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The design of Janus, the visible camera for the ESA JUICE mission

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The JUICE (JUpiter ICy moons Explorer) mission was selected in May 2012 as the first Large mission in the frame of the ESA Cosmic Vision 2015-2025 program. The mission is aimed at an in-depth characterization of the Jovian system, with an operational phase of about 3.5 years. During the whole operational phase, JANUS (Jovis, Amorum ac Natorum Undique Scrutator) will acquire panchromatic and narrow-band images in the visible – NIR range of many targets within the Jovian system: the Galilean satellites surfaces and exospheres, Jupiter atmosphere, minor and irregular satellites, the ring system.
After a long trade-off between different design solutions, based on performance requirements, mission design and constraints, the present JANUS design has been based on the following architectural choices detailed below.
A catoptric telescope with excellent optical quality is coupled with a framing CMOS detector, avoiding any scan-ning mechanism or operational requirement on the S/C. The three mirror anastigmatic (TMA) off-axis design with F#=4.67 allows an MTF between 62% and 72% at Nyquist, with good straylight rejection. The detector is the CIS115 from e2v; it is a CMOS with a squared 7 micron pixel pitch and image format of 2000x1504. It performs a high readout rate of up to 40 Mpixel/s, high quantum efficiency and low readout noise and dark signal. Fine tuning of instrument parameters allows to perform both high resolution targeted observations and lower resolution global coverage of targets, as required to meet science objectives. The IFoV (Fieldo of View per pixel) is 15 microrad, al-lowing sampling of 7.5 m/pixel from 500 km and 15 km/pixel from 10E6 km, while the FoV is 1.72x1.29 deg.
The acquisition parameters allow to cope with the many different observation requirements and conditions that JANUS will face. Design of the two electronics units (a proximity electronics controlling the detector and a main electronics controlling the instrument and the interfaces with spacecraft) will allow to adjust: the resolution through binning (from 2x2 up to 8x8 pixel); the field of view through windowing (subframe to be acquired can be set on every image); the signal levels and SNR through integration time (from 100 microsec up to tens of sec and minutes); the spectral bandwidth through broad- and narrow-band filter selection; the calibration parameters through in-flight calibration and data pre-processing; the data volume through tuneable compression module, with compression ratio from 1 up to 28. The spectral bandwidth is from 400 to 900 nm with panchromatic filter, while 11 filters with badwidth in the range 10-20 and 60-100 nm cover the spectral range from 370 to 1070 nm. Filter selection is allowed by a redunded filter wheel mechanism with short activation time. A multi-shot cover is implemented with redundancy and fail-safe mechanism; both mechanisms are based on heritage from previous missions. Cold redundancy is implemented for all critical electronic parts.
Thermal conditions and radiation shielding are important issues in instrument design; the particularly harsh radi-ation environment needs a combination of high radiation hardness components and materials and shielding at unit and component level.
JANUS is now in phase A-B1. It is being developed by a consortium involving institutes in Italy, Germany, Spain and UK, supported by the respective Space Agencies (ASI, DLR, MinEcon.yComp.-SNPRDI, UKSA), with contri-bution from Co-Investigators also from USA, France, Japan and Israel.