Dr. Ofek Birnholtz - Gravitational Waves Researcher

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Center for Computational Relativity & Gravitation (CCRG), Rochester Institute of Technology (RIT)

ACADEMIC

2018- **"Frontiers in Gravitational Wave Astrophysics" Fellow**, Rochester Inst. of Technology

2015-2017 **Post-Doctoral Research Scientist**, Max Planck Inst. for Grav. Phys. (AEI), Hanover
- Data Analysis Group for LIGO Scientific Collaboration
- Special Breakthrough Prize in Fundamental Physics 2016 for Discovery of GWs
- Gruber Cosmology Prize 2016 for Discovery of GWs
- Best Data-Analysis Poster, LIGO & VIRGO Collaboration meeting 08/2016
- Supervision of graduate students and interns

2016 (submitted 2015) **PhD in Physics**, Hebrew University of Jerusalem, Israel
- Research Thesis "***Gravitational Waves – Sources and Methods: From Astrophysics to Effective Field Theory & Back***"
- Supervisors: Tsvi Piran, Barak Kol
- Arnold Rosenblum Prize 2013 for Excellence in graduate research
- University Senate member for research students in Exact Sciences, 2011-2013

2013 **MSc in Physics**, Hebrew University of Jerusalem, Israel

2007 **BA in Mathematics & Physics**, Technion – Israel Institute of Technology
- Graduated SUMMA CUM LAUDE

2003 **BA in Computer Science**, Technion – Israel Institute of Technology
- Graduated SUMMA CUM LAUDE
- Degree completed at age 18, in parallel with high-school

TEACHING EXPERIENCE

2018 **Mathematics Lecturer substitute**, Rochester Institute of Technology

2009-2015 **Physics TA & Tutor**, Hebrew University of Jerusalem
- Taught physics courses from intro level (Mechanics, Electricity, Magnetism and Optics) to graduate level (General Relativity & Gravitation, Solid State Physics)
- Taught service courses to non-physicists, including Life Sciences & Math students

2006 **Mathematics TA**, Israeli Institution of Technology (Technion)

ENGINEERING EXPERIENCE

2014-2015 **Network Data Scientist & Developer,** Endor (prev. Athena Wisdom)

2006-2009 **System Engineer and Analyst, Project Leader**, Government of Israel
- Israeli National Security Prize 2010

2005-2006 **Project Manager and Software System Engineer**, IDF
- Israeli National Security Prize 2006

2003-2005 **Software Engineer**, IDF
- Honorary Citation 2004
- Fields of physical simulations, programmable hardware, and industrial processes

PROGRAMMING

C/C++, MATLAB, Python, Fortran, ASM (various), Perl, Java

LANGUAGES

Hebrew (Native), English (Native), French (Intermediate), German (Basic)

Publications List

(full updated list online: http://inspirehep.net/search?p=exactauthor%3AO.Birnholtz.1)

Doctoral Dissertation

[1] "Gravitational Waves – Sources and Calculation Methods: From Astrophysics to Field Theory and Back". Supervisors: Tsvi Piran and Barak Kol. Degree awarded Feb 2015, Hebrew University of Jerusalem, Israel.

Articles

[2] **Birnholtz, O.** & Piran, T., Gravitational Wave Memory from Gamma Ray Bursts' Jets, Physical Review D, Vol. 87, Issue 12, 24 June 2013.

[3] **Birnholtz, O.**, Hadar, S. & Kol, B., Theory of post-Newtonian radiation and reaction, Physical Review D, Vol. 88, Issue 10, 27 November 2013.

[4] **Birnholtz, O.** & Hadar, S., Action for reaction in general dimension, Physical Review D, Vol. 89, Issue 4, 5 February 2014.

[5] **Birnholtz, O.**, Hadar, S. & Kol, B., 2014, Radiation reaction at the level of the action, Int. Journal of Modern Physics A, Vol. 29, Issue 24, 30 September 2014.

