Marc Favata

Contact Info

Department of Physics & Astronomy
Montclair State University
1 Normal Avenue
Montclair, NJ 07043
montclair.edu/physics-astronomy

marc.favata@montclair.edu
montclair.edu/~favatam
office phone: (973)-655-4406

Education

Ph.D., Astrophysics, August 2006
M.S., Astrophysics, May 2004
Cornell University, Ithaca, NY
Advisors: Éanna Flanagan & Scott Hughes

B.S., Physics, with honors, June 2000
California Institute of Technology, Pasadena, CA
Research Advisor: Kip S. Thorne

Profile Summary

My primary research interests involve the detection of gravitational waves and how those detections allow us to observe the universe in new and unique ways. I work in a range of areas related to general relativity and the physics of black holes and neutron stars, especially in the context of the gravitational two-body problem.

I am a member of the LIGO Scientific Collaboration (LSC) and founding PI of the Montclair State LSC group (consisting of three faculty members plus students). I developed improved waveform models and parameterization schemes for gravitational wave detection, quantified issues related to measurement error and bias, and performed early investigations into novel effects in general relativity that helped initiate further investigations by others (black hole kicks, gravitomagnetic tidal couplings, binary eccentricity, memory effects, kick Doppler shifts). I am active in communicating the excitement of LIGO science to the physics community and general public, including via management of ligo.org and the development of soundsofspacetime.org.

As department chair I strive to create a supportive environment that fosters faculty and student success. I teach a range of courses using active-learning methods and other teaching best-practices. I have extensive experience in curriculum development and service in multiple areas of the university.

Primary Academic Positions

- Department Chairperson, Dept. of Physics & Astronomy, Montclair State University, 07/2019 - present
- Professor of Physics, Dept. of Physics & Astronomy, Montclair State University, 09/2022 - present;
- Associate Professor of Physics, Dept. of Physics & Astronomy, Montclair State University, 09/2017 - present (Dept. of Mathematical Sciences prior to July 2018)
- Assistant Professor of Physics, Dept. of Mathematical Sciences, Montclair State University, 09/2012 - 08/2017
- Postdoctoral Research Associate, LIGO Group, Center for Gravitation & Cosmology, Univ. of Wisconsin, Milwaukee, 09/2011 - 08/2012
- NASA Postdoctoral Fellow, Jet Propulsion Laboratory, Caltech, 08/2009 - 09/2011
- Postdoctoral Fellow, Kavli Institute for Theoretical Physics, UCSB, 09/2006 - 08/2009

Visiting/Temporary Positions

- Simons Fellow in Theoretical Physics, August 2018 - August 2019
- Visiting Scientist, Max Planck Institute for Gravitational Physics, Potsdam, Germany, 04/2019 - 07/2019
- Visiting Associate in Theoretical Physics, Caltech, 01/2019 - 04/2019
- KITP Scholar, Kavli Institute for Theoretical Physics, UCSB, 2014 - 2017
- Visiting Scientist, Theoretical Astrophysics Group, Caltech, 2009 - 2016
- Graduate Fellow, Kavli Institute for Theoretical Physics, UCSB, 09/2002 - 12/2002

KEY RESEARCH ACCOMPLISHMENTS (See end of CV for a full publication list.)

- Performed the first calculation of the gravitational-wave memory effect for the merger of two black holes and resulting sensitivity estimates for ground and space-based detectors. Explored various aspects of the linear and nonlinear memory effects, exposing subject to wider investigation by the gravity community.
- Prior to the numerical relativity era, computed first estimate of the black hole recoil (kick) velocities from binary black hole mergers; involved in the first study of the astrophysical implications of those black hole kicks. Studied retention of black holes by star clusters and effects of kicks on black hole formation via hierarchical mergers.
- First to consider the imprint of black hole merger kicks on gravitational-wave signals (via Doppler shift and memory) and estimate their magnitudes. Proposed a means to use black hole kicks to test GR.
- Developed the $(\Lambda, \delta\Lambda)$ parameterization used to quantify the imprint of neutron star tidal deformability on a gravitational-wave signal. This parameterization is widely used by the LSC and the gravitational-physics community.
- Developed a fast and simple-to-use waveform template to search for and measure gravitational-waves from compact binaries with small eccentricity (`TaylorF2Ecc`). Estimated constraints LIGO could place on orbital eccentricity. This waveform template has been adopted in studies by several other groups.
- Performed one of the earliest studies to investigate the impact of systematic (as opposed to statistical) errors on gravitational wave measurements. Applied techniques to consider bias on tests of general relativity.
- Applied formalism of gravitomagnetism to neutron star tidal effects; developed concept of gravitomagnetic Love number to characterize tidally induced matter currents.
- Performed detailed studies of the last stable orbit around black holes, including comparison of multiple analytic formalisms that predict non-dissipative corrections to this orbit beyond the test-particle limit.
- Founding PI of the Montclair State LIGO research group; developed group to include three faculty members and multiple undergraduate and graduate students.
- Over $\$640,000$ in external research grants, including NSF CAREER and Simons Foundation grants. Offered a Fulbright fellowship (declined).
- Co-author on all LIGO discovery papers and co-recipient of prizes shared by all collaboration members.
- Published in field's highest impact journals, including Physical Review Letters, Physical Review D, and Astrohysical Journal Letters. Multiple high-citation articles ($>$ 100k citations in total), including $>$ 20 papers with $>$ 1000 citations & $>$ 100 papers with $>$ 100 citations (Google Scholar). Multiple high-citation short-author papers, with $\sim$ 7 having $>$ 100 citations. h-index of $\sim$ 105 ($\sim$ 18 short-author). Listed on world's top 2% of scientists list by Stanford University.
- Research or commentary featured in multiple media outlets. Authored articles in the popular media.
- Active speaker, presenting $>$ 100 technical or outreach talks, with $>$ 30 invited talks.
- Developed popular website on the sonification of gravitational-wave signals with involvement of Montclair State students (`soundsofspacetime.org`).
- Leadership role in LIGO's Education and Public Outreach group. Primary content manager for `ligo.org`; responsible for communicating LSC discoveries on that site. Led development of new WordPress LSC site.

Key Service Accomplishments

- First elected chairperson of Physics & Astronomy department at Montclair State University. (Physics program was previously housed in Mathematical Sciences department.) Key successes include growing department's reputation, creating conditions for faculty to achieve success in research and teaching, curriculum modernization, developing new concentrations and degree programs, and improving student retention, enrollment, and graduation rates.
- Author of foundational department documents (strategic plan, bylaws, website, personnel action process, budgets, recruiting fliers, ...). Actively documented and shared with faculty all internal processes and policies to foster transparency, efficient operation, and future leadership transitions. Authored self-study report and organized first external department review.
- Led faculty search committees and successfully recruited three research-active faculty to build department of 5 full-time faculty.
- Served on numerous department-level committees, including personnel action, budget, and scholarship committees. Regularly organize department seminars and recruiting efforts. Responsible for department budget and staff hiring. Served as Physics Club mentor or co-mentor.
- Led department efforts to plan major renovation of lab and teaching spaces, as well as physics spaces in new science building. Co-led effort to develop new department machine shop. Frequent troubleshooting of all manner of building facility issues.
- Service on multiple University or College-level committees, including committees on General Education reform, curriculum process revisions, development of a General Science degree, curriculum review, internal research grants, and university effectiveness.
- Regularly engage with all levels of university leadership to promote the best interests of department faculty and students.
- Initiated MSU's involvement in the NJ Space Grant Consortium and the Physics Teacher Education Coalition (PhysTEC), providing access to new funding sources.
- Grew revenue by increasing course offerings in summer/winter sessions; initiated regular online course offerings.
- Reviewer for numerous research articles and grant applications. Reviewed multiple books for major academic publishers. Served on NSF panel review, external thesis committee, and two external tenure review committees.
- Occasional scientific consultant for the TV/movie/video game industry.

Key Teaching Accomplishments

- Taught $\sim$ 9 regular courses at all levels. Developed three fully online (primarily asynchronous) courses.
- Utilize multiple best-practices approaches in teaching, including: introduced clickers to promote active learning, frequent low-stakes assessments, modeling proper problem-solving techniques, in-class group problem solving (in both introductory and junior/senior level courses), exam and homework honor statements (to reduce cheating), customized student evaluations for each course, and detailed visual syllabi. Nearly all homework and exam problems are custom made, designed with multipart questions that lead students toward the correct solution and connect with popular culture or interesting applications.
- Led complete revision of physics curriculum. Developed 7 new courses. Switched curriculum to alternating-year course cycle (maximizing enrollment); added emphasis on laboratory instruction. Developed two seminar courses to teach "soft skills," including college and post-college preparation. Implemented changes to nearly all courses in the physics department catalog.
- Developed five combined bachelors + masters 5-year dual-degree programs, spanning multiple departments, college divisions, and universities.

- Significant efforts to promote student retention, including a summer orientation program, introduction of recitation sections and supplemental instructors for intro physics classes, and development of new math & computing prep course.
- Act as advisor to all students in physics program, regularly reviewing all student course schedules. Active student advising has helped lead to multiple years with the highest graduation rates in the history of the MSU physics program and among the best 4-year graduation rates at the university.
- Assisted department faculty with transition to online teaching. Organized meetings and developed documents to review strategies and collect new teaching tools; organized outdoor lectures/labs and developed ideas for at-home labs and lab kits.
- Perform regular teaching observation and mentoring of faculty and adjuncts. Actively work to recruit and retain high-performing teaching staff; provide regular feedback and discussions on teaching strategies. Development of program learning goals and assessment instruments.
- Research mentor for multiple undergraduates and three Montclair State masters degree students. Six students have pursued PhDs in physics or related fields.

Research Grants

- Approximately $\$642,000$ in awarded grant funds as PI, 2012-2024.
- PI, Simons Fellow in Theoretical Physics, *Gravitational-wave science for 3rd generation detectors*, Simons Foundation #554674, 1 August 2018 - 31 July 2019, $\$108,000$.
- Fulbright Global Scholar Award, 2018 (declined offer to accept Simons Fellowship).
- PI, NSF CAREER Award, *CAREER: Research and Education in Gravitational-Wave Science*, NSF PHY-1653374, $\$400,000$; 2016-2025
- PI, NSF RUI Award, *RUI: Issues in modeling gravitational-wave sources*, NSF PHY-1308527, FY2013-2017, $126,000.
- KITP Scholar Award; funds three visits to the Kavli Institute for Theoretical Physics, 2014-2017 ($\sim$ $8000).

