**FABIO BACCHINI**

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Centre for mathematical Plasma Astrophysics
Department of Mathematics, KU Leuven
Celestijnenlaan 200B 04.34, 3001 Leuven, Belgium

AND

Royal Belgian Institute for Space Aeronomy
Ringlaan 3 Avenue Circulaire, 1180 Brussels, Belgium

## Professional Experience

BELSPO FED-tWIN Assistant Professor (Tenure-track) / Research Scientist, 2022 – present
KU Leuven / Royal Belgian Institute for Space Aeronomy (Belgium)

CIPS PostDoctoral Fellow, University of Colorado Boulder (USA), 2020 – 2022
FWO PostDoctoral Fellow, KU Leuven (Belgium), 2019 – 2020
PostDoctoral Fellow, Goethe Universität Frankfurt am Main (Germany), 2019

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## Education

Department of Mathematics, KU Leuven (Belgium)
PhD in Mathematics, December 2018
Advisor: Giovanni Lapenta
Thesis: *Particle methods for Newtonian and relativistic plasma simulations*
*Research visit:* Columbia University, New York City (USA), 2017 – 2018. Host: Lorenzo Sironi

Energy Department, Politecnico di Torino (Italy)
MSc in Energy and Nuclear Engineering, 110/110, December 2014
Advisor: Gianni Coppa
Thesis: *A Lagrangian Particle-in-Cell Method for Magnetohydrodynamics*
*Research visit:* KU Leuven, Leuven (Belgium), 2014. Host: Giovanni Lapenta

Energy Department, Politecnico di Torino (Italy)
BSc in Energy Engineering, 96/110, November 2012
Advisor: Cesare Boffa

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## Language proficiency

Italian (native), English (fluent), Dutch (B1 level), French (B1 level)

### Selected Research Projects and Grants (full project list here)

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|---|---|
| COST Action CA24149 EXPAND (KU Leuven Co-PI), $\sim$ 550k EUR | **2025 – 2029** |
| FWO IRI Project I000725N (KU Leuven Co-PI), 14.8M EUR | **2025 – 2027** |
| KU Leuven IF Project GSF/25/062 (PI), 30k EUR | **2025 – 2026** |
| KU Leuven IF Project C16/24/010 (Co-PI), 1.73M EUR | **2024 – 2030** |
| FWO Junior Research Project G020224N (PI), 500k EUR | **2024 – 2027** |
| BRAIN-be Project PLATINUM (KU Leuven PI), 138k EUR | **2024 – 2026** |
| HORIZON 2.4 Project EuroHPC-SPACE (KU Leuven PI), 8M EUR | **2024 – 2026** |
| KU Leuven IF Project STG/22/018 (PI), 110k EUR | **2022 – 2024** |

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### Mentoring @KU Leuven

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| Supervision of PhD student S. Pande | **2025 –** |
| Supervision of PhD student K.-X. Argyropoulos | **2025 –** |
| Supervision of FWO PhD student C. Mora | **2025 –** |
| Co-supervision of PhD student O. Willocx | **2025 –** |
| Supervision of PhD student M. Péters de Bonhome | **2024 –** |
| Supervision of FWO PhD student N. Reisinger | **2024 –** |
| Co-supervision of CSC PhD student R. Lin | **2024 – 2025** |
| Supervision of FWO PhD student S. Ferro | **2023 –** |
| Supervision of FWO PhD student L. Pezzini | **2022 –** |
| Co-supervision of PhD student D. Maci | **2022 –** |
| Supervision of MSc student V. Chanfana Bruno Ferreira | **2025 – 2026** |
| Supervision of MSc student F. Ferreri | **2025 – 2026** |
| Supervision of MSc student R. Smets | **2023 – 2024** |
| Co-supervision of MSc student F. Hallein | **2023 – 2024** |
| Co-supervision of MSc student L. van Dael | **2022 – 2023** |
| Co-supervision of MSc student S. Staelens (Physics Thesis Prize 2022) | **2021 – 2022** |
| Supervision of BSc Honors student P. Deceuninck | **2024 – 2026** |

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### Teaching @KU Leuven

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| Teacher for the course G0P71B *Introduction to Plasma Dynamics* | **2024 –** |
| Teacher for the course G0N98A *Mathematical Introduction to Fluid Dynamics* | **2022 –** |
| T.A. in the course G0P71B *Introduction to Plasma Dynamics* | **2016 – 2019** |
| T.A. in the course G0Y37A *Calculus I* | **2016 – 2019** |
| T.A. in the course G0Y40A *Calculus II* | **2017 – 2018** |
| T.A. in the course G0N84B *Differential Equations* | **2016 – 2018** |
| T.A. in the course G0B32A *Space Weather* | **2015 – 2018** |