[6] **Birnholtz, O.**, Comments on initial conditions for the Abraham-Lorentz(-Dirac) equation, Int. Journal of Modern Physics A, Vol. 30, Issue 02, 20 January 2015.

[7] **Birnholtz, O.** & Hadar, S., Gravitational radiation-reaction in arbitrary dimension, Physical Review D, Vol. 91, Issue 12, 23 June 2015.

[8] LIGO Scientific & Virgo Collaborations (Abbot, B. P. et al.), Observation of Gravitational Waves from a Binary Black Hole Merger, Physical Review Letters, Vol. 116, Issue 6, 11 February 2016.

[9] LIGO Scientific & Virgo Collaborations (Abbot, B. P. et al.), Tests of general relativity with GW150914, Physical Review Letters Vol. 116 no.22, 221101, 21 May 2016.

[10] LIGO Scientific & Virgo Collaborations (Abbot, B. P. et al.), Properties of the Binary Black Hole Merger GW150914, Physical Review Letters Vol. 116 no.24, 241102, 14 June 2016.

[11] LIGO Scientific & Virgo Collaborations (Abbot, B. P. et al.), GW151226: Observation of Gravitational Waves from a 22-Solar-Mass Binary Black Hole Coalescence, Physical Review Letters, Vol. 116 no.24, 241103, 15 June 2016.

[12] LIGO Scientific & Virgo Collaborations (Abbot, B. P. et al.), Binary Black Hole Mergers in the first Advanced LIGO Observing Run, Physical Review X6 no.4, 041015, 21 October 2016.

[13] LIGO Scientific & Virgo Collaborations (Abbot, B. P. et al.), An improved analysis of GW150914 using a fully spin-precessing waveform model, Physical Review X6 no.4, 041014, 21 October 2016.

[14] LIGO Scientific & Virgo Collaborations (Abbot, B. P. et al.), The basic physics of the binary black hole merger GW150914, Annalen der Physik, Volume 529, Issue 1-2, 1600209, January 2017.

[15] Ashton, G., **Birnholtz, O.**, Cabero, M., Capano, C., Dent, T., Krishnan, B., Meadors, G., Nielsen, A., Nitz, A. & Westerweck, J., Comments on: "Echoes from the abyss: Evidence for Planck-scale structure at black hole horizons", arXiv:1612.05625 [gr-qc], 16 December 2016.

[16] LIGO Scientific & Virgo Collaborations (Abbot, B. P. et al.), Effects of Waveform Model Systematics on the Interpretation of GW150914, Classical and Quantum Gravity, Volume 34, Number 10, 12 April 2017.

[17] Nielsen, A. & **Birnholz, O.**, Testing pseudo-complex general relativity with gravitational waves, Astronomische Nachrichten, Volume 339, Issue 4, 298-305, 29 June 2018.

[18] Cabero, M, Capano, C., **Fischer-Birnholtz, O.**, Krishnan, B., Nielsen, A. B., Nitz, A. & Biwer, C. M., H., Observational tests of the black hole area increase law, Physical Review D97, 124069, 28 June 2018.

[19] Westerweck, J., Nielsen, A., **Fischer-Birnholtz, O.**, Cabero, M., Capano, C., Dent, T., Krishnan, B., Meadors, G. & Nitz, A., Low significance of evidence for black hole echoes in gravitational wave data, Physical Review D97, 124037, 15 June 2018.

[20] **Birnholtz, O.**, Higher dimensions and higher orders in EFT for gravitational waves, in Proceedings, 14th Marcel Grossmann Meeting (MG14), 2017.

[21] Nielsen, A. B., Capano, C., **Birnholtz, O.**, & Westerweck, J., Parameter estimation for black hole echo signals and their statistical significance, arXiv:1811.04904 [gr-qc], 12 November 2018, submitted to PRD.

[22] Pool-Kolb, D., **Birnholtz, O.**, Krishnan, B. & Schnetter, E., The existence and stability of marginally trapped surfaces, arXiv:1811.10405 [gr-qc], 26 November 2018, submitted to PRX.

