

Abstract

Dark matter was originally said to be “missing mass”. From sometime ago we changed its name and now settled down to call it “dark matter”. The history about this name is left out. Oort is the first person to propose the missing mass, but the prediction by F. Zwicky in 1933 is more famous. It was the opening scene of a play of the missing mass problem when Zwicky predicted from a calculation of the dynamical equilibrium of “Coma Berenices galaxy cluster” (handling called the Coma Berenices — Virgo galaxy cluster) that there might be the existence other than the glittering material, the baryon. The issue of the missing mass or the dark matter is not settled down until recent. According to CMB (Cosmic Microwave Background = cosmic background radiation or emission) observation with the Planck satellite, the latest observation, it is found that 26.8% of the energy of the universe is occupied by dark matter which is not baryonic. In addition, the existence of dark matter is essential in the computer simulation that is developed rapidly recently. For example, dark matter is very important in the large-scale structure formation of the universe. The large-scale structure formation of the universe cannot be demonstrated, if dark matter does not exist. Dark matter has very weak interaction with other particles, since it is neutral electrically. Observation of dark matter is rare even if it interacts, so that the substance of dark matter was only understood very recently. Existence of dark matter of baryon-like and that of non-baryon-like became clearer now, after approximately 80 years has passed from the submission of the problem. Neutrino is thought to exist as a fixed quantity in space. Because baryon-like dark matter is understood well from the astronomical observation in space, we will approach in this thesis, the observation of dark matter by WMAP or Planck which says that a large amount of the total energy of the universe is occupied by dark matter. First, from a time scale of the Milky Way collision simulation, three kinds (Hot, Warm, and Cold) of dark matters exist, and the existence of these three kinds is also supported theoretically. Difference between the three kinds is classified by the mass (or the speed, such as relativistic one or non-relativistic one). In fact, we understand that Hot dark matter is almost neutrino. Then what kind of particles will be Warm and Cold dark matters? In this thesis, we find the candidates of these two kinds in a five dimensional Kaluza-Klein model of neutrino, and propose a unified scenario of dark matters. Using a S^1/Z_2 compactified five dimensional Kaluza-Klein neutrino, if we restrict the fields by the Z_2 projection, we have a scenario in which HotDM is a left-handed neutrino, Warm DM is a right-handed neutrino and Cold DM is the first Kaluza-Klein excitation of the neutrino. A possibility is proposed towards examining the scenario by the mutual relations of position between “our Milky Way” (the Milky Way) and “the Sagittarius dwarfish Milky Way” attendant to the Milky Way. We want to state the findings so obtained in this thesis. Finally, we have to say that we do not deny the existence of a candidate except the dark matter candidates that we delivered in this thesis. The dark matter candidate particles of this article are candidates of dark

matters, but we do not say that it occupies all of dark matter.