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# Numerical simulations of Angular Momentum Transport and Intermittent Release of Magnetic Energy in Accretion Disks

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The origin of efficient angular momentum transport in accretion disks had been a puzz;e until Balbus and Hawley (1991) pointed out the importance of the magneto-rotational instability (MRI) in differentially rotating disks. Three-dimensional magnetohydrodynamic (MHD) simulations revealed that angular momentum of the disk is transported through the Maxwell stress of turbulent magnetic fields created by the nonlinear growth of MRI. Here, we present the results of global three-dimensional resistive MHD simulations of black hole accretion flows. General relativistic effects are imcorporated by using the pseudo-Newtonian potential.

As MRI grows, the torus deforms itself into an accretion disk. We found that the time evolution of disk magnetic fields couples with the global structure of the disk. When angular momentum transport is inefficient, an inner torus is created near the central black hole. In that case, growth of non-axisymmetric instability enhances the disk magnetic fields. When the magnetic energy increasess up to some critical value, the magnetic reconnection taking place inside the inner torus releases the magnetic energy intermittently. The disk magnetic energy shows sawtooth-likee nonlinear oscillation.

This quasi-periodic energy release is the origin of the quasi-periodeic oscillation (QPO) around 10Hz when we assumed the 10 M_dot black hole.

High-frequency QPOs are excited by this low-frequency QPO.