Other Awards, Honors, or Fellowships

- 2016 Special Breakthrough Prize in Fundamental Physics (shared with 1015 scientists and engineers contributing to the detection of gravitational waves).
- 2016 Gruber Cosmology Prize, (recognizing Ronald Drever, Kip Thorne, Rai Weiss, and the entire LIGO discovery team).
- 2017 Group Achievement Award of the Royal Astronomical Society (recognizing the entire LIGO Team).
- 2017 Princess of Asturias Award for Technical & Scientific Research (to Rai Weiss, Kip Thorne, Barry Barish and the LIGO Scientific Collaboration)
- NASA Postdoctoral Fellowship, 2009-2011.
- Kavli Institute for Theoretical Physics (KITP) Postdoctoral Fellow.
- KITP program participant, Physics of Galactic Nuclei, 2006.
- NASA Space Grant Fellow, 2002, 2004-2005.
- KITP Graduate Fellow, Fall 2002.
- Cornell Sage Fellow, 2000-2001.
- Multiple travel grants to attend APS and international conferences, 2000-2012.
- Sons of Italy *National Education & Leadership Award*, 2000.
- Perpall Speaking Award finalist, Caltech SURF program, 1999.
- Caltech SURF Program, 1997 & 1999.

Teaching Experience Montclair State

PHYS 191 & 192 – University Physics I & II: calculus-based introductory physics course sequence. [Fall 2012–2017 (191); spring 2013, 2015 – 2018 (192).]

PHYS 180/280 – Astronomy for Everyone/Physicists: introductory astronomy course with lab, at the level of *Universe* by Geller, Freedman, & Kaufmann. (Fall 2013, 2015; spring 2020, 2022; winter 2021, 2022, 2023; summer 2021, 2022, 2023.) Developed as a fully online (primarily asynchronous) course during summer/winter sessions. Course revised and added as a general education course (PHYS 180) in fall 2021.

PHYS 198 – New Physics Student Seminar: Newly created seminar course for freshmen. Reviews skills for success in college and the physics major. Texts include *Revolutions in 20th Century Physics* by Griffiths, *Mathematics for Physics with Calculus* by Biman Das, and *The Elements of Style* by Strunk & White. (spring 2020, 2022; fall 2021.)

PHYS 190–Introductory Math & Computing for Physical Sciences and Engineering: preparatory course for new physics majors to address math skills deficit. Covers precalculus, vectors, estimation, and selected topics in calculus and computing to prepare for calculus-based intro physics. (spring 2024.)

PHYS 210–Intermediate Mechanics: mechanics at the level of *Classical Mechanics* by Taylor. (Fall 2020, 2022, 2024) Developed as an online (partly asynch) course for fall 2021.

PHYS 300 – Junior/Senior Seminar: Newly created seminar course for juniors/seniors. Focuses on post-college success, guest speakers, and advanced topics; (spring 2020, fall 2022.)

PHYS 461/MATH 461/MATH 562–Special and General Relativity: introduction to relativity at the level of *Gravity* by Hartle. Co-seated with graduate MATH course. Taught spring 2014; fall 2016, 2019, 2021, 2023.

PHYS 480–Astrophysics: stellar astrophysics at the level of *Modern Astrophysics* by Carroll & Ostlie; (fall 2014, 2017, spring 2021/online, 2023).

PHYS 495 & MATH 497 – Independent Study Course: supervised multiple undergraduate students on research projects in general relativity, gravitational waves, & astrophysics; also an independent study course for quantum mechanics or relativity. (Multiple semesters since 2015.)

MATH 690 – Grad. Indep. Study & MATH 698 – Master's Thesis: supervised research for 3 master's degree students (AY 2014-2015, 2017-2018, & 2021-2022 AY),

Other Teaching Experience

Ph 79: Senior Thesis, Theoretical (Caltech): Senior thesis advisor for undergraduate Gary Binder. Project involved spin-effects and gravitational waves from inspiraling binaries (2010–2011 AY).

Ph 171: Reading and Independent Study Course (Caltech): Organized readings and homework problems related to gravitational waves & post-Newtonian theory; discussed with student in weekly meetings (spring 2010).

Guest Lecture on fluid mechanics in rotating frames, for Lars Bildsten's USCB course *Phys 120: The Physics of California: Waves, Weather, Quakes & Fires* (spring 2008).

Head Teaching Assistant for Cornell's *Astro 102: Our Solar System*: Led 2 or 3 recitation section lectures per week; developed and graded problem sets, held office hours, maintained course webpage, & organized TA meetings and responsibilities for one of Cornell's largest courses (spring 2003, 2004, & 2006).

Head Teaching Assistant for Cornell's *Astro 101: The Nature of the Universe*: same responsibilities as Astro 102 above (fall 2003 & 2005).

Teaching Assistant for Caltech's *Astronomy 1: The Evolving Universe*. Led section lectures on introductory general relativity and evaluated student term papers (spring 2000).

Research Students

Graduate students:

Master's thesis advisor for Michael Giarratana, Montclair State (2024-2026)

Advisor for Kevin Johansmeyer, Montclair State; gravitational wave sonification web app development (2021-2023).

Master's thesis advisor for Matthew Karlson, Montclair State; *Gravitational-wave memory from black hole and neutron star mergers*, May 2018. Currently PhD student in Applied Math at Pittsburgh U.

Master's thesis advisor for Goran Dojcinoski, Montclair State; *Nonlinear gravitational-wave memory from merging binary black holes*, May 2015. Currently adjunct at Bergen Community College.

Undergraduate Students/Montclair:

Michael Giarratana, 2022-2023. Project on developing waveform for inspiralling test particles into Kerr black holes; sonification of waveform data. Second project on computing final mass/spin in eccentric black hole mergers.

Lita de la Cruz, 2015–2018. Project on supernova memory waveforms. Princeton University Bridge Program; currently PhD student in astrophysics at Rutgers.

Kevin Chen, 2016 - 2018. Project on nonlinear memory waveform comparisons; modeling sounds from stochastic backgrounds. Winner of outstanding graduating physics major award. Currently working in industry.

Nicholas Provost, 2017 - 2018, CS student/indep. study. Developed iOS/Android app on Sounds of Spacetime. Currently employed in industry (programming/web development).

Blake Moore, 2013–2016. Project on eccentric waveforms. Winner of Dalton Astronomy Fellowship and Outstanding Graduating Senior Research Award. PhD in gravitational physics from Montana State University. Currently senior systems engineer at Raytheon.

Nicholas Drywa, 2014–2015. Project on gravitational lensing; modeling Schwarzschild geodesics. MS Physics Stevens Institute of Technology. Currently high school teacher (River Dell, NJ) and adjunct at Montclair State.

Undergraduate Students/Caltech:

Xinyi Guo, SURF student from Pomona College. Project regarding spin effects and nonlinear memory in merging black hole binaries; Summer 2011. PhD from Harvard/CfA. Currently at D.E. Shaw.

Gary Binder, SURF student from Caltech. Project on spin-effects in extreme mass ratio inspirals; Summer 2010. PhD UC Berkeley in neutrino physics. Currently researcher at Lawrence Berkeley National.

Professional Service

- Referee for *Astrophys. J. Lett.*, *Phys. Rev. Lett.*, *Phys. Rev. D*, *Mon. Not. Royal Astron. Soc.*, *Intern. J. Mod. Phy. A*.

- Regular proposal reviewer for National Science Foundation's Gravitational Physics Division; also panel reviewer.
- Proposal reviewer for NASA, 2022.
- Proposal reviewer for Oak Ridge Associated Universities
- Book reviewer for Cambridge University Press and CRC Press.
- Consultant for the Science & Entertainment Exchange; consulted on TV shows (Syfy Channel & MTV), film projects, & video games (Cloud Imperium Games).
- External member of PhD thesis committee for Dr. Shilpa Kastha, Institute for Mathematical Sciences, Chennai
- External reviewer for three tenure applications.
- Physics lab requirements consultant, Caldwell College
- Contributor to the *LISA Science Requirements Document*, v5.x, 2010.
- LIGO Service
  - Montclair State group founder & PI (2013-)
  - LSC Council (2013-2019)
  - Web Committee (chair, 2016-)
  - Education & Public Outreach (EPO) Committee (2016 -)

Departmental Service

- Department Chairperson, Physics & Astronomy (2019 - 2025)
- Physics faculty search committee (chair, 2018-2020)
- Physics Department Personnel Action Committee (2018 - 2019)
- Program associate/other staff search committees (2022, 2023-2024)
- Physics Club, faculty mentor or co-mentor (2019 -)
- North Jersey Astronomical Group, faculty advisor (2012 -)
- Dalton Astronomy Scholarship Committee (chair, 2016-)
- Department Scholarship Committee
- Department website manager
- Department seminar organizer
- Author of department bylaws and strategic plan
- Committees while in Mathematical Sciences Department:
  - Physics group chair (under Math Dept., 2016-2018)
  - Math Department Budget Committee (2017 - 2018)
  - Math Department Personnel Action Committee (2017 - 2018)
  - Math Department Website Committee (chair, 2012-2018)
  - Math Department Social Media Committee (2014-2016)
  - Math Department Faculty Search Committee (2015-2016; chair 2016-2017)
  - Math Department Scholarship Committee (2015- 2017)
  - Math Department "Space" & Renovation Committee (2015-2018)

University/College Service

- Blue Ribbon Task Force on General Education Reform (2019-2020); primary author of scientific reasoning rubric (2024).
- Committee on University Effectiveness (2021)
- University Curriculum Process committee (2022)
- University Academic Appeals Committee (alternate; 2015 - 2017)
- NJ Space Grant Consortium, MSU Affiliate representative and initiated MSU membership (2019 -)
- PhysTEC (Physics Teacher Education Coalition); MSU representative and initiated MSU membership
- College Curriculum Committee (2020 - 2023)
- College General Science Degree development committee (2021 - 2022)
- College Research Committee (2015 - 2018)
- College Facilities Committee (2015 - 2018, 2019 -)
- CSAM Chairs' Council (2019 - 2025)

Memberships

- LIGO Scientific Collaboration (LSC) member.
- American Physical Society, life member.
- Einstein Telescope Collaboration member.
- Anacapa Society (theoretical physics at undergrad institutions), member.
- Caltech Athenaeum faculty club, member.
- Caltech Alumni Association, member

Conferences Organized

2023 Annual Spring Meeting of the North Jersey Space Grant Consortium, Montclair State (04/28/2023)

10^{th} Theoretical Astrophysics in Southern California (TASC) Meeting, Caltech, co-organized with Christian Ott and Chris Hirata, (10/29/2010).

2^{nd} Santa Barbara Astrophysics Meeting, KITP, co-organized with Lars Bildsten, Marusa Bradac, and Marton Hidas (05/02/2008).

1^{st} Santa Barbara Astrophysics Meeting, KITP, co-organized with Lars Bildsten, Nairn Baliber, and Phil Marshall (05/04/2007).

6^{th} Theoretical Astrophysics in Southern California (TASC) Meeting, KITP, co-organized with Lars Bildsten and Eric Pfahl (October 20, 2006).

