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Statistical Theory of a Magnetized Accretion Disk Corona
DMITRI UZDENSKY, Princeton Univ. and CMSO, JEREMY GOODMAN, Princeton Univ. — We present a statistical description of a stochastic magnetic field in the force-free corona of a turbulent accretion disk. We represent the field by an ensemble of magnetic loops tied to the disk and introduce the distribution function of loops over their sizes. Each loop evolves under several physical processes, e.g., Keplerian shearing, random walk of the footpoints due to disk turbulence, and reconnection with other loops. To represent these processes statistically, we construct a loop kinetic equation for the evolution of the distribution function. This is similar to Boltzmann's kinetic equation, with reconnection represented by a binary collision integral. We solve the equation numerically and obtain a statistical steady state. Once the loop distribution function is known, we can calculate important integral characteristics of the coronal magnetic field, such as the overall magnetic energy and the magnetic dissipation rate; their distribution with height above the disk; and the rate of angular momentum transfer by the coronal loops. We also access the efficiency of the reconnective inverse cascade in producing a population of very large loops.

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