

[GC01] **Cosmological Shock Waves in the Large Scale Structure of the Universe: Non-gravitational Effects**

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Cosmological shocks result from supersonic flow motions induced by hierarchical clustering of nonlinear structures in the universe. These shocks govern the nature of cosmic plasmas through dissipation of gravitational energy into heat, acceleration of nonthermal high energy particles, generation and amplification of magnetic fields, and generation of vorticity. We study the statistics and energetics of shocks formed in cosmological simulations of a concordance LCDM universe with a special emphasis on the effects of non-gravitational physics such as radiative cooling, photoionization/heating and galactic superwind feedback. We find that shock speed is determined primarily by gravitational potential of the dominant dark matter component, so other non-gravitational processes do not affect significantly the global dissipation of cosmological shocks. Using a nonlinear diffusive shock acceleration model for CR protons, we estimate gas thermal energy and CR energy dissipated at shocks through the history of the universe. We also examine the generation of vorticity at these curved shocks. Our results are consistent with recent observations indicating that the intracluster medium and the WHIM may contain energetically significant components of nonthermal particles, turbulent flow motions, and magnetic fields.

[GC02] **Brans-Dicke gravity as a candidate theory for dark matter**

서 현 중

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It is generally expected that the rotation velocity of spiral galaxies in the outer parts of their luminous disks would be proportional to $r^{-1/2}$ by using Newtonian dynamics. However, in contrast to the expectation, observation shows that the rotation velocity of spiral galaxies is almost constant with the magnitude of several hundred km/sec in the outer region of their luminous disks. This phenomenon is so-called flat rotation curve of a galaxy. One can solve such discrepancy by assumption that there is a large amount of unseen matter(which is called dark matter) forming a massive halo around the galaxy. Another way to solve such discrepancy is to modify the theory of gravitation, i.e. using an alternative gravitation theory rather than Newtonian gravity or General Relativity. In this thesis, we focus on the alternative gravitation theory to explain flat rotation curves of spiral galaxies. We propose Brans-Dicke theory of gravity for an alternative gravitation theory in this thesis. According to Kim's study (2006), the pure Brans-Dicke theory of gravity has a Schwarzschild-de Sitter-type solution. Kim then suggested that such solution can represent halo-like structure, i.e. it can be a candidate for the geometry of dark halo of a galaxy. In this thesis, followed by Kim's study, we estimate Kim's results more precisely by numerical method, plot rotation curve that is the contribution of scalar field in Brans-Dicke gravity, and investigate the property of the current model for dark matter.