[초 GC-01] Outstanding Problems in Cosmic Ray Astrophysics

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The observed energy spectrum of cosmic rays (CRs) can be approximated over more than 12 orders of magnitude in energy by a broken power law, whose slope changes at several features such as the first knee, second knee, ankle and GZK cutoff. Moreover, the composition of CRs becomes heavier beyond the first knee toward the second knee, and it seems to get lighter again toward the ankle and then become proton-dominated above the ankle. Recent observational evidence indicates there seems to be positional correlation of arrival directions of ultrahigh energy cosmic rays above 1019.5eV with the large scale structure of the universe All these observational facts provide crucial clues to the search for the origin of high energy CRs, which is one of key unresolved astrophysical problems. In this review, we will examine some of currently debated issues in cosmic ray astrophysics.

[GC-02] A study of the astrophysical sources of ultra high energy cosmic rays

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In the course of propagation, the trajectories of ultra high energy cosmic rays (UHECRs) from the cosmologically distant sources deviate from the photon propagation paths due to the presence of ubiquitous

magnetic fields in the intergalactic space (IGMF) that are believed to follow the large scale structure (LSS) of the universe. Accordingly, finding the UHECR sources from the directional analysis of observed

events is not very straightforward. Performing the simulation of the propagation of UHE protons (Das et al 2008) through the magnetized LSS of the universe (Ryu et al 2008), we compute the statistics of the angular distance using the positional correlations between the arrival directions of UHECR events in our simulation and the possible nearby astrophysical candidates. In the simulation, UHECR sources are placed at the cluster regions and observers are selected inside groups of galaxies that have similar properties as the Local Group. With this, we quantify the probabilty of identifying the true UHECR sources in terms of the angular distance. We also calculate the cross correlation between the simulated UHECR events and the sources and estimate the angular correlation length. Due to the absence of any satisfactory observational description of magnetic fields within the Local Group, we study the above statistics of angular distance

in terms of the strength of the magnetic fields at the observer location as well. To compare our simulation result, we study the similar statistic with Auger detected events and a good agreement is observed. Implications of this study on the nature of UHECRs sources are discussed.