Public Lectures & Outreach (*=invited)

1. Solar eclipse outreach event at the Paterson Museum, March 2024*
2. "Science and *Linoleum*: Building a rocket in your garage," talk for screening of the movie *Linoleum* with Montclair Film, March 2023*
3. "Cosmic Clues from Gravitational Waves" Space Talk series at the Liberty Science Center planetarium, March 2023*
4. "Observing the Universe with Gravitational Waves" Science Fiction Association of Bergen County, May 2022*
5. "Observing the Universe with Gravitational Waves" Weston Science Scholars Program, Montclair State, July 2021
6. "Observing the Universe with Gravitational Waves" Dunworkin Club, Montclair, May 2021*

7. "The Scientific Legacy of Apollo," first lecture in MSU's *Journey to the Moon* series, September 2019*
8. "Listening to the Universe: detecting ripples in spacetime," Keynote lecture at River Dell HS STEM Symposium , May 2018*
9. "Listening to the Universe: detecting ripples in spacetime," Dunworkin Club, Montclair, February 2018*
10. "The first detection of gravitational waves by LIGO," lecture & exhibit booth, CSAM Discovery Day, April 2016
11. "The first detection of gravitational waves by LIGO," Brookdale Community College, April 2016*
12. "The first detection of gravitational waves by LIGO," MSU Physics Club, April 2016
13. "The first detection of gravitational waves by LIGO," North Jersey Astronomical Group, April 2016
14. "The first detection of gravitational waves by LIGO," Provost's Cross Disciplinary Discourse Lunchtime Series, April 2016*
15. Assisted with LIGO outreach exhibit at the World Science Festival, New York City (May 2015, June 2016)
16. Organized LIGO outreach exhibit at the North East Astronomy Forum (NEAF), Rockland Community College (April 2015, 2016)
17. "An update on LIGO and the search for gravitational waves," North Jersey Astronomical Group, (November 2013).
18. "The search for black holes & gravitational waves," Rockland Astronomy Club, (October 2013)*
19. "The search for black holes & gravitational waves," Amateur Astronomers, Inc., Union Co. College, NJ (October 2013)*
20. Lecture on the Solar System to Bradford School 1st grade class, Montclair, (March 2013)*
21. "The search for black holes & gravitational waves," Rockland Astronomy Club annual dinner, (February 2013)*
22. "Gravitational wave astronomy" to North Jersey Astronomical Group, Montclair, (October 2012)
23. "Gravitational wave astronomy" to visiting Univ. of Leiden physics students, KITP, (May 2008)
24. "Black holes and gravitational waves," Dos Pueblos High School, Santa Barbara, (May 2007)
25. "Black holes and gravitational waves," Rio Mesa High School, Oxnard (January 2007)
26. "Black holes and gravitational waves," Santa Barbara Museum of Natural History, (November 2006)*
27. "Relativity: an introduction to space, time, and gravity," 4-H Focus for Teens Program, Cornell, (June 2002).

Conference Talks, Seminars, & Colloquia (*=invited)

1. NASA Space Grant Mid-Atlantic Regional Meeting, Atlantic City, August 2024
2. PAX (Physics and Astronomy at the eXtreme) IX, London, panelist, July 2024
3. 15th LISA Symposium, poster presentation, Dublin, July 2024
4. Department seminar, Physics Department, New York Institute of Technology, September 2023*
5. "Gravitational waves: a tool for astrophysical discovery," talk to College faculty, Montclair State, October 2022*
6. Workshop talk, Holography and Gravitational Waves, Institute for Fundamental Physics of the Universe, Trieste, Italy, July 2022*
7. Department seminar, Physics Department, Stevens Institute of Technology, April 2022*
8. Department seminar/SIAM club talk, Montclair State, September 2021*
9. LIGO-Virgo-KAGRA Meeting, short talk in EPO session (virtual), September 2021
10. LIGO R&D telecon seminar on research results, August 2021
11. Attended APS Department Chairs conference (virtual), June 2021
12. Attended APS Department Chairs conference (virtual), June 2020
13. Attended PICUP (Partnership for Integration of Computation into Undergraduate Physics) summer conference, July 2020
14. Extreme Gravity session chair/talk, Physics & Astronomy at the Extreme (PAX), Cascina/Virgo, May 2019*
15. Astronomy Colloquium, Seoul National University, September 2018*
16. Physics Colloquium, Ewha Womans University, September 2018*
17. April APS Meeting, Columbus, Ohio (April 2018)
18. Talk to MSU Physics Club on LIGO results (December 2017)
19. Astrophysics Seminar, Rutgers University, New Brunswick, NJ (November 2017)*
20. 12^{th} Amaldi Conference on Gravitational Waves, Pasadena, CA (July 2017)*
21. LIGO-Virgo Collaboration meeting (March 2017)
22. Strong Gravity and Binary Dynamics with Gravitational Wave Observations, Ole Miss, MS (February 2017)*
23. "April" APS Meeting, Washington DC (January 2017)
24. 21st International Conference on General Relativity and Gravitation, Columbia Univ., NY (July 2016)
25. Gravitational-Wave Physics and Astronomy Workshop, Hyannis, MA (June 2016)
26. April APS Meeting, Salt Lake City, UT (April 2016)
27. LIGO-Virgo Collaboration Meeting, Pasadena, CA (March 2016)
28. 11^{th} Amaldi Conference on Gravitational Waves, Gwangju, S. Korea (June 2015)
29. Meeting of the American Astronomical Society's Division on Dynamical Astronomy, Caltech (May 2015)*
30. April APS Meeting, Baltimore, MD (April 2015)
31. LIGO-Virgo Collaboration Meeting, Stanford, poster (August 2014)
32. Numerical & Analytical Relativity & Data Analysis (NARDA), Cal State, Fullerton (August 2014)*
33. Frontiers of Neutron Star Astrophysics, Cornell (May 2014)
34. April APS Meeting, Savannah, GA (April 2014)
35. Seminar, International Centre for Theoretical Sciences, Bangalore (July 2013)*
36. Colloquium, International Centre for Theoretical Sciences, Bangalore (July 2013)*

37. Astronomy Dept. Colloquium, Seoul National University (June 2013)*
38. April APS Meeting, Denver, CO (April 2013)
39. LIGO-Virgo Collaboration Meeting, new group presentation (March 2013)
40. Rattle and Shine: Gravitational Wave and Electromagnetic Studies of Compact Binary Mergers, KITP, poster (August 2012)
41. Gravitational Wave Bursts Workshop, Tobermory, Scotland (May 2012)
42. MIT Lincoln Laboratory, group seminar (March 2012)*
43. Mathematical Sciences Dept., Montclair State U. (March 2012)*
44. Physics Dept., Cal State Fullerton (January 2012)*
45. Center for Gravitation & Cosmology Seminar, UW–Milwaukee (November 2011)*
46. 21st Midwest Relativity Metting, Univ. of Illinois (November 2011)
47. Astrophysics Luncheon Seminar, JPL (June 2011)
48. April APS Meeting, Anaheim, CA (April 2011)
49. 27th Pacific Coast Gravity Meeting, Caltech (March 2011)
50. Applied mathematics colloquium, Northwestern Univ. (November 2010)*
51. The Inns and Outs of Black Holes, Annapolis (November 2010)
52. 10th Theoretical Astrophysics in S. California Meeting, Caltech (October 2010)
53. JPL Postdoc Research Day, poster, JPL (August 2010)
54. 8th International LISA Symposium, SLAC/Stanford (June 2010)
55. Theory Meets Data Analysis (Capra/NRDA), Perimeter Institute (June 2010)
56. 26th Pacific Coast Gravity Meeting, UC San Diego (March 2010)
57. 8th Amaldi Conference on Gravitational Waves, Columbia Univ. (June 2009)
58. 12th Eastern Gravity Meeting, RIT (June 2009)
59. CITA Seminar, Univ. of Toronto (June 2009)*
60. UCSB Astrophysics Lunch Seminar (April 2009)
61. Physics Department Seminar, Univ. of Mississippi (March 2009)*
62. 24th Texas Symposium on Relativistic Astrophysics, Vancouver (December 2008)
63. Theoretical Astrophysics and Relativity seminar, Caltech (December 2008)*
64. 8th Theoretical Astrophysics in S. California Meeting, UC Irvine (November 2008)
65. 7th International LISA Symposium, Barcelona (June 2008)
66. 2nd Santa Barbara Astrophysics Meeting, KITP (May 2008)
67. 24th Pacific Coast Gravity Meeting, UCSB (March 2008)
68. 7th Theoretical Astrophysics in S. California Meeting, UCLA (Nov 2007)
69. UCSB Astrophysics Lunch Seminar (October 2007)
70. 18th International Conference on Gen. Relativity & Gravitation, Sydney (July 2007)
71. 1st Santa Barbara Astrophysics Meeting, KITP (May 2007)
72. 23rd Pacific Coast Gravity Meeting, Caltech (March 2007)
73. UCSB Gravity Lunch Seminar (November 2006)*
74. KITP Program: Physics of Galactic Nuclei, Discussion Talk (July 2006)*
75. Meeting of the American Physical Society, Dallas (April 2006), Session Chair
76. 9th East Coast Gravity Meeting, MIT (March 2006)
77. Center for Gravitational Wave Physics Seminar, Penn State (February 2006)*
78. Meeting of the American Physical Society, Tampa (April 2005)
79. 17th International Conference on Gen. Relativity & Gravitation, Dublin (July 2004)

80. Meeting of the American Physical Society, Denver (May 2004)
81. 20th Pacific Coast Gravity Meeting, Caltech (March 2004)
82. Gravitation: A Decennial Perspective, Penn State (June 2003)
83. Astrophysics of Gravitational Wave Sources, poster, Univ. of Maryland (April 2003)
84. Meeting of the American Physical Society, Philadelphia, (April 2003)
85. 2nd Theoretical Astrophysics in Southern California Meeting, UCSB (October 2002)
86. Meeting of the American Physical Society, Albuquerque (April 2002)
87. 3rd Capra Ranch Meeting on Radiation Reaction, Caltech (June 2000)
88. 14th National Conference on Undergraduate Research, Univ. of Montana (April 2000)
89. 16th Pacific Coast Gravity Meeting, Caltech (March 2000)
90. SURF Seminar Day, Caltech (October 1999)
91. SURF Seminar Day, Caltech (October 1997)

Media Coverage (links in pdf)

1. Listening for Cosmic Clues, MSU news release, March 2023.
2. Research featured in AAS Nova (research highlights from the American Astronomical Society): How Often Do Black Holes Get Kicked Out of Star Clusters?, by Kerry Hensley, November 2021
3. Research featured in The Hindu, the second highest circulation English-language Indian newspaper: Mergers of black holes and 'kicks' that hold a key to puzzles, by Shubashree Desikan, October 2021.
4. Scientists Observe Collisions of Neutron Stars with Black Holes, MSU news release, June 2021.
5. Experts Weight in on Current Job Market Trends, Zippia.com, November 2020.
6. What Happens When Black Holes Collide?, by David Eicher, Astronomy Magazine, July 2019.
7. Montclair State Faculty Member Marc Favata Earns Prestigious Simons Fellowship, MSU new release, March 2018; also on Patch.com
8. Shooting for the Stars, Crusader Magazine (Bergen Catholic H. S.), Winter 2018 issue.
9. Montclair State physicists part of team that detected distant stars colliding, by J. M. O'Neill, Bergen Record, Montclair Times, NorthJersey.com, other local papers; October 2017.
10. Neutron Star Collision, video interview for Jersey Matters, October 2017.
11. NJ scientists among team that discovered star collision, News12 NJ interview, Oct. 2017.
12. Groundbreaking Discovery by LIGO/Virgo Solves Cosmic Mystery, MSU news release, October 2017.
13. Solving Cosmic Mysteries by Amy Wagner, Montclair Magazine, Fall 2017.
14. Neutron Stars Collide, Forward Thinking (MSU research newsletter), Fall 2017.
15. Listening to the Universe, CSAM Insights (MSU research magazine), Fall 2017 Issue.
16. LIGO could detect gravitational waves' permanent space-time warp, quoted in New Scientist article, May 2017.
17. Gravitational Waves May Permanently Alter Spacetime, quote in NovaNext, October 2016.
18. Professor honored with NSF CAREER Award, Montclair Magazine, Spring 2017.
19. Tales from the Dark Side of the Universe, Forward Thinking, Spring 2017.
20. Montclair State Professor Earns Grant To Study Waves Of Universe, Daily Voice, Feb. 2017.

