SHORT GAMMA RAY BURSTS, JETS, AND KILONOVAE

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Short gamma-ray bursts require a rotating black hole, surrounded by a magnetized relativistic accretion disk, such as the one formed by coalescing binary neutron stars or neutron star - black hole systems. The accretion onto a Kerr black hole is the mechanism of launching a baryon-free relativistic jet. An additional uncollimated outflow, consisting of subrelativistic neutron-rich material which becomes unbound by thermal, magnetic and viscous forces, is responsible for blue and red kilonova.

We explore the formation, composition and geometry of the secondary outflow formation by means of simulating accretion disks with relativistic magnetohydrodynamics and employing realistic nuclear equation of state (Janiuk, 2017). We calculate the nucleosynthetic r-process yields by sampling the outflow with a dense set of tracer particles. Nuclear heating from the residual r-process radioactivities in the freshly synthesized nuclei is expected to power a red kilonova, contributing independently from the dynamical ejecta component, launched at the time of merger, and neutron-poor broad polar outflow, launched from the surface of the hypermassive neutron star by neutrino driven winds (Perego et al., 2014).

The strong magnetic fields are also responsible for collimation of relativistic jets of plasma, launched along the axis of the black hole rotation, after it has formed by the collapse of hypermassive neutron star. We study the properties of turbulent plasma in the short GRBs and we model the formation of the base of relativistic, Poynting-dominated jets. We discuss the origin of variability in the GRB jet emission, the timescales of which are related to the action of the magnetorotational instability (Sapountzis & Janiuk, 2019). We also estimate the value of a maximum achievable Lorentz factor in the jets, as resulting from the special relativistic transformation (see Vlahakis & Königl (2003)).

References

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