Death of Massive Stars: Supernovae and Gamma-Ray Bursts
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SVOM Visible Telescope: Performance and Data Process Scheme

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Abstract. VT (Visible Telescope) is an instrument onboard SVOM (Space-based multi-band astronomical Variable Objects Monitor) satellite working in the visible band, which will play an important role in follow-up of two categories of GRBs: very distant events at higher redshift and faint/soft nearby events in SVOM mission. To fulfill these primary science requirements, decent sensitivity and wavelength coverage are fundamental for VT design. VT performance and data process strategy were successfully studied on its feasibility in Phase A, which is presented in this poster. Additionally, preliminary VT image simulator is also introduced here.

Keywords. space vehicles: instruments, telescope, gamma rays: bursts.

1. Introduction

The SVOM mission is dedicated to observe gamma-ray bursts (GRB) in multi-bands from visible to MeV. The multi-bands observation is provided by four instruments on SVOM satellite, i.e. VT, MXT, GRM, and ECLAIR. VT is the only one working in the visible band, which serves the purpose of improving the GRB localizations obtained by the higher energy detectors ECLAIR and MXT to sub-arcsec precision through the observation of the optical afterglow. It will thus ensure a deep and uniform sample of optical-afterglow light-curves, and make a preliminary selection of optically dark GRBs and high-redshift GRB candidates (for detail, see Paul *et. al.* 2011).

2. VT performance

The general VT performance is presented in Table 1. The primary points in VT design are: (i) decent sensitivity and wavelength coverage: It is required by the scientific goal to detect faint and high-z GRBs. Therefore, VT will have two simultaneous channels with high EQ CCD and wavelength coverage from 400 nm to 950 nm. Detector parameters, such as read noise, working temperature, pixel size are also taken into account. (ii) The Field Of View (FOV) of VT should cover the entire ECLAIR localization error box of the GRB. Currently, the FOV of VT, modified to $26' \times 26'$, is just based on ECLAIR localization strategy update. (iii) Effectiveness and reliability: VT shall have the following operation modes: OFF, OBSERVATION MODE, STAND-BY, CALIBRATION, CCD CLEANING, FOCUS ADJUSTING, RESET, AND CCD BAKE-OUT, to make it working effectively and reliably. Furthermore, CCD shielding and internal shutter mechanism are also considered in VT design.

Table 1. Overview of VT performance.

Parameter	Value	Parameter	Value
Aperture	450 mm (diameter)	Focal Length	3600 mm
FOV	$26' \times 26'$ (new modification)	Trans. efficiency	$\geqq 0.7$ (optical path)
Channels	400–650 nm, 650–950 nm	Read noise	$\leqq 6e$ (100 s/300 s)
m_{Limit}	V = 23 (300 s exp; SNR$\geqslant$5)	T_{CCD}	$\leqq -65°C$

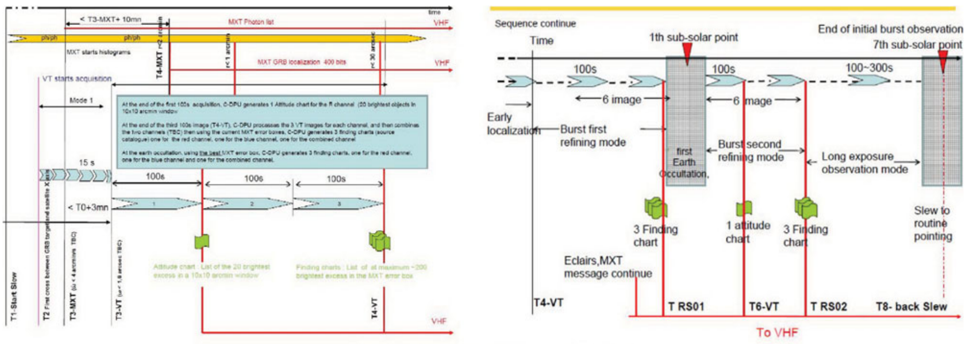

Figure 1. VT observation strategy.

3. Observation & data process strategy

Observation strategy. The on-board localization sequence is performed during the first and the second orbit of the initial burst observation, which is shown in Figure 1.

Data process strategy. On-board data process includes attitude chart and finding chart process for each 300s (see Figure 1). Ground data process comprises three pipelines: (i) Pipeline I: Astrometry calibration for GRB position of MXT with VT Attitude. (ii) Pipeline II: To Search GRB candidate in finding chart and do astrometry calibration. The output is GRB position in VT field. (ii) Pipeline III: Search of GRB fainter candidate in subimage and also do astrometry calibration. The output is GRB position in VT field.

4. VT image simulator

Purpose. (i) Pipeline: To provide input for pipeline development. (ii)Design: To validate the performance of VT design. (iii) Calibration: To understand SVOM photometry system. (iv) Observation strategy: To estimate GRB detection efficiency.

Methods & tools. Input of the simulator is the telescope optical system efficiency, CCDs performance parameters: gain, read noise, response curve, jitter stability, sky background, Space radiation environments, GRB knowledge (number, types, spatial distribution etc.), survey catalogues, SVOM observation strategy. Its output is VT image with GRB. Used tools are: skymaker,Pysyphot,IRAF artdata package, and HST handbook.

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References

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