Formation of intrinsically asymmetric jet from active galactic nucleus: theory and observations

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In the following paper there is discussed and shown the possibility of the formation of an intrinsically asymmetric jet from an astrophysical accretion disk in the presence of magnetic fields with the appropriate configuration, when the processes in the disk are described by the magnetohydrodynamic (MHD) model. It is shown [1-2] that if magnetic fields have specifical asymmetric configurations in the disk near the central object, then it is possible to form an asymmetric outflow in the jet acceleration region. Such a magnetic structure in the accretion disk can exist if it represents a combination of magnetic fields of two different origins: 1) the primordial dipole magnetic field and 2) the dynamo-driven quadrupole magnetic field. If this multipolar configuration is preserved during the accretion process, then in the central region it is found a structure of the toroidal magnetic field not reversing across the equatorial plane. This toroidal magnetic field with the weak poloidal magnetic field accreting towards center, guarantees the existence of a stationary MHD outflow solution in only one hemisphere of the disk, which results in the intrinsic asymmetry of the jet. A similar mechanism would be justified for the formation of a unidirectional jet in young stellar objects. In the present work, besides the theoretical model, the results of observational data processing are also presented, where the asymmetric structure of the disk-jet is clearly visible in the case of a real active galactic nucleus. Observations were conducted in the radio frequency range using the GMRT telescope [3]; In addition to the process described above, the results of the observations also indicate a jet-neighboring galaxy interaction. As well as the radio observational data processing, images of specific objects detected in the optical/infrared range by various optical telescopes have been analyzed in the context of jet-galaxy interactions, which give us the information about the jet-galaxy interaction and the orientation of the jet with respect to the neighboring galaxy.

References:

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[3] Hota, A., et al., 2022, *Monthly Notices of the Royal Astronomical Society: Letters*, *517*(1), L86-L91.