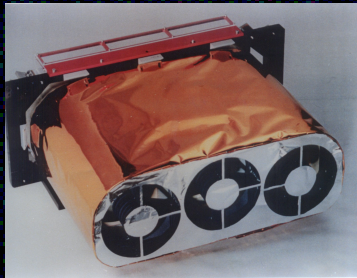




The TAUVE X Space Observatory: Overview

Margarita Safonova (modified
by J. Murthy)

TAUVEX Science Planning/
Observer Support



TAUVEX CORE GROUP

IIA, Bangalore

<http://tauvex.iia.res.in>





N. Brosch (PI)
H. Netzer (PI)
E. Almoznino

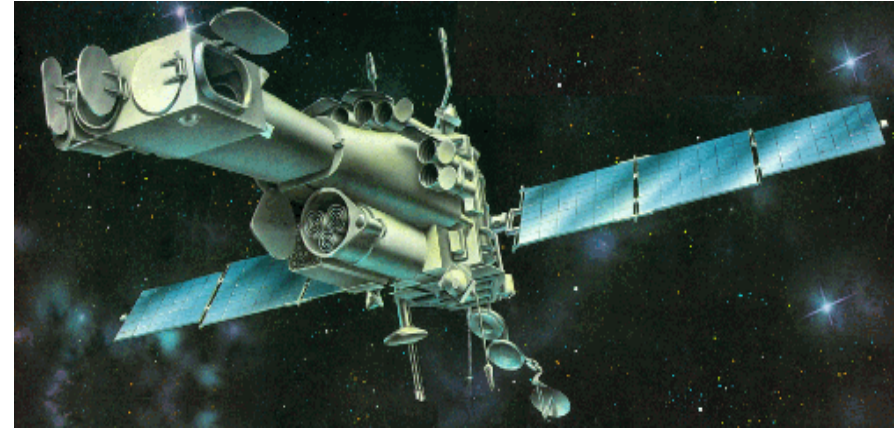


J. Murthy (PI)
N.K. Rao (PI)
M. Safonova
R. Mohan
P. Gopakumar



TAUVEX Chronology

- Proposed in 1991 for 1994 SRG flight on Russian Proton-2
- El-Op designed TAUVE X (1993)
- FM assembled (1994-1997): stored in class 1000 environment. Cleanliness test OK in 1999
- Project frozen at Prime Contractor 1999
- MOU signed between ISRO and ISA in 2004 to fly TAUVE X on GSAT-4



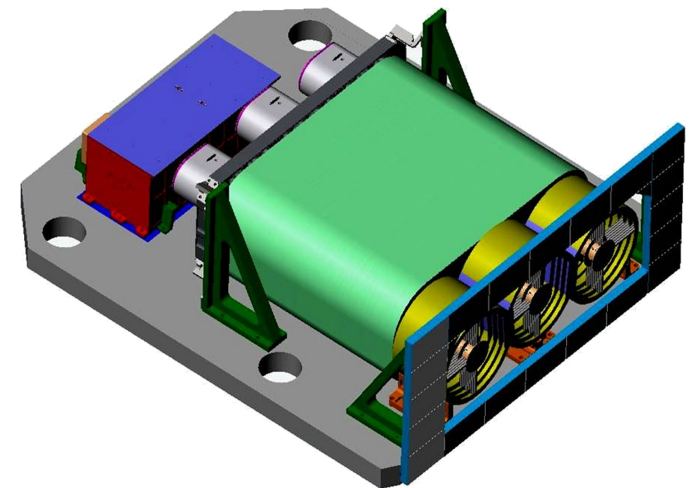
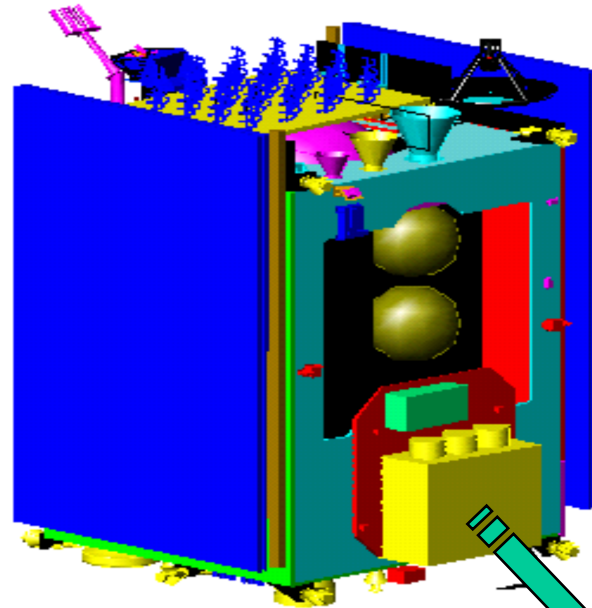
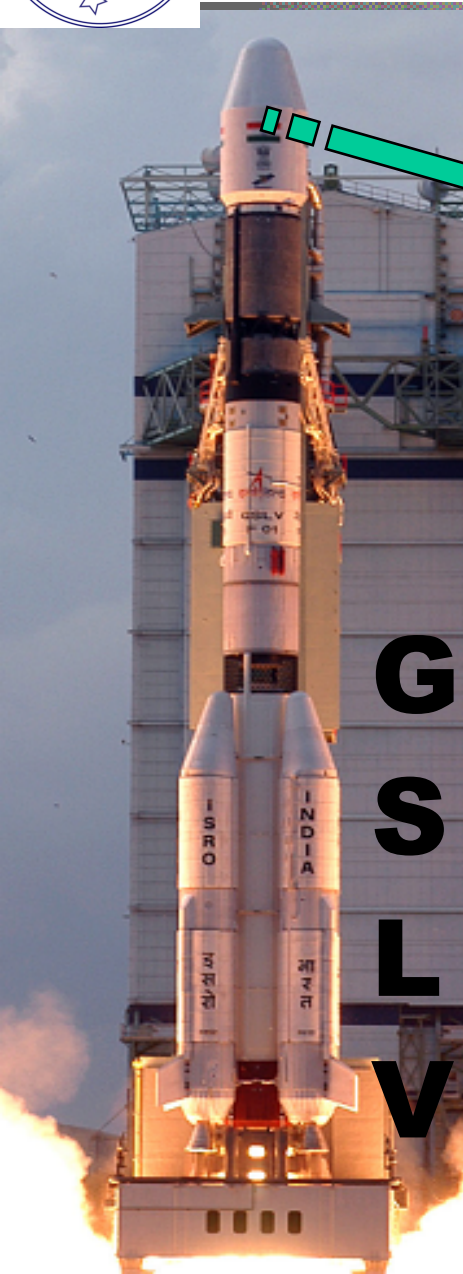
Spectrum
Roentgen-Gamma
(SRG)



