Global simulations of relativistic jets from accreting black holes

2024 report of Krzysztof Nalewajko

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- K. Nalewajko „Tension of toroidal magnetic field in reconnection plasmoids and relativistic jets", 2025, submitted to A&A

- new Ph.D. student: Wen Xuan Sia (stipend: CAMK -> OPUS 27)
- master student: Mateusz Kapusta
- new collaborators: Bart Ripperda, Alexander Philippov
- new grant NCN OPUS 27
- 2 invited conference talks (SCEECS*/NYU, Purdue),
  4 seminars (Grenoble, UMK, CAMK, St. Louis)
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- secretary of the Scientific Council

* Simons Collaboration on Extreme Electrodynamics of Compact Sources

Tension of toroidal magnetic field in reconnection plasmoids and relativistic jets

magnetic tension enhances energy density in plasmoids and jets, combined to enhance luminosity of blazar flares

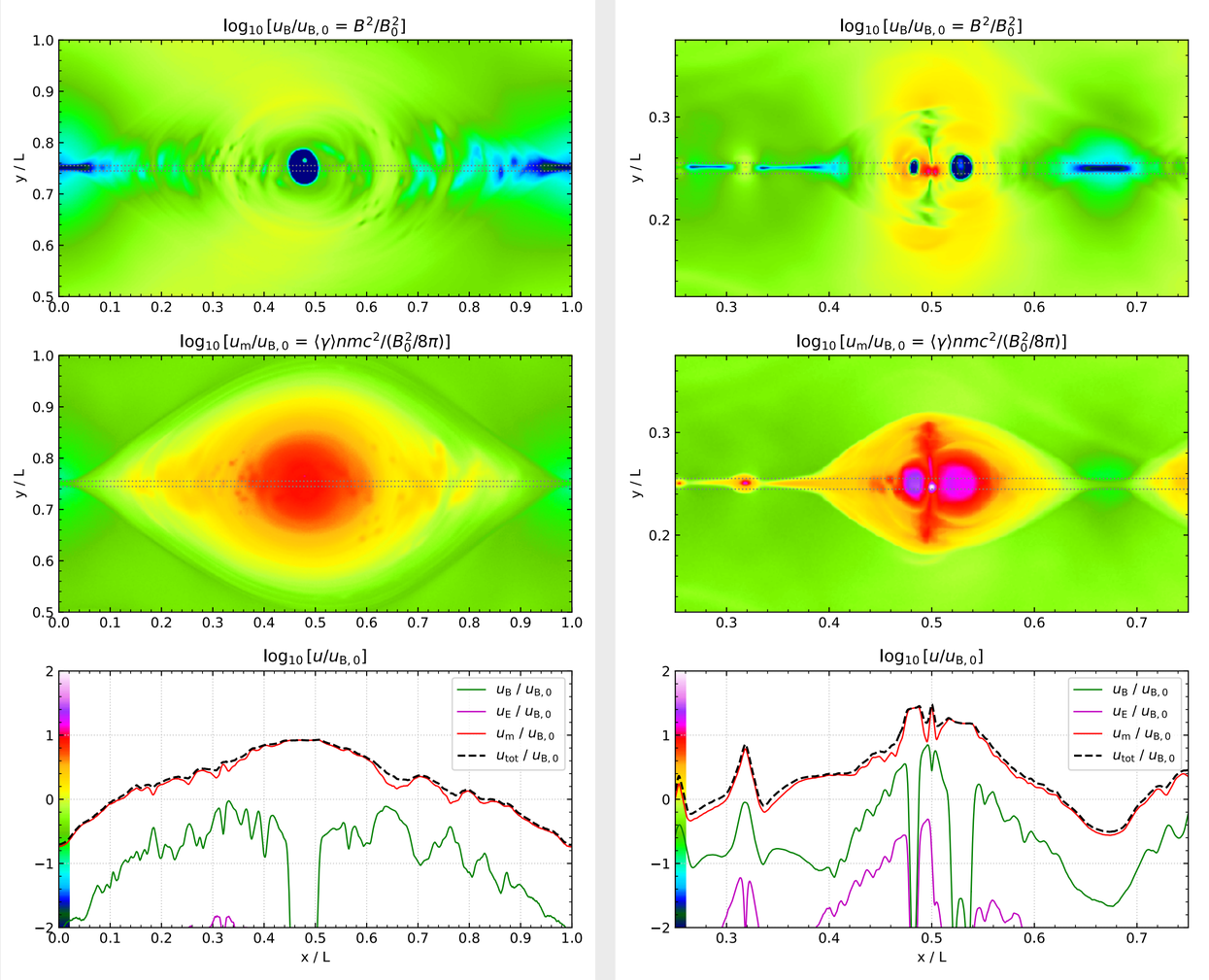
submitted to A&A

PIC simulations of relativistic reconnection

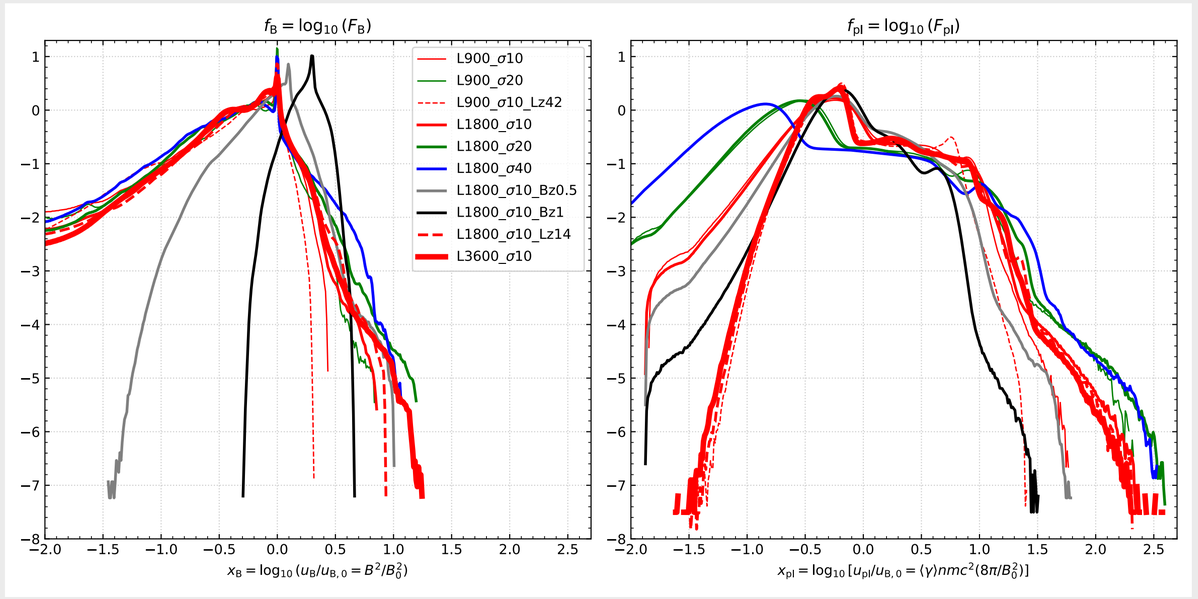
energy density: magnetic vs plasma

relaxed monster plasmoid

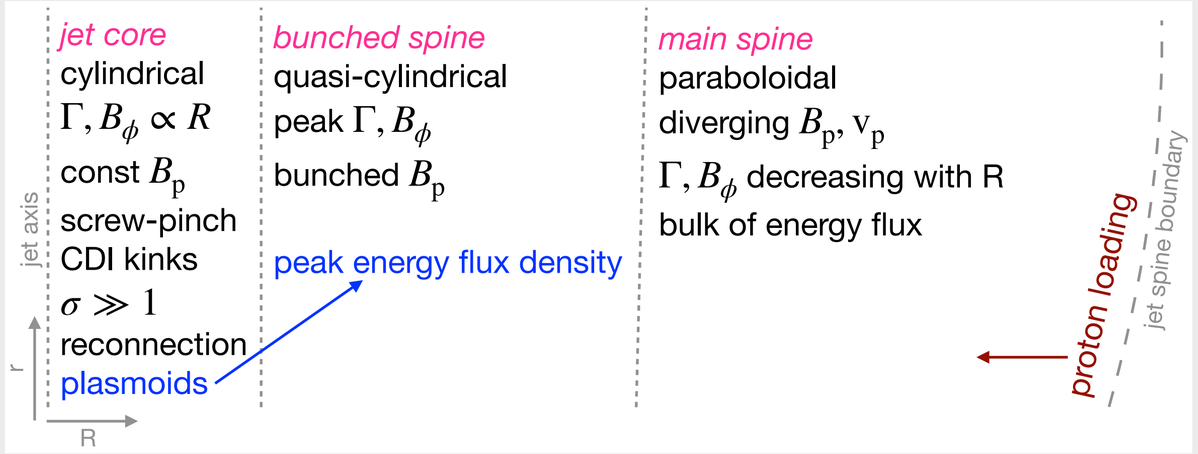
merger of 2 plasmoids



volume distributions of energy density



