

Progress on SVOM Satellite Development*

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Abstract SVOM (Space-based multiband Variable Object Monitor) is a Chinese-French space mission mainly designed to study Gamma-Ray Bursts. The satellite carries four instruments to detect and localize the prompt GRB emission and measure the evolution of the afterglow in the visible band and in soft X-rays, and a VHF communication system enables the fast transmission of SVOM alerts to the ground. The ground segment includes an array of wide-angle cameras and two follow-up telescopes. It was launched into an orbit of about 635 km on 22 June 2024, with three years of nominal operations and an extension of two years.

Key words Space astronomy, Gamma-ray burst

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SVOM (Space-based multiband Variable Object Monitor) is a mission dedicated to the study Gamma-Ray Bursts (GRBs)^[1], approved jointly by both Chinese and French space agencies. The satellite has an orbit with an altitude of 635 km and an inclination of 29°. The system Final Acceptance Review (FAR) was carried out by CNSA and CNES in January 2024. It was launched at Xichang Satellite Launch Center by Long March 2C on 22 June 2024.

GRBs are extremely luminous transient sources appearing when a newborn stellar mass black hole or magnetar emits an ultra-relativistic jet towards the Earth. Consequently, the study of GRBs has the potential to expand or revolutionize our understanding of key astrophysical issues on the mechanisms driving stellar explosions and the radiation processes of relativistic jets. In the next years, GRBs will also undoubtedly shed new light on the evolution of the young universe, particularly on the history of star formation, the metal enrichment of galaxies, and the reionization of the intergalactic medium^[2]. GRB 170817 A, a normal short GRB detect-

ed by Fermi-GBM, was the first confirmed counterpart of gravitational-wave transients, which made GRBs an even hotter topic^[3].

The scientific objectives of SVOM put a special emphasis on two categories of GRBs: very distant GRBs at $z > 5$ which constitute exceptional cosmological probes, and faint/soft nearby GRBs which allow probing the nature of the progenitors and the physics at work in the explosion. These goals have a major impact on the design of the mission: the onboard hard X-ray imager is sensitive down to 4 keV and computes online image and rate triggers, and the follow-up telescopes on the ground are sensitive in the NIR.

In order to take advantage of the astrophysical potential of GRBs, SVOM is designed to (i) permit the detection of all known types of GRBs; (ii) provide fast, reliable GRB positions; (iii) measure the spectral shape of the GRB prompt emission from visible to MeV; (iv) measure the temporal properties of the GRB prompt emission from visible to MeV; (v) identify quickly the afterglows of detected GRBs at both X-ray and visible

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bands, including the ones that are highly redshifted ($z > 5$); (vi) measure the spectral shape of the early and late GRB afterglow from visible to X-rays; (vii) measure the temporal evolution of the early and late GRB afterglow from visible to X-rays.

SVOM mission is designed to consist of a set of scientific instruments to implement the synergy between space and ground observations. The space-based instruments include (i) ECLAIRs, a wide field-of-view hard X-ray imager and spectrometer; (ii) GRM, a wide field-of-view soft gamma-ray spectrometer; (iii) MXT, a narrow field-of-view low-energy X-ray telescope; (iv) VT, a narrow field-of-view visible/near infrared (NIR) telescope. The ground-based instruments include (i) GFTs, two follow-up telescopes (one of which features efficient NIR capabilities); (ii) GWAC, an array of wide field-of-view cameras in the visible band. A network of about 45 VHF receiving stations, and a Beidou short-message system as supplement, are designed for real-time downlink communication.

SVOM is a unique multi-wavelength observatory with rapid slew capability and quick command up-link capability. Therefore, SVOM will also be a powerful target-of-opportunity observatory for the whole astronomy community beyond the specific objectives linked to GRBs. For example, the SVOM mission has been conceived to promptly point to the celestial fields where

sources have been detected by a wide field of view astronomical devices such as the upgraded generation of gravitational wave detectors (LIGO, VIRGO, GEO and KAGRA) and high-energy neutrino detectors (IceCube, KM3 NeT).

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