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Astrophysical Dynamics and Cosmology

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Abstract. *First*, the essence of a physical theory for a multilevel system is through coupling different physical laws in different levels by a symmetry-breaking principle, rather than through a unification using larger symmetry. In astrophysical dynamics, the symmetry-breaking mechanism and the coupling are achieved by prescribing the coordinate system so that the laws of fluid dynamics and heat conductivity are coupled with gravitational field equations. Another important ingredient in modeling fluid motion in astrophysics is to use the momentum density field to replace the velocity field as the state function of cosmic objects. *Second*, by applying the new symmetry-breaking mechanism and the new coupled astrophysical dynamics model, we rigorously prove a basic theorem on blackholes: Assume the validity of the Einstein theory of general relativity, then black holes are closed, innate and incompressible. *Third*, we prove a theorem on structure of universes. Assume the Einstein theory of general relativity, and the principle of cosmological principle that the universe is homogeneous and isotropic. Then we show that 1) all universes are bounded, are not originated from a Big-Bang, and are static; and 2) The topological structure of our Universe can only be the 3D sphere. Also, thanks to the basic properties of blackholes, we show that our results on our Universe resolve such fundamental problems as dark matter and dark energy, redshifts and CMB. *Fourth*, we discovered that both supernovae explosion and AGN jets, as well as many astronomical phenomena, are due to combined relativistic, magnetic and thermal effects. The radial temperature gradient causes vertical Bénard convection cells, and the relativistic viscous force (via electromagnetic, the weak and the strong interactions) gives rise to an huge explosive radial force near the Schwarzschild radius, leading e.g. to supernovae explosion and AGN jets.

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1 Introduction

The goal of this article is to examine fundamental issues in astrophysics and cosmology, based on Einstein theory of general relativity and the cosmological principle, leading to new theories on astrophysical dynamics and cosmology as outlined below.

Black holes

One main objective of this paper is to study the nature of black holes and the structure and formation of our Universe. The concept of black holes was originated by the Schwarzschild solution of the Einstein gravitational field equations, in an exterior of a central symmetric matter field:

$$ds^2 = -\left(1-\frac{R_s}{r}\right)c^2dt^2+\left(1-\frac{R_s}{r}\right)^{-1}dr^2+r^2d\theta^2+r^2\sin^2\theta d\varphi^2, \tag{1.1}$$

where

$$R_s = \frac{2MG}{c^2} \tag{1.2}$$

is the Schwarzschild radius. Here M is the mass of the matter in the centrally symmetric ball of radius R. It is well-known that when $R \le R_s$, the spherical 3D ball B_{R_s} is a black hole.

One main result we establish rigorously in this article is to show that

black holes are closed.

Namely, no energy can cross either side of the black hole surface $S_{R_s} = \{x \in \mathbb{R}^3 \mid |x| = R_s\}$. It is classical to know that no particles can escape from a black hole when they are in the Schwarzschild radius. Then in the exterior of a black hole, we have the energy-momentum conservation:

$$\frac{\partial E}{\partial \tau} + \text{div } P = 0, \tag{1.3}$$

where τ is the proper time, E and P are the energy and momentum densities. Then by (1.3), together with the fact that no matter can escape from inside of the black hole, we can easily show that

$$\lim_{r \to R_s^+} P_r = 0,$$

which implies that black holes are closed: no energy can penetrate the Schwarzschild surface. Here P_r is the radial component of the momentum density P.

The second main result on black holes we prove in this article is that

black holes are innate.

Namely, no new black holes can be generated from a massive object through a cosmic process. In particular, we show in this article that black holes can not be created by