21. Professor Receives Prestigious NSF CAREER Award, MSU news release, January 2017.
22. Professor Assists in Proving Einstein's Theory Again, MSU news release, June 2016. See related story in *Innovation New Jersey*, August 2016.
23. A Window into the Cosmos: University scientists among team confirming Einstein's theory of relativity, Montclair Magazine, Spring 2016.
24. The Revealing Sounds of the Cosmos, Forward Thinking, Spring 2016.
25. Montclair State University astrophysicist member of group to detect ripple in gravity, Bergen Record, Montclair Times, NorthJersey.com; February 2016.
26. Scientists find gravitational waves, say Einstein was right, quote in The Press of Atlantic City, February 2016.
27. LISTEN: Black holes collide, MSU Professor Involved in Scientific Breakthrough, Patch.com, February 2016.
28. Listening to the Universe: Montclair State professor and students are coauthors on gravitational waves detetion paper, MSU news release, February 2016.
29. Listening to the Universe, Forward Thinking, Fall 2013.
30. When black holes collide, by Steve Nadis, research featured in cover story for Astronomy Magazine, May 2006.
31. New study shows how black holes get their kicks RIT press release, February 2004.
32. Caltech comes out on top, by Ben Wildavsky, interview and photo for cover story in US News and World Report College Rankings Issue, August 1999.
33. *A facility for physics, and just about everything else*, by David P. Biggy, interview for Scholar of the Week column, Bergen Record, 2-Jan-1996.

Undergraduate Research

Showed that tidal work in binary systems is invariant under change in how gravitational energy is localized. (Summer 1999, Caltech, advisor: Kip S. Thorne)

Processed scans of photographic plates from Digitized Palomar Observatory Sky Survey. Worked on search for high-redshift quasars. Participated in observing runs at the Palomar 200-inch and 60-inch telescopes. (Summer 1998, Caltech, advisor: S. George Djorgovski)

Studied correlations between accretion torque and flux changes in low-mass x-ray binaries. (Summer 1997, Caltech, advisor: Thomas Prince)

Computer Skills

Proficiency in Maple, Mathematica; LaTeX, HTML, CSS, WordPress, git; Windows, Mac, Linux OS; MS Office/Google Docs, Sheets.

Marc Favata

Publication Links & metrics

The links below provide multiple ways to view all published or submitted papers, along with various citation metrics. Although checked periodically, these publication listings are automatically curated, have differences, and may contain errors.

[Updated 12 Oct. 2024]

- Google Scholar, tinyurl.com/marc-favata
- NASA Astrophysics Data Service, tinyurl.com/y58nvm9n
- arXiv, tinyurl.com/y43klabk
- iNSPIRE, inspirehep.net/authors/1010291
- Semantic Scholar, semanticscholar.org/author/M.-Favata/118468635
- ORCHID iD: 0000-0001-8270-9512, orcid.org/0000-0001-8270-9512
- Web of Science ResearcherID: webofscience.com/wos/author/rid/AAA-6755-2022
- Scopus Identifier: 6701628208, scopus.com/authid/detail.uri?authorId=6701628208
- Google Scholar metrics: $>104\,000$ citations; h-index: 105.
  Excluding all large-author publications: >2030 citations; h-index: 17.

Refereed or submitted publications (non-LIGO)

1. S. A. Bhat, P. Saini, M. Favata, C. Gandevikar, C. K. Mishra, & K. G. Arun, *Parametrized tests of general relativity using eccentric compact binaries*, (submitted, 2024); arXiv:2408.14132 [gr-qc]
2. P. Mahapatra, D. Chattopadhyay, A. Gupta, F. Antonini, M. Favata, K. G. Arun, & B. S. Sathyaprakash, *Reconstructing the genealogy of LIGO-Virgo black holes*, Astrophys. J. 975, 117 (2024); arXiv:2406.06390 [astro-ph.HE]
3. P. Mahapatra, M. Favata, & K. G. Arun, *Testing general relativity via direct measurement of black hole kicks*, Phys. Rev. D 110, 084041 (2024); arXiv:2308.08319 [gr-qc]
4. P. Saini, S. A. Bhat, M. Favata, & K. G. Arun, *Eccentricity-induced systematic error on parametrized tests of general relativity: hierarchical Bayesian inference applied to a binary black hole population*, Phys. Rev. D 109, 084056 (2024); arXiv:2311.08033 [gr-qc]
5. P. Mahapatra, D. Chattopadhyay, A. Gupta, M. Favata, K. G. Arun, & B. S. Sathyaprakash, *Predictions of a simple parametric model of hierarchical black hole mergers*, (submitted); arXiv:2209.05766 [astro-ph.HE]
6. S. A. Bhat, P. Saini, M. Favata, & K. G. Arun, *Systematic bias on the inspiral-merger-ringdown consistency test due to neglect of orbital eccentricity*, Phys. Rev. D 107, 024009 (2023); arXiv:2207.13761 [gr-qc]
7. P. Saini, M. Favata, & K. G. Arun, *Systematic bias on parameterized tests of general relativity due to neglect of orbital eccentricity*, Phys. Rev. D 106, 084031 (2022); arXiv:2203.04634 [gr-qc]
8. M. Favata, C. L. Kim, K. G. Arun, J. C. Kim, & H. W. Lee, *Constraining the orbital eccentricity of inspiralling compact binary systems with Advanced LIGO*, Phys. Rev. D, 105, 023003 (2022); arXiv:2108.05861 [gr-qc]
9. P. Mahapatra, A. Gupta, M. Favata, K. G. Arun, & B. S. Sathyaprakash, *Remnant black hole kicks and implications for hierarchical mergers*, Astrophys. J. Lett.,918, L31 (2021); arXiv:2106.07179 [astro-ph.HE]
10. B. Moore, M. Favata, K. G. Arun, & C. K. Mishra, *Gravitational-wave phasing for low-eccentricity inspiralling compact binaries to 3PN order*, Phys. Rev. D, 93, 124061 (2016); arXiv:1605.00304 [gr-qc]
11. M. Favata, *Systematic parameter errors in inspiraling neutron star binaries*, Phys. Rev. Lett., 112, 101101 (2014); arXiv:1310.8288 [gr-qc]
12. N. Andersson et al., *The transient gravitational-wave sky*, Classical Quantum Gravity 30, 193002 (2013); arXiv:1305.0816

13. B. Sathyaprakash et al., *Scientific Objectives of Einstein Telescope*, Class. Quantum Grav. 29, 124013, (2012); arXiv:1206.0331
14. M. Favata, *The gravitational-wave memory for eccentric binaries*, Phys. Rev. D, 84, 124013 (2011); arXiv:1108.3121 [gr-qc]
15. M. Favata, *Conservative corrections to the innermost stable circular orbit (ISCO) of a Kerr black hole: a new gauge-invariant post-Newtonian ISCO condition, and the ISCO shift due to test-particle spin and the gravitational self-force*, Phys. Rev. D, 83, 024028 (2011); arXiv:1010.2553 [gr-qc]
16. M. Favata, *Conservative self-force correction to the innermost stable circular orbit: comparison with multiple post-Newtonian-based methods*, Phys. Rev. D, 83, 024027 (2011); arXiv:1008.4622 [gr-qc]
17. M. Favata *The gravitational-wave memory effect*, Class. Quantum Grav., 27, 084036 (2010); arXiv:1003.3486 [gr-qc]
18. M. Favata, *Nonlinear gravitational-wave memory from binary black hole mergers*, Astrophys. J. Letters, 696, L159, (2009); arXiv:0902.3660 [astro-ph.SR]
19. M. Favata, *Post-Newtonian corrections to the gravitational-wave memory for quasicircular, inspiralling compact binaries*, Phys. Rev. D 80, 024002, (2009); arXiv:0812.0069 [gr-qc]
20. M. Favata, *Gravitational-wave memory revisited: memory from the merger and recoil of binary black holes*, J. Phys. Conf. Ser. 154, 012043, (2009) arXiv:0811.3451 [astro-ph]
21. M. Favata, *Are neutron stars crushed? Gravitomagnetic tidal forces as a mechanism for binary-induced collapse*, Phys. Rev. D, 73, 104005, (2006); astro-ph/0510668
22. M. Favata, S. A. Hughes, & D. E. Holz, *How black holes get their kicks: gravitational radiation recoil revisited*, Astrophys. J. Letters, 607, L5, (2004); astro-ph/0402056
23. D. Merritt, M. Milosavljević, M. Favata, S. A. Hughes, & D. E. Holz, *Consequences of radiation recoil*, Astrophys. J. Letters, 607, L9, (2004); astro-ph/0402057
24. M. Favata, *Energy localization invariance of tidal work in general relativity*, Phys. Rev. D., 63, 064013, (2001); gr-qc/0008061

Conference proceedings & other

25. M. Abernathy et. al., *Einstein gravitational wave Telescope conceptual design study*, (2011)
26. P. Jaranowski et. al., *Summary of session B3: analytic approximations, perturbation methods and their applications*, in Proceedings of the GR18 Conference, Class. Quantum Grav., 25, 114020 (2007); arXiv:0710.5658
27. S. A. Hughes, M. Favata, & D. E. Holz, *How black holes get their kicks: radiation recoil in binary black hole mergers*, in "Growing Black Holes: Accretion in a Cosmological Context," Edited by A. Merloni, S. Nayakshin, & R. Sunyaev, pg. 333 (2005); astro-ph/0408492

Popular press

28. M. Favata, *What Happens When Black Holes Collide*, All About Space Magazine, Issue 116, pg. 75 (2021).
29. M. Favata, *A roar, a crash and a major scientific tool that was a piece of New Jersey's roots is gone*, The Star Ledger, opinion section guest-columnist, 04 Dec. 2020.

Thesis

30. M. Favata, *Kicking Black Holes, Crushing Neutron Stars, and the Validity of the Adiabatic Approximation for Extreme-Mass-Ratio Inspirals*, Ph.D. thesis, Cornell Univ. (Aug. 2006)

LIGO Collaboration papers

LSC publications on which I am a co-author. For an updated list, see Publications of the LIGO and Virgo Collaborations, https://pnp.ligo.org/ppcomm/Papers.html .

