Hydrodynamic jets from protostellar accretion disks with turbulent viscosity

Erekle Arshilava [a,b], Mariam Gogilashvili [a,c], Vazha Loladze [a,c], Irakli Jokhadze [a], Beqa Modrekiladze [a] , Nana L. Shatashvili [a,d] and Alexander G. Tevzadze [a]

e-mail: nana.shatashvili@tsu.ge

[a] Department of Physics, Faculty of Exact and Natural Sciences, Javakhishvili Tbilisi State University, 3, Chavchavadze Ave., Tbilisi 0179, Georgia

[b] Department of Physics and Astronomy, Heidelberg University, 69120, Heidelberg, Germany.

[c] Department of Physics, Florida State University, Tallahassee, FL 32306, USA

[d] TSU Andronikashvili Institute of Physics, 6, Tamarashvili st. Tbilisi 0177, Georgia

We construct the analytic configuration of the hydrodynamic jet from Young Stellar Objects (YSOs) using the Beltrami-Bernoulli flow model [1,2] for disk-jet structure formation. For this purpose, we use the extended turbulent viscosity model and derive several classes of analytic solutions using the flow parametrization in the self-similar variables. Derived solution describes the disk-jet structure flow with jet properties linked to the properties of the accretion disk flow. Ratio of the disk accretion and jet ejection velocities is controlled by the turbulence parameter, while the ejection velocity increases with the decrease of local sound velocity and the jet launching radius.

We have formulated the realizability condition for the solutions [3] that reveal three classes of solutions: a) flow accreting in the radial and vertical direction, b) flow ejecting in the radial and vertical direction; c) flow in the ballistic regieme. Hence, constructing the global solution using the disk inflow at low poloidal angles and jet outflow at high poloidal angles, having ballistic transition from one to another, we have derived disk-jet structure with slow accretion and high ejection velocities. We show that disk-jet structure formation and its defining parameters depend on the thermal properties of the disk flow.

Derived solutions can be used to analyze the astrophysical jets from YSOs and link the properties of the outflows with the local conditions at the inner edge of the accretion disk flows.

The work of IJ and NLS was partially supported by Shota Rustaveli National Science Foundation Project N FR17_391; I.J.-s and M.G.-s work was partially supported by World Federation of Scientists National Scholarship Programme, Geneva, 2018.

References

[1] N.L. Shatashvili, N.L. and Z. Yoshida, Z., **AIPCP**, **1445**, 34-53 (2011).

[2] Z. Yoshida, Z. and N.L. Shatashvili, arXiv:1210.3558 (2012).

[3] E. Arshilava, M. Gogilashvili, V. Loladze, I. Jokhadze, B. Modrekiladze, N.L. Shatashvili, A.G. Tevzadze ***MNRAS*** *submitted (2018).*