronomy Department, UCLA, Los Angeles (CA), USA, June 2018	
	Invited talk at the third workshop on <i>Relativistic Plasma Astrophysics</i> , Purdue University, West Lafayette (IN), USA, May 2018	

Invited talk at the conference *European Week of Astronomy and Space Sciences (EWASS)*, Liverpool, UK, April 2018

PSFC seminar, Plasma Science and Fusion Center, MIT, Cambridge (MA), USA, February 2018

Colloquium in the Physics Department, MIT, Cambridge (MA), USA, February 2018

Invited talk at the conference *Cosmic Accelerators: Understanding Nature's High-Energy Particles and Radiation*, Annapolis (MD), USA, November 2017

Colloquium at the Department of Astronomy and Astrophysics, UCSC, Santa Cruz (CA), USA, November 2017

Invited talk at the conference *Diffuse Synchrotron Emission in Clusters of Galaxies - What's Next?*, Leiden, Netherlands, October 2017

Invited talk at the workshop *Exascale thinking of particle energization problems*, Stockholm, Sweden, August 2017

Invited talk at the *Workshop on Plasma Astrophysics*, Oxford, UK, July 2017

Invited plenary talk at the conference *JPP Frontiers in Plasma Physics*, Spineto, Italy, May 2017

Colloquium at the Princeton Plasma Physics Lab, Princeton (NJ), USA, May 2016

Colloquium at the Institute of Space Sciences, Barcelona, Spain, December 2016

Colloquium at the Max Planck Institute for Radio Astronomy, Bonn, Germany, September 2016

Invited talk at the workshop *Beyond a PeV: Particle Acceleration to Extreme Energies in Cosmic Sources*, Paris, France, September 2016

Invited talk at the *9th Plasma Kinetics Working Group Meeting*, Vienna, August 2016

Invited Plenary Talk at the 6th International Symposium on High-Energy Gamma-Ray Astronomy, Heidelberg, Germany, July 2016

Invited Plenary Talk at the 43rd Conference on Plasma Physics of the European Physical Society, Leuven, Belgium, July 2016

Colloquium at the Astronomical Observatory of Brera, Merate, Italy, June 2016

Invited talk at the Workshop on *Modelling Nebulae*, Barcelona, Spain, June 2016

Invited talk at the Workshop on *Aspects of General Relativity*, Harvard University, Cambridge (MA), USA, May 2016

Invited talk at the *HEDLA 2016* conference, SLAC, Stanford (CA), USA, May 2016

Invited talk at the second workshop on *Relativistic Plasma Astrophysics*, Purdue University, West Lafayette (IN), USA, May 2016

Princeton-IAS Colloquium, Princeton University, Princeton (NJ), USA, March 2016

Invited talk at *The US-Japan Workshop on Magnetic Reconnection 2016*, Napa (CA), USA, March 2016

Theoretical Astrophysics Center Seminar, UC Berkeley, Berkeley (CA), USA, March 2016

Astrophysics Seminar at the Astronomy Department, Boston University, Boston (MA), USA, February 2016

Astrophysics Colloquium at the University of Oxford, United Kingdom, November 2015

Invited talk at the ISSI Workshop on *Jets and Winds in Pulsar Wind Nebulae, Gamma-ray Bursts and Blazars: Physics of Extreme Energy Release*, Bern, Switzerland, November 2015

Invited talk at the Sixth International Fermi Symposium, Arlington (VA), USA, November 2015

Invited talk at the conference on *Magnetic Fields in the Universe V*, Cargese, France, October 2015

Colloquium in the Astronomy Department, University of Massachusetts at Amherst (MA), USA, September 2015

Colloquium at the Department of Astrophysical and Planetary Sciences, University of Colorado at Boulder (CO), USA, September 2015

Invited talk at the conference on *Relativistic Jets: Creation, Dynamics, and Internal Physics*, Krakow, Poland, April 2015

Colloquium at the Department of Astronomy, Columbia University, New York (NY), February 2015

