Carl Rodriguez | Curriculum Vitae

MIT, 37-664L – 77 Massachusetts Ave – Cambridge, MA, 02139

318.469.1779 • carlrodr@mit.edu • bhdynamics.com

Pappalardo Fellow at MIT studying the dynamics of compact objects in star clusters. Research interests include computational astrophysics, black hole formation, dynamics, and gravitational-wave astronomy. Strongly interested in the applications of astrophysics to STEM education and outreach.

Education

Academic Qualifications

Northwestern University — **Ph.D. Physics**
Evanston, IL — *2016*
Thesis – Modeling Dense Star Clusters and Their Implications for Advanced LIGO
Advisor – Frederic Rasio

Reed College — **B.A. Physics**
Portland, OR — *2010*
Thesis – Accretion Disk Geodesics in Extreme Kerr Geometries
Advisor – Joel Franklin

Honors and Awards

- **MIT Pappalardo Fellowship** 2016-Present
- **NSF Graduate Research Fellowship** 2011-2016
- **NSF GK12 Fellowship** 2013–2014
- **Illinois Space Grant Consortium Fellowship** 2010–2011, 2015–2016
- **NSF STEM Scholar** 2008–2010

First Author Papers (with links)

Post-Newtonian Dynamics in Dense Star Clusters: Highly-Eccentric, Highly-Spinning, and Repeated Binary Black Hole Mergers
C. L. Rodriguez, S. Chatterjee, F. Rasio, F. Rasio; PRL (Submitted) *2017*

Illuminating Black Hole Binary Formation Channels with Spins in Advanced LIGO **ApJL**
C. L. Rodriguez, M. Zevin, C. Pankow, V. Kalogera, F. Rasio; ApJL, **832**, L2 *2016*

Dynamical Formation of the GW150914 Binary Black Hole **ApJL**
C. L. Rodriguez, C.-J. Haster, S. Chatterjee, V. Kalogera, F. Rasio; ApJL, **824**, L8 *2016*
- Articles in *New Scientist*, *Sky News* (Links),
- Synopsis in *Astrobites* (Link)

Binary Black Hole Mergers from Globular Clusters: Masses, Merger Rates, and the Impact of Stellar Evolution **PRD** *2016*
C. L. Rodriguez, S. Chatterjee, F. Rasio; Phys. Rev. D, **93**, 084029

Million-Body Star Cluster Simulations: Comparisons between Monte Carlo and Direct N-*body* **MNRAS** *2016*
C. L. Rodriguez, M. Morscher, L. Wang, S. Chatterjee, F. Rasio, R. Spurzem; MNRAS **463**, 2109

Binary Black Hole Mergers from Globular Clusters: Implications for Advanced LIGO **PRL**
C. L. Rodriguez, M. Morscher, B. Pattabiraman, S. Chatterjee, C.J. Haster, and F. Rasio; Phys. Rev. Lett. **115**, 051101 *2015*
- Synopsis by APS in *Physics* (Link)
- Synopsis in popular science blog *IFLS* (Link)

Basic Parameter Estimation of Binary Neutron Star Systems by the Advanced LIGO/Virgo Network **ApJ**
C. L. Rodriguez, B. Farr, V. Raymond, W. Farr, T. Littenberg, D. Fazi, V. Kalogera; ApJ, **785**, 2, 119 *2014*

Inadequacies of the Fisher Information Matrix in gravitational-wave parameter *estimation* **PRD**
C. L. Rodriguez, B. Farr, W. Farr, I. Mandel; Phys. Rev. D, **88**, 8, 084013 *2013*

Verifying the no-hair property of massive compact objects with intermediate-mass-ratio inspirals in advanced gravitational-wave detectors **PRD**
C. L. Rodriguez, I. Mandel, J. Gair; Phys. Rev. D, **85**, 6, 062002 *2012*
- Synopsis in *Astrobites* (Link)

Contributing Author (with links)

Precessional Dynamics of Black Hole Triples: Binary Mergers with near-zero Effective Spin
F. Antonini, C. L. Rodriguez, C. Petrovich, C. Fischer; PRL, (Submitted) *2017*