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### Research awards, prizes, and fellowships

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| BELSPO FED-tWIN Fellowship (10 years), KU Leuven/BIRA | **2022** |
| CIPS PostDoctoral Fellowship (3 years), CIPS, CU Boulder | **2020** |
| MPPC PostDoctoral Fellowship (3 years), MPPC, Princeton University (declined) | **2020** |
| CIERA PostDoctoral Fellowship (3 years), CIERA, Northwestern University (declined) | **2020** |
| Perimeter PostDoctoral Fellowship (3 years), Perimeter Institute (declined) | **2020** |

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| FWO Junior PostDoctoral Fellowship (3 years), FWO of Belgium | **2019** |
| AVH PostDoctoral Fellowship (2 years), Alexander Von Humboldt Foundation (declined) | **2019** |
| Best Poster Prize award, WE-Heraeus-Seminar on Accretion in strong gravity | **2019** |
| JuMo research grant for long stay abroad (3 months), KU Leuven | **2018** |
| FWO research grant for long stay abroad (3 months), FWO of Belgium | **2017** |
| Master thesis research grant for foreign students (6 months), KU Leuven | **2014** |
| Research grant for thesis abroad (6 months), Politecnico di Torino | **2014** |
| Full scholarship for university studies (3 years), EDISU Piemonte | **2009** |

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**Computing grants (Total: 737.40M CPU-h, 387.9k GPU-h)**

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|---|---|
| Tier-0 Grant `EHPC-REG-2025R01-002`, 19.2M CPU-h, LXP-MeluXina (Luxembourg) | **2025** |
| Tier-0 Grant `2025-10-T384`, 9.00M CPU-h, CSC-LUMI (Finland) | **2025** |
| Tier-1 Grant `lt1_2025-087`, 7.6M CPU-h, VSC (Belgium) | **2025** |
| Tier-1 Grant `lt1_2025-076`, 10.22M CPU-h, VSC (Belgium) | **2025** |
| Tier-1 Grant `lt1_2025-071`, 4.1M CPU-h, VSC (Belgium) | **2025** |
| Tier-1 Grant `lt1_2025-058`, 9.84M CPU-h, VSC (Belgium) | **2025** |
| Tier-1 Grant `lt1_2025-053`, 8.96M CPU-h, VSC (Belgium) | **2025** |
| Tier-1 Grant `lt1_2025-051`, 40k GPU-h, VSC (Belgium) | **2025** |
| Tier-1 Grant `lt1_2025-050`, 12M CPU-h, VSC (Belgium) | **2025** |
| Tier-1 Grant `lt1_2025-037`, 8.51M CPU-h, VSC (Belgium) | **2025** |
| Tier-1 Grant `lt1_2025-027`, 10M CPU-h, VSC (Belgium) | **2025** |
| Tier-1 Grant `lt1_2025-019`, 12M CPU-h, VSC (Belgium) | **2025** |
| Tier-1 Grant `lt1_2025-018`, 40k GPU-h, VSC (Belgium) | **2025** |
| Tier-1 Grant `lt1_2025-015`, 17.75M CPU-h, VSC (Belgium) | **2025** |
| Tier-1 Grant `lt1_2025-013`, 7.37M CPU-h, VSC (Belgium) | **2025** |
| Tier-1 Grant `lt1_2025-005`, 8.6M CPU-h, VSC (Belgium) | **2025** |
| Tier-1 Grant `lt1_2025-004`, 12.27M CPU-h, VSC (Belgium) | **2025** |
| Tier-1 Grant `lt1_2025-003`, 4.96M CPU-h, VSC (Belgium) | **2025** |
| Tier-1 Grant `lt1_2025-001`, 9.37M CPU-h, VSC (Belgium) | **2025** |
| Tier-0 Grant `2025-09-T357`, 9.83M CPU-h, CSC-LUMI (Finland) | **2025** |
| Tier-0 Grant `2024-08-T330`, 250,300 GPU-h, CSC-LUMI (Finland) | **2024** |
| Tier-0 Grant `2024-08-T330`, 19.86M CPU-h, CSC-LUMI (Finland) | **2024** |
| Tier-1 Grant `lt1_2024-126`, 7.01M CPU-h, VSC (Belgium) | **2024** |
| Tier-1 Grant `lt1_2024-100`, 5.16M CPU-h, VSC (Belgium) | **2024** |
| Tier-1 Grant `lt1_2024-96`, 7.1M CPU-h, VSC (Belgium) | **2024** |
| Tier-1 Grant `lt1_2024-95`, 7.38M CPU-h, VSC (Belgium) | **2024** |
| Tier-1 Grant `lt1_2024-92`, 9.01M CPU-h, VSC (Belgium) | **2024** |
| Tier-1 Grant `lt1_2024-91`, 8.51M CPU-h, VSC (Belgium) | **2024** |
| Tier-1 Grant `lt1_2024-89`, 7.32M CPU-h, VSC (Belgium) | **2024** |
| Tier-1 Grant `lt1_2024-85`, 12.00M CPU-h, VSC (Belgium) | **2024** |
| Tier-1 Grant `lt1_2024-84`, 15.76M CPU-h, VSC (Belgium) | **2024** |
| Tier-1 Grant `lt1_2024-76`, 7.18M CPU-h, VSC (Belgium) | **2024** |
| Tier-1 Grant `lt1_2024-60`, 8.79M CPU-h, VSC (Belgium) | **2024** |
| Tier-1 Grant `lt1_2024-57`, 1.00M CPU-h, VSC (Belgium) | **2024** |
| Tier-1 Grant `lt1_2024-55`, 17.75M CPU-h, VSC (Belgium) | **2024** |
| Tier-1 Grant `lt1_2024-53`, 12.00M CPU-h, VSC (Belgium) | **2024** |