31. The LIGO-Virgo-KAGRA Collaboration, *Swift-BAT GUANO follow-up of gravitational-wave triggers in the third LIGO-Virgo-KAGRA observing run*, submitted to Astrophys. J (2024); arXiv:2407.12867; LIGO-P2300364
32. The LIGO-Virgo-KAGRA Collaboration, *Observation of Gravitational Waves from the Coalescence of a* $2.5-4.5\,M_\odot$ *Compact Object and a Neutron Star*, Astrophys. J. Lett. 970, L34 (2024); arXiv:2404.04248; LIGO-P2300352
33. The LIGO-Virgo-KAGRA Collaboration, *Ultralight vector dark matter search using data from the KAGRA O3GK run*, Phys. Rev. D 110, 042001 (2004); arXiv:2403.03004; LIGO-P2300250
34. The Fermi-GBM, Swift-BAT, LSC, Virgo and KAGRA Collaborations, *A Joint Fermi-GBM and Swift-BAT Analysis of Gravitational-Wave Events from the GWTC-3 Catalog*, Astrophys. J. 964, 149 (2024); arXiv:2308.13666; LIGO-P2100436
35. The LIGO-Virgo-KAGRA Collaboration, *Search for Eccentric Black Hole Coalescences During the Third Observing Run of LIGO and Virgo*, (accepted by Astrophys. J. 2023); arXiv:2308.03822; LIGO-P2300080
36. The LIGO-Virgo-KAGRA Collaboration, *Search for gravitational-lensing signatures in the full third observing run of the LIGO-Virgo network*, Astrophys. J. 970, 191 (2024); arXiv:2304.08393; LIGO-P2200031
37. The LIGO-Virgo-KAGRA Collaboration, *Open data from the third observing run of LIGO, Virgo, KAGRA and GEO*, Astrophys. J. Supp. 267, 29 (2023); arXiv:2302.03676; LIGO-P2200316
38. The LIGO-Virgo-KAGRA Collaboration, *Search for subsolar-mass black hole binaries in the second part of Advanced LIGO and Virgo's third observing run*, Mon. Not. R. Astron. S. 524, 5984 (2023); arXiv:2212.01477; LIGO-P2200139
39. The LIGO-Virgo-KAGRA Collaboration, *Search for gravitational-wave transients associated with magnetar bursts in Advanced LIGO and Advanced Virgo data from the third observing run*, Astrophys. J. 966, 137 (2024); arXiv:2210.10931; LIGO-P2100387
40. The LIGO-Virgo-KAGRA Collaboration, *Model-based cross-correlation search for gravitational waves from the low-mass X-ray binary Scorpius X-1 in LIGO O3 data*, Astrophys. J. Lett. 941, L30 (2022); arXiv:2209.02863; LIGO-P2100110
41. The LIGO-Virgo Collaboration, *Search for continuous gravitational wave emission from the Milky Way center in O3 LIGO-Virgo data*, Phys. Rev. D 106, 042003 (2022); arXiv:2204.04523; LIGO-P2100437.
42. The LIGO-Virgo-KAGRA Collaboration, *Search for gravitational waves associated with Fast Radio Bursts Detected by CHIME/FRB During the LIGO-Virgo Observing Run O3a*, Astrophys. J. 955, 155 (2023); arXiv:2203.12038; LIGO-PP2100124
43. The LIGO-Virgo-KAGRA Collaboration, *First joint observation by the underground gravitational-wave detector KAGRA with GEO 600*, Profess of Theor and Exp. Phys., 2002, 063F01 (2022); arXiv:2203.01270; LIGO-P2100286
44. The LIGO-Virgo-KAGRA Collaboration, *Search for gravitational waves from Scorpius X-1 with a hidden Markov model in O3 LIGO data*, Phys. Rev D 106, 062002 (2022); arXiv:2201.10104; LIGO-P2100405
45. The LIGO-Virgo-KAGRA Collaboration, *All-sky search for continuous gravitational waves from isolated neutron stars using Advanced LIGO and Advanced Virgo O3 data*, Phys. Rev. D 106, 102008 (2022); arXiv:2201.00697; LIGO-P2100367
46. The LIGO-Virgo-KAGRA Collaboration, et al., *Narrowband searches for continuous and long-duration transient gravitational waves from known pulsars in the LIGO-Virgo third observing run*, Astrophys. J. 932, 133 (2022); arXiv:2112.10990; LIGO-P2100267.

47. The LIGO-Virgo-KAGRA Collaboration, *Tests of General Relativity using the third LIGO-Virgo Gravitational-Wave Transient Catalog*, (accepted to PRD, 2024); arXiv:2112.06861; LIGO-P2100275.

48. The LIGO-Virgo Collaboration, *Search of the Early O3 LIGO Data for Continuous Gravitational Waves from the Cassiopeia A and Vela Jr. Supernova Remnants*, Phys. Rev. D 105, 082005 (2022); arXiv:2111.15116; LIGO-P2100298.

49. The LIGO-Virgo-KAGRA Collaboration, *All-sky search for gravitational wave emission from scalar boson clouds around spinning black holes in LIGO O3 data*, Phys. Rev. D 105, 102001 (2022); arXiv:2111.15507; LIGO-P2100343.

50. The LIGO-Virgo-KAGRA Collaboration, *Searches for Gravitational Waves from Known Pulsars at Two Harmonics in the Second and Third LIGO-Virgo Observing Runs*, Astrophys. J. 935, 1, (2022); arXiv:2111.13106; LIGO-P2100049.

51. The LIGO-Virgo-KAGRA Collaboration, *Constraints on the cosmic expansion history from the third LIGO-Virgo-KAGRA Gravitational-Wave Transient Catalog*, Astrophys. J. 949, 1 (2023); arXiv:2111.03604; LIGO-P2100185.

52. The LIGO-Virgo-KAGRA Collaboration, *GWTC-3: Compact Binary Coalescences Observed by LIGO and Virgo During the Second Part of the Third Observing Run*, Phys. Rev. X 13, 041039 (2023); arXiv:2111.03606; LIGO-P2000318.

53. The LIGO-Virgo-KAGRA Collaboration, *Search for Gravitational Waves Associated with Gamma-Ray Bursts detected by Fermi and Swift during the O3b LIGO-Virgo Run*, Astrophys. J. 928, 186 (2022); arXiv:2111.03608; LIGO-P2100091.

54. The LIGO-Virgo-KAGRA Collaboration, *The population of merging compact binaries inferred using gravitational waves through GWTC-3*, Phys. Rev. X 13, 011048 (2023); arXiv:2111.03634; LIGO-P2100239.

55. The LIGO-Virgo-KAGRA Collaboration, *All-sky, all-frequency directional search for persistent gravitational waves from Advanced LIGO's and Advanced Virgo's first three observing runs*, Phys. Rev. D 105, 122002 (2022); arXiv:2110.09834; LIGO-P2100292.

56. The LIGO-Virgo-KAGRA Collaboration, et al., *Search for subsolar-mass binaries in the first half of Advanced LIGO and Virgo's third observing run*, Phys. Rev. Lett. 129, 061104 (2022); arXiv:2109.12197; LIGO-P2100163.

57. The LIGO-Virgo-KAGRA Collaboration, et al., *Search for continuous gravitational waves from 20 accreting millisecond X-ray pulsars in O3 LIGO data*, Phys. Rev. D 105, 022002 (2022); arXiv:2109.09255; LIGO-P2100221.

58. The LIGO-Virgo-KAGRA Collaboration, *GWTC-2.1: Deep Extended Catalog of Compact Binary Coalescences Observed by LIGO and Virgo During the First Half of the Third Observing Run*; Phys. Rev. D 109, 022001 (2024); arXiv:2108.01045; LIGO-P2100063.

59. The LIGO-Virgo-KAGRA Collaboration, *All-sky search for long-duration gravitational-wave transients in the third Advanced LIGO observing run*, Phys. Rev. D 104, 102001 (2021); arXiv:2107.13796; LIGO-P2100078.

60. The LIGO-Virgo-KAGRA Collaboration, *All-sky search for short gravitational-wave bursts in the third Advanced LIGO and Advanced Virgo run*, Phys. Rev. D 104, 122004 (2021); arXiv:2107.03701; LIGO-P2100045.

61. The LIGO-Virgo-KAGRA Collaboration, *All-sky Search for Continuous Gravitational Waves in the Early O3 LIGO Data*, Phys. Rev. D 104, 082004 (2021); arXiv:2107.00600; LIGO-P2000334.

62. The LIGO-Virgo-KAGRA Collaboration, *Observation of gravitational waves from two neutron star-black hole coalescences*, Astrophys. J. Lett. 915, L5 (2021); arXiv:2106.15163; LIGO-P2000357.

63. The LIGO-Virgo-KAGRA Collaboration, *Search for intermediate mass black hole binaries in the third observing run of Advanced LIGO and Advanced Virgo*, Astronomy & Astrophysics 659, A84 (2022); arXiv:2105.15120; LIGO-P2100025.

64. The LIGO-Virgo-KAGRA Collaboration, *Constraints on dark photon dark matter using data from LIGO's and Virgo's third observing run*, Phys. Rev. D 105, 063030 (2022); Erratum 109, 089902 (2024); arXiv:2105.13085; LIGO-P2100098.

65. The LIGO-Virgo-KAGRA Collaboration, *Searches for continuous gravitational waves from young supernova remnants in the early third observing run of Advanced LIGO and Virgo*, Astrophys. J. 921, 80 (2021); arXiv:2105.11641; LIGO-P2000479.

66. The LIGO-Virgo Collaboration, *Search for lensing signatures in the gravitational-wave observations from the first half of LIGO-Virgo's third observing run*, Astrophys. J. 923, 14 (2021); arXiv:2105.06384; LIGO-P2000400.

67. The LIGO-Virgo-KAGRA Collaboration, et al., *Constraints from LIGO O3 data on gravitational-wave emission due to r-modes in the glitching pulsar PSR J0537-6910*, Astrophys. J. 922, 71 (2021); arXiv:2104.14417; LIGO-P2100069.

68. The LIGO-Virgo-KAGRA Collaboration, *Search for anisotropic gravitational-wave backgrounds using data from Advanced LIGO's and Advanced Virgo's first three observing runs*, Phys. Rev. D 104, 022005 (2021); arXiv:2103.08520; LIGO-P2000500.

69. The LIGO-Virgo-KAGRA Collaboration, *Constraints on cosmic strings using data from the third Advanced LIGO-Virgo observing run*, Phys. Rev. Lett. 126, 241102 (2021); arXiv:2101.12248; LIGO-P2000506.

70. The LIGO-Virgo-KAGRA Collaboration, *Upper limits on the isotropic gravitational-wave background from Advanced LIGO and Advanced Virgo's third observing run*, Phys. Rev. D 104, 022004 (2021); arXiv:2101.12130; LIGO-P2000314.

