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A critical overview of the theory of accretion onto black holes

Abstract

There are three main ingredients to the dynamics of black hole accretion: matter supply, transport of angular momentum, and radiative cooling. It is believed that the various ways these three ingredients can be balanced determine the rich phenomenology of astrophysical black holes ranging from galactic nuclei to X-ray binaries. I review our analytical understanding of these basic accretion dynamics, and show that it is mostly shaky and burdened by historical ad-hoc models. Faithful modelling through numerical simulations is currently affordable only for special limiting states and this leaves us with a number of unanswered questions for the full landscape of real astrophysical sources