[23] Ireland, B., **Birnholtz, O.**, Nakano, H., West, E. & Campanelli, M., Eccentric Binary Black Holes with Spin, in progress.

[24] Barlow, N., **Birnholtz, O.**, Brodie, L., Campanelli, M., Kolt, Q. & Weinstein, S., Semi-analytic Approximant for Binary Black Hole Coalescence Gravitational Waveforms, in progress.

[25] Champion, B. W., O'Shaughnessy, R. & **Birnholtz, O.**, Multi-messenger Astrophysics Parameter Estimation for GW and EM data channels, in progress.

LIGO Internal papers/technical documents

[T1] Allen, B., **Birnholtz, O.**, Ghosh, S., Nielsen, A., & Wiseman, A. G., Simple argument that GW150914 must be a binary black hole, Tech. Rep. T1500566 (LIGO Scientific Collaboration, 2016).

[T2] **Birnholtz, O.**, Machenschalk, B., & Nitz, A. H., Einstein@home for PyCBC, Tech. Rep. G1601133 (LIGO Scientific Collaboration, 2016).

[T3] Cabero M., **Birnholtz, O.**, Biwer, C., Capano, C., Krishnan, B., Nitz, A. H., & Prix, R., Prospects for observing multiple ringdown modes in a binary black hole merger, Tech. Rep. G1601513 (LIGO Scientific Collaboration, 2016).

[T4] Cabero M., Capano, C., Nitz, A. H. & **Birnholtz, O.**, Black-hole ringdown parameter estimation, Tech. Rep. G1601747 (LIGO Scientific Collaboration, 2016), https://dcc.ligo.org/public/0128/G1601747/001/LVC_2016.pdf.

[T5] Johnson-McDaniel, N., Gupta, A. P., Ajith, P., Keitel, D., **Birnholtz, O.**, Ohme, F. & Husa, S., Determining the final spin of a binary black hole system including in-plane spins: Method and checks of accuracy, Tech. Rep. T1600168 (LIGO Scientific Collaboration, 2016).

[T6] Pazhayath-Ravi, A., Nitz, A. H., & **Birnholtz, O.**, Template Bank Thinning based on Zeroth Order Threshold over Chirp Time, Tech. Rep. T1600311 (LIGO Scientific Collaboration, 2016).

[T7] Sturani, R., Taracchini, A., **Birnholtz, O.**, Eteienne, Z., Marsat, S., O'Shaughnessy, R. & Zlochower, Y., Review of SEOBNRv4T in LALSimulation, Tech. Rep. G1702470 (LIGO Scientific Collaboration, 2018).

[T8] Johnson-McDaniel, Sturani, R., Taracchini, A., **Birnholtz, O.**, Eteienne, Z., McWilliams, S. & Haster, C-J, Review of SEOBNRv3_opt in LALSimulation, Tech. Rep. G1702469 (LIGO Scientific Collaboration, 2018).

[T9] Breschi, M., **Birnholtz, O.**, Lange, J. & O'Shaughnessy, R., IMR Consistency Tests with Higher Modes on O2 events, Tech. Rep. T1600311 (LIGO Scientific Collaboration, 2018).

Full LIGO-VIRGO Collaborations' papers

[LVC1] LIGO Scientific & Virgo Collaborations (Abbot, B. P. 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, arXiv:1611.07947 [astro-ph.HE], 23 November 2016.

[LVC2] LIGO Scientific & Virgo Collaborations (Abbot, B. P. et al.), All-sky search for short gravitational-wave bursts in the first Advanced LIGO run, Physical Review D, Vol. 95, Issue 4, 16 February 2017.

[LVC3] LIGO Scientific & Virgo Collaborations (Abbot, B. P. et al.), Search for High-energy Neutrinos from Gravitational Wave Event GW151226 and Candidate LVT151012 with ANTARES and IceCube, arXiv:1703.06298 [astro-ph.HE], 18 March 2017.

