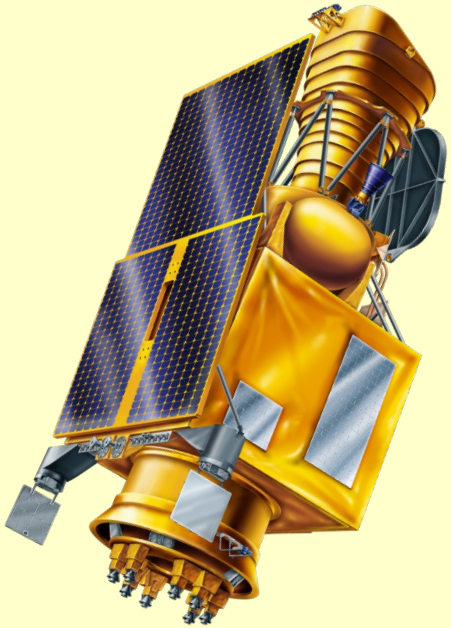
ULTRASAT: A Wide-Field UV Space Telescope

Revolutionize our understanding of the hot transient Universe



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Funding partners
ISA
WIS
DESY
NASA

Industry partners
IAI
Elop
Tower

Eli Waxman | Weizmann Institute of Science

ULTRASAT's uniqueness

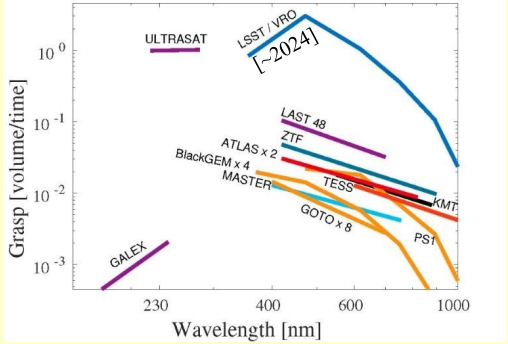
Key Properties

- Very large, 200 deg^2, field of view.
- High UV (230-290nm) sensitivity:
  1.5 x 10^{-3} ph/cm^2 s (900s, 5σ)
  [m = 22.5].

Key Capabilities

- Monitor an unprecedentedly large volume of the Universe.
- New window in wavelength (NUV) and in cadence (minutes - months).
- Real-time alerts to ground/space-based telescopes (GEO orbit), initiate world-wide follow-ups.
- ToO: Instantaneous >50% of the sky in <15 min for >3 hr.

Transient detection volume accessible to leading surveys



ULTRASAT: A broad science impact

Source Type	# Events per 3 yr mission	Science Impact
Supernovae		
Shock break-out and Early (shock cooling) of core collapse SNe	> 40 > 500	Understand the explosive death of massive stars
Superluminous SNe	> 250	Early evolution, shock cooling emission
Type Ia SNe	> 1000	Discriminate between SD and DD progenitors, dust reddening
Compact Object Transients		
Emission from Gravitational Wave events: NS-NS and NS-BH	~ 25	Constrain the physics of the sources of gravitational waves
Tidal disruption events	> 300 (high-cadence) > 4500 (low-cadence)	Accretion physics, black hole demographics
Quasars and Active Galactic Nuclei		
Continuous UV lightcurves	> 7500	Accretion physics, BLR reverberation mapping, lensed quasars
AGN-related flares & transients	> 100	Accretion physics
Stars & Exoplanets		
Active & Flaring stars	$> 4 \times 10^5$	Planet habitability, high-energy flare frequency, stellar magnetic structure, gyrochronology, magnetospheres
White dwarfs	$> 3 \times 10^4$	Planetary systems, debris accretion, rotation-related variability
RR Lyrae	> 1000	Pulsation physics
Nonradial hot pulsators, e.g., α Cyg, δ Scuti, SX Phe, β Cep types	> 250	Asteroseismology
Eclipsing binaries	> 400	Chromosphere and eclipse mapping
Galaxies and Clusters		
All Sky Survey – galaxies	$> 10^8$	Galaxy Evolution, star formation rate
Gamma Ray Bursts		
GRBs occurring in-field	~ 30	Prompt emission & afterglow physics, dust reddening
Orphan Afterglows	> 30	Fireball Γ and opening angle distributions
Solar System		
Asteroids and other small bodies	$> 10^4$	Asteroid classification, origin

ULTRASAT: Key Science Goals

EM counterparts to GW sources

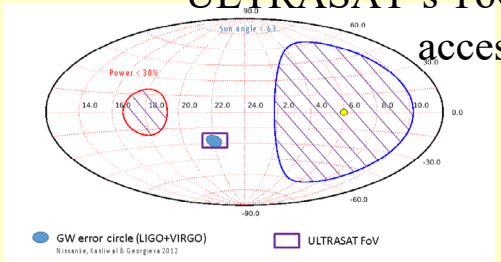
Starting 2026: ~ 10 NS-NS merger events per year,
~100 deg^2 error boxes.
ULTRASAT will provide:

- Fast localization of NS-NS/BH mergers-
  Rapid, <15min, access to >50% of sky,
  Cover GW error box in a single image.
- UV light curves to measure ejecta properties.

