



Research experience

Postdoctoral Researcher, Max Planck Institute for Gravitational Physics (Potsdam) Nov 2022 –

- Used numerical data to perform a resummation of weak-field expansions of the scattering angle due to a point-particle source to extend their validity into the strong-field regime [1].
- Extended the Spectral Einstein Code (SpEC) to be capable of handling more extreme parameters leading to the first known Numerical Relativity calculations of hyperbolic encounters between two black holes of unequal mass [9].
- Extended the pySEOBNR code to be able to calculate hyperbolic binary black hole encounters [9].

Postdoctoral Research Fellow, University of Southampton Jun 2022 – Oct 2022

- Used numerical data to extract high-order weak-field expansions of the scattering angle due to a point-particle source [3].

Ph.D. Student, University of Southampton Sep 2018 – May 2022

- Developed and implemented a numerical method for calculating perturbations due to a point-particle source in black hole perturbation theory [6, 7].
- Performed the first-ever calculation of the post-geodesic correction to the scattering angle of a point-particle in a black hole spacetime [6].
- Derived analytic formulae for scattering geodesics in a black hole spacetime [7]. Implemented the formulae in the KerrGeodesics package of the Black Hole Perturbation Toolkit [11].

Teaching experience

Postgraduate Student Demonstrator, University of Southampton Sep 2018 – Jan 2022

- Numerical Methods in Python: Run workshops based on problem sheets and coursework.
- Maths for Physicists: Run classes demonstrating mathematical techniques and coursework marking.
- Maths for Engineers: Run drop-in workshops, marking of exams, and exam writing.

Education

Ph.D. in Mathematical Sciences, University of Southampton Sep 2018 – Apr 2022

- Thesis title: Self-force in hyperbolic black hole encounters.
- Advisor: Prof. Leor Barack

MPhys in Physics, The University of Manchester Sep 2014 – Jun 2018

- Project title: Constraints on the neutrino sector using current and future cosmological data.
- Advisor: Dr Eleonora Di Valentino

Prizes and funding awards

Doctoral Prize Fellowship, Engineering and Physical Sciences Research Council. 2022

- Funding for the Postdoctoral Research Fellow position at the University of Southampton.
- Grant number: EP/T517859/1

Best Student Talk Runner Up, 25th Capra Meeting on Radiation Reaction in GR. Jun 2022

Publications

- [1] **O. Long**, C. Whittall, and L. Barack, “Black hole scattering near the transition to plunge: Self-force and resummation of post-Minkowskian theory,” Jun. 2024. arXiv: 2406.08363 [gr-qc].
- [2] N. Afshordi *et al.*, “Waveform Modelling for the Laser Interferometer Space Antenna,” Nov. 2023. arXiv: 2311.01300 [gr-qc].
- [3] L. Barack *et al.*, “Comparison of post-Minkowskian and self-force expansions: Scattering in a scalar charge toy model,” *Phys. Rev. D*, vol. 108, no. 2, p. 024025, 2023. DOI: 10.1103/PhysRevD.108.024025. arXiv: 2304.09200 [hep-th].
- [4] M. Boschini *et al.*, “Extending black-hole remnant surrogate models to extreme mass ratios,” *Phys. Rev. D*, vol. 108, no. 8, p. 084015, 2023. DOI: 10.1103/PhysRevD.108.084015. arXiv: 2307.03435 [gr-qc].
- [5] L. J. Gomes Da Silva *et al.*, “Hyperboloidal discontinuous time-symmetric numerical algorithm with higher order jumps for gravitational self-force computations in the time domain,” Jun. 2023, Accepted for publication in *Phys. Rev. D*. arXiv: 2306.13153 [gr-qc].
- [6] L. Barack and **O. Long**, “Self-force correction to the deflection angle in black-hole scattering: A scalar charge toy model,” *Phys. Rev. D*, vol. 106, no. 10, p. 104031, 2022. DOI: 10.1103/PhysRevD.106.104031. arXiv: 2209.03740 [gr-qc].
- [7] **O. Long** and L. Barack, “Time-domain metric reconstruction for hyperbolic scattering,” *Phys. Rev. D*, vol. 104, no. 2, p. 024014, 2021. DOI: 10.1103/PhysRevD.104.024014. arXiv: 2105.05630 [gr-qc].



Articles in preparation

- [8] M. Boyle *et al.*, “The SXS Collaboration catalog of binary black hole simulations,” (in preparation).
- [9] **O. Long**, H. Pfeiffer, A. Buonanno, *et al.*, “Comparing numeric and analytic methods for black hole scattering in unequal mass systems,” (in preparation).
- [10] **O. Long** and C. Whittall, “Highly accurate self-force calculations for hyperbolic orbits: A frequency/time-domain hybrid model,” (in preparation).
- [11] N. Warburton *et al.*, “The Black Hole Perturbation Toolkit,” (in preparation).

Invited talks

- “Comparing numeric and analytic methods for black hole scattering in unequal mass systems”, Gravitational Self-Force and Scattering Amplitudes Workshop, The Higgs Centre for Theoretical Physics, 20th March 2024.
- “Self-force meets post-Minkowskian in the scattering regime” Gravitational Waves meet Amplitudes in the Southern Hemisphere, International Center for Theoretical Physics South American Institute for Fundamental Research, 24th August 2023.
- “Hyperbolic self-force calculations within a hyperboloidal framework” Infinity on a Gridshell, Niels Bohr Institute, 10th July 2023.
- “Extraction of high-order post-Minkowskian results from scattering self-force calculations” QCD meets Gravity 2022, Universität Zürich, 13th December 2022.