proposed lateral structure of relativistic jets

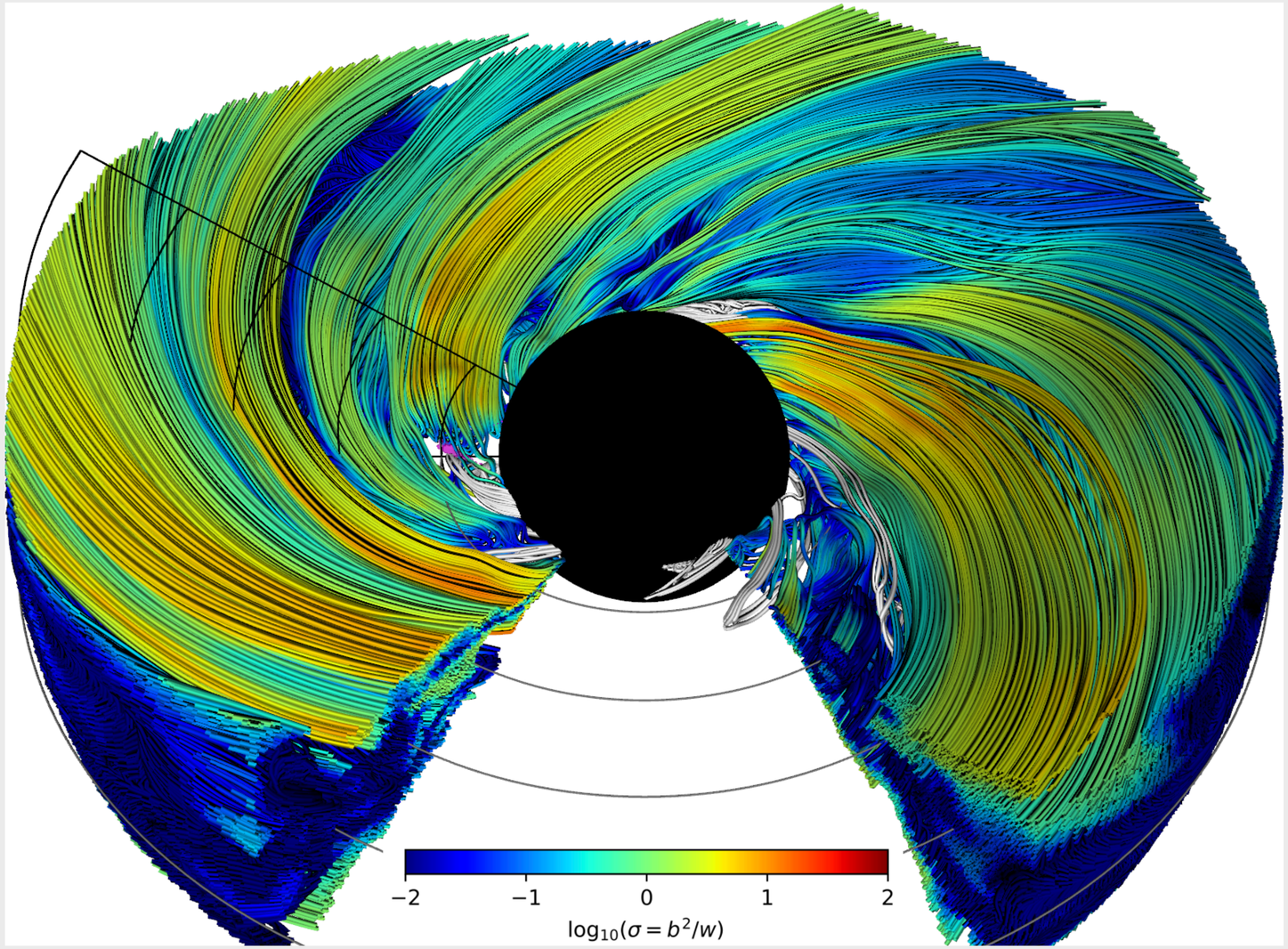


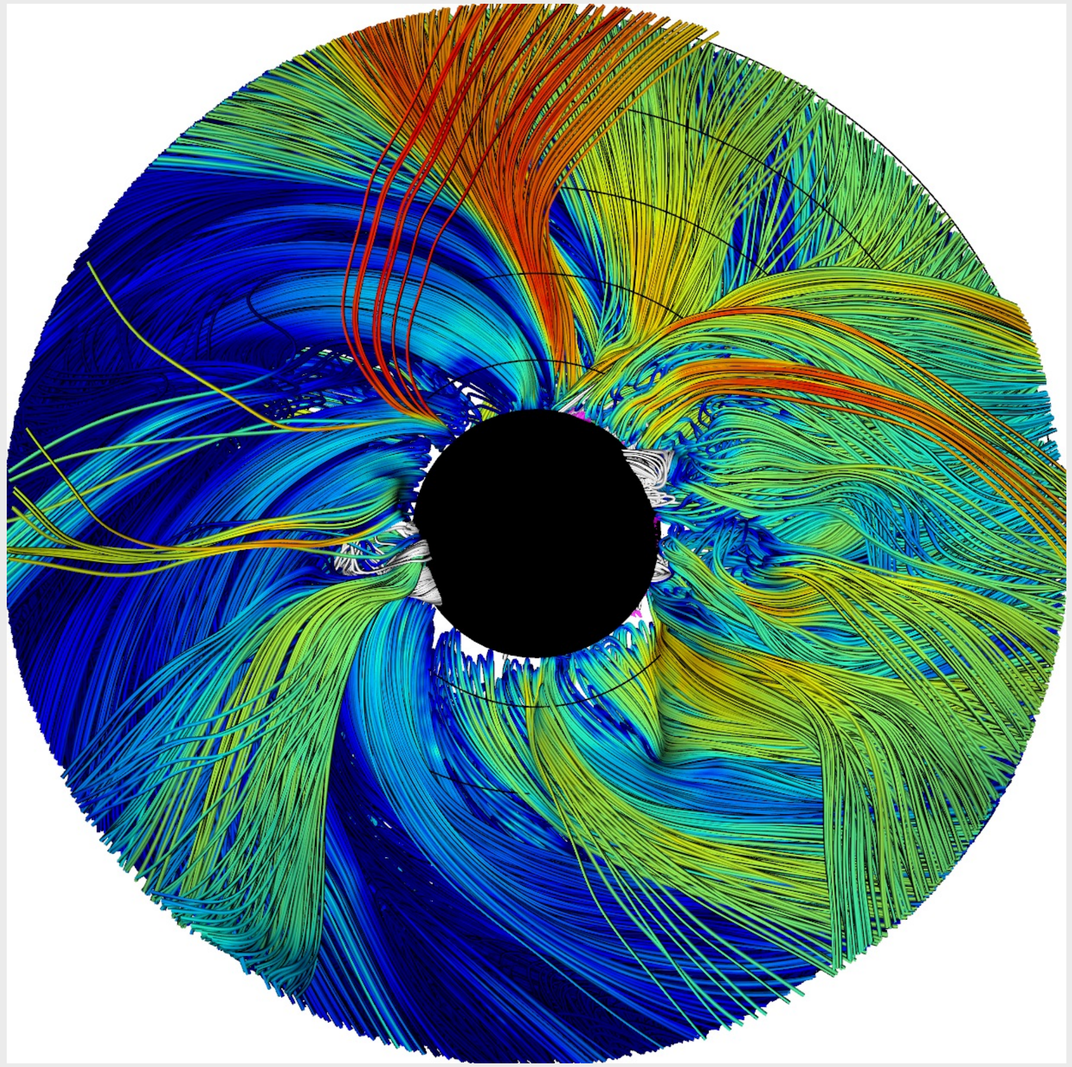
Chaotic magnetic disconnections trigger flux eruptions in accretion flows channeled onto magnetically saturated Kerr black holes

with Mateusz Kapusta and Agnieszka Janiuk; A&A, 692, A37; https://users.camk.edu.pl/knalew/aa50490-24/

prograde (a=0.9)

