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Relativistic outflows from advection-dominated accretion disks around black holes

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Advection-dominated accretion flows (ADAFs) (Ichimaru 1977; Narayan & Yi 1994; Kato et al. 1998) have a positive Bernoulli parameter, and are therefore gravitationally unbound. The Newtonian ADAF model has been generalized recently to obtain the ADIOS model (Blandford & Begelman 1999) that includes outflows of energy and angular momentum, thereby allowing accretion to proceed self-consistently. However, the utilization of a Newtonian gravitational potential limits the ability of this model to describe the inner region of the disk, where any relativistic outflows are likely to originate. In this paper we modify the ADIOS scenario to incorporate a pseudo-Newtonian potential, which approximates the effects of general relativity. The analysis yields a unique, self-similar solution for the structure of the coupled disk/wind system. Interesting features of the new solution include the relativistic character of the outflow in the vicinity of the radius of marginal stability, which represents the inner edge of the quasi-Keplerian disk in our model. Hence our self-similar solution may help to explain the origin of relativistic jets in active galaxies. At large distances the radial dependence of the accretion rate approachs the unique from $M \propto r^{1/2}$, with an associated density variation given by $\rho \propto r^{-1}$. This density variation agrees with that implied by the dependence of the X-ray hard time lags on the Fourier frequency for a number of accreting galactic black hole candidates (Kazanas, Hua and Titarchuk 1997; Kazanas & Hua 1999). While intriguing, the predictions made using our self-similar solution need to be confirmed in the future using a detailed model that includes a physical description of the energization mechanism (Subramanian, Becker and Kazanas 1999) that drives the outflow, which is likely to be powered by the shear of the underlying accretion disk. A detailed account of this model will appear in Becker, Subramanian and Kazanas, 2001.

References

Becker P.A., Subramanian P., Kazanas D., 2001, ApJ (in press)
Blandford R.D., Begelman M.C., 1999, MNRAS, 303, L1
Ichimaru S., 1977, ApJ, 214, 840
Kato S., Fukue J., Mineshige S., eds., 1998, Black Hole Accretion Discs, Kyoto University Press, Kyoto
Kazanas D., Hua X.-M. 1999, ApJ, 519, 750

Kazanas D., Hua X.-M., Titarchuk L., 1997, ApJ, 480, 735
Narayan R., Yi I. 1994, ApJ, 428, L13
Subramanian P., Becker P.A., Kazanas D., 1999, ApJ, 523, 203