

Title: Spectroscopy as a tool for exploring the surface composition of Mercury: Unveiling the mysteries of Mercury using datasets from NASA MESSENGER and future ESA-JAXA BepiColombo mission to Mercury

Dr. Indhu Varatharajan

Mercury, the smallest and the innermost of the terrestrial planets, is also the hottest planet among the airless bodies in the solar system. Understanding its formation and evolution are important to understand the formation of the solar system itself. The NASA MErcury Surface, Space ENvironment, GEOchemistry, and Ranging (MESSENGER) mission is the first to orbit Mercury between 2011 and 2015. MESSENGER carried seven scientific instruments out of which four instruments which includes Mercury Atmospheric and Surface Composition Spectrometer (MASCS), Mercury Dual Imaging System (MDIS), X-ray Spectrometer (XRS), and Gamma-Ray and Neutron Spectrometer (GRNS) are specifically sent to understand the surface chemistry and its mineralogy. The optical spectroscopy suite (MASCS, MDIS) onboard MESSENGER covered the near-ultraviolet to near-infrared spectral range (300-2000 nm). None of the spectral measurements obtained so far have shown silicate absorption bands in this spectral range due to the Fe-poor nature of the surface minerals. This poses necessary challenges for direct identification of the surface mineralogy. On October 20, 2018, ESA/JAXA's BepiColombo mission was successfully launched to Mercury which carried visible-infrared (V-NIR) spectrometer SIMBIO-SYS/VIHI covering the spectral region from 0.4 – 2 μm and the Mercury Radiometer and Thermal Imaging Spectrometer (MERTIS) which will map Mercury surface at wavelength range of 7-14 μm (mid-infrared; MIR). This talk will focus primarily on understanding the composition of Mercury from orbital remote sensing observations, especially with the MERTIS instrument onboard ESA-JAXA BepiColombo mission to Mercury. MERTIS will be the first radiometer and the first thermal infrared (TIR; 7-14 μm) hyperspectral spectrometer to orbit Mercury. To this purpose a specialized spectral library was created of various Mercury analogues under their extreme environmental conditions as a function of temperature (100°C-500°C) under vacuum, the stability and spectral signature of a range of sulfides was studied, the derivation of various spectral parameters to facilitate the mapping of surface composition was evaluated and with these the analysis of data in the visible and near-infrared by the NASA MESSENGER was revisited. Put together, they will aid the mapping of the crustal and volcanic mineralogy of the Mercury surface.

Indhu Varatharajan is a Postdoctoral Research Associate in the Center for Planetary Exploration (CPEX), Department of Geosciences, Stony Brook University, New York. Her research interests are focused on integrated spectroscopy approach (laboratory, remote sensing, numerical modelling, and telescope data analysis) to understand the characterization, abundance, and distribution of silicate and volatile mineralogy of planetary surface targets. She received her Ph.D. in Planetary Science at the Institute of Planetary Research, German Aerospace Center (DLR), Berlin in affiliation with Freie University, Berlin for her research on evaluating new spectral analysis techniques to study the hot surface of planet Mercury with MERTIS instrument on ESA/JAXA BepiColombo mission. She is one of the Co-Investigators of the MERTIS instruments onboard BepiColombo mission to Mercury. She received her Bachelors in Geoinformatics Engineering from College of Engineering, Guindy in India and received her Masters in Planetary Science from University College London, UK.