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AIRS: the Infrared Spectroscopic Instrument of ESA M4 ARIEL mission

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Abstract

ARIEL the Atmospheric Remote - sensing Infrared Exoplanet Large - survey has been selected in March 2018 as the Cosmic Vision M4 mission. This 1.4-tons satellite will be launched in mid-2028 by an Ariane 62 from Kourou toward a large amplitude orbit around L2 for a 4 years mission. It will perform transit spectroscopy of over a 1000 of exoplanets to complete a statistical survey, including gas giants, Neptunes, super-Earths and Earth-size planets around a wide range of host stars. It will complement the ESA and NASA continuing effort to understand the diversity of planetary system and the complexity of planet formation scenarios. AIRS will be the infrared spectroscopic instrument of the ARIEL mission providing spectroscopic data to answer the key scientific questions addressed by this mission: what are the exoplanets made of? How do planets and planetary system form? How do planets and their atmospheres evolve over time? Following trade-off analysis during the phase A of the study, a prism-based design was selected for the 2-channels spectrometer of the instrument. The instrument is based on two independent channels covering the CH0 [1.95-3.90] µm and the CH1 [3.90-7.80] µm wavelength range with dispersive elements producing spectrum of low resolutions R>100 in CH0 and R>30 in CH1 on two independent detectors. The spectrometer is designed to provide spectrum Nyquist-sampled in both spatial and spectral directions to limit the sensitivity of measurements to the jitter noise and intra pixels pattern during the long (10 hours) transit spectroscopy exposures. From the optical design, a full instrument overview will be presented covering the thermal mechanical design of the instrument functioning in a 60-K cold environment, up to the detection and acquisition chain of both channels based on 2 HgCdTe detectors functioning at 42-K. The instrument is composed of three main architectural blocks: the AIRS-OB optical bench including the two channels slits, and the optical elements within an aluminum structure; AIRS-FPA the focal plane assembly including the detectors with its mechanical housing and thermal control elements along with their interface to the active cryo-cooler, and the AIRS-DCU Detector Control Unit in charge of control of the detector system and on-board processing of the spectroscopic data.