Riccardo Gonzo

Curriculum Vitae

Education

2022–2025	**Postdoctoral research associate**, *University of Edinburgh*, Edinburgh.
2018–2022	**Phd in theoretical particle physics**, *Trinity College Dublin*, Dublin, I graduated from TCD with a Phd thesis on scattering amplitudes, supervised by Ruth Britto.
2015–2017	**Master of Physics**, *University of Padova*, Padova, *110/110 cum laude*.
	+5 extra exams (not required, 34 ECTS credits more) in the study plan/learning agreement
2012–2015	**Bachelor of Physics**, *University of Padova*, Padova, *110/110 cum laude*.
	+1 extra exams (not required, 6 ECTS credits more) in the study plan/learning agreement

PhD Thesis

Title	*Coherent states and classical radiative observables in the S-matrix formalism* (Link)
Supervisors	Prof. Ruth Britto
Description	In this thesis, we study classical radiative observables perturbatively in terms of on-shell scattering amplitudes. In particular, we focus primarily on the two-body problem in gauge and gravitational theories by using an effective field theory approach. The Kosower-Maybee-O'Connell (KMOC) approach, which follows from the classical on-shell reduction of the in-in formalism by using appropriate massive particle wavefunctions, is extended to include classical waves which are naturally described by coherent states. Global observables like the impulse and localized observables like the waveform and gravitational event shapes are then studied in the amplitude approach, making contact also with asymptotic symmetries and light-ray operators defined near null infinity. The classical factorization of radiative observables from the uncertainty principle is proved to be equivalent to a Poisson distribution in the Fock space, and this provides a new evidence in favor of a representation of the classical S-matrix in terms of an eikonal phase and a coherent state of gravitons.

Master Thesis

Title	*The infinite-spin representations of the Poincaré group*
Supervisors	Prof. Karl Henning Rehren & Prof. Pieralberto Marchetti

✉ rgonzo@ed.ac.uk

Articles

My INSPIRE HEP profile is available at Riccardo Gonzo INSPIRE HEP profile (◉).

Publication list

[1] Riccardo Gonzo, Tristan Mc Loughlin, Diego Medrano, and Anne Spiering. "Asymptotic charges and coherent states in QCD". In: *Phys. Rev. D* 104.2 (2021), p. 025019. DOI: 10.1103/PhysRevD.104.025019. arXiv: 1906.11763 [hep-th].

[2] Shamik Banerjee, Sudip Ghosh, and Riccardo Gonzo. "BMS symmetry of celestial OPE". In: *JHEP* 04 (2020), p. 130. DOI: 10.1007/JHEP04(2020)130. arXiv: 2002.00975 [hep-th].

[3] Riccardo Gonzo and Andrzej Pokraka. "Light-ray operators, detectors and gravitational event shapes". In: *JHEP* 05 (2021), p. 015. DOI: 10.1007/JHEP05(2021)015. arXiv: 2012.01406 [hep-th].

[4] Andrea Cristofoli, Riccardo Gonzo, David A. Kosower, and Donal O'Connell. "Waveforms from amplitudes". In: *Phys. Rev. D* 106.5 (2022), p. 056007. DOI: 10.1103/PhysRevD.106.056007. arXiv: 2107.10193 [hep-th].

[5] Riccardo Gonzo and Canxin Shi. "Geodesics from classical double copy". In: *Phys. Rev. D* 104.10 (2021), p. 105012. DOI: 10.1103/PhysRevD.104.105012. arXiv: 2109.01072 [hep-th].

[6] Andrea Cristofoli, Riccardo Gonzo, Nathan Moynihan, Donal O'Connell, Alasdair Ross, Matteo Sergola, and Chris D. White. "The Uncertainty Principle and Classical Amplitudes". In: (Dec. 2021). arXiv: 2112.07556 [hep-th].

[7] Ruth Britto, Riccardo Gonzo, and Guy R. Jehu. "Graviton particle statistics and coherent states from classical scattering amplitudes". In: *JHEP* 03 (2022), p. 214. DOI: 10.1007/JHEP03(2022)214. arXiv: 2112.07036 [hep-th].

[8] Riccardo Gonzo, Tristan McLoughlin, and Andrea Puhm. "Celestial holography on Kerr-Schild backgrounds". In: *JHEP* 10 (2022), p. 073. DOI: 10.1007/JHEP10(2022)073. arXiv: 2207.13719 [hep-th].

