5th Asia-Pacific Conference on Plasma Physics, 26 Sept-1Oct, 2021, Remote e-conference

Ultrafast outflows from black hole accretion disk

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Ultrafast outflows (UFOs) are frequently observed in active galactic nuclei (AGNs). They have velocity in the range from 10000 km/s to 0.3c, with c being speed of light. The UFOs are highly ionized. The column density is in the range from 10^{22}-10^{24}/cm^2. The UFOs are believed to originate from black hole accretion disk in the region around 100 Rs, with Rs being Schwarzschild radius (Tombesi et al. 2011).

The possible driving mechanisms of UFOs include radiation line force and Lorentz force. Nomura et al. (2016) performed numerical hydrodynamic simulations to study the line force driven UFOs. They found the line force driven model can roughly explain the properties of UFOs (velocity, column density and ionization parameter).

However, there are some properties of UFOs that can not be explained by the line force driven model (Nomura et al. 2016). First, the line force can only drive UFOs with velocity lower than 0.2 c. Observationally, the maximum velocity of UFOs can exceed 0.3 c. Second, the detection probability of UFOs predicted by the line force model is much smaller than observations. In addition to line force, there should be other mechanism at work. Magnetic field must be present in accretion disk and should play important role in the evolution of accretion disk. The UFOs may be simultaneously driven by both line force and Lorentz force.

We perform magnetohydrodynamic simulations to study the line force and Lorentz force driven mechanisms simultaneously. We find that the observational properties of UFOs can be well reproduced by numerical simulations.

References

[1] F. Tombesi *et al*, ApJ, 742, 44 (2011)
[2] M. Nomura *et al*, PASJ, 68, 16 (2016)