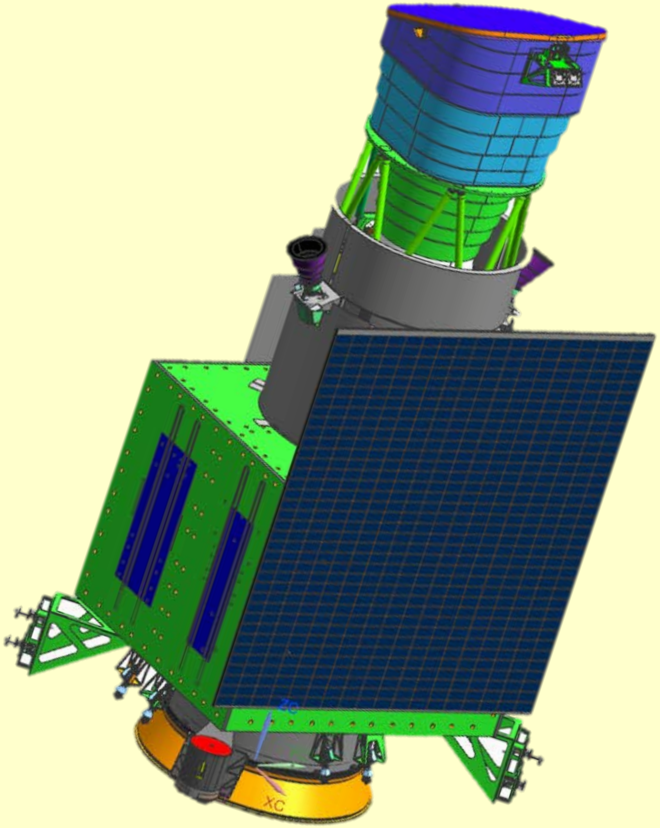
ULTRASAT: A Wide-Field UV Space Telescope

Revolutionize our understanding of the hot transient Universe



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Funding partners
ISA
WIS
DESY
NASA

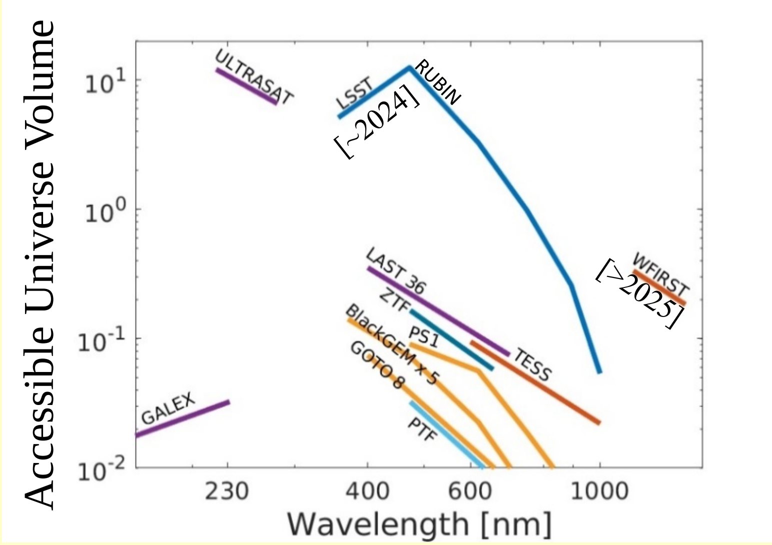
Industry partners
IAI
Elop
Tower

ULTRASAT's uniqueness

Key Properties

- Very large, 200 deg^2, field of view.
- High UV (220-280nm) sensitivity:
  1.5×10^{-3} ph/cm^2 s (900s, 5σ)
  [m = 22.4].

Transient detection rates of leading surveys



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.

