Feasibility study of a UV photometer on-board a 3U Cubesat for the study of bright massive stars

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Introduction

• PhD Research topic
  ▫ Feasibility study of a **UV photometer** on-board a **3U Cubesat**. The scientific purpose of the payload is to collect time series of photometric measurements of **bright massive stars**.

• Time schedule: from December 2013 to December 2017

• This research is funded through the ARC grant for Concerted Research Actions, financed by the Federation Wallonia-Brussels
Near-UV Photometer requirements

- Optical performances needed:
  - Collect and focus star light from 250 to 350 nm (no wavelength dispersion)
  - Signal to noise ratio $\geq 1000$ in less than 5 minutes for star magnitude $V \leq 5$

- Scientific optical requirements: $\text{FoV} \geq 1^\circ$, $\Delta \theta \leq 15^\prime$

- Geometrical constraints:
  - Entrance pupil diameter $\leq 90 \text{ mm}$
  - Payload volume $\leq 1.5U$ (from entrance pupil to focal plane)
Near-UV Photometer design

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<td>Entrance pupil</td>
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<tr>
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<td>M1</td>
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<td>M2</td>
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<td>Bandpass filter</td>
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Diagram showing the components 1 to 6 with measurements:
- Entrance pupil to M1: 90 mm
- M1 to M2: 100 mm
- M2 to Focal plane: 45 mm

Scale: 1.10  RD 08-Mar-16
Near-UV Photometer characteristics

- Optimized FoV = 1°
- Entrance pupil diameter = 90 mm
- Effective diameter = 80 mm
- Angular resolution = 11 arcsec
- Detector: back-thinned CCD with 13X13 µm pixel size working in 2X2 binning mode

Worst case for photometric budget:
- « Cold » star ($T_{eff} \approx 15000K$)
- Hot observational case ($T_{CCD}$ is max)
3U Overview

Deployable solar panels

Deployable antenna

Telescope aperture
3U Overview

- Baffling system
- Detector assembly
- Communication controller
- ADCS
- M2
- M1
- On-board computer
- Battery
- 1.5 Unit for the payload
- 1.5 Unit for the sub-units
Conclusion

- 3U Cubesat project demonstrates that a high level scientific mission is achievable with very small spacecraft platforms.
- Heritage from the 3U Cubesat project:
  - The 3U study is extended to a 6U study that will carry a UV spectropolarimeter for the study of bright massive stars.
  - The polarimeter is a static system that allows measuring the entire polarimetric state of the incident light. It could be used as a technology demonstrator.
Thank you!