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MANGA : an investigation of the elemental composition of Mercury for the BEPI COLOMBO mission.

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Introduction: Combined high-resolution gamma-ray spectrometers and neutron spectrometers such as MANGA (Mercury Analysis of Neutrons and GAmma-rays) have already been implemented on several planetary exploration missions (Mars Odyssey [1], Lunar Prospector [2] Messenger [3], Selene [4]) and have become key instruments to determine and map elemental composition of planetary surfaces. The MANGA Gamma Sensor Head is based on a large n-type high purity germanium crystal. The energy resolution of such a detector is more than 15 times better than that of any scintillator, and its sensitivity is highly suited to fulfill the scientific requirements. The Neutron Sensor Head is based on a "phoswich" (phosphor sandwich) concept which is made of a compact assembly of two scintillitators that will allow separate detection of thermal, epithermal and fast neutrons. The proposed MANGA instrument weighs 6.5 kg and requires 15.7 W of power and is currently undergoing a technology demonstration as provisional part of the payload for the Mercury Planetary Orbiter (MPO) of the BepiColombo mission to planet Mercury.

Science objectives: Among the overall scientific objectives of the BepiColombo mission [5], the determination and mapping of the elemental composition of Mercury's surface is of the highest priority.

Thanks to its high spectral resolution and high efficiency, MANGA will detect gamma-ray lines of most of the major elements (O, Si Fe, Ti, Mg, Al, Na, Ca) and of some minor or trace elements (H, C, S, U, Th, K) which make up the surface of Mercury. Data from the neutron spectrometer will provide a support to gamma-ray measurements and will detect H, Sm + Gd, and the mean atomic mass of the surface.

The precise knowledge of global abundances of refractory elements such as Ca, Mg, Al, Ti, radioactive elements such as K, Th and U, and their ratios will help to discriminate between various models of formation and evolution of the planet [6]. Of equal importance as measurement goals, maps of abundances will reveal regional heterogeneities in the elemental composition of the Hermean surface. In particular, this will allow:

- To characterize the broad geochemical regions of the Mercury surface;
- To distinguish between exogenic (impact cratering, formation of large basins,...) and endogenetic (volcanism, early crustal evolution,...) modifications of the surface;
- To identify the material that causes anomalous radar echoes in the polar regions;
- To locate volatile components at the origin of Mercury's exosphere.

Detection performances: In planetary remote gamma-ray spectroscopy, the requirement on high energy resolution is the most needed [7] In addition, two observation characteristics are to be considered : a long observation time is needed in order to maximize the signal to noise ratio, as well as a low altitude to get a good spatial resolution for mapping purposes. In this respect Bepi-Colombo offers large measurement time below 800 km altitude, and will allow to build a map of the entire planet, due to its polar orbit with limited eccentricity and 400 km pericenter altitude. In one Earth year of nominal mission duration, the observation time per 10° x 10° pixel varies from 4.8 hours at equator to 6.3 hours at the poles. The mean altitude varies from $\sim$ 400 km (equator) to 816 km (poles).

Although preceded by Messenger gamma-ray spectrometer, MANGA will provide new and more precise observations. Messenger GRS will essentially cover the northern mid latitude regions of Mercury while MANGA will equally cover both hemispheres.

References: [1] Boynton W.V., et al. (2004), *Space Sci. Rev.*, Vol. 110, p. 37. [2] Feldmazn W.C., et al. (1999), *Nucl. Instr. Methods Phys. Rev*.A422, p. 562. [3] Burks M., et al., (2005) *IEEE transactions* to appear.[4] Hasebe N. et al. (1999) LPS XXX, Abstract #1171. [5] Bepi Colombo Science Requirements, (2004), SCI-PB-RS-1156. [6] Brückner J., Masarik J. (1997), Planet. Space Sci. 45, p.39. [7] Evans L., et al. , (2005) *J. Geophys. Res*., submitted.