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|---|---|
| Tier-1 Grant lt1_2024-48, 8.51M CPU-h, VSC (Belgium) | **2024** |
| Tier-0 Grant 2024-06-T235, 2.64M CPU-h, CSC-LUMI (Finland) | **2024** |
| Tier-0 Grant 2024-06-T234, 8.79M CPU-h, CSC-LUMI (Finland) | **2024** |
| Frontera LRAC Grant AST21007, 22M CPU-h, TACC (USA) | **2024** |
| Tier-1 Grant lt1_2024-40, 6.40M CPU-h, VSC (Belgium) | **2024** |
| Tier-1 Grant lt1_2024-23, 8.79M CPU-h, VSC (Belgium) | **2024** |
| Tier-1 Grant lt1_2024-22, 8.51M CPU-h, VSC (Belgium) | **2024** |
| Tier-0 Grant 2024-06-T185, 9.5M CPU-h, CSC-LUMI (Finland) | **2024** |
| Tier-1 Grant lt1_2023-99, 4.24M CPU-h, VSC (Belgium) | **2023** |
| Tier-1 Grant lt1_2023-83, 57.60k GPU-h, VSC (Belgium) | **2023** |
| Tier-1 Grant lt1_2023-42, 6.08M CPU-h, VSC (Belgium) | **2023** |
| Tier-1 Grant lt1_2023-12, 8.29M CPU-h, VSC (Belgium) | **2023** |
| Tier-1 Grant lt1_2023-4, 6.94M CPU-h, VSC (Belgium) | **2023** |
| Tier-1 Grant lt1_2022-48, 7.65M CPU-h, VSC (Belgium) | **2022** |
| Tier-1 Grant lt1_2022-26, 9.10M CPU-h, VSC (Belgium) | **2022** |
| Frontera Grant AST22001, 34.6M CPU-h, TACC (USA) | **2022** |
| INCITE Grant 10002, 128M CPU-h, ALCF (USA) | **2021** |
| Tier-1 Grant lt1_2021-56, 6.02M CPU-h, VSC (Belgium) | **2021** |
| Frontera Grant AST21007, 12.8M CPU-h, TACC (USA) | **2021** |
| Tier-1 Grant lt1_2021-17, 3.23M CPU-h, VSC (Belgium) | **2021** |
| Tier-1 Grant lt1_2021-16, 6.42M CPU-h, VSC (Belgium) | **2021** |
| Tier-1 Grant lt1_2020-36, 2.82M CPU-h, VSC (Belgium) | **2020** |
| Tier-1 Grant lt1_2019-43, 6.88M CPU-h, VSC (Belgium) | **2019** |
| Tier-1 Grant lt1_2019-11, 3.39M CPU-h, VSC (Belgium) | **2019** |
| Tier-1 Grant lt1_2018-51, 3.39M CPU-h, VSC (Belgium) | **2018** |

**Publication list (most recent first)**

46. Reisinger, N., **Bacchini, F.** (2025), *Comparing Simulated and Observed Particle Energy Distributions through Magnetic Reconnection in Earth's Magnetotail*, submitted to GRL
Preprint: arXiv:2509.07621