Accreting Black Hole Binaries in Globular Clusters **ApJ**
K. Kremer, S. Chatterjee, C. L. Rodriguez, F. Rasio; ApJ, (accepted) *2017*

Constraining Models of Binary Black Hole Formation with Gravitational-Wave Observations **ApJ**
M. Zevin, C. Pankow, C. L. Rodriguez, L. Sampson, E. Chase, V. Kalogera, F. Rasio; ApJ, **846**, 82Z *2017*

Dynamical Formation of Low-mass Merging Black Hole Binaries like GW151226 **ApJL**
S. Chatterjee, C. L. Rodriguez, V. Kalogera, F. Rasio; ApJL, **836**, L26 *2017*

Binary Black Holes in Dense Star Clusters: Exploring the Theoretical Uncertainties **ApJ**
S. Chatterjee, C. L. Rodriguez, F. Rasio; ApJ, **834**, 1, 68 *2017*

Distinguishing Between Formation Channels for Binary Black Holes with LISA **ApJL**
K. Breivik, C. L. Rodriguez, S. Larson, V. Kalogera, F. Rasio; ApJL, **830**, L18 *2016*

Black Hole Mergers and Blue Stragglers from Hierarchical Triples Formed in Globular Clusters **ApJ**
F. Antonini, S. Chatterjee, C. L. Rodriguez, M. Morscher, B. Pattabiraman, V. Kalogera, F. Rasio; ApJ, **816**, 2, 65 *2016*

The Dynamical Evolution of Stellar Black Holes in Globular Clusters **ApJ**
M. Morscher, B. Pattabiraman, C. L. Rodriguez, F. Rasio, S. Umbreit; ApJ, **800**, 1, 21 *2015*

Parameter estimation for compact binaries with ground-based gravitational-wave observations using the LALInference software library **PRD**
J. Veitch, V. Raymond, B. Farr, W. Farr, P. Graff, S. Vitale, B. Aylott, K. Blackburn, N. Christensen, M. Coughlin, W. Del Pozzo, F. Feroz, J. Gair, C.J. Haster, V. Kalogera, T. Littenberg, I. Mandel, R. O'Shaughnessy, M. Pitkin, C. L. Rodriguez, C. Röver, T. Sidery, R. Smith, M. Van Der Sluys, A. Vecchio, W. Vousden, L. Wade; Phys. Rev. D, **91**, 4, 042003 *2015*

Comparison of Gravitational Wave Detector Network Sky Localization Approximations **PRD**
K. Grover, S. Fairhurst, B. Farr, I. Mandel, C. L. Rodriguez, T. Sidery, A. Vecchio; Phys. Rev. D, **89**, 4, 042004 *2014*

Estimating parameters of coalescing compact binaries with proposed advanced detector networks **PRD**
J. Veitch, I. Mandel, B. Aylott, B. Farr, V. Raymond, C. L. Rodriguez, M. van der Sluys, V. Kalogera, A. Vecchio; Phys. Rev. D **85**, 104045 *2012*

Mock data challenge for the Einstein Gravitational-Wave Telescope **PRD**
T. Regimbau, T. Dent, W. Del Pozzo, S. Giampanis, T.G.F. Li, C. Robinson, C. Van Den Broeck, D. Meacher, C. L. Rodriguez, B.S. Sathyaprakash, K. Wójcik; Phys. Rev. D **86**, 122001 *2012*

Lateral alignment of InGaAs quantum dots as function of spacer thickness **APL**
Z. Wang, C. L. Rodriguez, S. Seydmohamadi, Y. I. Mazur, G. Salamo; Appl. Phys. Lett. **94**, 083107 *2009*

Controlling fluorescence intermittency of a single colloidal CdSe/ZnS quantum dot in a half cavity **PRB**
Y. Zhang, V. Komarala, C. L. Rodriguez, M. Xiao; Phys. Rev. B **78**, 241301(R) *2008*

Collaboration Papers

Coauthor on 23 Collaboration Papers as a Member of the LIGO Scientific Collaboration
Click Here for Full List of Citations *2011-2015*

