【Grant-in-Aid for Scientific Research(S)】

Science and Engineering (Mathematical and physical sciences)

Title of Project : Approach to understand the solar coronal and chromospheric heating — from Hinode, IRIS & CLASP to SOLAR-C

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Research Area : Astrophysics, Solar Physics, Plasma Science

Keyword : Sun, International Cooperation, Satellite, Rocket, Plasma

【Purpose and Background of the Research】

Since its launch in 2006, the Japanese solar satellite Hinode has significantly contributed to solar physics. Specifically it has revealed that magneto-hydrodynamic waves and super-sonic jets happen in the solar chromosphere, ubiquitously. The chromosphere is not only an intermediate layer smoothly connecting the photosphere and corona, but a site where those dynamics may play an important role in the chromospheric and coronal heating. Such discoveries imply that the next frontier in solar physics lies in simultaneous observations between the dynamics and magnetic structures in the chromosphere and transition region, where the gas-dominant photosphere changes to the magnetic-dominant corona.

One major objective of the next solar satellite SOLAR-C, which is proposed to be launched in FY2019, is to determine 3D magnetic structures in the solar atmosphere for clarifying the dynamics and heating in the chromosphere and corona. In this research, we will clarify the scientific objectives and the technical feasibilities for SOLAR-C, by investigating the chromosphere and transition region. This will be achieved by combining data from state-of-art Hinode, with data provided by the up-coming IRIS and CLASP instruments.

【Research Methods】

[Step1] Investigations through Hinode – IRIS joint observations.

IRIS (Interface Region Imaging Spectrograph) is NASA's new solar satellite launched in June 2013. It will make spectroscopic observations in the chromosphere and transition region, and give us temperature, density and velocity diagnostics in such regions. Hinode will provide essential complementary information through precise magnetic field measurements in the photosphere.

Some of our researchers will stay at the IRIS science operation center in US, and make Hinode – IRIS coordinated observations intensively and systematically in the early phase of the IRIS operation starting in the summer of 2013.

[Step2] Development of the CLASP instrument

CLASP (Chromospheric Lyman-Alpha Spectro-Polarimeter) is our project using NASA's sounding rocket for making a precise measurement of the linear polarization of the Lyman-α line emitted from the chromosphere and transition region. Its main aim is to infer, for the first time, the magnetic fields in the chromosphere and transition region with the Hanle effect. We will develop the CLASP instrument by the end of FY2014, and launch it in 2015. Observations with CLASP will be coordinated with Hinode and IRIS.

【Expected Research Achievements and Scientific Significance】

Hinode, IRIS and CLASP give us a complementary set of data, which certainly constitutes a significant breakthrough in solar physics. Specifically, such data are directly relevant for one of the main SOLAR-C science objectives: the magnetic coupling of the chromosphere (and transition region) with the photosphere and corona. Significant development of the SOLAR-C project will be achieved by providing essential information in the following main issues: (1) specifications of the instrument to measure chromospheric magnetic fields, (2) achievable accuracy of the chromospheric magnetic fields, and (3) detection of waves which can significantly contribute to chromospheric/coronal heating and solar-wind acceleration.

【Publications Relevant to the Project】

- "Small-Scale Jetlike Features in Penumbral Chromospheres", Katsukawa,Y. et al., Science 318, 1594 (2007)
- "Propagating Waves along Spicules", Okamoto, J. et al., Astrophysical Journal, 724, L24 (2011)
- "Chromospheric Lyman-Alpha Spectro-Polarimeter (CLASP)", Kano,R. et al., Proc. of SPIE 8443, 84434F (2012)

【Term of Project】 FY2013 - 2017

【Budget Allocation】 150,900 Thousand Yen

【Homepage Address and Other Contact Information】

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