Astrophysical Jet Formation from Weakly Magnetized Accretion Disks of Electron-Ion-Photon Gas

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We studied the problem of Astrophysical Jet formation from relativistic accretion disks through the establishment of relativistic disk-powerful jet equilibrium structure applying the *Beltrami-Bernoulli equilibrium approach* [1,2]. Accretion disk is weakly magnetized and consists of fully ionized relativistic electron-ion plasma and photon gas strongly coupled to electron gas due to Thompson Scattering, often met in different binary systems. Hence, photon gas behaves as a charged fluid and problem reduces to the study of relativistic three-fluid system. We consider the extreme case of equilibrium ($\boldsymbol{j} \times \boldsymbol{B} = 0$) in the local approximation neglecting the space-expansion and strong azimuthal flow. Analysis is based on the generalized Shakura-Sunyaev α-turbulent dissipation model, in which the dissipation includes both the photon gas and ion gas contributions being the main source of accretion. Ignoring the self-gravitation in the disk we constructed the analytical self-similar solutions for the equilibrium relativistic disk-jet structure characteristic parameters (velocity field, generalized vorticity, magnetic field, Alfvèn Mach number) in the field of gravitating central compact object for the force-free condition justified by observations for our system of study. It is shown, that the magnetic field energy in Jet is several orders greater compared to accretion disk, while jet is locally Super-Alfvènic. The derived solutions can be used to analyze the astrophysical jets observed in binary systems while the star formation process linking the jet properties with the parameters of relativistic accretion disks of electron-ion-photon gas.

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References

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