GSAT-4



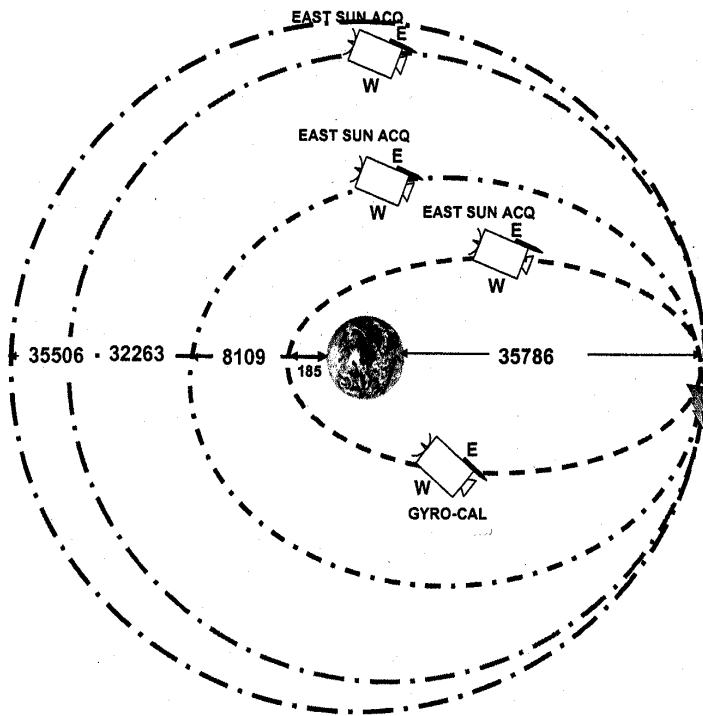
TAUVEX on GSAT4



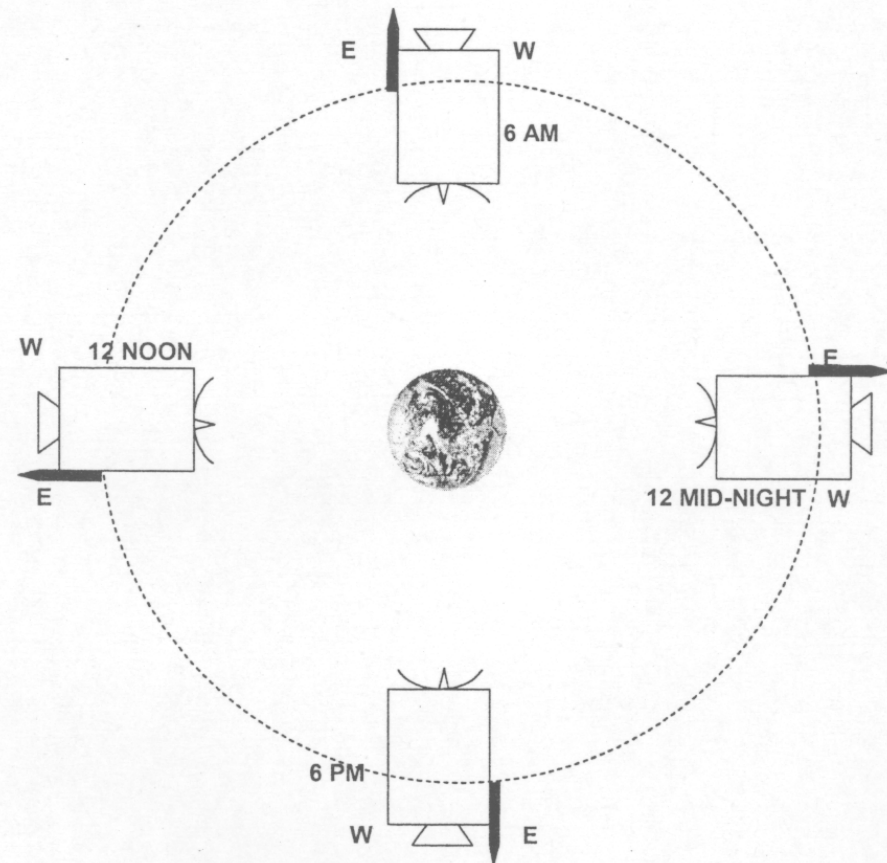


TAUVEX-GSAT4 Orbit

- Geostationary orbit at $\sim 36,000$ km – outside main radiation belts
- No need for Earth avoidance
- $\pm 90^\circ$ rotation allows all sky coverage