45. Schoeffler, K.M., **Bacchini, F.**, Kormann, K., Eichmann, B., Innocenti, M.E. (2025), *Energetic spectra from semi-implicit particle-in-cell simulations of magnetic reconnection*, submitted to Scientific Reports
Preprint: arXiv:2509.11100

44. Lapenta, G., Berchem, J., El-Alaoui, M., Walker, R., Aravindakshan, H., Reisinger, N., Pucci, F., Arrò, G., **Bacchini, F.** (2025), *A Lagrangian-Frame Technique for Investigating Plasma Turbulence in Complex Underlying System-Scale Structures*, accepted in Fundamental Plasma Physics

43. Granier, C., Grošelj, D., Comisso, L., **Bacchini, F.** (2025), *Onset of Driven Collisionless Reconnection in Strongly Magnetized Pair Plasmas*, accepted in ApJ
Preprint: arXiv:2506.06059

42. Grehan, M.P., Ghosal, T., Beattie, J.R., Ripperda, B., Porth, O., **Bacchini, F.** (2025), *Comparison of magnetic diffusion and reconnection in ideal and resistive relativistic magnetohydrodynamics, ideal magnetodynamics and resistive force-free electrodynamics*, PRD 112, 063046
DOI: 10.1103/8xf2-x2nq; Preprint: arXiv:2503.20013

41. Shukla, N., Romeo, A., Caravita, C., Redenti, M., Vavrik, R., Riha, L., Mignone, A., Rossazza, M., Truzzi, S., Tornatore, L., Ragagnin, A., Castro, T., Karademir, G.S., and Dolag, K., Deka, P.J., **Bacchini, F.**, Wilhelm, R.-P., Gregori, D., Boella, E. (2025), *Towards Exascale Computing for Astrophysical Simulation Leveraging the Leonardo EuroHPC System*, Procedia Computer Science 267, 112
DOI: 10.1016/j.procs.2025.08.238

40. **Bacchini, F.**, Werner, G.R., Granier, C., Vos, J. (2025), *Three-dimensional Dynamics of Strongly Magnetized Ion–Electron Relativistic Reconnection*, ApJL 991, L9
DOI: 10.3847/2041-8213/ae0197; Preprint: arXiv:2507.12509

39. Gorbunov, E.A., Grošelj, D., **Bacchini, F.** (2025), *Leaking Outside the Box: Kinetic Turbulence with Cosmic-Ray Escape*, PRL 135, 065201
DOI: 10.1103/3777-z37m; Preprint: arXiv:2503.03820
[Note: PRL Editor's Suggestion]

38. Shukla, N., Romeo, A., Caravita, C., Riha, L., Vysocky, O., Strakos, P., Jaros, M., Barbosa, J., Vavrik, R., Mignone, A., Rossazza, M., Truzzi, S., Berta, V., Colonnelli, I., Medić, D., Boella, E., Gregori, D., Sciacca, E., Tornatore, L., Taffoni, G., Deka, P.J., **Bacchini, F.**, Wilhelm, R.-P., Doulis, G., Pierre, K., Rezzolla, L., Colman, T., Commerçon, B., Bouizi, O., Kuhn, M., Raffin, E., Sergent, M., Wissing, R., Marin, G., Dolag, K., Karademir, G.S., Perna, G., Zanotti, M., Trujillo-Gomez, S. (2025), *EuroHPC SPACE CoE: Redesigning Scalable Parallel Astrophysical Codes for Exascale. Invited Paper*, Proceedings of the 22nd ACM International Conference on Computing Frontiers: Workshops and Special Sessions 177, 8
DOI: 10.1145/3706594.3728892

37. Maci, D., Keppens, R., **Bacchini, F.** (2025), *Toward applications of the BxC toolkit*, J. Phys.: Conf. Ser. 2997, 012003
DOI: 10.1088/1742-6596/2997/1/012003

36. Péters de Bonhome, M., Pierrard, V., **Bacchini, F.** (2025), *A Kinetic Model of Solar Wind Acceleration Driven by Ambipolar Electric Potential and Velocity-Space Diffusion*, A&A 679, A104
DOI: 10.1051/0004-6361/202554250; Preprint: arXiv:2502.18132

35. Zou, M., Hakobyan, H., Mbarek, R., Ripperda, B., **Bacchini, F.**, Sironi, L. (2025), *New Particle Pusher with Hadronic Interactions for Modeling Multimessenger Emission from Compact Objects*, PRD 111, 083032
DOI: PhysRevD.111.083032; Preprint: arXiv:2410.22781