[LVC4] LIGO Scientific & Virgo Collaborations (Abbot, B. P. et al.), Upper Limits on the Stochastic Gravitational-Wave Background from Advanced LIGO's First Observing Run, Physical Review Letters, Vol. 118, Issue 12, 24 March 2017.

[LVC5] LIGO Scientific & Virgo Collaborations (Abbot, B. P. et al.), Directional Limits on Persistent Gravitational Waves from Advanced LIGO's First Observing Run, Physical Review Letters, Vol. 118, Issue 12, 24 March 2017.

[LVC6] LIGO Scientific & Virgo Collaborations (Abbot, B. P. et al.), First Search for Gravitational Waves from Known Pulsars with Advanced LIGO, The Astrophysical Journal, Vol. 839, Number 1, 7 April 2017.

Scientific Conferences & Lectures

- "Gravitational Wave open data from LIGO and VIRGO", Up-Stat - 7th Annual Conference of the Up-State Chapters of The American Statistical Association, University of Rochester, New York, April 2018 (invited)
- "Testing pseudo-complex general relativity with gravitational waves", Quantum Black Holes in the Sky workshop, Perimeter Institute, Waterloo, ON, November 2017 (invited)
- "Gravitational Waves & LIGO", seminar at Hebrew University of Jerusalem, September 2017 (invited)
- "LAL: What our code tells about us", LIGO-VIRGO Collaboration meeting in CERN, Switzerland, August 2017 (invited).
- "Gravitational Wave Observations — LIGO Introduction for students & researchers", Ben-Gurion University, Be'er Sheva, April 2017 (invited).
- "Modeled searches for Compact Binary Coalescences in LIGO data", Gravitational Waves and Compact Objects workshop, Technion, Haifa, November 2016 (invited).
- "Black-hole ringdown parameter estimation" poster, LIGO-VIRGO Collaboration meeting, September 2016, Glasgow.
- "The Latest from LIGO, and What's Next", seminar at Tel Aviv University, April 2016 (invited).
- "The Latest from LIGO, and What's Next", seminar at Technion – Israel Institute of Technology, Haifa, April 2016 (invited).
- "PyCBC with Einstein@home", LIGO-VIRGO Collaboration meeting, March 2016, Pasadena.
- "LIGO First Highlights: Gravitational Waves detected from Binary Black Hole Coalescence", Weizmann Institute, Rehovot, February 2016 (invited).
- "LIGO First Highlights: Gravitational Waves detected from Binary Black Hole Coalescence", Israeli National Astronomy Day, Hebrew University, Jerusalem, February 2016.

- "Higher Dimensions & Higher Orders in EFT for Gravitational Waves", 14th Marcel Grossman Meeting, La Sapienza University, Rome, July 2015.
- "How are Gravitational Waves in any dimension like a bead on a string?", 17th Capra Meeting on Radiation Reaction in General Relativity, Caltech, June 2014.
- "An action for reaction: From a bead on a string to Gravitational Waves", 15th Canadian Conference on General Relativity and Relativistic Astrophysics, Winnipeg, May 2014.
- "Gravitational Wave Memory from Gamma Ray Bursts' Jets", Yukawa International Seminar, Kyoto, June 2013.

Popular Engagements

- "Gravitational Waves: A Nobel-Prize Discovery", opening lecture in International Science Week, Jerusalem, October 2017.
- "Gravitational Waves: history & future of Gravity", 21st Icon Festival, Tel Aviv, October 2017.
- "Gravitational Waves – the discovery that won the Nobel Prize", interview to Israel's Channel 2, October 2017.
- "Do ripples in space-time herald a new theory of gravity?", interview to Sabine Hossenfelder on Aeon Essays, March 2017.
- "Gravitational Waves and Astronomical Revolutions", a 'Lecture on the Bar', Be'er-Sheba, May 2016.
- "The Story of Gravitational Waves", on the webcast HaHalalit ("The Spaceship"), Israel, February 2016.

Scientific Service

- Referee for Physical Review Letters, Physical Review D, Nature Scientific Reports.