71. The LIGO-Virgo-KAGRA Collaboration, et al., *Diving below the spin-down limit: Constraints on gravitational waves from the energetic young pulsar PSR J0537-6910*, Astrophys. J. Lett. 913, L27 (2021); arXiv:2012.12926; LIGO-P2000407.

72. The LIGO-Virgo Collaboration, *All-sky search in early O3 LIGO data for continuous gravitational-wave signals from unknown neutron stars in binary systems*, Phys. Rev. D 103, 064017 (2021); Erraturm Phys. Rev. D 108, 069901 (2023); arXiv:2012.12128; LIGO-P2000298.

73. The LIGO-Virgo Collaboration, *GWTC-2: Compact Binary Coalescences Observed by LIGO and Virgo during the First Half of the Third Observing Run*, Phys. Rev. X 11, 021053 (2021); arXiv:2010.14527; LIGO-P2000061.

74. The LIGO-Virgo Collaboration, *Tests of general relativity with binary black holes from the second LIGO-Virgo gravitational-wave transient catalog*, Phys. Rev. D 103, 122002 (2021); arXiv:2010.14529; LIGO-P2000091.

75. The LIGO-Virgo Collaboration, *Population properties of compact objects from the second LIGO-Virgo Gravitational-Wave Transient Catalog*, Astrophys. J. Lett. 913, L7 (2021); arXiv:2010.14533; LIGO-P2000077.

76. The LIGO-Virgo Collaboration, *Search for Gravitational Waves Associated with Gamma-Ray Bursts Detected by Fermi and Swift during the LIGO-Virgo Run O3a*, Astrophys. J. 915, 86 (2021); arXiv:2010.14550; LIGO-P2000040.

77. The LIGO-Virgo Collaboration, *GW190521: A Binary Black Hole Merger with a Total Mass of 150 Msun O3*, Phys. Rev. Lett. 125, 101102 (2020); arXiv:2009.01075; LIGO-P2000020.

78. The LIGO-Virgo Collaboration, *Properties and astrophysical implications of the 150 Msun binary black hole merger GW190521*, Astrophys. J. Lett. 900, L13 (2020); arXiv:2009.01190; LIGO-P2000021.

79. The LIGO-Virgo-Collaboration, et al., *Gravitational-wave constraints on the equatorial ellipticity of millisecond pulsars*, Astrophys. J. Lett. 902, L21 (2020); arXiv:2007.14251; LIGO-P2000029.

80. The LIGO-Virgo Collaboration, *GW190814: Gravitational Waves from the Coalescence of a 23 Solar Mass Black Hole with a 2.6 Solar Mass Compact Object*, Astrophys. J. Lett. 896, L44 (2020); arXiv:2006.12611; LIGO-P190814.

81. The LIGO-Virgo Collaboration, *GW190412: Observation of a Binary-Black-Hole Coalescence with Asymmetric Masses*, Phys. Rev. D 102, 043015 (2020); arXiv:2004.08342; LIGO-P190412.

82. The LIGO-Virgo Collaboration, *Trigger Data to Accompany "GWTC-1: A Gravitational-Wave Transient Catalog of Compact Binary Mergers Observed by LIGO and Virgo during the First and Second Observing Runs"*; LIGO-P1900392.

83. The LIGO-Virgo Collaboration, *GW190425: Observation of a compact binary coalescence with total mass 3.4 Msun*, Astrophys. J. Lett. 892, L3 (2020); arXiv:2001.01761; LIGO-P190425.

84. The Fermi-GBM Team and the LIGO-Virgo-Collaboration, *A joint Fermi-GBM and LIGO/Virgo analysis of compact binary mergers from the first and second gravitational-wave observing runs*, Astrophys. J. 893, 100 (2020); arXiv:2001.00923; LIGO-P1900186.

85. The LIGO-Virgo Collaboration, *Open data from the first and second observing runs of Advanced LIGO and Advanced Virgo*, SoftwareX 13, 100658 (2021); arXiv:1912.11716; LIGO-P1900206.

86. The LIGO-Virgo-KAGRA Collaboration, *Prospects for Observing and Localizing Gravitational-Wave Transients with Advanced LIGO, Advanced Virgo and KAGRA*, Living Reviews in Relativity 23, 3 (2020); arXiv:1304.0670; LIGO-P1200087-V58 (update of Living Review).

87. The LIGO-Virgo Collaboration, *A guide to LIGO-Virgo detector noise and extraction of transient gravitational-wave signals*, Classical and Quantum Gravity 37, 055002 (2020); arXiv:1908.11170; LIGO-P1900004.

88. The LIGO-Virgo Collaboration, *A gravitational-wave measurement of the Hubble constant following the second observing run of Advanced LIGO and Virgo*, Astrophys. J. 909, 218 (2021); arXiv:1908.06060; LIGO-P1900015.

89. The LIGO-Virgo-Collaboration, et al., *Optically targeted search for gravitational waves emitted by core-collapse supernovae during the first and second observing runs of Advanced LIGO and Advanced Virgo*, Phys. Rev. D 101, 084002 (2020); arXiv:1908.03584; LIGO-P1700177.

90. The LIGO-Virgo Collaboration, *Model comparison from LIGO-Virgo data on GW170817's binary components and consequences for the merger remnant*, Classical and Quantum Gravity 37, 045006 (2020); arXiv:1908.01012; LIGO-P1800379.

91. The LIGO-Virgo Collaboration, *Search for eccentric binary black hole mergers with Advanced LIGO and Advanced Virgo during their first and second observing runs*, Astrophys. J. 883, 149 (2019); arXiv:1907.09384; LIGO-P1900110.

92. The LIGO-Virgo Collaboration, et al., *Search for gravitational wave signals associated with gamma-ray bursts during the second observing run of Advanced LIGO and Advanced Virgo*, Astrophys. J. 886, 75 (2019); LIGO-P1900034; arXiv:1907.01443.

93. The LIGO-Virgo Collaboration, *Search for gravitational waves from Scorpius X-1 in the second Advanced LIGO observing run with an improved hidden Markov model*, Phys. Rev. D 100, 122002 (2019); LIGO-P1800208; arXiv:1906.12040.

94. The LIGO-Virgo Collaboration, *Search for intermediate mass black hole binaries in the first and second observing runs of the Advanced LIGO and Virgo network*, Phys. Rev. D 100, 064064 (2019); LIGO-P1900045; arXiv:1906.08000.

95. The LIGO-Virgo Collaboration, *All-sky search for short gravitational-wave bursts in the second Advanced LIGO and Advanced Virgo run*, Phys. Rev. D 100, 024017 (2019); LIGO-P1800308; arXiv:1905.03457.

96. The LIGO-Virgo Collaboration, et al., *Search for sub-solar mass ultracompact binaries in Advanced LIGO's second observing run* Phys. Rev. Lett., 123, 161102 (2019); LIGO-P1900037; arXiv:1904.08976.

97. The LIGO-Virgo Collaboration, *All-sky search for long-duration gravitational wave transients in the second Advanced LIGO observing run*, Phys. Rev. D 99, 104033 (2019); LIGO-P1800323; arXiv:1903.12015.

98. The LIGO-Virgo Collaboration, *Directional limits on persistent gravitational waves using data from Advanced LIGO's first two observing runs*, Phys. Rev. D, 100, 062001 (2019); LIGO-P1900053; arXiv:1903.08844.

99. The LIGO-Virgo Collaboration, *Tests of general relativity with the binary black hole signals from the LIGO-Virgo catalog*, Phys. Rev. D, 100, 104036 (2019); LIGO-P1800316; arXiv:1903.04467.

100. The LIGO-Virgo Collaboration, *Search for the isotropic stochastic background with Advanced LIGO's second observing run*, Phys. Rev. D, 100, 061101(R) (2019); LIGO-P1800248; arXiv:1903.02886.

101. The LIGO-Virgo Collaboration, et al., *All-sky search for continuous gravitational waves from isolated neutron stars using Advanced LIGO O2 data*, Phys. Rev. D 100, 024004 (2019); LIGO-P1900012; arXiv:1903.01901.

102. The LIGO-Virgo Collaboration, et al., *Narrow-band search for gravitational waves from known pulsars using the second LIGO observing run*, Phys. Rev. D 99, 122002 (2019); LIGO-P1800391; arXiv:1902.08442.

103. The LIGO-Virgo Collaboration, et. al, *Searches for gravitational waves from known pulsars at two harmonics in 2015-2017 LIGO data*, Astrophys. J. 879, 10 (2019); LIGO-P1800344; arXiv:1902.08507.

104. The LIGO-Virgo Collaboration, *Search for transient gravitational wave signals associated with magnetar bursts during Advanced LIGO's second observing run*, Astrophys. J. 874, 163 (2019); LIGO-P1800165; arXiv:1902.01557.

105. The LIGO-Virgo Collaboration, *Low-latency gravitational-wave alerts for multimessenger astronomy during the second Advanced LIGO and Virgo observing run*, Astrophys. J. 875, 161 (2019); LIGO-P1800255; arXiv:1901.03310.

106. The LIGO-Virgo and DES Collaborations, *First measurement of the Hubble constant from a dark standard siren using the Dark Energy Survey galaxies and the LIGO/Virgo binary-black-hole merger GW170814*, Astrophys. J. Lett. 876, L7 (2019); arXiv:1901.01540.

107. The LIGO-Virgo Collaboration, *Searches for continuous gravitational waves from 15 supernova remnants and Fomalhaut b with Advanced LIGO*, Astrophys. J. 875, 122 (2019); LIGO-P1800333; arXiv:1812.11656.

108. The LIGO-Virgo Collaboration, *GWTC-1: A Gravitational-Wave Transient Catalog of Compact Binary Mergers Observed by LIGO and Virgo during the First and Second Observing Runs*, Phys. Rev. X, 9, 031040 (2019); LIGO-P1800307; arXiv:1811.12907.

109. The LIGO-Virgo Collaboration, *Binary Black Hole Population Properties Inferred from the First and Second Observing Runs of Advanced LIGO and Advanced Virgo*, Astrophys. J. Lett. 882, L24 (2019); LIGO-P1800324; arXiv:1811.12940.

110. The LIGO-Virgo Collaboration, *Tests of General Relativity with GW170817*, Phys. Rev. Lett. 123, 011102 (2019); LIGO-P1800059; arXiv:1811.00364.

111. The LIGO-Virgo, ANTARES, and IceCube Collaborations, *Search for multimessenger sources of gravitational waves and high-energy neutrinos with Advanced LIGO during its first observing run*, Astrophys. J. 870, 134 (2019); arXiv:1810.10693.

112. The LIGO-Virgo Collaboration, *Search for gravitational waves from a long-lived remnant of the binary neutron star merger GW170817*, Astrophys. J. 875, 160 (2019); LIGO-P1800195; arXiv:1810.02581.

113. The LIGO-Virgo and Fermi-GBM Collaborations, *A Fermi Gamma-ray Burst Monitor search for electromagnetic signals coincident with gravitational-wave candidates in Advanced LIGO's first observing run*, Astrophys. J. 871, 90 (2019); arXiv:1810.02764.