34. Gorbunov, E.A., **Bacchini, F.**, Zhdankin, V., Werner, G.R., Begelman, M.C., Uzdensky, D.A. (2025), *First-principles measurement of ion and electron energization in collisionless accretion flow*, ApJL 982, L28
DOI: 10.3847/2041-8213/adbca4; Preprint: arXiv:2410.02872

33. Baratashvili, T., Popescu Braileanu, B., **Bacchini, F.**, Keppens, R., Poedts, S. (2025), *Icarus 3.0: Dynamic Heliosphere Modelling*, A&A 694, A306
DOI: 10.1051/0004-6361/202452705; Preprint: arXiv:2501.15923

32. Scolini, C., Lugaz, N., Winslow, R.M., Farrugia, C.J., Magyar, N., **Bacchini, F.**, Zhuang, B. (2025), *Can Alfvénic Fluctuations Affect the Coherence and Complexity of Magnetic Ejecta? A Case Study Based on Multi-Spacecraft Measurements at 1 au*, ApJ 978, 146
DOI: 10.3847/1538-4357/ad9a55; Preprint: arXiv:2412.08008

31. Pezzini, L., Zhukov, A.N., **Bacchini, F.**, Arrò, G., López, R.A., Micera, A., Innocenti, M.E., Lapenta, G. (2024), *Fully Kinetic Simulations of Proton-Beam-Driven Instabilities from Parker Solar Probe Observations*, ApJ 975, 37
DOI: 10.3847/1538-4357/ad7465; Preprint: arXiv:2405.08196

30. **Bacchini, F.**, Zhdankin, V., Gorbunov, E.A., Werner, G.R., Arzamasskiy, L., Begelman, M.C., Uzdensky, D.A. (2024), *Collisionless Magnetorotational Turbulence in Pair Plasmas: Steady-state Dynamics, Particle Acceleration, and Radiative Cooling*, PRL 133, 045202
DOI: 10.1103/PhysRevLett.133.045202; Preprint: arXiv:2401.01399
[Note: PRL Editor's Suggestion]

29. Maci, D., Keppens, R., **Bacchini, F.** (2024), BxC *Toolkit: Generating Tailored Turbulent 3D Magnetic Fields*, ApJS 273, 11
DOI: 10.3847/1538-4365/ad4bdf; Preprint: arXiv:2405.09587
[Note: Highlighted in AAS NOVA]

28. Ferro, S., Faganello, M., Califano, F., **Bacchini, F.** (2024), *Comparative simulations of Kelvin-Helmholtz induced magnetic reconnection at the Earth's magnetospheric flanks*, PoP 31, 052902
DOI: 10.1063/5.0191674; Preprint: arXiv:2312.11161

27. Croonen, J., Pezzini, L., **Bacchini, F.**, Lapenta, G. (2024), *An Exactly Energy-conserving Electromagnetic Particle-in-Cell Method in Curvilinear Coordinates*, ApJS 271, 63
DOI: 10.3847/1538-4365/ad31a3; Preprint: arXiv:2310.17253

26. Sandoval, A., Riquelme, M., Sptikovsky, A., **Bacchini, F.** (2024), *Particle-in-cell Simulations of the Magnetorotational Instability in Stratified Shearing Boxes*, MNRAS 530, 2
DOI: 10.1093/mnras/stae959; Preprint: arXiv:2308.12348

25. **Bacchini, F.**, Ruan, W., Keppens, R. (2024), *Particle Trapping and Acceleration in Turbulent Post-flare Coronal Loops*, MNRAS 529, 3
DOI: 10.1093/mnras/stae723; Preprint: arXiv:2403.07107

24. **Bacchini, F.**, Philippov, A. A. (2024), *Fundamental, Harmonic, and Third-harmonic Plasma Emission from Beam-plasma Instabilities: A First-principles Precursor for Astrophysical Radio Bursts*, MNRAS 529, 1
DOI: 10.1093/mnras/stae521; Preprint: arXiv:2402.11011

23. Scolini, C., Lugaz, N., Winslow, R. M., Farrugia, C. J., Magyar, N., **Bacchini, F.** (2024), *On the Role of Alfvénic Fluctuations as Mediators of Coherence within Interplanetary Coronal Mass Ejections: Investigation of Multi-Spacecraft Measurements at 1 au*, ApJ 961, 135
DOI: 10.3847/1538-4357/ad0ed1; Preprint: arXiv:2312.04480

22. **Bacchini, F.** (2023), *RelSIM: A Relativistic Semi-Implicit Method for Particle-in-Cell Simulations*, ApJS 268, 60
DOI: 10.3847/1538-4365/acefba; Preprint: arXiv:2306.04685

