A Novel Mechanism of the Formation of Electron-Positron Outflow from Hot Accretion Disks

T.Yamasaki, F.Takahara (Osaka Univ.), M.Kusunose (Kwansei Gakuin Univ.)

A mechanism is proposed for the formation of relativistic outflows in active galactic nuclei and Galactic black hole binaries, i.e., the ejection of electron-positron pairs produced in two-temperature accretion disks in these objects. We investigate the pair production processes in the accretion disks, coupled with the pair ejection by solving the disk structure equations, including the vertical momentum equation of the electron-positron pairs, within the one-zone approximation. We assume that the electron-positron component can escape independently of the electron-proton one which forms a hydrostatic atmosphere. The results show that, in the inner region of the disks, when the mass accretion rate becomes larger than about a tenth of the Eddington rate, most of the viscously dissipated energy is converted into the thermal and kinetic energy of the ejected electron-positron pairs. Furthermore, the produced pairs are accelerated in the vertical direction by their own gas pressure rather than by the radiative force. This result means that the outflow energy is not supplied by the radiation field, but by the thermal energy of the electron-positron pairs which comes from protons through Coulomb collisions. It solves the difficulty explaining the observational fact of high power of jets in models that the pairs are produced and accelerated outside of the disks. This mechanism is, thus, successful in extracting accretion-power to form powerful electron-positron outflows as suggested by recent observations of active galactic nuclei and Galactic objects.