[9] Tim Adamo and Riccardo Gonzo. "Bethe-Salpeter equation for classical gravitational bound states". In: *JHEP* 05 (2023), p. 088. DOI: 10.1007/JHEP05(2023)088. arXiv: 2212.13269 [hep-th].

[10] Riccardo Gonzo and Canxin Shi. "Boundary to bound dictionary for generic Kerr orbits". In: *Phys. Rev. D* 108.8 (2023), p. 084065. DOI: 10.1103/PhysRevD.108.084065. arXiv: 2304.06066 [hep-th].

[11] Riccardo Gonzo and Anton Ilderton. "Wave scattering event shapes at high energies". In: *JHEP* 10 (2023), p. 108. DOI: 10.1007/JHEP10(2023)108. arXiv: 2305.17166 [hep-th].

[12] Stefano De Angelis, Riccardo Gonzo, and Pavel P. Novichkov. "Spinning waveforms from KMOC at leading order". In: (Sept. 2023). arXiv: 2309.17429 [hep-th].

✉ rgonzo@ed.ac.uk

[13] Tim Adamo, Riccardo Gonzo, and Anton Ilderton. "Gravitational Bound Waveforms from Amplitudes". In: (Jan. 2024). arXiv: 2402.00124 [hep-th].

Experience

Invited talks (conferences, workshops)

21/12/2020 **"Light-ray operators and detector algebra" (XVI Avogadro Meeting)**.

17/05/2021 **"Waveforms from the KMOC formalism and coherent states" (GGI workshop)**, *GGI*, Florence, (Link video).

15/12/2021 **"An infinity of amplitude relations in classical physics" (QCD meets gravity)**, *UCLA*, (Link video).

31/08/2022 **"High-energy limit of quantum and classical wave scattering observables" (Physics in Intense Fields, PIF22)**.

14/09/2022 **Celestial holography on non-trivial backgrounds" (Workshop on celestial amplitudes and flat space holography)**, Corfu, (Link video).

14/09/2022 **Speaker for the discussion session "Connections between gravity, classical observables and scattering amplitudes" in the Workshop on celestial amplitudes and flat space holography**, Corfu.

14/12/2022 **"Bethe-Salpeter equation for classical gravitational bound states" (QCD meets gravity)**, Zurich, (Link video).

22/08/2023 **"From classical scattering amplitudes to bound state observables" (GWs meet Amplitudes)**, Sao Paulo, (Link video).

27/09/2023 **"Classical Gravitational Bound States with Amplitudes" (New Frontiers in Theoretical Physics - XXXVII Convegno Nazionale di Fisica Teorica)**, Cortona.

23/01/2024 **"Classical Gravitational Bound States with Amplitudes" (General Relativity from AMPlitudes Alliance (GRAMPA),ICMS)**, Edinburgh, (Link video).

13/02/2024 **"Black holes as point particles: from amplitudes to self-force" (Workshop JENAS Initiative: Gravitational Wave Probes of Fundamental Physics)**, Rome.

22/03/2024 **Speaker for the discussion session "Self-force and amplitudes" in the Workshop "Gravitational self-force and scattering amplitudes"**, Edinburgh.

Invited seminars

29/05/2017 **"The structure of intertwiners in the infinite spin representation"**, Göttingen.

30/01/2020 **"OPE at null infinity"**, *TCD*, Dublin.

18/02/2021 **"Waveforms from amplitudes and coherent states"**, *NBI institute*, Copenaghen.

30/06/2021 **"Coherent states from amplitudes and classical factorization"**, *Higgs Centre*, Edinburgh.

29/09/2021 **"Gravitational event shapes and coherent states for gravitational waves"**, *Caltech*.

21/03/2022 **"Classical amplitudes for the two-body problem in GR"**, *UCD*, Dublin.

28/04/2022 **"Amplitudes for the classical two-body problem in general relativity"**, *University of Padova*, Padova.

18/11/2022 **"Celestial holography on non-trivial backgrounds"**, University of Nottingham.

01/12/2022 **"Bethe-Salpeter equation for classical bound states"**, *Higgs Centre*, Edinburgh.

22/03/2023 **"Shedding light on bound states with amplitudes"**, University of Geneva, Geneva.