21. Selvi, S., Porth, O., Ripperda, B., **Bacchini, F.**, Sironi, L., Keppens, R. (2023), *Effective resistivity in relativistic collisionless plasmoid-mediated reconnection*, ApJ 950, 169
DOI: 10.3847/1538-4357/acd0b; Preprint: arXiv:2211.04553

20. Staelens, S., Mayerson, D.R., **Bacchini, F.**, Ripperda, B., Küchler, L. (2023), *Black Hole Photon Rings Beyond General Relativity*, PRD 107, 124026
DOI: 10.1103/PhysRevD.107.124026; Preprint: arXiv:2303.02111

19. Keppens, R., Popescu Braileanu, B., Zhou, Y., Ruan, W., Xia, C., Guo, Y., Claes, N., **Bacchini, F.** (2023), *MPI-AMRVAC 3.0: updates to an open-source simulation framework*, A&A 673, A66
DOI: 10.1051/0004-6361/202245359; Preprint: arXiv:2303.03026

18. Galishnikova, A., Philippov, A.A., Quataert, E., **Bacchini, F.**, Parfrey, K., Ripperda, B. (2023), *Collisionless accretion onto black holes: Dynamics and flares*, PRL 130, 115201
DOI: 10.1103/PhysRevLett.130.115201; Preprint: arXiv:2212.02583

17. **Bacchini, F.**, Arzamasskiy, L., Zhdankin, V., Werner, G.R., Begelman, M.C., Uzdensky, D.A. (2022), *Fully kinetic shearing-box simulations of magnetorotational turbulence in 2D and 3D. I. Pair plasmas*, ApJ, 938, 86
DOI: 10.3847/1538-4357/ac8a94; Preprint: arXiv:2206.07061

16. **Bacchini, F.**, Pucci, F., Malara, F., Lapenta, G. (2022), *Kinetic heating by Alfvén waves in magnetic shears*, PRL, 128, 025101
DOI: 10.1103/PhysRevLett.128.025101; Preprint: arXiv:2112.00768

15. **Bacchini, F.**, Mayerson, D.R., Ripperda, B., Davelaar, J., Olivares, H., Vercnocke, B., Hertog, T. (2021), *Fuzzball Shadows: Emergent Horizons from Microstructure*, PRL, 127, 171601
DOI: 10.1103/PhysRevLett.127.171601; Preprint: arXiv:2103.12075

14. Zhao, X., **Bacchini, F.**, Keppens, R. (2021), *Magnetic Island Merging: Two-dimensional MHD Simulation and Test-Particle Modeling*, PoP, 28, 9
DOI: 10.1063/5.0058326; Preprint: arXiv:2108.13508

13. **Bacchini, F.**, Ripperda, B., Philippov, A.A. (2020), *A coupled guiding center–Boris particle pusher for magnetized plasmas in compact-object magnetospheres*, ApJS, 251, 10
DOI: 10.3847/1538-4365/abb604; Preprint: arXiv:2007.14401

12. Ripperda, B., **Bacchini, F.**, Philippov, A.A. (2020), *Magnetic reconnection and hot spot formation in black hole accretion disks*, ApJ, 900, 100
DOI: 10.3847/1538-4357/ababab; Preprint: arXiv:2003.04330
[Note: Top Cited Paper Award 2023 from IOP/AAS]

11. **Bacchini, F.**, Ripperda, B., Chen, A.Y., Sironi, L. (2020), *Numerical methods for General Relativistic particles*, Proceedings of the IAU 342 Symposium "Perseus in Sicily: From Black Hole to Cluster Outskirts"
DOI: 10.1017/S1743921318007834; Preprint: arXiv:1810.01153

10. Ripperda, B., **Bacchini, F.**, Porth, O., Most, E.R., Olivares, H., Nathanail, A., Rezzolla, L., Teunissen, J., Keppens, R. (2019), *General-relativistic Resistive Magnetohydrodynamics with Robust Primitive-variable Recovery for Accretion Disk Simulations*, ApJS, 244, 10
DOI: 10.3847/1538-4365/ab3922; Preprint: arXiv:1907.07197
[Note: Shared main-authorship]

9. **Bacchini, F.**, Amaya, J., Lapenta, G. (2019), *The relativistic implicit Particle-in-Cell method*, J. Phys: Conf. Ser. 1225, 012011
DOI: 10.1088/1742-6596/1225/1/012011

8. **Bacchini, F.**, Ripperda, B., Porth, O., Sironi, L. (2019), *Generalized, Energy-conserving Numerical Simulations of Particles in General Relativity. II. Test particles in electromagnetic fields and GRMHD*, ApJS, 240, 40
DOI: 10.3847/1538-4365/aafcb3; Preprint: arXiv:1810.00842

