Abstract for an Invited Paper
for the DPP09 Meeting of
The American Physical Society

High Energy Plasmas in the Surroundings of Black Holes: Composite Disk Structures and Characteristic Modes*

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Theoretically finding of composite disk structures around compact objects (e.g. black holes) and recent experimental observations indicate that highly coherent and dynamically important magnetic field configurations exist in the core of these structures [1]. These coherent configurations provide a means to resolve the "accretion paradox" for a magnetized disk [2] while the formation of jets that are emitted in the close vicinity of the compact object is related to them. The absence of vigorous accretion activity in the presence of black holes in old galaxies can be attributed to the loss of the surrounding coherent magnetic configurations during their history. As for relevant dynamics, axisymmetric (ballooning) modes as well as tri-dimensional spirals can be excited from disks with a "seed" magnetic field, under the effects of differential rotation and of the vertical plasma pressure gradient. The properties of these spirals are strongly dependent on their vertical structure. Axisymmetric modes can produce vertical flows of thermal energy [3] and particles in opposing directions that can be connected to the winds emanating from disks in Active Galactic Nuclei (AGN's). A similarity with the effects of temperature gradient driven modes in magnetically confined laboratory plasmas is pointed out. Spiral modes that are oscillatory in time and in the radial direction can produce transport of angular momentum toward the outer region of the disk structure, a necessary process for the occurrence of accretion [3]. The excitation of radially localized density spirals co-rotating with the plasma, at a distance related to the Schwartzchild radius $R_S = 2GM_*/c^2$ where M_* is the black hole mass, is proposed [4] as the explanation for High Frequency Quasi Periodic Oscillations (HFQPOs) of non-thermal X-ray emission from compact objects. *Sponsored in part by the U.S. Department of Energy.

[1] B. Coppi and F. Rousseau *Ap. J.* **641** 458 (2006)
[2] B. Coppi to be published in *Pl. Phys. Cont. Fus.* (2009)
[3] B. Coppi *Europhys. Letters* **82** 19001 (2008)
[4] Coppi B and P. Rebusco, Paper P5.154, EPS Int. Conf. Pl. Phys. (Crete, Greece, 2008).