Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

PPS01-P03 Room:Convention Hall Time:May 26 18:15-19:30

JUICE-GALA : Concept of Focal Plane Assembly and Analog Electronics Module

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Ganymede Laser Altimeter (GALA) is scheduled on board JUICE mission by ESA to be launched in 2022. GALA will be developed and manufactured jointly by teams of Germany, Japan, Switzerland, and Spain. Japanese team is responsible for a receiver unit out of GALA instrument; a receiver telescope, a backend optics (BEO), a focal plane assembly (FPA) accommodating an APD sensor module and an analog electronic module (AEM).

Return laser pulse from the target body is collected by the receiver telescope and is fed into the following BEO. The BEO focuses the return light on the surface of an APD sensor contained in an APD module. For APD as optical sensor, we adopted a product of Excelitas Technologies Corporation that has a lot of experiences in space laser altimeter. The APD sensor is mounted on a hybrid IC of the APD module including a trans-impedance amplifier (TIA) for signal readout in a wide band width as 120MHz, a thermos-sensor for measurement of the APD sensor temperature and a thermoelectric (TE) cooler for control of the APD sensor temperature to stabilize the temperature as 25 deg-C or so. The APD sensor has an enhanced quantum efficiency of up to 40% at 1060 nm. APD typically has a large temperature dependency of gain. The APD module is equipped with TE cooler and the TE cooler is capable to control the temperature of APD precisely. Two redundant optical fibers are attached to the FPA so that a part of transmitted laser pulse generated in Laser head Module (LHM) is introduced to the APD sensor.

The TIA in the APD module outputs voltage signals corresponding to the input light pulses. The voltage signals are fed into the AEM. The transmitted pulses introduced from LHM are attained not to overshoot by a programmable amplifier in the AEM because the following part of analogue signal processing circuit in AEM is to be tuned for signals returned from the target body which are much smaller than the introduced laser pulses. Signal waveform from the introduced laser pulse to the received return pulse is converted to digital data by analogue-to-digital conversion (ADC) circuit and digitized waveform are transmitted to a range finder module (RFM). In RFM, the digital waveform with the transmitted pulse and the received pulse are filtered to optimize signal-to-noise ratio by ”matched filter” and the timings of both pulse are detected for ranging and also the width and height of the received pulse can be identified more precisely.

In our poster presentation, the current development status of the optical sensor and analogue module of GALA will be reported.

Keywords: JUICE, GALA, Laser altimeter, APD, Ganymede, analogue signal processing circuit