Conference presentations

- “Hyperbolic BBH encounters with SpEC” Simulating Extreme Spacetimes with SpEC and SpECTRE, The Institute for Computational and Experimental Research in Mathematics, Brown University, 7th August 2024.
- “Double the hype: Hyperboloidal framework for self-force in hyperbolic black hole encounters” 27th Capra Meeting on Radiation Reaction in General Relativity, National University of Singapore, 17th June 2024.
- “Comparison of post-Minkowskian and self-force expansions: Scattering in a scalar charge toy model” 26th Capra Meeting on Radiation Reaction in General Relativity, Niels Bohr Institute, 4th July 2023.
- “Self-force in hyperbolic black hole encounters” LISA Symposium XIV, 25th – 29th July 2022. 
- “Self-force in hyperbolic black hole encounters” 23rd International Conference on General Relativity and Gravitation, Chinese Academy of Science via Zoom, 5th July 2022. 

- “Self-force in hyperbolic black hole encounters” 25th Capra Meeting on Radiation Reaction in General Relativity, University College Dublin, 22nd June 2022. [!\[\]\(6302aad5aed157b291fddf37b4870784_img.jpg\)](#)
- “Self-force in hyperbolic binary-black-hole encounters” BritGrav22, University of Glasgow via Zoom, 4th April 2022. [!\[\]\(a9ca2c237943a6d0a9f22252f295b6f3_img.jpg\)](#)
- “Time-domain metric reconstruction for hyperbolic scattering” 24th Capra Meeting on Radiation Reaction in General Relativity, Perimeter Institute via Zoom, 10th June 2021. [!\[\]\(9a01a64e0b4ff865df7d32ee7991fe8b_img.jpg\)](#)
- “Towards a self-force calculation of the scatter angle in hyperbolic encounters” BritGrav21, University College Dublin via Zoom, 13th April 2021. [!\[\]\(6aefe9a3d997eb8b55c40ecd5fa7053f_img.jpg\)](#)
- “Towards a self-force calculation of the scatter angle in hyperbolic encounters” LISA Symposium XIII, 1st – 3rd October 2020. [!\[\]\(baa8f8ba8c970db55300f5bb45bb3460_img.jpg\)](#)
- “Towards a self-force calculation of the scatter angle in hyperbolic encounters” 23rd Capra Meeting on Radiation Reaction in General Relativity, University of Texas at Austin via Zoom, 24th June 2020. [!\[\]\(a6e28495607b2299466d3d5d3193848c_img.jpg\)](#)

Conference posters

- “Time-domain metric reconstruction using the Hertz potential” 3rd meeting of the GWVerse COST action, Institute for Fundamental Physics of the Universe, International School for Advanced Studies, 13th – 16th January 2020.

Other events attended

- Black Hole Perturbation Toolkit Workshop (via Zoom), The Institute for Computational and Experimental Research in Mathematics, Brown University, 25th – 27th July 2022.
- From Scattering Amplitudes to Gravitational-Wave Predictions for Compact Binaries, Universität Zürich & ETH Zürich, 4th – 15th July 2022.
- Advances and Challenges in Computational Relativity Workshop (Online), The Institute for Computational and Experimental Research in Mathematics, Brown University, 14th – 18th September 2020.
- Black Hole Perturbation Toolkit Workshop (Online), Astronomical Institute of the Academy of Sciences of the Czech Republic, 25th – 27th May 2020.
- Kavli RISE Summer School on Gravitational Waves, University of Cambridge, 23rd – 27th September 2019.
- 22nd International Conference on General Relativity and Gravitation and 13th Edoardo Amaldi Conference on Gravitational Waves, Palau de congressos de Valencia, 8th – 12th July 2019.
- 22nd Capra Meeting on Radiation Reaction in General Relativity, Centro Brasileiro de Pesquisas Físicas, 17th – 21st June 2019.
- LISA Waveform Working Group Meeting, Max Planck Institute for Gravitational Physics (Albert Einstein Institute), 13th – 15th May 2019.
- BritGrav19, Durham University, 15th – 16th April 2019.
- Black Hole Perturbation Toolkit Workshop, University College Dublin, 19th – 21st March 2019.

Research collaborations

Laser Interferometer Space Antenna (LISA) Consortium	Oct 2018 –
• Member of the Waveform Working Group and LISA Early Career Scientists (LECS).	
The Black Hole Perturbation Toolkit	Mar 2019 –
• Contributor to the KerrGeodesics package.	
Simulating eXtreme Spacetimes (SXS) collaboration	Nov 2022 –
• Contributor to the Spectral Einstein Code (SpEC).	

LIGO Scientific Collaboration (LSC)

Apr 2023 – Nov 2023

- Member of the Waveform Working Group.

Computing experience

Advanced: C/C++, Python, Mathematica, Git, Linux, MacOS, L^AT_EX.

Intermediate: Bash, OpenMP, Slurm, Paraview, Windows.

Some experience: Perl, Cython, OpenMPI.