- Scanning mode **only**



Final configuration



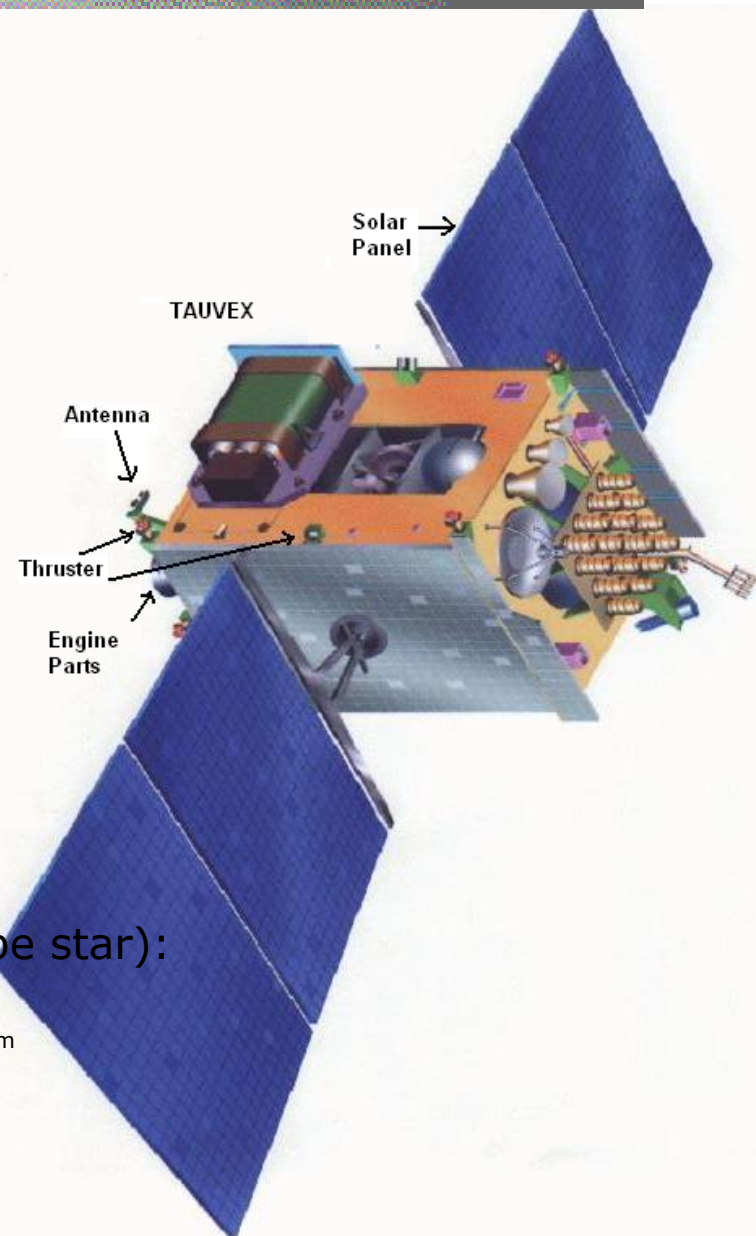


The Observatory

- **LAUNCH: Dec-2009**
- **3** 20 cm f/8 Ritchey-Chrétien telescopes
- Spectral Range: 125—350 nm
- FOV: 0.9°
- Min exposure time: 216 sec, max: 24 hrs

