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Using Neutron Spectroscopy to Obtain Quantitative Composition Data of Ganymede's Surface from the Jupiter Ganymede Orbiter

D. J. Lawrence (1), S. Maurice (2), G. W. Patterson (1), and C. A. Hibbitts (1)

(1) Johns Hopkins University Applied Physics Laboratory, Laurel, MD, USA (David.J.Lawrence@jhuapl.edu), (2) Centre d'Etude Spatiale des Rayonnements, Toulouse, France

Understanding the global composition of Ganymede's surface is a key goal of the Europa Jupiter System Mission (EJSM) that is being jointly planned by NASA and ESA. Current plans for obtaining surface information with the Jupiter Ganymede Orbiter (JGO) use spectral imaging measurements. While spectral imaging can provide good mineralogy-related information, quantitative data about elemental abundances can often be hindered by non-composition variations due to surface effects (e.g., space weathering, grain effects, temperature, etc.). Orbital neutron and gamma-ray spectroscopy can provide quantitative composition information that is complementary to spectral imaging measurements, as has been demonstrated with similar instrumental combinations at the Moon, Mars, and Mercury. Neutron and gamma-ray measurements have successfully returned abundance information in a hydrogen-rich environment on Mars. In regards to neutrons and gamma-rays, there are many similarities between the Mars and Ganymede hydrogen-rich environments. In this study, we present results of neutron transport models, which show that quantitative composition information from Ganymede's surface can be obtained in a realistic mission scenario. Thermal and epithermal neutrons are jointly sensitive to the abundances of hydrogen and neutron absorbing elements, such as iron and titanium. These neutron measurements can discriminate between regions that are rich or depleted in neutron absorbing elements, even in the presence of large amounts of hydrogen. Details will be presented about how the neutron composition parameters can be used to meet high-level JGO science objectives, as well as an overview of a neutron spectrometer than can meet various mission and stringent environmental requirements.