7. Bemporad, A., Susino, R., Frassati, F., Mancuso, S., Lapenta, G., **Bacchini, F.** (2019), *Determination of plasma physical properties across collisionless shocks driven by solar eruptions*, Proceedings 46$^{\text{th}}$ EPS Conference on Plasma Physics
http://ocs.ciemat.es/EPS2019PAP/pdf/O2.J802.pdf

6. Olshevsky, V., **Bacchini, F.**, Poedts, S., Lapenta, G. (2019), *Slurm: Magnetohydrodynamic Particle-in-cell model of plasma*, CPC, 235, 16
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5. **Bacchini, F.**, Ripperda, B., Chen, A.Y., Sironi, L. (2018), *Generalized, Energy-conserving Numerical Simulations of Particles in General Relativity. I. Time-like and Null Geodesics*, ApJS, 237, 6
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4. Ripperda, B., **Bacchini, F.**, Teunissen, J., Xia, C., Porth, O., Sironi, L., Lapenta, G., Keppens, R. (2018), *A comprehensive comparison of relativistic particle integrators*, ApJS, 235, 21
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3. **Bacchini, F.**, Olshevsky, V., Poedts, S., Lapenta, G. (2017), *A new Particle-in-Cell method for modeling magnetized fluids*, CPC, 210, 79
   DOI: 10.1016/j.cpc.2016.10.001

2. **Bacchini, F.**, Olshevsky, V., Lapenta, G. (2016), *An innovative, particle-supported Lagrangian method for MHD plasma simulations*, Proceedings 43rd EPS Conference on Plasma Physics
   http://ocs.ciemat.es/EPS2016PAP/pdf/P1.096.pdf

1. **Bacchini, F.**, Susino, R., Bemporad, A., Lapenta, G. (2015), *Plasma Physical Parameters along CME-driven Shocks. II. Observation-simulation comparison*, ApJ, 809, 58
   DOI: 10.1088/0004-637X/809/1/58

**Computer codes for astrophysical simulations (main developer)**

- Slurm, a Lagrangian Particle-in-Cell code for magnetohydrodynamics (link)

  Applications: heliophysics, coronal mass ejections.

- MPI-AMRVAC, an MHD code incorporating adaptive mesh refinement (link)

  Applications: heliophysics, general plasma physics, generic hyperbolic systems of equations.

- BHAC, a general-relativistic MHD code with adaptive mesh refinement (link)

  Applications: high-energy astrophysics in strong-gravity limits (employed for EHT 2019).

- FOORT, a general-purpose ray tracer for string-theoretical spacetimes (link)

  Applications: tracing of photons in curved spacetimes and investigation of string-theoretical black-hole alternatives.

- iPic3D and RiPic3D, semi-implicit PiC codes for (relativistic) kinetic plasma simulations (link)

  Applications: large-scale simulations of collisionless solar and high-energy plasmas.

- ECSIM and RelSIM, semi-implicit PiC codes with exact energy conservations for (relativistic) plasma modeling (link)

  Applications: long-term simulations of (relativistic) reconnection, turbulence, and shocks in the collisionless regime.

- xPic, a general framework for PiC simulations on next-gen superclusters (link)

  Applications: high-performing simulations of collisionless Newtonian and relativistic plasmas.

- Zeltron, a relativistic PiC code for plasma turbulence (link)

  Applications: relativistic turbulence in collisionless plasmas and accretion flows.

