מכון ויצמן למדע
WEIZMANN INSTITUTE OF SCIENCE

LIMSAT-UV: A Wide Field UV Transient Explorer Satellite Mission

LIMSAT
Less Is More
Transient Explorer

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Science

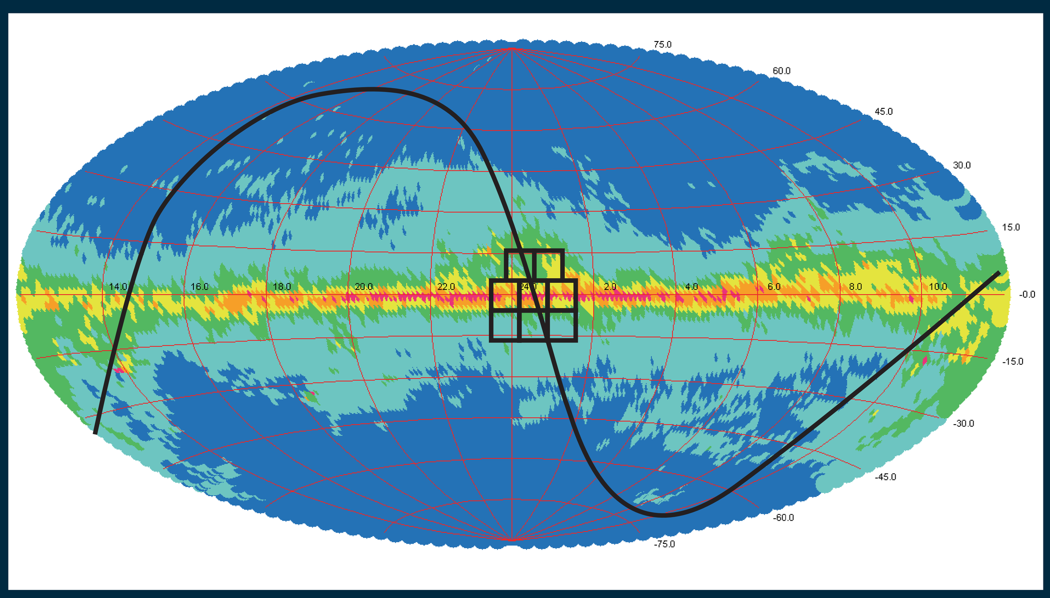
The extra-Galactic transient UV sky holds great potential for new discoveries. One example is the early (minutes, hours) UV flares from Supernovae. The UV signal is produced by the initial breakout of the explosion shock from the stellar surface. This early UV emission provides constraints on the progenitor radius and chemical composition, which can not be derived from later (~days) observations.

Large scale experiments searching for gravity waves and high energy neutrinos from astrophysical sources such as black hole mergers or stellar disruptions by black holes have recently begun operation. Correlating a detection from these experiments with an electromagnetic counterpart can provide an independent verification of weak signals and therefore substantial improvement in the effective sensitivity as well as crucial information for understanding the signal's source. LIMSAT-UV will have the combination of wide field of view, short cadence and sensitivity to find such signals.

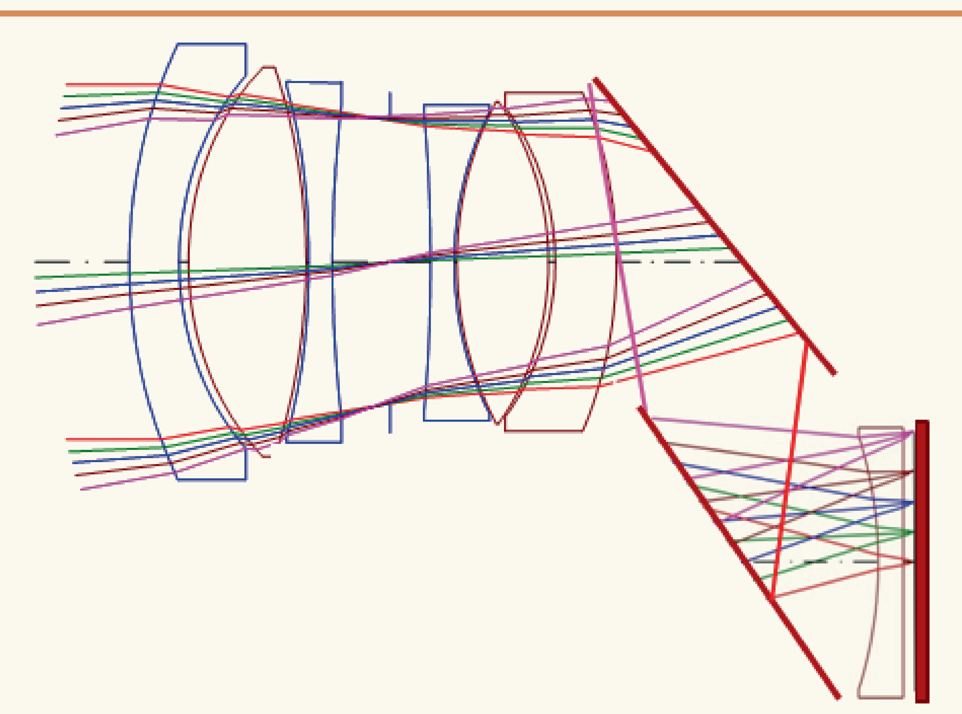
Additional science goals from detectable transients in the UV may include:

