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Unveiling the role of relativistic jets in galaxy evolution through MHD simulations

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Relativistic jets from supermassive blackholes are an important driver of galaxy evolution. They can impact the nearby environment over different physical scales during their lifetime, with varying effects. They first interact with the host galaxy's ISM before breaking out to larger scales, significantly affecting the galaxy's morphology and evolution. I shall present the results of such 3D relativistic magneto-hydrodynamic simulations, performed on scales of several kiloparsecs, of jets evolving through a galaxy's core [1,2,3].

The young relativistic jets initially couple strongly with the turbulent ISM, launching local outflows, before breaking out to larger scales. A key focus of these simulations has been understanding the interaction of such jets with the multi-phase interstellar medium (ISM) of their host galaxy and its immediate environment. The simulations are spatially well resolved to capture the interaction of such jets with gas rich clouds in the ISM. This also allows to explore possible predictions on the observable signatures of such interactions, which are indeed found to compare favourably.

We also model the evolution of synchrotron emitting non-thermal electrons through a novel hybrid fluid and particle scheme, including diffusive shock acceleration. New simulations [4,5] of relativistic jets with such module give better insight of impact of fluid instabilities on emission processes.

References

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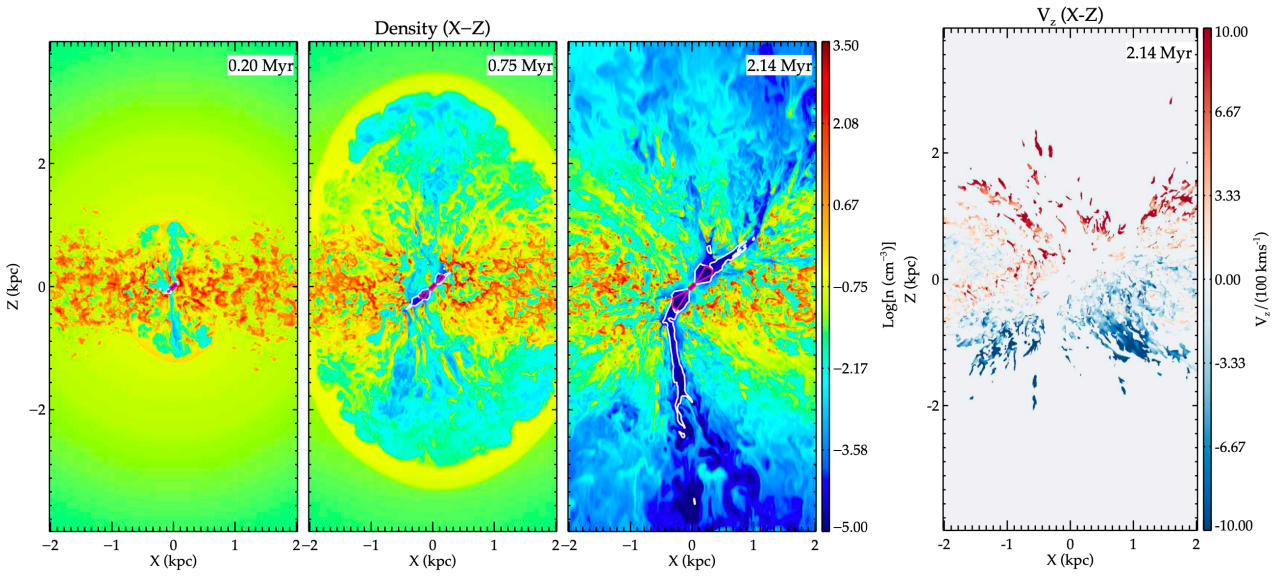

A simulation of an inclined jet interacting with a dense galactic disc [3]. The three left panels show density slices at different times. The right panel shows the vertical velocity at the final time. The white and red contours denote jet velocities of 0.4c and 0.9c respectively.