Rigorous derivation of the equations describing objects called "accretion disk"

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Abstract

We study the 3-D compressible barotropic Navier-Stokes-(Fourier)- Poisson system describing the motion of a compressible rotating viscous fluid with renormalized gravitation, confined to a straight layer $\Omega_\epsilon = \omega \times (0, \epsilon)$, where ω is a 2-D domain. We shall show that the weak solutions in the 3D domain converge to the strong solution of a rotating 2-D Navier-Stokes-(Fourier)-Poisson system on ω as $\epsilon \to 0$ for either all times less than the maximal life time of the strong solution of the 2-D system or the initial data are small when the Froude number is small ($Fr = \mathcal{O}(\sqrt{\epsilon})$. We consider just the selfgravity force. In the second case we consider a rotating pure 2-D Navier-Stokes-(Fourier) system on ω as $\epsilon \to 0$ when $Fr = \mathcal{O}(1)$ in the case of the external gravity see [1, 2].

Keywords: Navier–Stokes–Fourier–Poisson system, weak solution, entropy, rotation, accretion disk, thin domains, dimension reduction.

References

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