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Investigation of Black Holes in Analogous and Astrophyscial Regimes

We explore the behaviour of barotropic and irrotational fluids with a small viscosity under the effect of first-order acoustic perturbations. We discuss, following the extant literature, the difficulties in gleaning an acoustic geometry in the presence of viscosity. In order to obviate various technical encumbrances, when viscosity is present, for an extraction of a possible acoustic geometry, we adopt a method of double perturbations, whereby dynamical quantities such as the velocity field and underlying potential undergo a perturbation both in viscosity and in an external acoustic stimulus. The resulting perturbation equations yield a solution which can be interpreted in terms of a generalised acoustic geometry, over and above the one known for inviscid fluids. Once the black hole's physics is understood in a laboratory-like setting, we embark on understanding the phenomenology of black holes in a astrophysical setting. We explore various properties of astrophysical black holes and their associated accretion disks. Using numerical and simulation techniques, we evaluate the luminosity of radiation coming from accretion disks and the corresponding spectra for black holes with different parameters like plasma-β of the accretion disk, mass and spin of the black hole. These results are used to interpret the dependence of spectra and luminosity on the aforementioned parameters and also to explain the behaviour and constituent details of anomalous X-ray sources like ultraluminous X-ray sources etc.

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