Satellite mission: PhoENiX (Physics of Energetic and Non-thermal plasmas in the X (= magnetic reconnection) region)

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We are planning a new solar satellite mission, "*PhoENiX*", for understanding of particle acceleration during magnetic reconnection, which are ubiquitous features exhibited by a wide range of plasmas in the universe. The main observation targets of this mission are solar flares, which are generated by magnetic reconnection and accelerate plasma particles. The sun is a unique target in the sense that it can be investigated in great detail with good spatial, temporal and energy resolutions.
The scientific objectives of this mission are (1) to identify particle acceleration sites, (2) to investigate temporal evolution of particle acceleration, and (3) to characterize properties of accelerated particles, during solar flares. In order to achieve these science objectives, the *PhoENiX* satellite is planned to be equipped with three instruments of (1) Photon-counting type focusing-imaging spectrometer in soft X-rays (up to ~10 keV) to observe the contexts of particle accelerations (e.g., shocks, plasmoids, flows, etc.), (2) Photon-counting type focusing-imaging spectrometer in hard X-rays (up to ~30 keV) to identify the accelerated particles, and (3) Spectropolarimeter in soft gamma-rays (spectroscopy is available in the energy range of from > 20 keV to < 600 keV; spectropolarimetry is available from > 60 keV to < 600 keV) to detect the anisotropy of accelerated particles. We plan to realize *PhoENiX* satellite mission around next solar maximum (around 2025).
The basic developments of key technologies for these instruments have been completed. The soft X-ray imaging spectroscopy is planned to be realized with the combination of high-precision glass-polished X-ray mirrors and high-speed CMOS cameras. The hard X-ray imaging spectroscopy consists of high-precision electroforming X-ray mirrors and CdTe cameras. The soft gamma-ray spectropolarimeter is a redesigned instrument of *Hitomi* / Soft Gamma-ray Detector (SGD) that has Compton cameras with active shields. Some of these technologies required for the X-ray imaging spectroscopy have been demonstrated by *FOXSI* sounding rocket series launched in 2012, 2014 and 2018. The *FOXSI* successfully obtained the focusing imaging spectroscopic data of the solar corona in X-rays (from ~0.5 keV to ~15 keV).
In this presentation, we explain the details of science goal and objectives, and instruments of *PhoENiX* mission.

Keywords: PhoENiX, Particle Acceleration, Magnetic Reconnection, Solar Flare, X-rays, Imaging Spectroscopy

