Geophysical Research Abstracts
Vol. 19, EGU2017-5208, 2017
EGU General Assembly 2017


# Heavy Metal – Exploring a magnetised metallic asteroid

Jan-Erik Wahlund (1), David Andrews (1), Yoshifumi Futaana (2), Adam Masters (3), Nicolas Thomas (4), Maria Cristina De Sanctis (5), Alain Herique (6), Kurt Retherford (7), Paolo Tortora (8), Joseph Trigo-Rodriguez (9), Nickolay Ivchenko (10), and Sven Simon (11)

(1) Swedish Institute of Space Physics, Uppsala, Sweden (jwe@irfu.se), (2) Swedish Institute of Space Physics, Kiruna, Sweden, (3) Imperial College London, UK, (4) Univ. of Bern, Switzerland, (5) INAF-IAPS, Roma, Italy, (6) IPAG/PLANETO, Grenoble, France, (7) SwRI, San Antonio, USA, (8) Univ. of Bologna, Italy, (9) CSIC-IEEC, Barcelona, Spain, (10) KTH, Stockholm, Sweden, (11) GIT, Atlanta, USA

We propose a spacecraft mission (Heavy Metal) to orbit and explore (16) Psyche – the largest M-class metallic asteroid in the main belt. Recent estimates of the shape, $\sim$279$\times$232$\times$189 km and mass, $\sim$2.7$\times$10(19) kg make it one of the largest and densest of asteroids, and together with the high surface radar reflectivity and the spectral data measured from Earth it is consistent with a bulk composition rich in iron-nickel. The M5 mission Heavy Metal will investigate if (16) Psyche is the exposed metallic core of a planetesimal, formed early enough to melt and differentiate. High-resolution mapping of the surface in optical, IR, UV and radar wavebands, along with the determination of the shape and gravity field will be used to address the formation and subsequent evolution of (16) Psyche, determining the origin of metallic asteroids. It is conceivable that a cataclysmic collision with a second body led to the ejection of all or part of the differentiated core of the parent body. Measurements at (16) Psyche therefore provide a possibility to directly examine an iron-rich planetary core, similar to that expected at the center of all the major planets including Earth. A short-lived dynamo producing a magnetic field early in the life of (16) Psyche could have led to a remnant field (of tens of micro Tesla) being preserved in the body today. (16) Psyche is embedded in the variable flow of the solar wind. Whereas planetary magnetospheres and induced magnetospheres are the result of intense dynamo fields and dense conductive ionospheres presenting obstacles to the solar wind, (16) Psyche may show an entirely new 'class' of interaction as a consequence of its lack of a significant atmosphere, the extremely high bulk electrical conductivity of the asteroid, and the possible presence of intense magnetic fields retained in iron-rich material. The small characteristic scale of (16) Psyche ($\sim$200 km) firmly places any solar wind interaction in the "sub-MHD" scale, in which kinetic plasma effects must be considered. Heavy Metal will investigate if (16) Psyche has an extended magnetosphere by mapping the local plasma density, composition, energy state and dynamics around the body, along with the magnetic field. By accurately mapping any internally retained magnetic field of (16) Psyche, we will address the origin of any magnetization (the possible remains of an early magnetic dynamo). The Heavy Metal spacecraft will be launched from Earth with an Ariane 6.2 rocket in the time window 2029 - 2031, and by using electric propulsion, along with a possible gravity assist manoeuvre by Mars, arrive at (16) Psyche some 4 – 4.5 years later. The S/C is then planned to orbit the body for a period of 1 year, and release a CubeSat for close up studies.