

Marie Cassing

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- ✳ born: 03.12.2000 in Gießen, Germany



Research Profile

- **Research focus:** Relativistic astrophysics and numerical relativity, with emphasis on the structure and evolution of compact objects, their surrounding matter, and the remnants of compact-object mergers.
- **Research experience:** Current doctoral research investigates how neutrino transport and magnetic fields shape the long-term evolution of binary-neutron-star merger remnants. Previous work includes differentially rotating neutron-star equilibria, black-hole tori in parametrized spacetimes, and exotic compact objects with two dark-matter fluids.
- **Methods & leadership:** Relativistic equilibrium modelling, large-scale numerical simulations, and scientific code development, including neutrino-radiation methods. Experience in HPC proposal writing and collaborative projects, with both principal-investigator and contributor roles across computing allocations.

Employment

- **Dec. 2023 – ongoing** **Doctoral Researcher**, Goethe University Frankfurt, Germany.
Supervisor: Prof. Dr. Luciano Rezzolla.
Research topic: *Neutrino radiation and the long-term evolution of post-merger dynamics*.
Funded by ERC Advanced Grant 884631, *JETSET: Launching, propagation and emission of relativistic jets from binary mergers and across mass scales*. Expected PhD completion September 2027

Education

- **2021 – 2023** **M.Sc. in Physics**, Goethe University Frankfurt; final grade: *magna cum laude*.
Thesis title: *Realistic equilibria of general-relativistic differentially rotating stars*.
Supervisor: Prof. Dr. Luciano Rezzolla.
- **2018 – 2021** **B.Sc. in Physics**, Goethe University Frankfurt.
Thesis title: *Equilibrium tori in generic static black hole spacetimes*.
Supervisor: Prof. Dr. Luciano Rezzolla.
- **2010 – 2018** **Gymnasium**, Abitur at the Liebigschule in Giessen, Germany.
MINT-EC-price for natural sciences
- **2006 – 2010** **Elementary School**, Brüder-Grimm Schule in Giessen, Germany

Awards & Scientific Memberships

Awards

- **11 July 2025** *Physikerin der Woche* (Physicist of the Week), Deutsche Physikalische Gesellschaft, DPG (German Physical Society).
- **13 Feb. 2025** Wissenschaftspreis des Physikalischen Vereins 2024, Science prize of the Physical Society Frankfurt for the best Master's thesis.
- **July 2018** MINT-EC-price for natural sciences

Memberships

- **July 2025 – ongoing** Member of **CRC-TR 211**, *Strong Interaction Matter under Extreme Conditions*.
- **Dec. 2024 – ongoing** Founder and board member of **Physik für Alle e.V.**, a society for science communication at schools.

- **Nov. 2024 – ongoing** Member of the **Deutsche Physikalische Gesellschaft e.V.** (DPG).
- **Jan. 2024 – ongoing** Member of **Helmholtz Graduate School for Hadron and Ion Research** "HGS-HiRe for FAIR", GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany
- **Dec. 2023 – ongoing** Member of the **JETSET** ERC Advanced Grant team, *Launching, propagation and emission of relativistic jets from binary mergers and across mass scales*.

Research Funding & HPC Allocations

- **2026–2027 Project contributor**, MUSIC (*Muons and Spins in Compact Object Mergers*), Tier-0/Tier-1 HPC allocation on the GPU-accelerated Hunter supercomputer, High-Performance Computing Center Stuttgart (HLRS), Germany (25,000 node-hours; 1 November 2026–31 October 2027).
- **2025 Project Leader, Principal Investigator**, EuroHPC General Access allocation (*Pushing the edge in compact binary mergers: Inspiral, Instabilities, and Radiation-Driven Outflows*) on MareNostrum5 GPP, Barcelona Supercomputing Center, Spain (25M CPUh/224,140 node-hours). Responsible for proposal writing, allocation management, project development, code development, scaling tests, simulation setup, and production runs.
- **2025 Project contributor**, MICMAC project on SuperMUC-NG, Gauss Centre for Supercomputing, Jülich Supercomputing Centre, Germany (60M CPUh; PI: Luciano Rezzolla).
- **2024–2025 Project contributor**, GRACE (*Development of GRACE: a GRMHD Toolkit for Exascale heterogeneous systems*), preparatory GPU access on Hawk-I, High-Performance Computing Center Stuttgart (HLRS), Germany (1 November 2024–30 April 2025; PIs: Carlo Musolino and Luciano Rezzolla).
- **2024 Project contributor**, BNSMIC extension on the HPE-Apollo HAWK Tier-0/1 supercomputer, High-Performance Computing Center Stuttgart, Germany (100M CPUh; PI: Luciano Rezzolla).
- **2023 Project contributor**, BNSMIC extension on the HPE-Apollo HAWK Tier-0/1 supercomputer, High-Performance Computing Center Stuttgart, Germany (100M CPUh; PI: Luciano Rezzolla).

