New observations of aurora and the inner magnetosphere from ground and space

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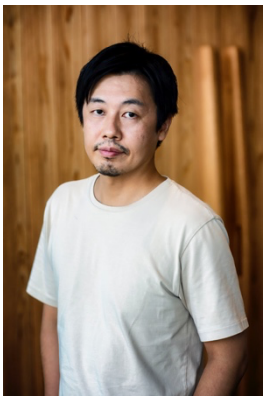
Abstract:

The spectacular aurora which appears in the polar night is a visualization of plasma and electromagnetic processes occurring in space around the Earth (geospace). Multi-point ground-based optical, magnetic, and radio measurements provide two-dimensional distribution of these processes, while in-situ satellite measurements provide direct evidence of physical processes occurring in geospace. On December 20, 2016, the Japanese Arase (ERG) satellite was launched to geospace to investigate the dynamics of the inner magnetosphere. In order to make coordinated ground-satellite measurements of geospace with Arase, multi-point ground network was constructed at subauroral latitudes near 60 degree north around the north geomagnetic pole. This ground network project, called as PWING, together with the Arase satellite and related geospace modellings, have generated a lot of new insights in plasma and electromagnetic processes in geospace, such as visualization of temporal and spatial variation of wave-particle interaction via auroral patches, longitudinal development of radio waves associated with auroral substorms, geospace origin of spectacular red aurora which sometimes appears even in Hokkaido, Japan, during geomagnetic storms. In this presentation, I will review these new insights obtained from the ground-satellite coordinated measurements of geospace in the Arase era.

Figure 1. Active auroral patches and a ground observatory of the PWING project (Sept.3, 2022, 1036 UT at Athabasca, Canada).

Diversity of habitable worlds in the Solar System



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Abstract:

How did Earth and Earth's life emerge? Is there life beyond Earth – These are fundamental and universal questions that people all over the world might raise once, and that Earth and planetary scientists have been tackling to address them. Recent years have seen remarkable progress in the exploration of the Solar System. In the last decade, in-situ chemical investigations, such as elemental, mineralogical, and isotopic analyses, can be performed on planetary bodies beyond Earth by spacecrafts. As a result, our knowledge is widening and deepening from an individual understanding of the chemistry and environments on each planetary body to a comprehensive understanding of the key factors that control to the diversity and universality of the habitability of planets in the Solar System and beyond.

In my presentation, I will discuss the diversity of chemistry and environments across the radial distance from the Sun in the Solar System, including Mars, Jovian satellites, and Saturnian satellites, and the factors that shape them to the current states. In particular, I will introduce a new dichotomy of ocean chemistry in the Solar System, in which nitrogen- and phosphorus-rich oceans are more likely to appear in the distant, cold regions of the Solar System; meanwhile, sulfur-rich oceans are more likely to appear closer to the Sun. The possibility of life on these bodies, the terrestrial analogs, and future perspectives will also be discussed. Solar System exploration will develop as a means of interdisciplinary research that includes not only planetary science and engineering, but also life science and complexity science in future.