114. The LIGO-Virgo Collaboration, et al., *Constraining the p-mode–g-mode tidal instability with GW170817*, Phys. Rev. Lett. 122, 061104 (2019); arXiv:1808.08676.

115. The LIGO-Virgo Collaboration, et al., *Search for sub-solar mass ultracompact binaries in Advanced LIGO's first observing run*, Phys. Rev. Lett. 121, 231103 (2018); LIGO-P1800158; arXiv:1808.04771.

116. The LIGO-Virgo Collaboration, *GW170817: Measurements of neutron star radii and equation of state*, Phys. Rev. Lett. 121, 161101 (2018); LIGO-P1800115; arXiv:1805.11581

117. The LIGO-Virgo Collaboration, *Properties of the binary neutron star merger GW170817*, Phys. Rev. X 9, 011001 (2019); LIGO-P1800061; arXiv:1805.11579

118. The LIGO-Virgo Collaboration, *A Search for Tensor, Vector, and Scalar Polarizations in the Stochastic Gravitational-Wave Background*, Phys. Rev. Lett. 120, 201102 (2018); LIGO-P1700369; arXiv:1802.10194

119. The LIGO-Virgo Collaboration, *Full Band All-sky Search for Periodic Gravitational Waves in the O1 LIGO Data*, Phys. Rev. D 97, 102003 (2018); LIGO-P1600164; arXiv:1802.05241

120. The LIGO-Virgo Collaboration, *Constraints on cosmic strings using data from the first Advanced LIGO observing run*, Phys. Rev. D 97, 102002 (2018); LIGO-P1700051; arXiv:1712.01168

121. The LIGO-Virgo Collaboration, *All-sky search for long-duration gravitational wave transients in the first Advanced LIGO observing run*, Class. Quantum Grav. 35, 065009 (2018); LIGO-P1600277; arXiv:1711.06843

122. The LIGO-Virgo Collaboration, *GW170608: Observation of a 19-solar-mass Binary Black Hole Coalescence*, ApJ Lett. 851, L35 (2017); LIGO-P170608; arXiv:1711.05578

123. The LIGO-Virgo Collaboration, *Gravitational-wave Search for a Post-Merger Remnant of the Binary Neutron Star Merger GW170817*, Astrophys. J. Lett. 851, L16 (2017); LIGO-P17000318; arXiv:1710.09320

124. The ANTARES, IceCube, Pierre Auger, LIGO and Virgo Collaborations, *Search for High-energy Neutrinos from Binary Neutron Star Merger GW170817 with ANTARES, IceCube, and the Pierre Auger Observatory*, Astrophys. J. Lett. 850, L35 (2017); LIGO-P1700344; arXiv:1710.05839

125. The LIGO-Virgo Collaboration, *GW170817: Implications for the Stochastic Gravitational-Wave Background from Compact Binary Coalescences*, Phys. Rev. Lett. 120, 091101 (2018); LIGO-P1700272; arXiv:1710.05837

126. The LIGO-Virgo Collaboration, *On the progenitor of binary neutron star merger GW170817*, Astrophys. J. Lett. 850, L40 (2017); LIGO-P1700264; arXiv:1710.05838

127. The LIGO-Virgo Collaboration, *Estimating the Contribution of Dynamical Ejecta in the Kilonova Associated with GW170817*, Astrophys. J. Lett, 850, L39 (2017); LIGO-P1700309; arXiv:1710.05836

128. The LIGO-Virgo Collaboration and observer teams who found the EM counterpart, *A gravitational-wave standard siren measurement of the Hubble constant*, Nature, doi:10.1038/nature24471, (2017); LIGO-P1700296; arXiv:1710.05835

129. The LIGO-Virgo Collaboration and many EM partners, *Multi-Messenger Observations of a Binary Neutron Star Merger*, Astrophys. J. Lett. 848, L12 (2017); LIGO-P1700294; arXiv:1710.05833

130. The LIGO-Virgo, Fermi, and Integral Collaborations, *Gravitational Waves and Gamma-rays from a Binary Neutron Star Merger: GW170817 and GRB 170817A*, Astrophys. J. Lett. 848, L13 (2017); LIGO-P1700308; arXiv:1710.05834

131. The LIGO-Virgo Collaboration, *GW170817: Observation of Gravitational Waves from a Binary Neutron Star Inspiral*, Phys. Rev. Lett. 119, 161101 (2017); LIGO-P170817; arXiv:1710.05832

132. The LIGO-Virgo Collaboration, et al., *First narrow-band search for continuous gravitational waves from known pulsars in advanced detector data*, Phys. Rev. D 96, 122006 (2017); LIGO-P1700221; arXiv:1710.02327

133. The LIGO-Virgo Collaboration, *GW170814: A Three-Detector Observation of Gravitational Waves from a Binary Black Hole Coalescence*, Phys. Rev. Lett. 119, 141101 (2017); LIGO-P170814; arXiv:1709.09660

134. The LIGO-Virgo Collaboration, *First search for nontensorial gravitational waves from known pulsars*, Phys. Rev. Lett. 120, 031104 (2018); LIGO-P1700009; arXiv:1709.09203

135. The LIGO-Virgo Collaboration, *First low frequency Einstein@Home all-sky search for continuous gravitational waves in advanced LIGO data*, Phys. Rev. D 96, 122004 (2017); LIGO-P1700127; arXiv:1707.02669

136. The LIGO-Virgo Collaboration, *All-sky Search for Periodic Gravitational Waves in the O1 LIGO Data*, Phys. Rev. D 96, 062002 (2017); LIGO-P1700052; arXiv:1707.02667

137. The LIGO-Virgo Collaboration, et al., *Upper Limits on Gravitational Waves from Scorpius X-1 from a Model-Based Cross-Correlation Search in Advanced LIGO Data*, ApJ 847, 47 (2017); LIGO-P1600297; arXiv:1706.03119

138. The LIGO-Virgo Collaboration, *GW170104: Observation of a 50-Solar-Mass Binary Black Hole Coalescence at Redshift 0.2*, Phys. Rev. Lett. 118, 221101 (2017); LIGO-P170104; arXiv:1706.01812

139. The LIGO-Virgo Collaboration, *Search for intermediate mass black hole binaries in the first observing run of Advanced LIGO*, Phys. Rev. D 96, 022001 (2017); LIGO-P1600273; arXiv:1704.04628

140. The LIGO-Virgo Collaboration, *Search for gravitational waves from Scorpius X-1 in the first Advanced LIGO observing run with a hidden Markov model*, Phys. Rev. D 95, 122003 (2017); LIGO-P1700019; arXiv:1704.03719

141. The LIGO, Virgo, Antares, & IceCube Collaborations, *Search for High-energy Neutrinos from Gravitational Wave Event GW151226 and Cantidate LVT151012 with ANTARES and IceCube*, Phys. Rev. D 96, 022005 (2017); LIGO-P1600271; arXiv:1703.06298

142. The LIGO-Virgo Collaboration, et al., *First search for gravitational waves from known pulsars with Advanced LIGO*, Astrophys. J. 839, no.1, 12, (2017); LIGO-P1600159; arXiv:1701.07709

143. The LIGO-Virgo Collaboration, *Directional limits on persistent gravitational waves from Advanced LIGO's first observing run*, Phys. Rev. Lett. 118, 121102 (2017); LIGO-P1600259; arXiv:1612.02030

144. The LIGO-Virgo Collaboration, *Upper Limits on the Stochastic Gravitational-Wave Background from Advanced LIGO's First Observing Run*, Phys. Rev. Lett. 118, 121101 (2017); LIGO-P1600258; arXiv:1612.02029

145. The LIGO-Virgo Collaboration, et al., *Search for Gravitational Waves Associated with Gamma-Ray Bursts During the First Advanced LIGO Observing Run and Implications for the Origin of GRB 150906B*, Astrophys. J. 841, no.2, 89 (2017); LIGO-P1600298; arXiv:1611.07947

146. The LIGO-Virgo Collaboration, et al., *Effects of waveform model systematics on the interpretation of GW150914*, Class. Quantum Grav. 34, 104002 (2017); LIGO-P1500259; arXiv:1611.07531

147. The LIGO-Virgo Collaboration, *All-sky search for short gravitational-wave bursts in the first Advanced LIGO run*, Phys. Rev. D 95, 042003 (2017); LIGO-P1600129; arXiv:1611.02972

148. The LIGO-Scientific Collaboration, et al., *Exploring the Sensitivity of Next Generation Gravitational Wave Detectors*, Class. Quantum Grav. 34, 044001 (2017); LIGO-P1600143; arXiv:1607.08697

149. The LIGO-Virgo Collaboration, *The basic physics of the binary black hole merger GW150914*; Annalen Phys. 529, 1600209 (2017), LIGO-P1600161; arXiv:1608.01940

150. The LIGO-Virgo Collaboration, *Upper limits on the rates of binary neutron star and black-hole neutron-star mergers from Advanced LIGOs first observing run*, Astrophys. J. Lett. 832, L21 (2016); LIGO-P1600171; arXiv:1607.07456

151. The LIGO-Virgo Collaboration, *Search for continuous gravitational waves from neutron stars in globular cluster NGC 6544*, Phys. Rev. D 95, 082005 (2017); LIGO-P1500225; arXiv:1607.02216

152. The LIGO-Virgo Collaboration, *Results of the deepest all-sky survey for continuous gravitational waves on LIGO S6 data running on the Einstein@Home volunteer distributed computing project*, Phys. Rev. D 94, 102002 (2016); LIGO-P1500156; arXiv:1606.09619

153. The LIGO-Virgo Collaboration, *Binary Black Hole Mergers in the first Advanced LIGO Observing Run*, Phys. Rev. X 6, 041015 (2016); LIGO-P1600088; arXiv:1606.04856

154. The LIGO-Virgo Collaboration, *GW151226: Observation of Gravitational Waves from a 22-Solar-Mass Binary Black Hole Coalescence*, Phys. Rev. Lett. 116, 241103 (2016); LIGO-P151226; arXiv:1606.04855

155. The LIGO-Virgo Collaboration, *Directly comparing GW150914 with numerical solutions of Einstein's equations for binary black hole coalescence*, Phys. Rev. D 94, 064035 (2016); LIGO-P1500263; arXiv:1606.01262

156. The LIGO-Virgo Collaboration, *An improved analysis of GW150914 using a fully spin-precessing waveform model*, Phys. Rev. X 6, 041014 (2016); LIGO-P1600048; arXiv:1606.01210

157. The LIGO-Virgo Collaboration, *A First Targeted Search for Gravitational-Wave Bursts from Core-Collapse Supernovae in Data of First-Generation Laser Interferometer Detectors*, Phys. Rev. D 94, 102001 (2016); LIGO-P1400208; arXiv:1605.01785

158. The LIGO-Virgo Collaboration, *Comprehensive All-sky Search for Periodic Gravitational Waves in the Sixth Science Run LIGO Data*, Phys. Rev. D 94, 042002 (2016); LIGO-P1500219; arXiv:1605.03233