Talks & Conferences

- **21–25 Sept. 2026** ECT*-EMMI/GSI Workshop, "The interplay of magnetic fields, nuclear physics, and nucleosynthesis in neutron-star mergers and supernovae", ECT*, Trento, Italy.
Talk: *The Role of Neutrino Transport in Delayed Collapse Binary Neutron Star Merger Remnants*.
- **15–17 July 2026** NewFunFiCO Workshop, "Extreme Gravity of Astrophysical Compact Objects", Frankfurt am Main, Germany.
Talk: *The Role of Neutrino Transport in Delayed-Collapse Binary-Neutron-Star Merger Remnants*. Local organizing committee and session chair.
- **15–20 March 2026** DPG Spring Meeting, Erlangen, Germany.
Talk: *A Novel Approach for the Systematic Study of Long-Lived Merger Remnants with Neutrino Radiation*.
- **21–25 July 2025** Workshop "New Frontiers in Numerical Relativity", Palma de Mallorca, Spain.
Talk: *A Novel Approach for the Systematic Study of Long-Lived Merger Remnants with Neutrino Radiation*.
- **July 2025** Palaver Seminar, Institute for Theoretical Physics, Frankfurt am Main, Germany.
Talk: *Neutrino Radiation in Binary-Neutron-Star Mergers*.
- **31 March–04 April 2025** DPG Spring Meeting, Göttingen, Germany.
Talk: *Realistic Equilibria of General-Relativistic Differentially Rotating Stars*.
- **11–14 Feb. 2025** BHAC-hackathon workshop on the BHAC+ code, Friedrichsdorf, Germany.
Invited talk: *BHAC+M1: Radiation Transport in the BHAC+ Code*.
- **8–12 July 2024** Workshop "Solving the Boltzmann Equation for Neutrino Transport in Relativistic Astrophysics", ICERM, Providence, USA. Attendance.
- **Nov. 2023** Palaver Seminar, Institute for Theoretical Physics, Frankfurt am Main, Germany.
Talk: *Realistic Equilibria of General-Relativistic Differentially Rotating Stars*.
- **Feb. 2023** Seminar at the Frankfurt Institute for Advanced Studies (FIAS), Frankfurt am Main, Germany.
Talk: *Compact Objects with Two Dark Matter Fluids*.

- **Aug. 2022** EXPLORE Summer School Conference, Goethe University Frankfurt, Germany. Talk: *Dark Stars*.
- **May 2022** ELEMENTS Annual Conference, FIAS, Frankfurt am Main, Germany. Attendance.
- **Nov. 2021** Palaver Seminar, Institute for Theoretical Physics, Frankfurt am Main, Germany. Talk: *Equilibrium Tori*.
- **Nov. 2021** Frankfurt-Mainz Cosmo-Coffee, FIAS, Frankfurt am Main, Germany. Attendance.
- **Aug. 2021** EXPLORE Summer School, Goethe University Frankfurt, Germany. Research collaboration with the University of Toronto and York University, Canada.

Teaching, Reviewing & Outreach

Reviewing

- **2025 – ongoing** Co-reviewer for *Physical Review D* (PRD).
- **2024 – ongoing** Reviewer for the American Astronomical Society (AAS).

Teaching

- **2026** Tutor, *Astrophysics 2: Introduction to Galaxies and Large Scale Structure*, Goethe University Frankfurt.
- **2025** Tutor, *Mathematics for Biophysicists*, Goethe University Frankfurt.
- **2024** Tutor, *General Relativity*, Goethe University Frankfurt.
- **2023** Tutor, *General Relativity*, Goethe University Frankfurt.
- **2021** Tutor, *Experimental Physics 1*, Goethe University Frankfurt.

