SIMULTANEOUS IMPLOSIVE ACCRETION AND JET FORMATION IN QUASARS: CORRELATION OF OPTICAL OUTBURSTS WITH VLBI JETS

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A model and simulation code have been developed for time-dependent axisymmetric disk accretion onto a compact object including for the first time the influence of an ordered magnetic field and magnetically driven outflow of energy and angular momentum in $(\pm z)$ directions (see also Lovelace et al., 1993). It was shown that the system behaviour crucially depends on the amplitude of the poloidal magnetic field fluctuation B_{p}, compared to the critical value $B_{\mathrm{cr}} \sim (\alpha^2 T^{1/2} \sigma / R^{3/2})^{1/2}$, where $T(r,t)$ is the temperature, $\sigma(r,t)$ the surface density of the disk, R the radial distance, α the alpha coefficient of Shakura-Sunyaev disk model. If the fluctuation is small, $B_{\mathrm{p}} < B_{\mathrm{cr}}$, then it diffuses outwards with decreasing the amplitude and eventually disappears. In the opposite case $B_{\mathrm{p}} > B_{\mathrm{cr}}$, a soliton-like structure forms in the disk density, temperature, and magnetic field and propagates implosively inward. In this case the radial accretion speed $u(r,t)$ is shown to be the sum of the usual viscous contribution and magneitic contribution $\sim R^{3/2} B_{\mathrm{p}}^2 / \sigma$. The essential part of angular momentum and energy is going to the jet from the region of fluctuation. Compression of matter in the propagating wave leads to enhancement of magnetic field and more effective angular momentum outflow. This leads in turn to accelerated accretion and subsequent enhancement of magnetic field. It gives the implosive nature of the process, which can be observed as: simultaneous burst in the radiation and outflow. The model is pertinent to the formation of discrete components observed in VLBI jets which appear to originate at times of optical outbursts at some quasars.

References

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