Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

U06-P14 会場:コンベンションホール 時間:5 月 24 日 18:15-19:30

シームレス科学としての宇宙線物理学
Cosmic-ray physics as a seamless science

増田 公明 [1*]
MASUDA, Kimiaki[1*]

[1] 名古屋大学太陽地球環境研究所
[1]STE Lab., Nagoya University

Cosmic rays are high-energy radiation flying in extra-terrestrial space. Particularly those coming from extra-heliosphere are called the galactic cosmic-rays and have a energy spectrum ranging over a broad region of 10^8 eV to 10^{20} eV. Among the galactic cosmic-rays, charged particles reach the earth being affected by magnetic fields in the space. The flux of charged particles with the kinetic energy less than 10 GeV/n are modulated by solar magnetic activity. The cosmic rays entering the earth's atmosphere interact with earth's atmospheric atomic nuclei and produce secondary particles called the air shower. For high energy region, by detection of air showers using various methods and comparison with simulation results, original particle energy and its species are determined. On the other hand, the secondary particles produce atmospheric ions through atomic-molecular interaction by ionization process, and then form atmospheric electric field and relate production of aerosol particles and cloud condensation nucleation.

Three subjects in the cosmic-ray study are (a) mechanism of acceleration and production, (b) nature of cosmic-ray particles themselves and (c) propagation and relation to the sun and the earth in neighboring environment. Here, two detailed topics connected from the space to the solar-terrestrial environment are introduced.

The frequency of cosmic-rays around the highest energy is less than 1 particle/km^2/year. Good statistical detection with such low frequency needs an extensive observation site. In the measurements of primary cosmic ray energy and nuclear species, florescence detection of air showers originated by cosmic rays and extended sampling detection of air shower particles at the ground are used together with simulations. However, particularly for ultra-high energy regions, hadron interaction models used in simulations have not yet verified and this uncertainty gives large systematic errors for determination of cosmic ray energy and species of nuclei. We are carrying out a verification experiment (LHCf collaboration) at LHC, which is a particle accelerator with the highest energy in the world. We have obtained good results up to the energy of 10^{17} eV equivalent with proton-proton collisions. In order to apply to the real air shower, collision experiments of proton-light nucleus (nitrogen, oxygen, etc.) and light nucleus-light nucleus to iron nucleus are needed.

Cosmic-ray particles entering the earth initiate nuclear interactions with atmospheric atomic nuclei and produce many secondary particles. These secondary cosmic-rays create atmospheric ions according to their ionization ability. It is considered that these ions promote the production and growth of aerosol particles, which become cloud condensation nuclei in the atmosphere. We are trying to verify the correlation between the time variations in the cosmic-ray intensity measured by neutron monitors at the ground and the earth's low-altitude cloud cover, by a chamber experiment with artificial radiation sources.

Cosmic rays reach the earth surface from the space far away through the heliosphere and the earth's atmosphere, and interact with each region. It is necessary to consider such broad regions connecting seamlessly.

We have conducted the study on elementary process on cosmic-ray interactions with earth's atmosphere and verification of its relation to global climate, and would like to clarify the seamless process through the cosmic-rays. In this talk, we introduce the details of these studies.

キーワード: 宇宙線, 太陽, 地球大気, ハドロン相互作用, イオン誘発核生成
Keywords: cosmic ray, the sun, earth's atmosphere, hadron interaction, ion-induced nucleation