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A 3U CubeSat to Collect UV Photometry of Bright Massive Stars

Richard Desselle, Christian Kintziger, and Pierre Rochus
Centre Spatial de Liège, University of Liège
Liège, Belgium

Gregor Rauw and Yaël Nazé
Groupe d'Astrophysique des Hautes Energies
University of Liège
Liège, Belgium

Abstract

The last decade has witnessed exciting progress with the miniaturization of essential components of spacecraft, leading to the development of nano-and micro-satellites beyond their use as mere technological experiments. These small satellites are now considered to be important complements of much larger and more sophisticated probes to conduct scientific research. In this context, the current authors have conducted a feasibility study of a near-ultraviolet (UV) telescope onboard a three-unit (3U) CubeSat. The scientific purpose of this payload will be to collect time series of photometric measurements of bright, mainly massive, stars down to an optical magnitude of V=5. This paper presents the optimized optical design of the payload and its associated detector. It further discusses the system accommodation and integration, as well as a providing a preliminary mission analysis. A photometric budget taking into account the characteristics of the target stars and the payload performances is also presented. This feasibility study demonstrates that it is possible to conduct a robust science mission using a very small satellite at limited cost.

1. Introduction

1.1. Astrophysical Background

Since the termination of the International Ultraviolet Explorer (IUE) mission in 1996 and the end of the Far Ultraviolet Spectroscopic Explorer (FUSE) in 2007, the ultraviolet (UV) domain suffers from a lack of dedicated instrumentation. Indeed, the situation is very different from other wavelength domains. The optical and near-IR (infrared) wavelength ranges can be observed from the ground at many observatories. Moreover, several far-IR space observatories are under construction or in planning. However, there is currently no mid-to far-UV mission at a similar level of preparation, though the UV domain has great diagnostic potential, especially for the study of bright massive stars whose spectral energy distribution peaks in the UV. Spectroscopy clearly offers the highest scientific return, as many chemical elements have strong resonance lines in this wavelength domain. The analysis of such lines provides sensitive diagnostics of the stellar and wind parameters. However, high-resolution

Corresponding Author: Richard Desselle, rdesselle@ulg.ac.be
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