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The Colour and Stereo Surface Imaging System for ESA's Trace Gas Orbiter

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The Colour and Stereo Surface Imaging System (CaSSIS) is an 11 μrad/px imaging system ready to launch on the European Space Agency's (ESA) ExoMars Trace Gas Orbiter (TGO) on 14 March 2016 from Baikonur. CaSSIS is based around an 880 mm focal length carbon-fibre reinforced polymer (CFRP) telescope with a 135 mm primary mirror and a 2k x 2k CMOS hybrid detector with 10 micron pixel pitch providing 4.6 m/px imaging from the nominal 400 km circular orbit. The telescope is a slightly modified three mirror anastigmat optical configuration with no central obscuration. The instrument is designed to operate in "push-frame" mode where 2048 x 256 images are acquired at a repetition rate which matches the ground-track velocity ($\sim$3 km/s) allowing sufficient overlap for co-registration thereby building image strips along the surface.

A filter strip assembly (FSA) is mounted directly above the detector providing images in 4 wavelength bands. Two of these (480.5nm and 676.5nm prior to convolution with the rest of the instrument) correspond closely to bands used by the HiRISE instrument on the Mars Reconnaissance Orbiter [4]. Two other filters split the NIR wavelengths with centres at 838 nm and close to 985 nm. Analyses show that the filters provide good differentiation between expected surface minerals, particularly Fe-bearing phases (Tornabene et al. LPSC, 2016).

CaSSIS is designed to produce stereo from images acquired $\sim$30 s apart by using a rotation drive. The telescope points 10 degrees off-nadir. The drive aligns the telescope with the ground-track direction so that the telescope is pointing forward. After image acquisition, the telescope is rapidly rotated by 180 degrees to point in the opposite direction and the second image of the stereo pair is acquired.

CaSSIS will extend the monitoring of past missions to future years allowing the tracking of longer-term changes. It will also provide contemporaneous imaging of regions that may produce unique signatures detected by other instruments such as localized trace gases. The additional coverage provided will complement the moderate to high resolution coverage provided by HiRISE and CTX and will significantly improve upon the colour coverage and photometry of previous missions. The 74 degree inclination, circular orbit of TGO is not Sun-synchronous. Hence, imaging at different local times will be possible, allowing searches for diurnal effects. This may be of major importance for the investigation of, for example, RSL (McEwen et al., Nature Geoscience, 2014) and sublimation processes in the 55-75 degree latitude range. The diurnal variation of other dynamic phenomena, for example those associated with weather, can also be investigated.