ULTRASAT: Key Science Goals

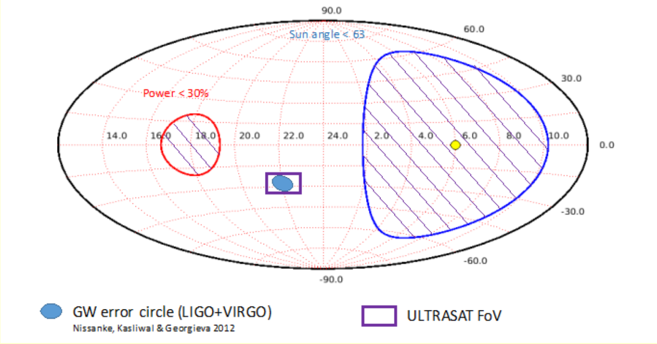
<u>EM counterparts to GW sources</u>

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

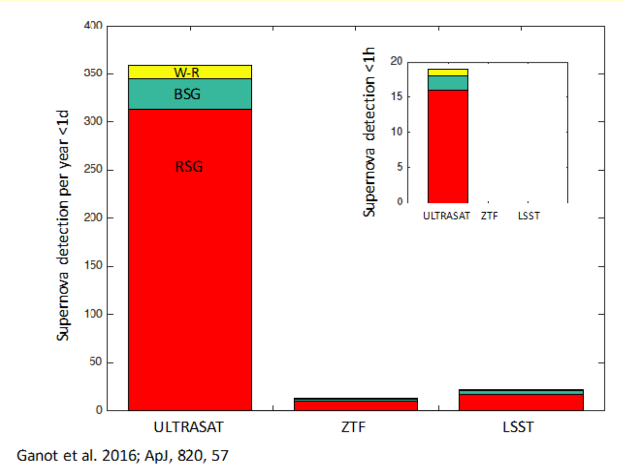
<u>Deaths of massive stars</u>

- 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.

ULTRSAT's ToO access



Rates of early detections of SNe



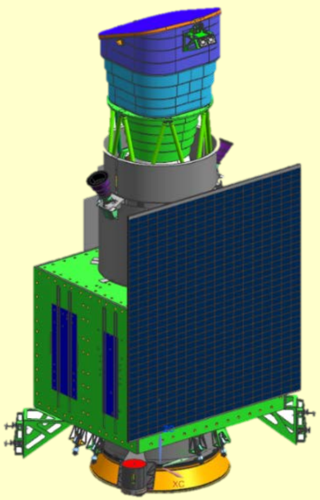
ULTRASAT: A broad science impact

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	>40	Discriminate between SD and DD progenitors
Compact Object Transients			
	Emission from Gravitational Wave events: NS-NS and NS-BH	~25	Constrain the physics of the sources of gravitational waves
	Cataclysmic variables	>25	Accretion and outburst physics
	Tidal disruption of stars by black holes	>250	Accretion physics, black hole demographics
Quasars and Active Galactic Nuclei			
	Continuous UV lightcurves	>7500	Accretion physics, BLR Reverberation mapping
Stars			
	M star flares	$>4\times10^5$	Planet habitability, magnetospheres
	RR Lyrae	>1000	Pulsation physics
	Nonradial hot pulsators, e.g., α Cyg, δ Scuti, SX Phe, β Cep etc. types	>250	Asteroseismology
	Eclipsing binaries	>400	Chromosphere and eclipse mapping
Galaxies and Clusters			
	All Sky Survey – galaxies	$>10^8$	Galaxy Evolution, star formation rate

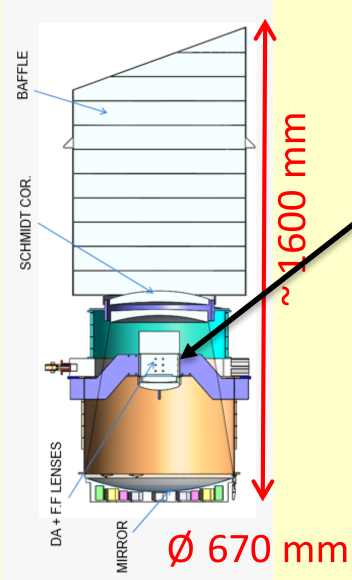
ULTRASAT: Implementation & Collaboration

Management: Program Office @ WIS

Spacecraft: IAI



Telescope: Elop/Elbit



Focal Plane Array DESY/Helmholtz (Germany)

Sensor: Tower (Israel)

