Oliver Long

Research experience

Postdoctoral Researcher, Max Planck Institute for Gravitational Physics — 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 accurately and efficiently calculating hyperbolic binary black hole encounters.

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 [9].

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

Oliver Long

Publications (total: 7)

[1] **O. Long**, C. Whittall, and L. Barack, "Black hole scattering near the transition to plunge: Self-force and resummation of post-Minkowskian theory," *Phys. Rev. D*, vol. 110, no. 4, p. 044 039, 2024. DOI: 10.1103/PhysRevD.110.044039. 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. 024 025, 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. 084 015, 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. 104 031, 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. 024 014, 2021. DOI: 10.1103/PhysRevD.104.024014. arXiv: 2105.05630 [gr-qc].

Articles in preparation (total: 2)

[8] R. P. Macedo, **O. Long**, and L. Barack, "Comoving hyperboloidal-slicing framework for self-force in black hole scattering," (in preparation).

[9] N. Warburton *et al.*, "The Black Hole Perturbation Toolkit," (in preparation).

Invited talks (total: 8)

- "Black hole scattering in the strong-field regime: Merging post-Minkowskian theory with numerical methods", WQFT Seminar, Humboldt University, 25th November 2024 (Scheduled).
- Gravity Seminar, University of Southampton, 7th November 2024 (Scheduled).
- "Black hole scattering in the strong-field regime: Merging post-Minkowskian theory with numerical methods", Séminaire Amplitudes et Gravitation sur l'Yvette, Institut des Hautes Études Scientifiques, 16th October 2024.
- "Modelling of unbound binary black hole encounters", Fundamental Physics Meets Waveforms With LISA, Max Planck Institute for Gravitational Physics, 6th September 2024.
- "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.

Presentations (total: 12)

- NR Community Call, 2nd December 2024 (Scheduled).
- "Hyperbolic Binary Black Hole 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.
- "Self-force in hyperbolic binary-black-hole encounters" BritGrav22, University of Glasgow via Zoom, 4th April 2022.
- "Time-domain metric reconstruction for hyperbolic scattering" 24th Capra Meeting on Radiation Reaction in General Relativity, Perimeter Institute via Zoom, 10th June 2021.
- "Towards a self-force calculation of the scatter angle in hyperbolic encounters" BritGrav21, University College Dublin via Zoom, 13th April 2021.
- "Towards a self-force calculation of the scatter angle in hyperbolic encounters" LISA Symposium XIII, 1st – 3rd October 2020.
- "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.

Posters (total: 1)

- "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 (total: 11)

- 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.

Oliver Long

Other community service

- Member of the Simulating eXtreme Spacetimes (SXS) Social Media Team. Aug 2024 –
- Member of the Capra community's Equality, Diversity and Inclusion (EDI) Team. Jun 2024 –
- Reviewer for *Physical Review D*. Mar 2023 –
- Discussion chair for "Scattering – What? Why? How?", Fundamental Physics Meets Waveforms With LISA, Max Planck Institute for Gravitational Physics, 6th September 2024.
- Discussion chair for "Self-force meets Amplitudes", 26th Capra Meeting on Radiation Reaction in General Relativity, Niels Bohr Institute, 4th July 2023.

Research collaborations

Simulating eXtreme Spacetimes (SXS) collaboration Nov 2022 –

- Contributor to the Spectral Einstein Code (`SpEC`).
- Member of the SXS Social Media Team.

The Black Hole Perturbation Toolkit Mar 2019 –

- Contributor to the KerrGeodesics package.

Laser Interforemeter Space Antenna (LISA) Consortium Oct 2018 –

- Member of the Waveform Working Group and LISA Early Career Scientists (LECS).

LIGO Scientific Collaboration (LSC) Apr 2023 – Nov 2023

- Member of the Waveform Working Group.

Computing experience

Advanced: `C/C++`, `Python`, `Mathematica`, Git, Linux, MacOS, LaTeX.

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

Some experience: `Perl`, `Cython`, OpenMPI.