RESEARCH TRAINING GROUP
Models of Gravity

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Self-Similar Models of Accretion Disks

Abstract

Mass accretion plays a fundamental role for structure formation on very different scales throughout the whole universe from the genesis of stars and planets to the growth of supermassive black holes in galactic centers and the emergence of galaxies. The general conception of the accretion process is rather simple: Gravitational forces lead to a concentration of mass which forms a rotating gaseous disk due to the conservation of angular momentum. Thus non-relativistic theoretical modelling usually involves the solution of Poisson's equation for the gravitational potential and the Navier-Stokes equation.

In the first part of the talk I will shortly review the basic concepts and introduce the classical 1+1D model for axisymmetric geometrically thin disks and discuss some known analytical solutions. I will then show how to extent the model to account for self-gravity using the monopole approximation and self-consistent treatment of black hole growth. Since both effects are considered in a dynamical way, the model allows to examine the impact of a varying gravitational potential on the accretion process. The proposed non-linear advection-diffusion equation is invariant with respect to a one parameter Lie group of scaling transformations. Therefore a simple ansatz leads to the construction of self-similar solutions. The analysis of these yields a deep insight into basic properties of self-gravitating disks and the fundamental parameters which control the accretion process.