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The stereo channel (STC) of the SIMBIO-SYS instrument for the BepiColombo mission to Mercury

G. Cremonese[1], M.T. Capria[2], C. Barbieri[3], V. Da Deppo[3], D. Fantinel[1], G. Forlani[4], S. Fornasier[3], E. Giro[1], M. Massironi[5], G. Naletto[3], G. Salemi[6], M. Sgavetti[7], M. Zaccariotto[3], E. Flamini[8], S. Debei[3], and the SIMBIO-SYS international team

(1) INAF – Osservatorio Astronomico, Vic. Osservatorio 5, I-35122 Padova, Italy
(2)INAF – IASF, Roma
(3)CISAS, Università di Padova, Padova, Italy
(4) Dipartimento di Ingegneria Civile, Università di Parma, Parma, Italy
(5) Dipartimento di Geologia, Università di Padova, Padova, Italy
(6) DAUR, Università di Padova, Padova, Italy
(7) Dip. di Scienza della Terra, Università di Parma, Parma, Italy
(8) Agenzia Spaziale Italiana, Roma, Italy
e-mail: cremonese@pd.astro.it

Abstract. BepiColombo is the cornerstone n.5 of ESA, and it will be launched on August 2013. It is composed by two modules: the Mercury Planetary Orbiter (MPO) and the Mercury Magnetospheric Orbiter (MMO), and with a suite of instruments which shall allow to perform observations with a level of details considerably improved respect to the NASAs Messenger mission launched in 2004. The SIMBIO-SYS (Spectrometers and Imagers for MPO BepiColombo Integrated Observatory SYStem) instrument is a system integrating a STereoscopic imaging Channel (STC), a High spatial Resolution Imaging Channel (HRIC) and a Visual and Infrared Hyper-spectral Imager channel (VIHI). SIMBIO-SYS has been selected by ESA in the payload of the MPO. The main scientific objective of STC is the global mapping of the entire surface of Mercury in 3D and colors with a maximum spatial resolution of 50 m per pixel. It will allow to generate the Digital Terrain Model (DTM) of the entire surface improving the interpretation of morphological features at different scales and topographic relationships.

Key words. Planets: Mercury; Space vehicles: instruments

1. STC design

STC will perform a stereo colour mapping of the whole surface of Mercury, with a maximum resolution of 50 m per pixel at the periherm, 400 km above the Mercury surface, on the equator. It will be composed by two channels looking at the surface at $\pm 20^o$ from the nadir direction. It is based on a catadioptric de-

Send offprint requests to: G.Cremonese

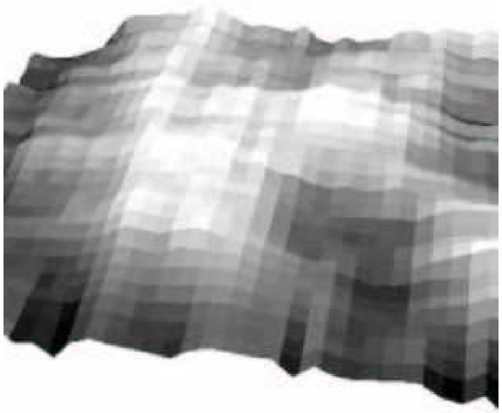

Fig. 1. Simulation of the Roter Kamm observed by the STC at a distance of 1500 km.

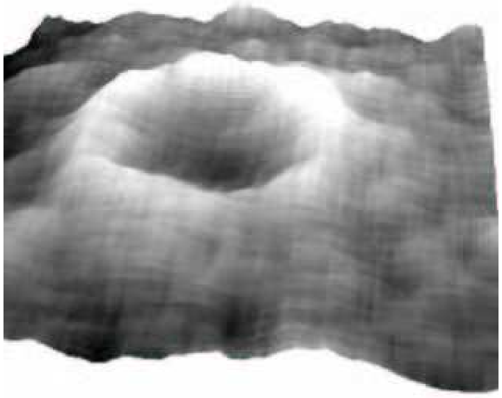

Fig. 2. Simulation of the Roter Kamm observed by the STC at a distance of 400 km.

sign using a single focal plane assembly utilizing Active Pixel Sensor (APS) on CMOS technology. Tab. 1 reports the scientific requirements of STC, while Tab. 2 reports the optical characteristics.

2. STC scientific objectives

The scientific objectives of STC are based on the global mapping of the planet and the generation of the DTM of the entire surface. They can be summarized as follows:

- surface geology (smooth plains, intercrater plains, heavily cratered terrains and hilly and lineated terrains)
- cartography; global, regional, and local topographic maps where the DTM will be used to rectify the maps
- crater
  - morphometric characterization and reconstruction of the degradation sequence;
  - depth-to-diameter ratios;
  - slope stability analysis;
  - mapping of possible ring-related structures in the unknown part of Mercury surface and detailed survey of the 500 km long ring at the NE of Caloris;
  - forms of crater degradation and possible latitude and/or longitude dependences of degradational processes (Neukum et al. 2001);
  - crater removal rate and thus still unknown rate of global resurfacing (effects on the crater-size-frequency distribution);
  - spectral units associated with impact craters and their ejecta in order to define the vertical zoning of material units, making use of craters as windows into the upper hundreds of meters in the mercurian crust (Neukum et al. 2001);
- Volcanism and the origin of smooth plain and Inter-crater plains
- tectonics;
  - global grid network nucleated during equatorial bulge relaxation;
  - lobate scarps related to core cooling and associated crustal contraction;
  - structures connected to Caloris basin (wrinkle ridges and troughs), including the hilly and lineated terrain antipodal to the basin itself;
  - minor structures as rectilinear troughs, grooves and hills, linked to local tectonic events.

Table 1. Scientific requirements

Ground pixel scale	50 m/px at 400 km (periherm)
Swath	30 km
Spectral range	500-900 nm
Filters	1 panchromatic (650 ± 125) 550 ± 10 nm 700 ± 10 nm 880 ± 10 nm

Table 2. Optical characteristics

Optical concept	original design
Focal length	90 mm
Pixel size	10μm
Pupil size	15 mm
Focal ratio	F/6
IFoV	23"/px (114μrad/px)
FoV (cross-track direction)	4^o

3. Simulations

We have started simulations on the spatial resolution required and the accuracy of the DTM at different solar illuminations, using well known subjects on Earth and the Moon, in order to study the stereo reconstruction to be applied to the STC images.
The first example taken into account is the impact crater Roter Kamm in Namibia, characterized by a diameter of 2500 m and a depth of 130 m.
Simulating the Roter Kamm observed from STC at a distance of 1500 km, corresponding to the apoherm of the MPO, we can see in Fig. 1 that is difficult to identify the crater. While Fig. 2 shows the same crater as observd by STC at 400 km, corresponding to the periherm of the MPO.

References

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