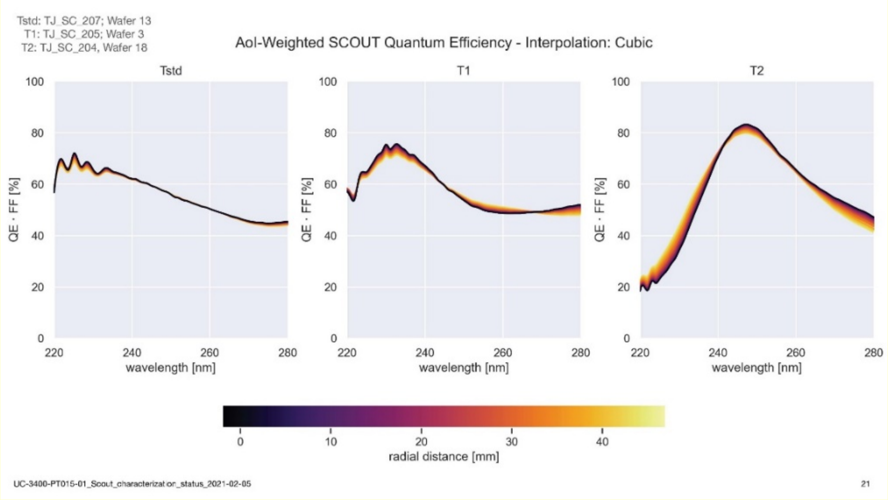
Hosted launch to GTO: NASA
(MoU negotiations near final stage)

Launch Q1 2025
>3.5 year science mission (6 year fuel)

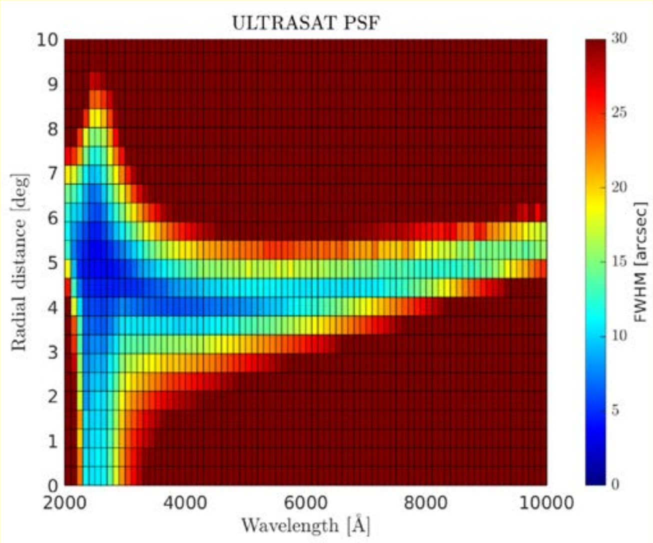
Dimentions: 1.5 x 1.7 x 3.4 (m^3)
Power: 500 W
Mass: 500 + 630 (Prop) kg

ULTRASAT: Key technology challenges

- CMOS sensor - UV QE>60% (Tower).



- UV optics performance across a wide FOV (WIS/Elop).



ULTRASAT: Status & Timeline

- The program is on track.
- Full teams have been assigned and are working.
- Major risks identified and managed:
  - Challenging time line,
  - Complex Interfaces,
  - Contamination prevention and control.

- Mission cost (including launch) approx. $110M.

Mile Stone	ARO + Month	Time
Kick off	0 (23 September 2019)	"Q4" 2019
SRR	3	Q1 2020
SDR	6	Q2 2020
PDR	17	Q1 2021
CDR	27	Q4 2021/ Q1 2022
Supply of FPA ("camera")	42	Q1 2023
Supply of Telescope	52	Q4 2023
Satellite ready	52	Q3 2024
Launch	63 to 66	Q1 2025

ULTRASAT: Science Collaboration

- 13 Science Working Groups - WG members receive real time data access.
  Open to all (and already including most) Israeli astronomers.

- NASA Launch contribution- MoU negotiations near final stage,
  Science return: US PIs (NASA funded) will join WG's,
  NASA project scientist: J. Rhoads.

- DESY Camera contribution-
  Science return: 3 DESY PIs in WG's.

- Rubin (LSST) collaboration- advanced negotiations.

ULTRASAT: Science impact

- Revolutionize our view of the hot transient Universe:
  - Discovery volume 300 X GALEX,
  - Continuous min-mon cadence at 22.4mag 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.