Colloquium at the Physics Department, MIT, Cambridge (MA), February 2015

Colloquium at the Department of Applied Mathematics and Theoretical Physics, Cambridge University, Cambridge, UK, February 2015

Colloquium at the Department of Astronomy and Astrophysics, UCSC, Santa Cruz (CA), February 2015

Colloquium at the Niels Bohr Institute, University of Copenhagen, Copenhagen, Denmark, January 2015

Invited talk at the workshop on *Shock Acceleration: From the Solar System to Cosmology*, Amsterdam, Netherlands, January 2015

Professional Societies

Member of the Computational Training Subcommittee of the Shared High Performance Policy Advisory Committee (SRCPAC) at Columbia, Jan. 2018 – present

Co-convener for the session on plasma energization during magnetic reconnection at the 2017 Fall AGU meeting, Dec. 2017

Member of the “Frontiers of Computing System” working group (part of the Data Science Institute at Columbia), Feb. 2017 – present

Co-organizer of the pizza lunch in the Astronomy Dept. at Columbia, Feb. 2017 – present

Member of the Operating Committee of *Habanero*, the Columbia computing cluster, Sept. 2016 – present

Member of the Science Working Group for X-ray Surveyor, July 2016 – present

Member of the Breakthrough Starshot Initiative, Sept. 2015 – present

SOC and LOC at the meeting *Accelerating Cosmic-Ray Comprehension (ACRC)*, April 2015, Princeton University, Princeton (NJ), USA

Organizer of the ITC Luncheon talks (four presentations per week), Feb. 2012 – July 2015

Member of the ISSI research group on *Fermi Shock Acceleration Process: from Non-Relativistic to Ultra-Relativistic Shocks*, July 2010 – June 2012

Peer Review

The Astrophysical Journal, *The Astrophysical Journal Letters*, *Monthly Notices of the Royal Astronomical Society*, *Journal of Plasma Physics*, *Monthly Notices of the Royal Astronomical Society Letters*, *Physics of Plasmas*, *New Astronomy*, *Scientific Reports*, *Physics Letters B*, *Space Science Reviews*, *Proceedings of the National Academy of Sciences*, *Science Advances*.

Panelist / Reviewer for: NASA ATP Proposals; ERC Advanced Grants; German-Israeli Foundation for Scientific Research and Development; Office of Basic Energy Sciences (BES) within the Department of Energy (DoE); PRACE.

Collaborators

J. Arons (UC Berkeley), F. Bacchini (Leuven, Belgium), X. Bai (Tsinghua University, China), D. Ball (Arizona), R. Blandford (Stanford), A. Bret (Universidad Castilla La Mancha, Spain), A. Bykov (Ioffe Institute for Physics and Technology, Russia), D. Caprioli (University of Chicago), B. Cerutti (Grenoble, France), C.-K. Chan (Arizona), A. Chen (Princeton), I. Christie (Northwestern), L. Comisso (Columbia), G. Ghirlanda (INAF Merate, Italy), G. Ghisellini (INAF Merate, Italy), D. Giannios (Purdue University), M. Hoshino (Tokyo, Japan), D. Kagan (Hebrew University, Israel), U. Keshet (Tel Aviv University,

Israel), S. Komissarov (University of Leeds, UK), M. Lemoine (IAP, France), M. Lyutikov (Purdue University), A. Marcowith (Laboratoire Univers et Particules de Montpellier, France), R. Margutti (Northwestern University), R. Narayan (Harvard University), L. Nava (Hebrew University, Israel), F. Ozel (University of Arizona), A. Pe'er (Cork, Ireland), M. Petropoulou (Princeton University), O. Porth (Amsterdam, Netherlands), D. Psaltis (Arizona), B. Ripperda (Leuven, Belgium), M. Rowan (Harvard), A. Spitkovsky (Princeton University), F. Tavecchio (INAF Merate, Italy), Y. Yuan (Princeton).