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Development of semi-implicit numerical method on a moving grid for differentially rotating astrophysical MHD flows with self-gravity.

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We represent a numerical method for the simulation of 3D differentially rotating astrophysical MHD flows in cylindrical and spherical geometries. This approach belongs to the class of mixed Euler-Lagrange methods. The grid consists of rings which are rotating in a quasi-Lagrangian manner together with the background (differential and solid state) large-scale rotation, significantly reducing the numerical diffusion of the method associated with advection in the azimuthal direction. We use explicit Godunov-type scheme, while acoustic waves are treated in a semi-implicit way. This approach makes it possible to solve the equations of gas dynamics uniformly for wide range of Mach. The stability condition for the scheme does not depend on the speed of sound. This approach allows to simulate MHD differentially rotating flows like core collapse supernovae or accretion problems.

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