Outreach & Organization

- **2026** Member of the local organizing committee and session chair for the NewFunFiCO meeting, *Extreme Gravity of Astrophysical Compact Objects*, Frankfurt am Main, Germany.
- **Dec. 2024 – ongoing** Founder and board member of *Physik für Alle e.V.*; science communication and physics outreach for schools.
- **Oct. 2024** Assisted with the scientific art exhibition *Presence of Absence* at Frankfurter Kunstverein, contributing to exhibits connecting art and theoretical physics.
- **2022 – 2023** Secondary studies: coursework in philosophy.

Skills

Technical & HPC

- **Programming & Parallel Computing:** Fortran, C, C++, Python, Bash, MPI, OpenMP, Kokkos, CUDA/HIP.
- **HPC Environments:** Slurm, PBS, Spack, Intel oneAPI, HDF5, parallel I/O, profiling.
- **Simulation Codes:** BHAC, BHAC+(M1), GRACE, Einstein Toolkit, FIL, FUKA, RNS, POSSIS.
- **CPU/GPU Computing:** Development and scaling on Tier-o/1 supercomputers, including SuperMUC-NG, HAWK, HAWK-AI, Hunter, and MareNostrum5.
- **Data Analysis & Visualization:** Python, ParaView, VisIt, Amira Avizo, kuibit, BHAC_tools, GRACEPY.

Scientific Communication & Design

- **Scientific Illustration & Visual Design:** Scientific figures, schematic illustrations, presentation graphics, outreach material, art and visualisations for complex physical concepts with Procreate and Canva.

Languages

- **German:** native; **Russian:** native; **English:** fluent; **Spanish:** intermediate; **Latin:** Big Latinum.

Publications

- **M. Cassing**, K. Miler, H. H.-Y. Ng, C. Musolino, and L. Rezzolla, “GRACE-M1: Neutrino transport and muons in the long-term evolution of binary neutron-star mergers,” [2026](#), in preparation.
- **M. Cassing**, C. Musolino, and L. Rezzolla, “Neutrino and Magnetic Effects in the Black-Hole–Torus Remnant of a Delayed-Collapse Binary Neutron-Star Merger,” [2026](#), in preparation.
- Z. Chen, **M. Cassing**, P. Singh, and L. Rezzolla, “Quasi-spherical Fallback as Fuel and Obstacle in a Secondary-jet Model for Extended Emission from Binary Neutron Star Mergers,” [2026](#), in preparation.
- C. Musolino, C. Ecker, K. Topolski, **M. Cassing**, K. Miler, H. H.-Y. Ng, K. Pierre, E. R. Most, and L. Rezzolla, “GRACE: An Open-Source Framework for GPU-Accelerated Numerical Relativity,” [Jul. 2026](#). arXiv: 2607.09854 [gr-qc].
- S. D. Tootle, T. P. Jacques, and **M. Cassing**, “New code for computing differentially rotating neutron stars,” *Phys. Rev. D*, vol. 113, no. 8, p. 084 066, [2026](#).  DOI: 10.1103/cs37-8g78. arXiv: 2601.05176 [gr-qc].
- **M. Cassing** and L. Rezzolla, “Realistic models of general-relativistic differentially rotating stars,” *Mon. Not. Roy. Astron. Soc.*, vol. 532, no. 1, pp. 945–964, [2024](#).  DOI: 10.1093/mnras/stae1527. arXiv: 2405.06609 [gr-qc].
- **M. Cassing**, A. Brisebois, M. Azeem, and J. Schaffner-Bielich, “Exotic Compact Objects with Two Dark Matter Fluids,” *Astrophys. J.*, vol. 944, no. 2, p. 130, [2023](#).  DOI: 10.3847/1538-4357/acb3be. arXiv: 2210.13697 [gr-qc].
- **M. Cassing** and L. Rezzolla, “Equilibrium non-self-gravitating tori around black holes in parametrized spherically symmetric space-times,” *Mon. Not. Roy. Astron. Soc.*, vol. 522, no. 2, pp. 2415–2428, [2023](#).  DOI: 10.1093/mnras/stad1039. arXiv: 2302.09135 [gr-qc].