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Particle acceleration and outflows in the accretion disks of young stars

Magnetohydrodynamic (MHD) outflows from the accretion disks of T Tauri stars with fossil large-scale magnetic field are investigated. We consider two mechanisms of the outflows: rise of the magnetic flux tubes (MFTs) formed in the regions of efficient generation of the toroidal magnetic field in the disk due to Parker instability, and acceleration of plasma in the current layer formed near the boundary between stellar magnetosphere and the accretion disk.

Structure of the disk is calculated using our MHD model of the accretion disks [1]. We have shown that the magnetic buoyancy appears as an additional mechanism of magnetic flux escape from the accretion disks [2]. In present work, we further develop our approach and model the dynamics of the MFTs in frame of slender flux tube approximation taking into account aerodynamic and turbulent drags, and radiative heat exchange with external gas [2]. The plasma acceleration in the current layer is investigated on the basis of Sweet-Parker model of magnetic reconnection.

Our calculations show that the MFTs can accelerate to velocities up to 50 km/s causing periodic outflows from the accretion disks. Estimations of the particle acceleration in the current layer are applied to interpret high-speed jets and X-rays observed in T Tauri stars with the accretion disks.

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