Project 5.1 Modeling of kilonova emission

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Background:

In the accretion flows at the base of gamma ray burst jets, the physical conditions lead to a copious production of heavy elements. Light isotopes (helium, lithium, beryllium), as well as heavier elements with mass numbers in the range A ~ 60- 80, corresponding to the first maximum in their abundance pattern, are created in the accretion disks. The magnetically driven ejecta from these disks may be prone to a further synthesis of nuclides, namely the second, and third peak of in the process of rapid neutron capture (r-process), until mass number A~200. The recent observational discoveries (e.g., electromagnetic counterpart of GW 170817) have proven that the subsequent radioactive decay of such isotopes is responsible for the emission in the Optical band, following gamma-ray bursts, and the effect is called “kilonova”.

Aim:

Aim of this project is to model the accretion flows at the base of gamma ray burst jets, by means of magneto-hydrodynamic computer simulations. The model, including synthesis of heavy isotopes computed by a nuclear reaction network, will describe the evolution of a black hole accretion disk wind. We will verify the role of magnetic fields and neutrino transport in the disk dynamics. The theoretical lightcurves, will be confronted with observed kilonova signals.

Requirements:

- Master degree in physics or astronomy,
- very strong computer skills and knowledge of numerical methods,
- interest in fluid dynamics and magneto-hydrodynamics,
- independence and creativity in problem solving.