An integrated payload design for the Atmospheric Remote-sensing Infrared Exoplanet Large-survey (ARIEL): results from phase A and forward look to phase B1

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ABSTRACT

ARIEL (the Atmospheric Remote-sensing Infrared Exoplanet Large-survey) has been selected by ESA as the next medium-class science mission (M4), expected to be launched in 2026. The mission will be devoted to observing spectroscopically in the infrared a large population of warm and hot transiting exoplanets (temperatures from ~500 K to ~3000 K) in our nearby Galactic neighborhood, opening a new discovery space in the field of extrasolar planets and enabling the understanding of the physics and chemistry of these far away

worlds. ARIEL was selected for implementation by ESA in March 2018 from three candidate missions that underwent parallel phase A studies. This paper gives an overview of the design at the end of phase A and discusses plans for its evolution during phase B1, in the run-up to mission adoption. The associated technology development activities necessary to reach the required TRL at the end of phase B1 are outlined.

ARIEL is based on a 1 m class telescope feeding two instruments: a moderate resolution spectrometer covering the wavelengths from 1.95 to 7.8 microns; and a three channel photometer (which also acts as a fine guidance sensor) with bands between 0.5 and 1.2 microns combined with a low resolution spectrometer covering 1.25 to 1.95 microns. During its 3.5 years of operation from an L2 orbit, ARIEL will continuously observe exoplanets transiting their host star.

This paper presents the overall view of the integrated design of the payload proposed for this mission. The design tightly integrates the various payload elements in order to allow the exacting photometric stability targets to be met, while providing simultaneous spectral and photometric data from the visible to the mid-infrared. We identify and discuss the key requirements and technical challenges for the payload and address the trade-offs that were assessed during phase A, culminating in the baseline design for phase B1. We show how the design will be taken forward to produce a fully integrated and calibrated payload for ARIEL that can be built within the mission and programmatic constraints and will meet the challenging scientific performance required for transit spectroscopy.

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