- Characterization of the LIGO detectors during their sixth science run
- Searching for stochastic gravitational waves using data from the two colocated LIGO Hanford detectors
- Constraints on Cosmic Strings from the LIGO-Virgo Gravitational-Wave Detectors
- Application of a Hough search for continuous gravitational waves on data from the fifth LIGO science run
- Gravitational Waves from Known Pulsars: Results from the Initial Detector Era
- First Searches for Optical Counterparts to Gravitational-wave Candidate Events
- Search for long-lived gravitational-wave transients coincident with long gamma-ray bursts
- Directed search for continuous gravitational waves from the Galactic center
- Parameter estimation for compact binary coalescence signals with the first generation gravitational-wave detector network
- A first search for coincident gravitational waves and high energy neutrinos using LIGO, Virgo and ANTARES data from 2007
- Einstein@Home all-sky search for periodic gravitational waves in LIGO S5 data
- Search for gravitational waves from binary black hole inspiral, merger, and ringdown in LIGO-Virgo data from 2009-2010
- Swift Follow-up Observations of Candidate Gravitational-wave Transient Events
- Search for Gravitational Waves Associated with Gamma-Ray Bursts during LIGO Science Run 6 and Virgo Science Runs 2 and 3
- The characterization of Virgo data and its impact on gravitational-wave searches
- All-sky search for gravitational-wave bursts in the second joint LIGO-Virgo run
- Upper limits on a stochastic gravitational-wave background using LIGO and Virgo interferometers at 600-1000 Hz
- Search for gravitational waves from intermediate mass binary black holes
- First low-latency LIGO+Virgo search for binary inspirals and their electromagnetic counterparts
- Search for gravitational waves from low mass compact binary coalescence in LIGO's sixth science run and Virgo's science runs 2 and 3
- Implementation and testing of the first prompt search for gravitational wave transients with electromagnetic counterparts
- All-sky search for periodic gravitational waves in the full S5 LIGO data
- A gravitational wave observatory operating beyond the quantum shot-noise limit

Invited Talks/Seminars

Columbia Astrophysics Colloquium — **Seminar**
Dense Star Clusters as Binary Black Hole Factories — *2017*
New York, NY

ITC Lunch Seminar — **Seminar**
Identifying Binary Black Holes formed in Dense Stellar Environments — *2017*
Cambridge, MA **(Link)**

Strong Gravity and Binary Dynamics with Gravitational Wave Observations — **Workshop**
Binary Black Holes from Dense Star Clusters — *2017*
Oxford, MS

UCSC Flash Seminar — **Seminar**
Binary Black Holes from Dense Star Clusters — *2017*
Santa Cruz, CA

April APS Meeting — **Invited Talk**
Binary Black Holes from Dense Star Clusters — *2017*
Washington, DC

JSI Fall Workshop: Astrophysics in the Era of Grav. Wave Observations — **Invited Talk**
Binary Black Holes from Dense Star Clusters — *2016*
Annapolis, MD

KITP Rapid Response Workshop — **Invited Talk**
Dense Star Clusters as Binary Black Hole Factories — *2016*
Santa Barbara, CA

Compton Lecture Series — **Guest Seminar**
Dense Star Clusters as Binary Black Hole Factories — *2016*
Chicago, IL **(Link)**

Stellar N-body Conference — **Invited Talk**
Monte Carlo Methods: Recent Results and Future Work — *2014*
Sexten, Italy

Center for Relativistic Astrophysics, Georgia Tech — **Seminar**
Verifying the No-Hair Property of Massive Compact Objects in Advanced LIGO — *2011*
Atlanta, GA

Contributed Talks/Posters

Aspen Center for Physics: Dawning Era of Gravitational-Wave Astrophysics — **Talk**
Distinguishing BBH Formation Channels with Eccentricity and Spin — *2017*
Aspen, CO

APS Meeting — **Talk**
Binary Black Holes from Globular Clusters in the Advanced LIGO Era — *2016*
Salt Lake City, UT

Midwest Relativity Meeting — **Talk**
Binary Black Hole Mergers from Globular Clusters: Implications for Advanced LIGO — *2015*
Evanston, IL

April APS Meeting — **Talk**
Binary Black Holes Produced in Globular Clusters — *2015*
Baltimore, MD

IAU Meeting — **Talk**
Modeling Black Hole Dynamics within Globular Clusters — *2014*
Beijing, China

