Application for Linnestod 2007

Research interests: Johan Warell

Chemical composition and surface properties of planetary bodies

This research topic is broad in context and has been focussed on observational and modelling studies of Mercury and the Moon in order to interpret their surface composition, light scattering properties and microphysical characteristics. From this information studies of possible evolutionary paths that have brought the surfaces to their present state may be carried out. One of the major drivers is to provide boundary constraints to deduce the formation model of Mercury, which has to explain, e.g., the origin of its large and massive core, iron-diluted upper mantle and crust and the presence of a magnetic field.

Observationally, imaging, photometry and spectroscopy in the optical, near-infrared and thermal infrared regimes have been made of Mercury and the Moon and other solar system objects with a variety of telescopes and instruments (IRTF/SpeX+MIRSI+CSHELL, NOT/NOTCam+ALFOSC, Swedish Vacuum Solar Telescope and Swedish Solar Telescope). Remote-sensing data from an extended wavelength range is required to determine the nature of the minerals and rock types on the surface, and the extent of maturation processes. While iron-rich minerals and Ti-Fe-oxides may be identified through the presence of charge transfer and crystal field absorption features in the optical and near-infrared, iron-poor or even iron-free minerals, expected to be dominant in Mercury's upper crust, are identifiable through vibrational emission and absorption bands in the thermal infrared.

Hapke's radiative transfer-based model for light scattering in porous particulate media has been extensively employed to interpret the observational data. Using the Moon as a reference object, whose properties are largely characterized and for which maturation processes are partly understood from laboratory work, is crucial. This theory has been used to model the photometric properties and the reflectance spectrum to derive information on mineral and chemical composition, particle size, regolith porosity, particle scattering functions, surface roughness etc.

Other research topics include the numerical integration studies of the stability and dynamic evolution of particles in Mercury-centric and Mercury-like heliocentric orbits, spectrum-based taxonomic classification of minor bodies, and observational search for near-Earth objects.

I am Science Co-I on two ESA BepiColombo instruments: the X-ray spectrometer MIXS and the infrared spectrometer MERTIS. Currently engaged in the selection of analogues for Mercury's surface composition and acquisition of laboratory emissivity spectra for interpretation of MERTIS data. I am member of the ESA Gaia mission SSU15 work package Minor Planets to provide code for minor planet classification from Gaia's minor body spectroscopy data.