**Selected Conferences and Seminars**

- Invited Talk at the *51st EPS Conference on Plasma Physics*, Vilnius, Lithuania, July 2025
- Invited Seminar at the *SCEECS Seminar Series*, Remote meeting, March 2025
- Invited Talk at the *Feeding the spinning top - Accretion-induced torques onto young and strongly magnetized neutron stars in high-mass X-ray binaries* workshop, Santander, Spain, March 2025
- Invited Talk at the *2025 SIAM Conference on Computational Science and Engineering*, Fort Worth, Texas, USA, March 2025
- Invited Talk at *Solar MHD 2024*, Tenerife, Spain, September 2024
- Invited Talk at the *PHYSHPC 2024 - Workshop in High-Performance Computing in Physics*, Madrid, Spain, August 2024
- Invited Talk at the Lorentz Center Workshop *Modeling Plasmas Around Black Holes*, Leiden, The Netherlands, September 2023
- Invited Seminar at Ruhr-Universität Bochum, Bochum, Germany, August 2023
- Invited Seminar at Princeton University, Princeton, New Jersey, USA, June 2023
- Invited Talk at the PCTS/PGI workshop *Next-generation high-energy plasma modeling*, Princeton, New Jersey, USA, April 2023
- Invited Seminar at the University of Santiago de Chile, Santiago de Chile, Chile, March 2023
- Invited Talk at the *7$^{th}$ Workshop on Magnetic Fields in Laboratory High Energy Density Plasmas*, Paris, France, December 2022
- Invited Colloquium at the *JPP Frontiers of Plasma Physics Colloquium*, Remote meeting, November 2022
- Invited Seminar at Université Grenoble Alpes, Grenoble, France, July 2022
- Invited Seminar at Princeton University, Princeton, New Jersey, USA, November 2021
- Invited Seminar at the Institute for Advanced Studies, Princeton, New Jersey, USA, November 2021
- Invited Colloquium at the Center for Integrated Plasma Studies, Boulder, Colorado, USA, October 2021
- Invited Talk at the *Lorentz Center@Oort Workshop — Magnetohydrodynamics: Physics for the 21st Century*, Leiden, The Netherlands, October 2021
- Invited talk at the GPIWG — Event Horizon Telescope remote meeting, March 2021
- Invited Colloquium at the Center for Integrated Plasma Studies, Boulder, Colorado, USA, December 2020

- Invited Seminar at the Institute for Advanced Studies, Princeton, New Jersey, USA, November 2020
- Invited Talk at the *ASTRONUM 2020 - 15$^{th}$ international conference on numerical modeling of space plasma flows*, Pasadena, California, USA (cancelled due to the global pandemic)
- Invited Seminar at the Paris Observatory, Meudon, France, March 2018
- Invited Seminar at Goethe University, Frankfurt am Main, Germany, February 2018
- Invited Seminars at Princeton University, Princeton, New Jersey, USA, September 2017 – January 2018
- Invited Seminar at Harvard University, Cambridge, Massachusetts, USA, September 2017
- Invited Seminar at Columbia University, New York City, New York, USA, July 2017
- Invited Seminar at Princeton University, Princeton, New Jersey, USA, July 2017

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## Computing Skills

*Programming languages:* Fortran, C/C++, Python, Matlab.
*Visualization tools:* Python, ParaView, VisIt.
*Supercomputing/HPC:* Implementation and use of massively parallel codes (MPI/OpenMP) on superclusters in Europe (VSC BrENIAC, Hortense, Genius, ThinKing; LRZ SuperMUC; CSC Lumi) and in the USA (ALCF Theta; NASA Pleiades; TACC Stampede, Frontera).

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## Review, Editing, and Community Service

Peer reviewer for *Physical Review Letters; Physical Review D; Monthly Notices of the Royal Astronomical Society; The Astrophysical Journal; The Astrophysical Journal Supplement Series; Computer Physics Communications; Earth, Moon, and Planets; Mathematics and Computers in Simulation; Physics of the Dark Universe.*
Community Reviewer for *Frontiers in Physics; Frontiers in Astronomy and Space Sciences.*
Panelist reviewer for *INCITE computing proposals* submitted to the DoE (USA)
Panelist reviewer for proposals submitted to the *National Science Foundation* (USA)
External reviewer for proposals submitted to the *Deutschen Forschungsgemeinschaft* (Germany)
Invited reviewer for the ASL Research Award for Science and Technology @KU Leuven
Invited member of the Council of the Faculty of Science @KU Leuven
Service in PhD Supervisory/Examination Committees @KU Leuven
BSc/MSc thesis evaluation in Mathematics, Physics, Computer Science @KU Leuven
Member of the International Astronomical Union
Member of the Leuven Gravity Institute and the Einstein Telescope Working Group
Management Committee member and Working Group leader for the COST Action EXPAND

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## Conference Organization, Press Coverage, and Outreach Activities

Coverage in the popular science magazine Phys.org, 2025

Science-based art exhibition Sál in collaboration with art studio fuse*, 2025

Public lectures in high schools via the Scientist@School program, 2025–present

Public lecture at the Urania seminar series, 2025

Coverage in the popular science magazine Phys.org, 2024

Member of the Programme Committee of the ICPP 2024

Science Highlight in the Argonne Leadership Computing Facility, 2023

Organization of and teaching in the KU Leuven Summer of Science for high school students, 2023–present

Coverage in the Dutch popular scientific magazine Eos, 2022

Contribution to science-based art exhibitions at the "Imaginary" initiative and at the opening of the BEL center, 2022

Contribution to science-based music project "ADS/CFT", 2021

**Career Breaks**

Paternity leave (May 2024)