Dr. Jonathan J. Zrake

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Post-doctoral positions

Columbia University *New York, NY*
Position: Postdoctoral Research Scientist
Supervisor: Dr. Andrei Beloborodov
Dates: February 2017 - Present
Concentration: Binary neutron star mergers, gamma-ray burst prompt emission

Stanford University *Menlo Park, CA*
Position: Kavli Postdoctoral Fellow
Supervisors: Dr. Roger Blandford and Dr. Tom Abel
Dates: September 2013 - January 2017
Concentration: High energy astrophysics: magnetic reconnection, pulsar wind nebulae

Education

New York University *New York, NY*
Degree: Ph.D. in Physics
Position: Graduate student, James Arthur Fellow
Thesis advisor: Dr. Andrew MacFadyen
Dates: July 2007 - August 2013
Concentration: Numerical methods: relativistic magnetohydrodynamic turbulence

Rutgers, The State University of New Jersey *New Brunswick, NJ*
Degree: B.S. in Physics
Undergraduate advisor: Dr. John Hughes
Dates: September 2002 - June 2007
Concentration: Observational X-ray astronomy: supernova remnants

Publications

Sub-photospheric turbulence as a heating mechanism in gamma-ray bursts
J. Zrake, A. Beloborodov, and C. Lundman
The Astrophysical Journal (submitted)

Radio sky maps of the GRB 170817A afterglow from simulations
J. Zrake, X. Xi, and A. MacFadyen
The Astrophysical Journal Letters, Volume 865, Issue 1 (2018)

Dissipation of Alfvén waves in relativistic magnetospheres of magnetars
X. Li, **J. Zrake**, and A. Beloborodov
The Astrophysical Journal (submitted)

Efficient non-thermal particle acceleration by the kink instability in relativistic jets
P. Alves, **J. Zrake**, and F. Fiuza
Physical Review Letters (accepted)

Numerical simulations of the binary neutron star merger event GW 170817
X. Xi, **J. Zrake**, and A. MacFadyen
The Astrophysical Journal, Volume 863, Issue 1 (2018)

A decline in the X-ray through radio emission from GW 170817
K. Alexander et al. (incl. **J. Zrake**)
The Astrophysical Journal Letters, Volume 863, Issue 2 (2018)

The binary neutron star event LIGO/Virgo GW 170817 160 days after merger
R. Margutti et al. (incl. **J. Zrake**)
The Astrophysical Journal Letters, Volume 856, Issue 1 (2018)

Turbulent magnetic relaxation in pulsar wind nebulae
J. Zrake and J. Arons
The Astrophysical Journal, Volume 847, Issue 1 (2017)

Ab initio simulations of a supernova driven galactic dynamo in an isolated disk galaxy
I. Butsky, **J. Zrake**, J. Kim, E. Yang, and T. Abel
The Astrophysical Journal, Volume 843, Issue 2 (2017)

Kinetic study of radiation-reaction-limited particle acceleration: unstable force-free equilibria
Y. Yuan, K. Nalewajko, **J. Zrake**, W. East, and R. Blandford
The Astrophysical Journal, Volume 828, Issue 2 (2016)

Kinetic simulations of the fundamental unstable mode of relativistic harmonic magnetic equilibria
K. Nalewajko, **J. Zrake**, Y. Yuan, W. East, and R. Blandford
The Astrophysical Journal, Volume 826, Issue 2 (2016)

Crab flares due to turbulent dissipation of the pulsar striped wind
J. Zrake
The Astrophysical Journal, Volume 823, Issue 1 (2016)

Freely decaying turbulence in force-free electrodynamics
J. Zrake and W. East
The Astrophysical Journal, Volume 817, Issue 2 (2016)

Simplex-in-cell technique for collisionless plasma simulations
J. Kates-Harbeck, S. Totorica, **J. Zrake**, and T. Abel
Journal of Computational Physics, Volume 304 (2016)

Spontaneous decay of periodic magnetostatic equilibria
W. East, **J. Zrake**, Yajie Yuan, and R. Blandford
Physical Review Letters, Volume 115, Issue 9 (2015)

Magnetic field generation in stars
L. Ferrario, A. Melatos, and **J. Zrake**
Space Science Reviews (2015)

Producing magnetar magnetic fields in the merger of binary neutron stars
B. Giacomazzo, **J. Zrake**, P. Duffell, A. MacFadyen, and R. Perna
The Astrophysical Journal, Volume 809, Issue 1 (2015)

Inverse cascade of nonhelical magnetic turbulence in a relativistic fluid
J. Zrake
The Astrophysical Journal Letters, Volume 794, Issue 2 (2014)

Magnetic energy production by turbulence in binary neutron star mergers
J. Zrake and A. MacFadyen
The Astrophysical Journal Letters, Volume 769, Issue 2 (2013)

Spectral and intermittency properties of relativistic turbulence
J. Zrake and A. MacFadyen
The Astrophysical Journal Letters, Volume 763, Issue 1 (2013)

Numerical simulations of relativistic magnetohydrodynamic turbulence
J. Zrake and A. MacFadyen
The Astrophysical Journal, Volume 744, Issue 1 (2012)

Invited talks

How AGN jets shine: relativistic turbulence and current-driven instabilities
Astrophysics Colloquium, Boston University (March 2019)

A tale of two neutron stars: from gamma-ray bursts to gravitational waves
Physics Colloquium, Bard College (March 2019)

Relativistic turbulence and multi-messenger astrophysics
Perimeter Institute (November 2018)