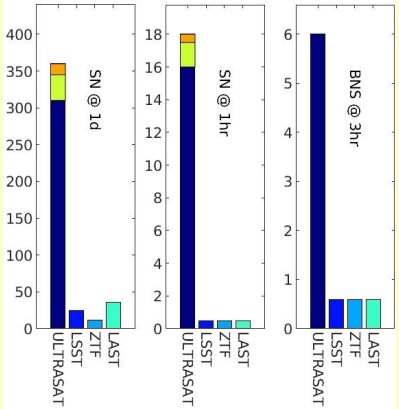
Deaths of massive stars

- High quality early high cadence UV data,
  Rapid alerts for follow-ups,
  100's of SNe including rare types.
- Measure properties of supernova progenitors.
- Map progenitors to supernova types.
- Reveal pre-explosion evolution and mass loss.

ULTRASAT's ToO access



Yearly detection



ULTRASAT: Mission profile

- ALL SKY SURVEY
  - 3hr/day during the first 6 months
  - 7x deeper than state-of-the art (GALEX) (23 AB limiting mag @ |b|>30°)

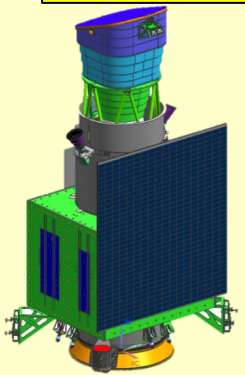
- LONG STARES
  - 2 directions near the Ecliptic poles, minimize Galactic extinction and zodiac bgnd
    21 hr/d – 5 min cadence, 200 deg^2
    3 hr/d – 4 d cadence, 8000 deg^2
  - Real-time data download and analysis
  - Alerts within 15min of observations

- Targets of Opportunity (ToO's)
  - Instantaneous >50% of the sky in <15 min for >3 h
  - No limit on ToO number, except for max 75 with negative power balance (~33%)
  - Continuous transmission to the ground

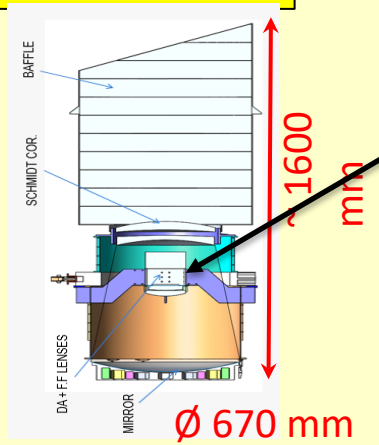
ULTRASAT: Implementation & Collaboration

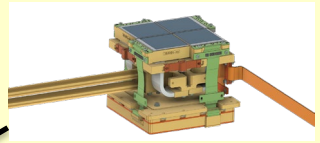
Management: Program Office @ WIS

Spacecraft: IAI



Telescope: Elop/Elbit





Focal Plane Array
DESY/Helmholtz

Sensor:
Tower
(Israel)

Hosted launch to GTO: NASA

Launch Q2 2026
>3.5 year science mission (6 year fuel)

Dimensions: 1.5 x 1.7 x 3.4 (m^3)
Power: 500 W
Mass: 500 + 630 (Prop) kg

ULTRASAT: Science Collaboration

Data policy: Alerts public in real time;
12 mon. proprietary period for all other data products.

- NASA Launch contribution-

  Science return: 8 US PIs (NASA funded) joined WG's,

  NASA project scientist: J. Rhoads.
- VRO (LSST) collaboration-

  Science return: 6 US PIs joined WG's.

  ** Joint NASA/VRO US PI selection process through the NASA call- completed.

US PIs: Barclay (GSFC), Bodewits (Auburn), Cenko (GSFC), Coughlin (Minnesota), Daylan (WUStL), Gezari (STScI), Ho (Cornell), Kara (MIT), Kilic (Oklahoma), Ramiaramanantsoa (ASU), Sand (Arizona), Stassun (Vanderbilt), Stern (JPL), Zabludoff (Arizona)

- DESY Camera contribution-

  Science return: 3 DESY PIs in WG's.

ULTRASAT: Science impact

- Revolutionize our view of the hot transient Universe:
  - Discovery volume 300 X GALEX,
  - Continuous min-mon cadence at 22.5 mag in a new window (NUV),
  - Real-time alerts to ground/space-based telescopes.

- A broad impact:
  GW sources, SNe, variable and flare stars, AGN, TDEs, compact objects, galaxies.

- Groundbreaking science with an affordable satellite mission.