- The afterglow from Gamma Ray Bursts (GRB), including "orphan" GRBs
- Stellar disruption by a Black Hole
- Planetary transits around young stars
- A census of stellar and AGN UV variability

Galactic extinction in the UV (Schlegel et al., extrapolated to 240nm) with the LIMSAT field of view of eight 11° x 11° telescopes covering ~1000 deg^2

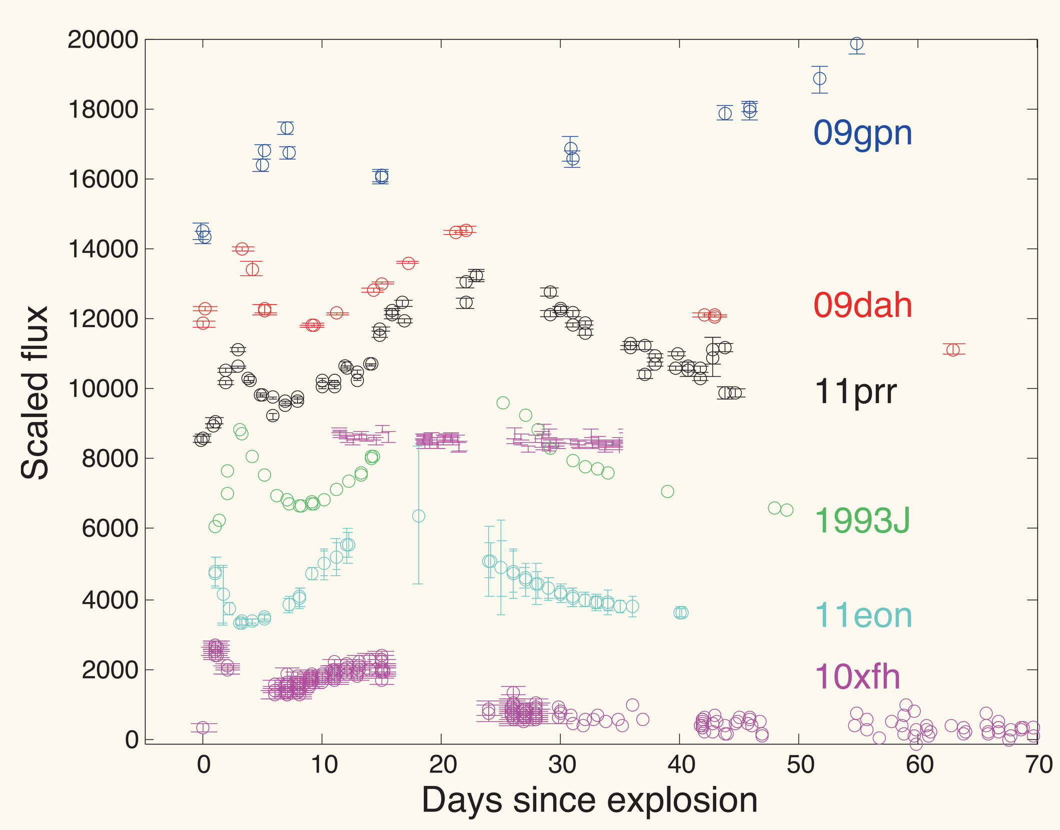


1. Optics



Optical design of a single LIMSAT-UV telescope (by Elbit Systems ltd.). The lenses will be made of Fused Silica and Calcium Fluoride. A pair of reflecting filters will reject >99.7% of the visible light to prevent detector saturation by visible light.

2. Supernova light curves



Several supernova light curves showing emission flares at early times. Arcavi et al. 2012 (in preparation)

Mission

We are designing LIMSAT-UV: a wide field (~1000 deg^2) transient explorer satellite mission. LIMSAT-UV will have eight telescopes equipped with CCD cameras and reflective filters. It will have sensitivity 10 times lower than GALEX but a field of view more than 1000 times larger. The detection rate for transients in the UV is more than 30 times greater than that of GALEX. LIMSAT-UV will detect transient signals and will distribute real time alerts to the community.

Typically, space missions cost hundreds of millions of dollars and take many years to design, build and launch. Here, the concept of `Less is More' is our guideline as we rely on 'off-the-shelf' technology and compromise resolution in order to construct a small satellite with a wide field of view in a short time. Our aim is to launch LIMSAT-UV in 3-4 years and at a cost of a few tens of millions of dollars.

LIMSAT-UV will orbit the Earth at an altitude of 720km where it will stare in the anti-sun direction. The combination of short cadence (300 sec) with a wide field of view will enable LIMSAT-UV to discover approximately 10 SN shock breakout per year. LIMSAT-UV is currently in the design phase and is planned to be launched to low earth orbit in 2015.

LIMSAT-UV has been approved for pre-phase A study by the Israeli Space Agency (ISA) in collaboration with NASA Ames Research Center.

LIMSAT-UV design summary

# of telescopes	8
# of pixels per telescope	2048x2048
Pixel size	30x30 µm
F/#	2.4
Aperture diameter	120 mm
Integration time	300 secs
QE x transmittance	0.57 with reflective filter
PSF fraction on pixel	0.75
Bandwidth	50nm
Background flux	0.08 photon/sec/cm^2/arcmin^2
Detection threshold (5σ)	0.006 photon/sec/cm^2