Reconstructing the geometry of GRB170817A
Astrophysics Seminar, Stanford University (November 2018)

Non-thermal particle acceleration by the helical kink mode in AGN jets
Princeton Astroplasma Seminar (October 2018)

Turbulence in the high energy universe: binary neutron star mergers and relativistic jets
Astrophysics Colloquium, University of Maryland (March 2018)

Sub-photospheric turbulence in gamma-ray burst prompt emission

Workshop on Relativistic Plasma Astrophysics, Purdue University (May 2018)

Particle acceleration by current-driven instabilities in relativistic jets
Cosmic Accelerators Workshop, Joint Space Institute (November 2017)

Binary neutron star mergers and turbulent dynamo
Astrophysics of Binary Neutron Star Mergers, Simons Center in the Flatiron (November 2017)

Pulsars wind nebulae
Astrophysics Colloquium, Nicolaus Copernicus Astronomical Center, Warsaw, Poland (May 2017)

Magnetic energy dissipation and turbulence in pulsar wind nebulae
Princeton Astroplasma Seminar (April 2017)

Gamma-ray flares and magnetic energy dissipation in pulsar wind nebulae
Cosmic Rays, Pulsars, and Dark Matter Conference (March 2017)

Relativistic magnetohydrodynamic turbulence
Astrophysics Seminar, Los Alamos National Laboratory (February 2017)

Magnetic reconnection in the Crab Nebula
Astrophysics Seminar, Stanford University (November 2016)

Taylor relaxation in relativistic magnetized plasma
11th International Conference on High Energy Density Laboratory Astrophysics (May 2016)

Crab Nebula gamma-ray flares
Workshop on Relativistic Plasma Astrophysics, Purdue University (May 2016)

Crab Nebula gamma-ray flares and turbulence in the pulsar striped wind
Astrophysics Seminar, Columbia University (January 2016)

Turbulence in the high energy universe
Astrophysics Seminar, Stony Brook University (January 2016)

Turbulence in the high energy universe
Physics Colloquium, Florida International University (January 2016)

Magnetic energy dissipation and turbulence in relativistic plasma
Workshop on Astroparticle Physics, Peking University (September 2015)

Can magnetic reconnection explain rapid variability of gamma-ray sources?
Astrophysics Seminar, Stanford University (September 2015)

Magnetic energy dissipation in relativistic plasma
Astrophysics Seminar, University of California, Berkeley (September 2015)

Relativistic magnetic turbulence and "magneto-luminescence"
Krakow Jets Meeting, Krakow, Poland (April 2015)

Rise and fall of magnetic fields in relativistic astrophysics
TAPIR Astrophysics Seminar, California Institute of Technology (January 2015)

Inverse cascading of magnetic fields

Eliot Quataert's Group Meeting, University of California, Berkeley (October 2014)

Production and decay of magnetic energy in a relativistic fluid
Workshop on Relativistic Plasma Astrophysics, Purdue University (May 2014)

Cosmic turbulence
Physics Colloquium, Georgia Institute of Technology (April 2014)

Magnetic energy budget of binary neutron star mergers
ISSI: Strongest Magnetic Fields in the Universe, Bern, Switzerland (February 2014)

Relativistic turbulence
Physics Colloquium, The University of Padua, Italy (January 2014)

Magnetic energy production by turbulence in binary neutron star mergers
Huntsville in Nashville Gamma-ray Burst Symposium (April 2013)

Magnetic energy production by turbulence in binary neutron star mergers
Princeton University Department of Astrophysical Sciences (November 2012)

Simulations of driven turbulence in relativistic magnetohydrodynamics
Harvard Institute for Theory and Computation (April 2011)

Teaching Experience

- *Guest lecturer for Brian Metzger, Engineering electrodynamics: Columbia (Spring 2018)*
- *Guest lecturer for Andrei Beloborodov, Classical fields and waves: Columbia (Spring 2018)*
- *Instructor, fluid mechanics for exceptional high school students: Columbia SHP (Fall 2017)*
- *Guest lecturer for Tom Abel, undergraduate numerical methods: Stanford (Spring 2014)*
- *Teaching assistant, undergraduate fluid dynamics (Spring 2012)*
- *Teaching assistant, graduate computational physics: NYU (Fall 2012)*
- *Teaching assistant, graduate computational physics: NYU (Fall 2011)*
- *Teaching assistant, graduate computational physics: NYU (Fall 2010)*
- *Teaching assistant, undergraduate electrodynamics: NYU (Spring 2010)*
- *Teaching assistant, graduate computational physics: NYU (Fall 2009)*
- *Teaching assistant, graduate/undergraduate computational physics: NYU (Fall 2008)*

Outreach Activities

- Interviewed for Sky and Telescope on GW170817 (2018)
- Science and ethics series: Pleasant Valley State Prison, CA (2015, 2016)
- KIPAC Open house for kids: SLAC (2015, 2016)
- Nightlife guide: California Academy of Sciences (2013 - 2015)
- Science and religion series: Jikoji Zen Center, CA (2013, 2014)
- Higher education in science: NJ middle school students (2007)

Service Activities

- KIPAC colloquium organizing committee, Stanford University, 2014 - 2016
- NASA Astrophysics Theory Program panel member, Fall (2016)
- Referee: The Astrophysical Journal
- Referee: The Astrophysical Journal Letters
- Referee: Monthly Notices of the Royal Astronomical Society
- Referee: Physics of Plasmas
- Referee: Journal of Plasma Physics