⋆ ⋆ News Letter No.16 ⋆ ⋆

Apr. 6, 2023

Editorial

Dear CB1 members & friends,

First of all, we would like to thank all of you who have cast their votes to select a month for the next ChaICA meeting. In total, 17 members voted and the results were 14-3 in favour of a November meeting. Thanks to all those who took part in the survey.

As early November is a clear winner, we are glad to inform you that **ChaICA V** will be held online during a week starting on November 6th. So please note down these dates and start thinking about your contribution!

We also have two announcements, which are attached to this newsletter. Generally, do send us your announcements and other news at any time for a next newsletter, which is going to be circulated in the middle of May:
the deadline for contributions is set to **31 April, 2023**.

With kind regards,

Christian Boily
CB1 president

MPI-AMRVAC 3.0: Updates to an open-source simulation framework

Communicated by: Rony Keppens, K.U. Leuven, Belgium

Abstract

A paper now accepted by A&A accompanies the recent (November 2022) release 3.0 of the open-source `MPI-AMRVAC` code. The paper showcases the code flexibility on a variety of hydrodynamic and magnetohydrodynamic (MHD) tests, and documents new modules of direct interest for state-of-the-art solar physics applications. We demonstrate the use of super-time-stepping strategies for specific parabolic terms and give details on all the implemented implicit-explicit integrators. Synthetic observations of 3D MHD simulations can now be rendered on the fly, in many spectral wavebands. Our open-source strategy welcomes any further code usage, contribution, or spin-off development.

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For more information — Forthcoming A&A `doi:10.1051/0004-6361/202245359`
For more information — ArXiv preprint
For more information — Code website `amrvac.org`

Research projects : profiling your work

Communicated by: Christian Boily, Université de Strasbourg, France

Abstract

It has become a common practice to use GitHub as a repository to promote your research projects (and computational science in general). Some new projects (as well as some older ones, for sure) deserve to be better known. I have had this experience with the code MP-Gadget (link below) which allows me easily to put my research on interacting black holes in a proper cosmological setting. Downloading and installing codes from a public source can be a positive experience (easy to configure, portable, and so on) and I would encourage this community to advertise more any new codes or methods being developed in your group or through collaboations.

Just use the same LaTeX template as for regular announcements, give a brief summary of what this is about (with links to your depository / paper / tutorial .. if possible) and send it to us so we can start a new topic on *Profile in numerical astrophysics* (title to be confirmed ..) in our future newsletters.

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Link to MP-Gadget (12 contributors)
Reference paper Dravid & Katsaggelos 2021 (ArXiv)

Spinning black holes magnetically connected to a Keplerian disk
Magnetosphere, reconnection, particle acceleration & coronal heating

Ileyk El Mellah, Benoît Cerutti, Benjamin Crinquand, Kyle Parfrey

Abstract

Context: Accreting black holes (BHs) may be surrounded by a highly magnetized plasma threaded by an organized poloidal magnetic field. Nonthermal flares and power-law spectral components at high energy could originate from a hot, collisionless, and nearly force-free corona. The jets we often observe from these systems are believed to be rotation-powered and magnetically driven.
Aims: We study axisymmetric BH magnetospheres, where a fraction of the magnetic field lines anchored in a surrounding disk are connected to the event horizon of a rotating BH. For different BH spins, we identify the conditions and sites of magnetic reconnection within 30 gravitational radii.
Methods: With the fully general relativistic particle-in-cell code GRZeltron, we solve the time-dependent dynamics of the electron-positron pair plasma and of the electromagnetic fields around the BH. The aligned disk is represented by a steady and perfectly conducting plasma in Keplerian rotation, threaded by a dipolar magnetic field.
Results: For prograde disks around Kerr BHs, the topology of the magnetosphere is hybrid. Twisted open magnetic field lines crossing the horizon power a Blandford-Znajek jet, while open field lines with their footpoint beyond a critical distance on the disk could launch a magneto-centrifugal wind. In the innermost regions, coupling magnetic field lines ensure the transfer of significant amounts of angular momentum and energy between the BH and the disk. From the Y point at the intersection of these three regions, a current sheet forms where vivid particle acceleration via magnetic reconnection takes place. We compute the synchrotron images of the current sheet emission.
Conclusions: Our estimates for jet power and BH-disk exchanges match those derived from purely force-free models. Particles are accelerated at the Y point, which acts as a heat source for the so-called corona. It provides a physically motivated ring-shaped source of hard X-rays above the disk for reflection models. Episodic plasmoid ejection might explain millisecond flares observed in Cygnus X-1 in the high-soft state, but are too fast to account for daily nonthermal flares from Sgr A*. Particles flowing from the Y point down to the disk could produce a hot spot at the footpoint of the outermost closed magnetic field line.

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For more information — 10.1051/0004-6361/202142847