04/05/2023 **"Boundary to bound dictionary for generic Kerr orbits"**, IPhT, Paris.

10/11/2023 **"Spinning waveforms from classical amplitudes"**, STAG centre, Southampton.

20/11/2023 **"Scattering and bound waveforms for Kerr black holes"**, Tor Vergata, Rome.

22/11/2023 **"Scattering and bound waveforms for Kerr black holes"**, Sapienza, Rome.

28/02/2024 **"Gravitational bound waveforms from amplitudes"**, Joint Belgian HEPTH Seminars, Brussels, Belgium.

13/03/2024 **"Gravitational bound waveforms from amplitudes"**, ITMP, Moscow State University (online).

03/04/2024 **"Gravitational bound waveforms from amplitudes"**, NTNU, Taiwan (online).

Conference/Workshops/School/Seminar organization

2021 **Organizer of the SAGEX amplitude school (Link)**, NBI institute, Copenhagen.

2022-2023 **Organizer of the GRAMPA seminar series**, (online).

2024 **Organizer of "Gravitational self-force and scattering amplitudes" workshop (Link)**, Higgs Centre, Edinburgh.

Teaching activities

2019 **Teaching Assistant of Algebraic Geometry class MA341F**, TCD.

2019 **Teaching Assistant of Quantum Field theory II class MA4446**, TCD.

2020 **Teaching Assistant of Combinatorics class MAU34107**, TCD.

2022 **Math teacher for differential calculus (Niels Brock program,3 months)**, ISB.

2022 **Tutor for the Conformal Bootstrap course at the Higgs Centre School of Theoretical Physics (1 week)**, Higgs Centre, Edinburgh.

2022 **Tutor for the Phd school BUSSTEPP 2022 (2 weeks)**, Imperial College, London.

2024 **Panel member for MPhys thesis presentations**, University of Edinburgh.

Visiting experience

08/2019 CERN (invited by Claude Duhr)

02/2020 Higgs Centre for Theoretical Physics (invited by Donal O'Connell)

11-12/2021 Institut de Physique Théorique - IPhT (invited by David Kosower)

03/2023 Le Centre de Physique Théorique - CPHT (invited by Andrea Puhm)

11/2023 University of Southampton (invited by Adam Pound)

11/2023 LNF- Laboratori Nazionali di Frascati (invited by Vittorio del Duca)

Referee activities

Journals: JHEP

Press/Outreach activities

2021 **SAGEX online exhibition: Feynman diagram section (Link)**.

2022	**Quanta Magazine (with Z.Bern, A.Buonanno, D.O'Connell and R.Roiban):** **"Massive Black Holes Shown to Act Like Quantum Particles" (Link)**.

Programming experience

07/2011- 10/2011	**Software developer in Visual Fox Pro**. I worked for 3 months as a software developer for "Studio 74" located in Santorso (VI, Italy)
03/2021- 06/2021	**Software developer in Mathematica (Wolfram)**, Champaign, Illinois. During the 3-months internship at Wolfram I've developed a code for definite integration of (product of) Meijer G functions, together with my supervisor Devendra Kapadia. Meijer G functions include as a particular case all pFq hypergeometric functions as well as many orthogonal polynomials and elementary functions as a special case. This code outperformed the original Integrate code based on standard techniques both in efficiency and reliability, and will be included in Mathematica 14.0.

Supervision

2023	**Msc student, Edinburgh (Leixi Wang)**, Classical spacetimes from amplitudes.
2024	**Msc student, Edinburgh (Arwa Musallam)**, Black holes and classical amplitudes.
2024	**Msc student, Sapienza (Damiano Barcaro),Cosupervision with V.Del Duca**.
2024	**Msc student, Sapienza (Andrea de Simone), Cosupervision with V.Del Duca**.

Awards

2011	First place, "Riccardo Rossi" scholarship (Link to the webpage)
2019	Marie Skłodowska-Curie grant from the European Union's Horizon 2020 research and innovation programme (Link to the webpage)
2023	10400 £ awarded for the organization of the workshop "Gravitational self-force and amplitudes" at the Higgs Centre

Computer skills

Advanced	C++, LaTeX, Mathematica, Inkscape, Linux, Microsoft
Intermediate	Comsol, Matlab, Git
Basic	HTML

Languages

Italian	**Mothertongue**	
English	**Professional working language**	*Fluent in conversation*