

Lunar plasma observation by MAP-PACE onboard KAGUYA (SELENE)

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Low energy charged particles around the Moon were vigorously observed by Moon orbiting satellites and plasma instrumentation placed on the lunar surface in 1960s and 1970s. Though there were some satellites that explored the Moon afterwards, most of them were dedicated to the global mapping of the lunar surface. One of the fourteen science instruments onboard KAGUYA MAP-PACE (MAGnetic field and Plasma experiment - Plasma energy Angle and Composition Experiment) was developed for the comprehensive three-dimensional plasma measurement around the Moon. MAP-PACE consists of 4 sensors: ESA (Electron Spectrum Analyzer)-S1, ESA-S2, IMA (Ion Mass Analyzer), and IEA (Ion Energy Analyzer).

After the successful functional check of the low voltage part, high voltage power supplies were turned on. The applied high voltage was gradually raised to the observation level. Since 14 December 2007, MAP-PACE has been observing plasma around the Moon. PACE sensors have been measuring solar wind, plasmas in the wake region of the Moon and plasmas in the Earth's magnetosphere. ESA sensors have discovered electron heating over magnetic anomalies on the lunar surface. ESA sensors have also observed electrons accelerated from the lunar surface in the wake region. PACE ion sensors have discovered new features of low energy ions around the Moon. The in-situ measurement of low energy ions at 100km altitude around the Moon is realized almost three decades after the Apollo period. IMA has discovered the existence of alkali ions that are originated from the lunar surface or lunar atmosphere and are picked up by the solar wind. IEA and IMA sensors discovered solar wind reflection by the Moon. PACE ion sensors also discovered that ions are rarefied over the magnetic anomaly on the lunar surface while electrons are heated. MAP-PACE observation has been revealing unexpectedly active plasma environment around the Moon.