VECTOR: AN ANALYSIS OF SMALL SATELLITES AS CONTRIBUTORS TOWARDS HIGH ENERGY ASTROPHYSICS

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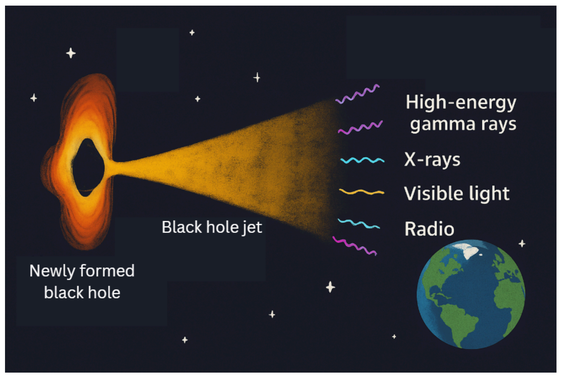
Within a small satellite form factor, demonstrate an optical telescope with onboard processing to perform search algorithms.

Gamma ray bursts and their afterglows

A gamma-ray burst (GRB) is a cosmic explosion caused by a dying star or a neutron star collision, sending out powerful jets of energy. First there's a short flash of gamma rays (milliseconds to minutes). As the jet interacts with surrounding gas and dust, it glows in X-rays, visible light, and radio waves for days to weeks. This is the afterglow, which appears as a point source. Catching these afterglows provides information about the black hole.



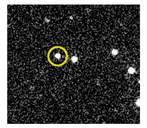
GRB afterglows span the whole electromagnetic spectrum

VECTOR

Artificially testing search algorithms to see if a small satellite could capture a GRB afterglow.

Artificial map loaded onto VECTOR with a star purposely removed

VECTOR searches the area in the real sky to find the new bright object (simulating a GRB afterglow)



Real GRB afterglow (looks like a star)

Video depiction

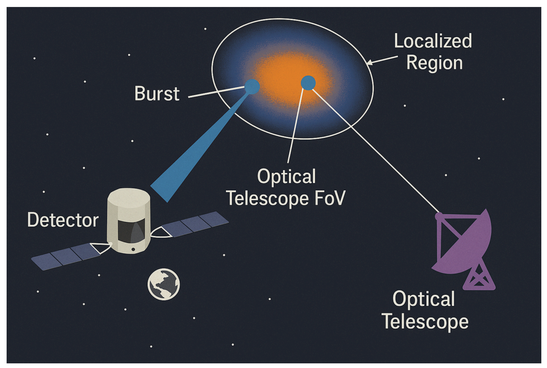
Mission Objectives:

MO-1: Capture images of astronomical objects on a CubeSat.
MO-2: Demonstrate the use of on-board processing to detect an artificial transient.

Success Criteria:

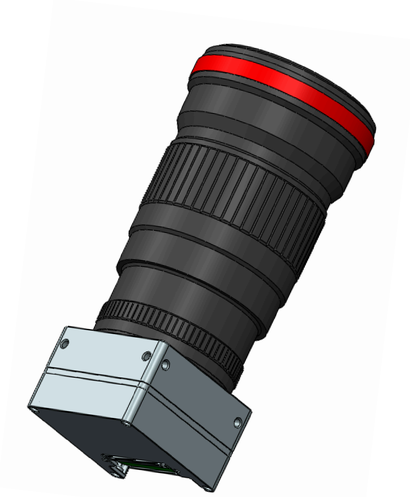
FSC-1: VECTOR's limiting magnitude is ≥12.
FSC-2: Using multiple algorithms, detect an artificial transient (+/- TBD positional error) through a 30 degree by 30 degree square (TBR) probability density function (PDF)-defined region within 30 minutes (TBR).
FSC-3: Complete the process outlined in FSC-2 with more than one algorithm.

Optical telescopes need search algorithms



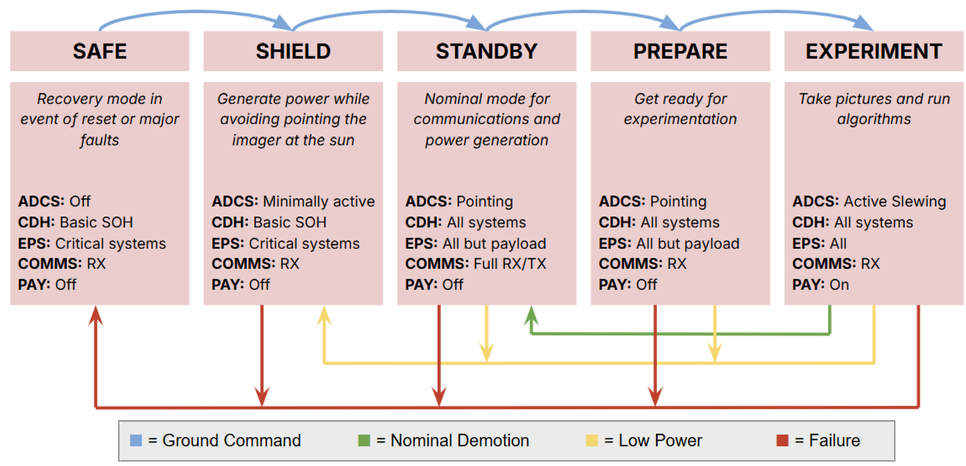
GRB afterglows span the whole electromagnetic spectrum

GRB detectors often produce wide localized regions where they think the burst occurred. An optical telescope, with a small field of view (FoV) often has to search through this region to find the burst. This localized data can then be sent to other instruments.
It is important to catch the optical parts of these bursts as soon as possible. Early optical light curve data can lead to insights about the GRB source.



CAD Depiction of VECTOR's payload

Concept of Operations



Larger optical telescopes are busy and ground observatories can be blocked by weather or location. Small satellites could act as additional, cheaper detectors. This mission determines if this is feasible.

PAYLOAD	
Lens	**Canon 200mm f/2.8**
Sensor	**Ximea MX042MR-GP-BSI-X4G2** 4.1 MP Monochrome CMOS, 91% QE, 1.2e- Read Noise

Collaborators

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Get in Touch

References