AAS Head Meeting — **Poster**
Simulating Black Holes in Star Clusters: A Hybrid N-body/Monte Carlo Approach — *2014*
Chicago, IL

LIGO Scientific Collaboration Meeting — **Talk**
Basic Parameter Estimation of Binary Neutron Star Systems — *2013*
Bethesda, MD

Midwest Relativity Meeting — **Talk**
Inadequacies of the Fisher Information Matrix in gravitational-wave parameter estimation — *2012*
Chicago, IL

Gravitational-Wave Physics and Astronomy Workshop — **Poster**
Usefulness of the Fisher Matrix in the advanced-detector era — *2012*
Hannover, Germany
- 3rd place award for best poster

Gravitational-Wave Burst Workshop — **Talk**
Usefulness of the Fisher Matrix in the Advanced-Detector Era — *2012*
Tobermory, Scotland

Midwest Relativity Meeting — **Talk**
Detecting off-Kerr Perturbations with IMRIs in the Advanced LIGO Era — *2011*
Urbana, IL

Gravitational-Wave Physics and Astronomy Workshop — **Talk**
Testing the No-Hair Theorem with IMRIs in Advanced LIGO — *2011*
Milwaukee, WI

Public Lectures

MIT Independent Activities Period — **Public Talk**
The era of Gravitational-wave Astronomy; Cambridge, MA — *2017*

Compton Lecture Series — **Guest Seminar**
Dense Star Clusters as Binary Black Hole Factories **(Link)** — *2016*
Chicago, IL

TEDxNorthwesternU — **TEDx Talk**
Listening to Einstein's Final Symphony **(Link)** — *2016*
Evanston, IL

Conversations with an Astronomer — **Lecture Series**
Series of Public Lectures at Adler Planetarium — *2011–2016*
Chicago, IL

Film Submission: Jackson Hole Science Media Festival — **Short Film**
Black Holes and Globular Clusters **(Link)** — *2014*

Perseid Meteor Shower — **Public Talk**
Illinois Science Council in coordination with Chicago Parks Department — *2013*
Chicago, IL

Public Lecture at North Central Purdue University — **Public talk**
Catching Gravitational Waves with LIGO — *2011*
Westville, IN

Teaching/Education Activities

General Relativity — **Lecture/TA**
Guest Lecturer and TA; Northwestern University, Evanston, IL — *2015*

GK12 Fellowship — **Teaching**
Reach for the Stars; Highland Park, IL — *2013–2014*
Co-taught weekly in math department of Highland Park High School
Developed mathematics lessons, visualizations, and applets for high-school students **(Link)**

Mentoring Telescope Interns — **Mentoring**
Teaching High School Summer Interns at Adler Planetarium; Chicago, IL — *2013*

Einstein and the 20th Century — **Lecture/TA**
Guest Lecturer and TA; Northwestern University, Evanston, IL — *2013*

Science Club Mentor — **Mentoring**
Weekly after-school science program at Boys and Girls Club; Chicago, IL — *2012–2013*

Visualization Creation — **Visualizations**
Produced for Adler Planetarium Space Visualization Lab and; Chicago, IL — *2011-2016*
- Black Hole Dynamics in Core of Globular Cluster N-Body Simulation **(Link)**
- Binary Black Holes Emitting Gravitational Waves **(Link)**

Student Mentored and Co-Mentored

Caitlin Fischer — **Undergraduate**
Spinning Black Hole Triples; MIT Undergraduate Research Opportunities Program — *2017-Present*
Primary Mentor

Michael Zevin — **Grad Student**
Binary-Binary Scatterings in Globular Clusters; KSPI Summer Program — *2017*
Co-mentored

Joshua Fuhrman — **Undergraduate**
Merging Binary Black Holes in Open Clusters; Northwestern REU — *2016*
Co-mentored

Service Work

Peer Reviewer for: — *2015-Present*
- - Physical Review Letters
- Physical Review D
- Astrophysical Journal Letters
- Astrophysical Journal
- Monthly Notices of the Royal Astronomical Society

IAP Co-Organizer — **Organizer**
MIT Independent Activities Period; Cambridge, MA — *2017*

Co-Organizer — **Organizer**
Astronomy On Tap – Boston; Cambridge, MA — *2016-Present*