159. The LIGO-Virgo Collaboration, et al., *Search for Transient Gravitational Waves in Coincidence with Short Duration Radio Transients*, Phys. Rev. D 93, 122008 (2016); LIGO-P1400154; arXiv:1605.01707

160. The LIGO-Virgo Collaboration, et al., *Localization and broadband follow-up of the gravitational-wave transient GW150914*, Astrophys. J. Lett. 826, L13, (2016); LIGO-P1500227; arXiv:1602.08492

161. The Antares, IceCube, LIGO, and Virgo Collaborations, *High-energy Neutrino follow-up search of Gravitational Wave Event GW150914 with IceCube and ANTARES*, Phys. Rev. D 93, 122010 (2016); LIGO-P1500271; arXiv:1602.05411

162. The LIGO-Virgo Collaboration, *GW150914: Implications for the stochastic gravitational-wave background from binary black holes*, Phys. Rev. Lett. 116, 131102 (2016); LIGO-P1500222; arXiv:1602.03847

163. The LIGO-Virgo Collaboration, *Astrophysical Implications of the Binary Black-Hole Merger GW150914*, Astroph. J. Lett. 818, L22, (2016); LIGO-P1500262; arXiv:1602.03846

164. The LIGO Scientific Collaboration, *Calibration of the Advanced LIGO detectors for the discovery of the binary black-hole merger GW150914*, Phys. Rev. D 95, 062003 (2017); LIGO-P1500248; arXiv:1602.03845

165. The LIGO-Virgo Collaboration, *Characterization of transient noise in Advanced LIGO relevant to gravitational wave signal GW150914*, Class. Quant. Grav. 33, 134001 (2016); LIGO-P1500238; arXiv:1602.03844

166. The LIGO-Virgo Collaboration, *Observing gravitational-wave transient GW150914 with minimal assumptions* Phys. Rev. D 93, 122004 (2016); LIGO-P1500229; arXiv:1602.03843

167. The LIGO-Virgo Collaboration, *The Rate of Binary Black Hole Mergers Inferred from Advanced LIGO Observations Surrounding GW150914*, Astrophys. J. Lett. 833, L1 (2016); LIGO-P1500217; arXiv:1602.03842

168. The LIGO-Virgo Collaboration, *Supplement: The Rate of Binary Black Hole Mergers Inferred from Advanced LIGO Observations Surrounding GW150914*, Astrophys. J. Supp. 227, 14 (2016); LIGO-P1500217; arXiv:1606.03939

169. The LIGO-Virgo Collaboration, *Tests of general relativity with GW150914*, Phys. Rev. Lett. 116, 221101 (2016); LIGO-P1500213; arXiv:1602.03841

170. The LIGO-Virgo Collaboration, *Properties of the binary black hole merger GW150914*, Phys. Rev. Lett. 116, 241102 (2016); LIGO-P1500218; arXiv:1602.03840

171. The LIGO-Virgo Collaboration, *GW150914: First results from the search for binary black hole coalescence with Advanced LIGO*, Phys. Rev. D 93, 122003 (2016); LIGO-P1500269; arXiv:1602.03839

172. The LIGO-Virgo Collaboration, *GW150914: The Advanced LIGO Detectors in the Era of First Discoveries*, Phy. Rev. Lett. 116, 131103 (2016); LIGO-P1500237; arXiv:1602.03838

173. The LIGO-Virgo Collaboration, *Observation of Gravitational Waves from a Binary Black Hole Merger*, Phys. Rev. Lett. 116, 061102 (2016); LIGO-P150914; arXiv:1602.03837

174. The LIGO-Virgo Collaboration, *Prospects for Localization of Gravitational Wave Transients by the Advanced LIGO and Advanced Virgo Observatories*, Living Rev. Relativity, 19, 1 (2016); LIGO-P1200087; arXiv:1304.0670

175. The LIGO-Virgo Collaboration, *An all-sky search for long-duration gravitational wave transients with LIGO*, Phys. Rev. D 93, 042005 (2016); LIGO-P1400138; arXiv:1511.04398

176. The LIGO-Virgo Collaboration, *First low frequency all-sky search for continuous gravitational wave signals*, Phys. Rev. D 93, 042007 (2016); LIGO-P1500030; arXiv:1510.03621

177. The LIGO-Virgo Collaboration, *A search of the Orion spur for continuous gravitational waves using a "loosely coherent" algorithm on data from LIGO interferometers*, Phys. Rev. D 93, 042006 (2016); LIGO-P1500034; arXiv:1510.03474

178. The LIGO-Virgo Collaboration, *Searches for continuous gravitational waves from nine young supernova remnants*, Astrophys. J. 813, 39, (2015); LIGO-P1400182; arXiv:1412.5942

179. The LIGO Scientific Collaboration, *Advanced LIGO*, Class. Quantum Grav., 32, 074001, (2015); LIGO-P1400177; arXiv:1411.4547

180. The LIGO-Virgo Collaboration, *A directed search for gravitational waves from Scorpius X-1 with initial LIGO*, Phys. Rev. D 91, 062008, (2015); LIGO-P1400094; arXiv:1412.0605

181. The LIGO-Virgo Collaboration, et al., *Narrow-band search of continuous gravitational-wave signals from Crab and Vela pulsars in Virgo VSR4 data*, Phys. Rev. D 91, 022004, (2015); LIGO-P1400045; arXiv:1410.8310

182. The LIGO-Virgo Collaboration, *Characterization of the LIGO detectors during their sixth science run*, Class. Quantum Grav., 32, 105012, (2015); LIGO-P1000142; arXiv:1410.7764

183. The LIGO-Virgo Collaboration, *Searching for stochastic gravitational waves using data from the two co-located LIGO Hanford detectors*, Phys. Rev. D 91, 022003, (2015); LIGO-P1000112; arXiv:1410.6211

184. The LIGO-Virgo and IceCube Collaborations, *Multimessenger Search for Sources of Gravitational Waves and High-energy Neutrinos: Results for Initial LIGO-Virgo and IceCube*, Phys. Rev. D 90, 102002, (2014); LIGO-P1400046; arXiv:1407.1042

185. The LIGO-Virgo Collaboration, *Improved Upper Limits on the Stochastic Gravitational-Wave Background from 2009-2010 LIGO and Virgo Data*, Phys. Rev. Lett 113, 231101, (2014); LIGO-P1300154; arXiv:1406.4556

186. The LIGO-Virgo Collaboration, *First all-sky search for continuous gravitational waves from unknown sources in binary systems*, Phys. Rev. D, 90, 062010, (2014); LIGO-P1300048; arXiv:1405.7904

187. The LIGO-Virgo Collaboration, *Methods and results of a search for gravitational waves associated with gamma-ray bursts using the GEO600, LIGO, and Virgo detectors*, Phys. Rev. D, 89, 122004 (2014); LIGO-P1300086; arXiv:1405.1053

188. The LIGO-Virgo Collaboration, *Search for gravitational radiation from intermediate mass black hole binaries in data from the second LIGO-Virgo joint science run*, Phys. Rev. D, 89, 122003 (2014); LIGO-P1300158; arXiv:1404.2199

189. The LIGO-Virgo and IPN Collaborations, *Search for gravitational waves associated with gamma-ray bursts detected by the Interplanetary Network*, Phys. Rev. Lett., 113, 011102 (2014); LIGO-P1300226; arXiv:1403.6639

190. The LIGO-Virgo Collaboration, *Search for gravitational wave ringdowns from perturbed intermediate mass black holes in LIGO-Virgo data from 2005-2010*, Phys. Rev. D, 89, 102006 (2014); LIGO-P1300156; arXiv:1403.5306

191. The LIGO-Virgo Collaboration, *Implementation of an F-statistic all-sky search for continuous gravitational waves in Virgo VSR1 data*, Class. Quantum Grav., 31, 165014 (2014); LIGO-P1300133; arXiv:1402.4974

192. The LIGO-Virgo and NINJA Collaborations, *The NINJA-2 project: Detecting and characterizing gravitational waveforms modelled using numerical binary black hole simulations*, Class. Quantum Grav., 31, 115004 (2014); LIGO-P1300199; arXiv:1401.0939

193. The LIGO-Virgo Collaboration, *Application of a Hough search for continuous gravitational waves on data from the 5th LIGO science run*, Class. Quantum Grav., 31, 085014 (2014); LIGO-P1300071; arXiv:1311.2409

194. The LIGO-Virgo Collaboration, *Constraints on cosmic (super)strings from the LIGO-Virgo gravitational-wave detectors*, Phys. Rev. Lett., 112, 131101 (2014); LIGO-P130093; arXiv:1310.2384

195. The LIGO-Virgo Collaboration, et al.,*First Searches for Optical Counterparts to Gravitational-wave Candidate Events*, Astrophys. J. Supp., 211, 7, (2014); LIGO-P1200171; arXiv:1310.2314

196. The LIGO-Virgo Collaboration, *A directed search for continuous gravitational waves from the galactic center*, Phys. Rev. D, 88, 102022, (2013); LIGO-P1300037; arXiv:1309.6221

197. The LIGO-Virgo Collaboration, *A search for long-lived gravitational-wave transients coincident with long gamma-ray bursts*, Phys. Rev. D, 88, 122004, (2013); LIGO-P1200093; arXiv:1309.6160

198. The LIGO-Virgo Collaboration, et al.,*Gravitational waves from known pulsars: results from the initial detector era*, Astrophys. J., 785, 119, (2014); LIGO-P1200104; arXiv:1309.4027

199. The LIGO Scientific Collaboration, *Enhanced sensitivity of the LIGO gravitational wave detector by using squeezed states of light*, Nature Photonics, doi: 10.1038/nphoton.2013.177 (2013)

200. The LIGO-Virgo Collaboration, *Parameter estimation for compact binary coalescence signals with the first generation gravitational-wave detector network*, LIGO-P1200021, Phys. Rev. D 88, 062001 (2013); arXiv:1304.1775

201. The ANTARES, LIGO, and Virgo Collaborations, *A First Search for coincident Gravitational Waves and High Energy Neutrinos using LIGO, Virgo and ANTARES data from 2007*, LIGO-P1200006, J. Cosmol. Astropart. Phys. 06, 008 (2013); arXiv:1205.3018

202. The LIGO-Virgo Collaboration, *Einstein@Home all-sky search for periodic gravitational waves in LIGO S5 data*, LIGO-P1200026, Phys. Rev. D, 87, 042001, (2013); arXiv:1207.7176

203. The LIGO-Virgo Collaboration, *Search for Gravitational Waves from Binary Black Hole Inspiral, Merger and Ringdown in LIGO-Virgo Data from 2009-2010*, LIGO-P1200024, Phys. Rev. D, 87, 022002 (2013); arXiv:1209.6533

204. The LIGO, Virgo, and Swift Collaborations, *Swift follow-up observations of candidate gravitational-wave transient events*, (2012), LIGO-P1100038, Astrophys. J. Suppl. Ser., 203, 28 (2012); arXiv:1205.1124

205. The LIGO-Virgo Collaboration, *The characterization of Virgo data and its impact on gravitational-wave searches*, Class. Quantum Grav., 29, 155002 (2012); arXiv:1203.5613