EPSC Abstracts
Vol. 13, EPSC-DPS2019-270-1, 2019
EPSC-DPS Joint Meeting 2019

EPSC
EPSC-DPS Joint Meeting 2019
15–20 September 2019 | Geneva, Switzerland

ArielRad: the *ARIEL* Radiometric Model

Lorenzo Mugnai (1), Billy Edwards (2), Andreas Papageorgiou (3), Enzo Pascale (1,3) and Subhajit Sarkar (3)
(1) Dipartimento di Fisica, La Sapienza Università di Roma, Piazzale Aldo Moro 2, 00185 Roma, Italy, (2) Department of Physics and Astronomy, University College London, Gower Street, London, WC1E 6BT, UK, (3) School of Physics and Astronomy, Cardiff University, Queens Buildings, The Parade, Cardiff, CF24 3AA, UK (lorenzo.mugnai@uniroma1.it)

Abstract

ARIEL, the Atmospheric Remote-Sensing Infrared Exoplanet Large-survey, has been selected by ESA as M4 mission in the Cosmic Vision programme. During its 4 years of operation, *ARIEL* will perform a spectroscopic survey of about 1000 transiting exoplanet atmospheres. ArielRad, the *ARIEL* radiometric model, has been developed to addressing the challenges in optimising the instruments and reach the *ARIEL* performance requirements, needed to fulfill the mission science mandate. The simulator shows that the measurement uncertainties arise from photon statistic, and that an observing programme with 1000 exoplanetary targets can be completed during the mission lifetime.

1. Introduction

ARIEL [1, 2] has been selected in March 2018 by ESA as the next medium-class science mission in the Cosmic Vision programme. *ARIEL* will investigate the atmospheres of $\sim$ 1000 different planets orbiting different start types, aiming to address the fundamental questions on what exoplanets are made of and how planetary systems form and evolve.

According to the *ARIEL* design, radiation is collected by an off-axis Cassegrain telescope with an elliptical primary mirror, and feeds two separated instrument modules. The first contains three photometers (VISPhot, $0.5\mu m - 0.6\mu m$; FGS-1, $0.6\mu m - 0.8\mu m$; FGS-2, $0.8\mu m - 1.1\mu m$) and a spectrometer (NIRSpec, $1.1\mu m - 1.95\mu m$). Two of the photometers serve as Fine Guidance System (FGS), providing both photometric and pointing stability information for the attitude and orbital control system. The second module hosts the *ARIEL* Infrared Spectrometer (AIRS [3]), that consists of two channels covering in total the $1.95\mu m - 7.8\mu m$ band with spectral resolving power between $30 - 100$.

2. The ArielRad simulator

The ArielRad simulator is a python software maintained by the *ARIEL* Consortium. With ArielRad it is possible to evaluate the photometric performance of the *ARIEL* science payload. Each simulation starts with one estimate of the target signal from the star. Then the signal is propagated through the instrument to the focal planes, taking into account the transmission of each optical component and the prism dispersion for the spectrometers. The signal is then spectrally binned to the desired spectral resolution. Uncertainties estimates account for photon and detector noise, plus margins. From an estimate of the transit and eclipse signals, an estimate of the Signal to Noise Ratio (SNR) achievable during transit and eclipse observations is obtained.

ArielRad has been extensively validated. Comparison with ExoSim [4] or with a static radiometric model of Puig et al. (2018) [5] shows excellent agreement at a few percent level.

3. Use of ArielRad

ArielRad is used to demonstrate compliance of the *ARIEL* mission design with the science requirements which are to observe a large and diverse sample of about 1000 exoplanet atmospheres. Additional uses of ArielRad involve the optimisation of the payload design ahead of mission adoption in 2020.

References

[1] Pascale, E et al.: The ARIEL space mission, SPIE, vol. 10698, 2018

[2] Tinetti, G. et al.: A chemical survey of exoplanets with ARIEL, Experimental Astronomy, vol. 46, pp. 135-209, 2018

[3] Amiaux, J. et al.: AIRS: the Infrared Spectroscopic Instrument of ESA M4 ARIEL mission, European Planetary Science Congress, EPSC2018-652, 2018

[4] Sarkar, S. and Pascale, E.: ExoSim: a novel simulator of exoplanet spectroscopic observations, European Planetary Science Congress, EPSC2015-187, 2015

[5] Puig, L. et al.: The Phase A study of the ESA M4 mission candidate ARIEL, Experimental Astronomy, vol. 46, pp. 211-239, 2018