ID de Contribution: **32** Type: **Non spécifié**

Meridional self-similarity MHD flow: From Classical to flow around Kerr Hole

mardi 22 mai 2018 11:45 (20 minutes)

The meridional self-similarity method was a very effective method in classical MHD to produce models describing the MHD flows of young stellar jets.

But the jets produced by AGN are extremely energetic natural phenomena and thus constitute a real laboratory of higly reltivistic MHD flow and high energy physics. Indeed, it is well admitted that the fluid velocity of thes jets atteins higly relativistic regim and some recent observation seems show that the base of the jets start in some region we cannot neglect the general relativity effect.

Thus to describe the inner-spine jet of AGN in the context of ideal, stationary and axial-symetric MHD, we build a meridional self-similar model in Kerr metric. The choice of this metric is justified in order to describe the flow near the super-massive central black hole, and in particular to study the effects of its rotation. The model, characterized by 8 parameters, is based on a first order expansion of the governing general relativistic equations in the magnetic flux function around the symmetry axis of the system. A complete treatment for an outflow in a Kerr metric allowed us to present four enthalpy driven solutions with different field geometries and Lorentz factors, wherein the contribution of the Poynting flux is rather small. The jet power of the ultra-relativistic outflow solutions are of the same order as that determined from numerical simulations conducted by several groups.

Furthermore, our model is able to describe both an incoming and outgoing flow at the level of the stagnation radius; at this radius, pairs are created from neutrinos or highly energetic photons coming from the disk. Coupling inflow and outflow models allows us to describe the MHD flow from the horizon of the black hole up to infinity. We can estimate the different contributions of each of those processes: at the black hole level the energetic component coming from the Blandford-Znajek effect or the generalized Penrose mechanism, and the energetic input due to the creation of pairs.

Contribution

Talk

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Classification de Session: S1 Theory and models