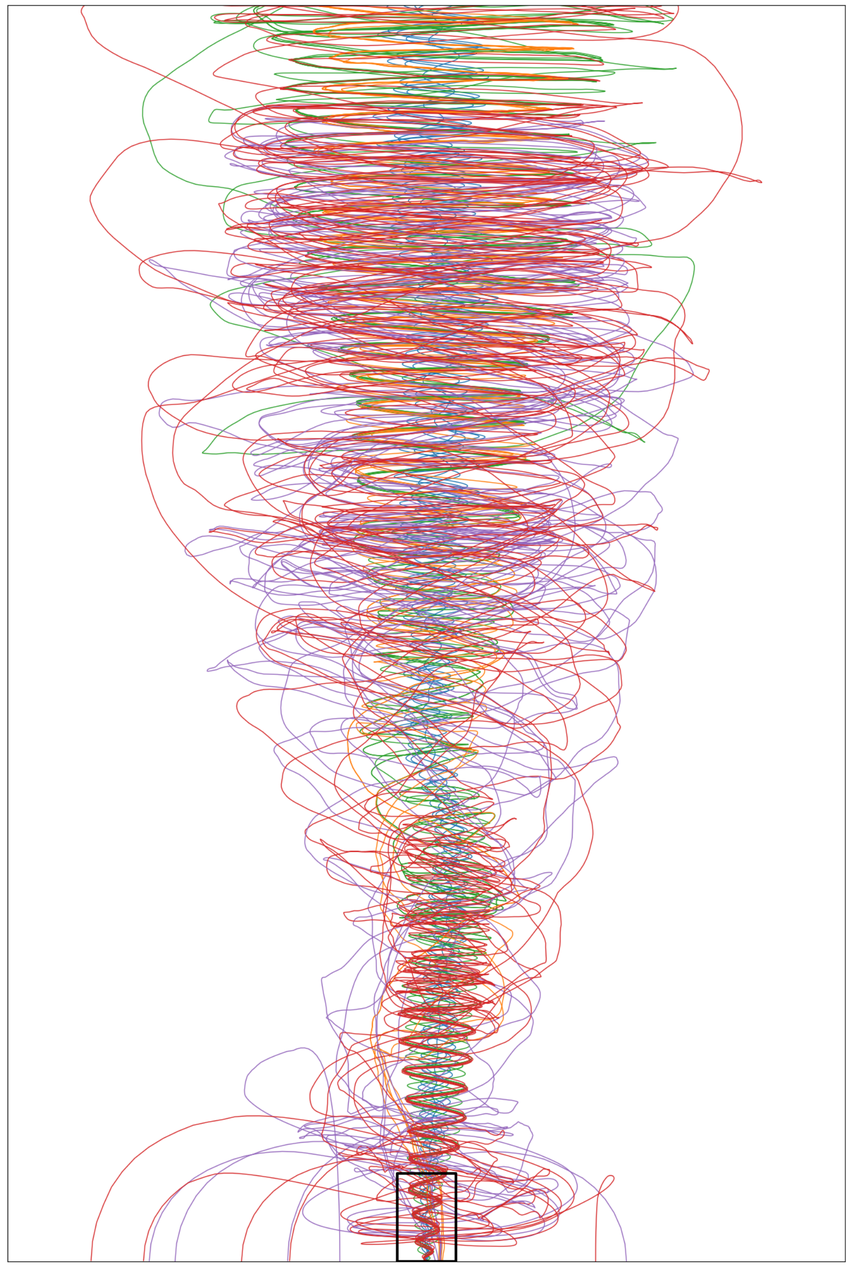
retrograde (a=-0.9)





Extreme-resolution simulation of relativistic jet

with Mateusz Kapusta (OAUW; master project), Bart Ripperda (Toronto) and Alexander Philippov (Maryland)



- data from GRMHD simulation performed with H-AMR, presented in Ripperda+22
- numerical resolution 5376 x 2304 x 2304 (r, θ, ϕ); no AMR
- relativistic jet from magnetically saturated accretion (MAD)
- effects of magnetic flux eruptions
- large samples of integrated field lines

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