Predicted Performance (ground calibrations ongoing, updates will be available online)

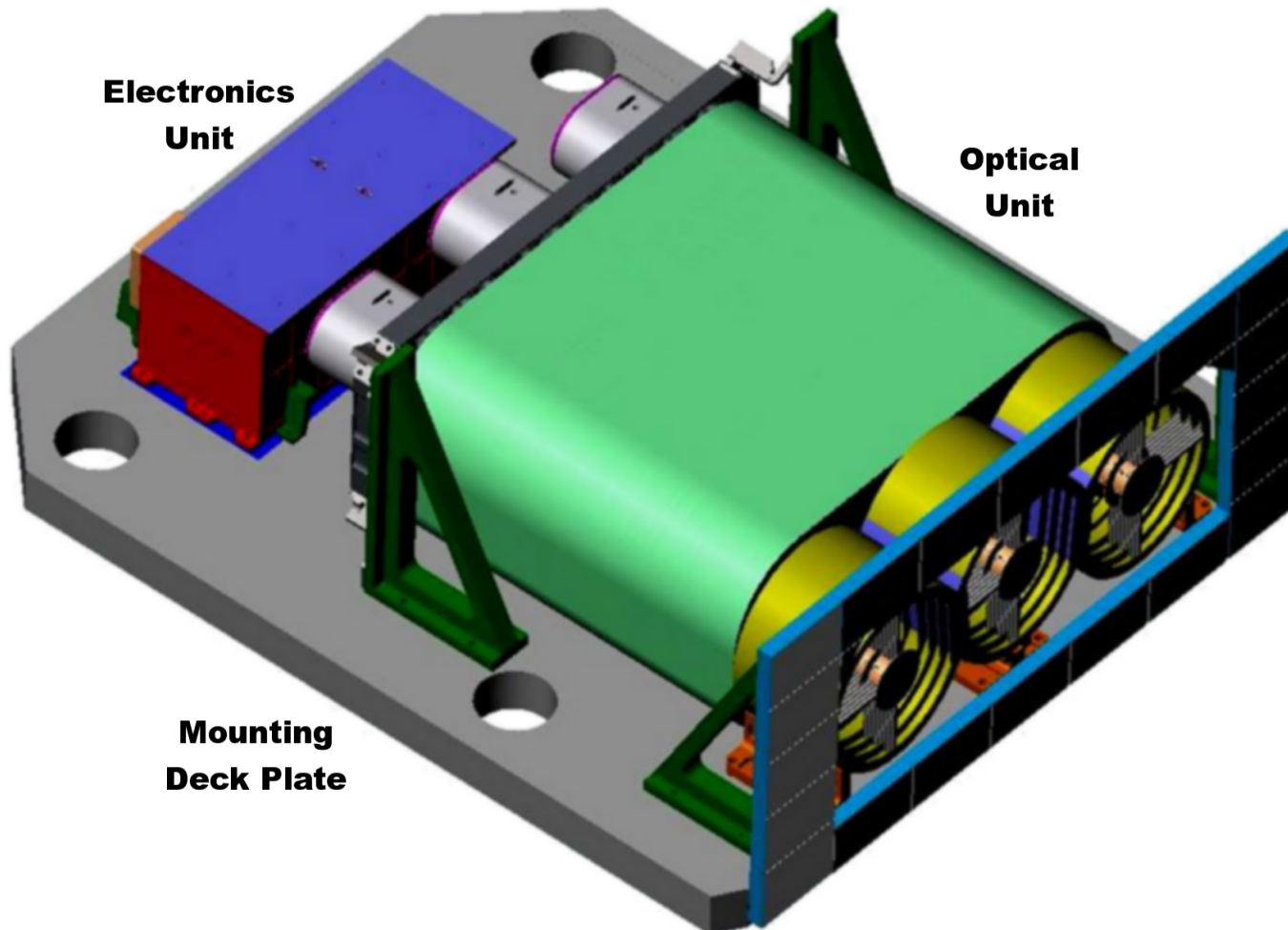
- Angular resolution: 8"—10"
- Time resolution: 128 ms
- Bright Limit: $F_{\lambda} = 1.3 \times 10^{-11} \text{ erg cm}^2 \text{ s}^{-1} \text{ \AA}^{-1}$
- Point source sensitivity (200s, S/N=5) (O type star):
 - BBF: $V \sim 22^m$
 - SF3: $V \sim 20.2^m$
 - NBF: $V \sim 19.2^m$
 - SF1: $V \sim 20.3^m$
 - SF2: $V \sim 20.8^m$
- 3 year life-time (5 years – goal)





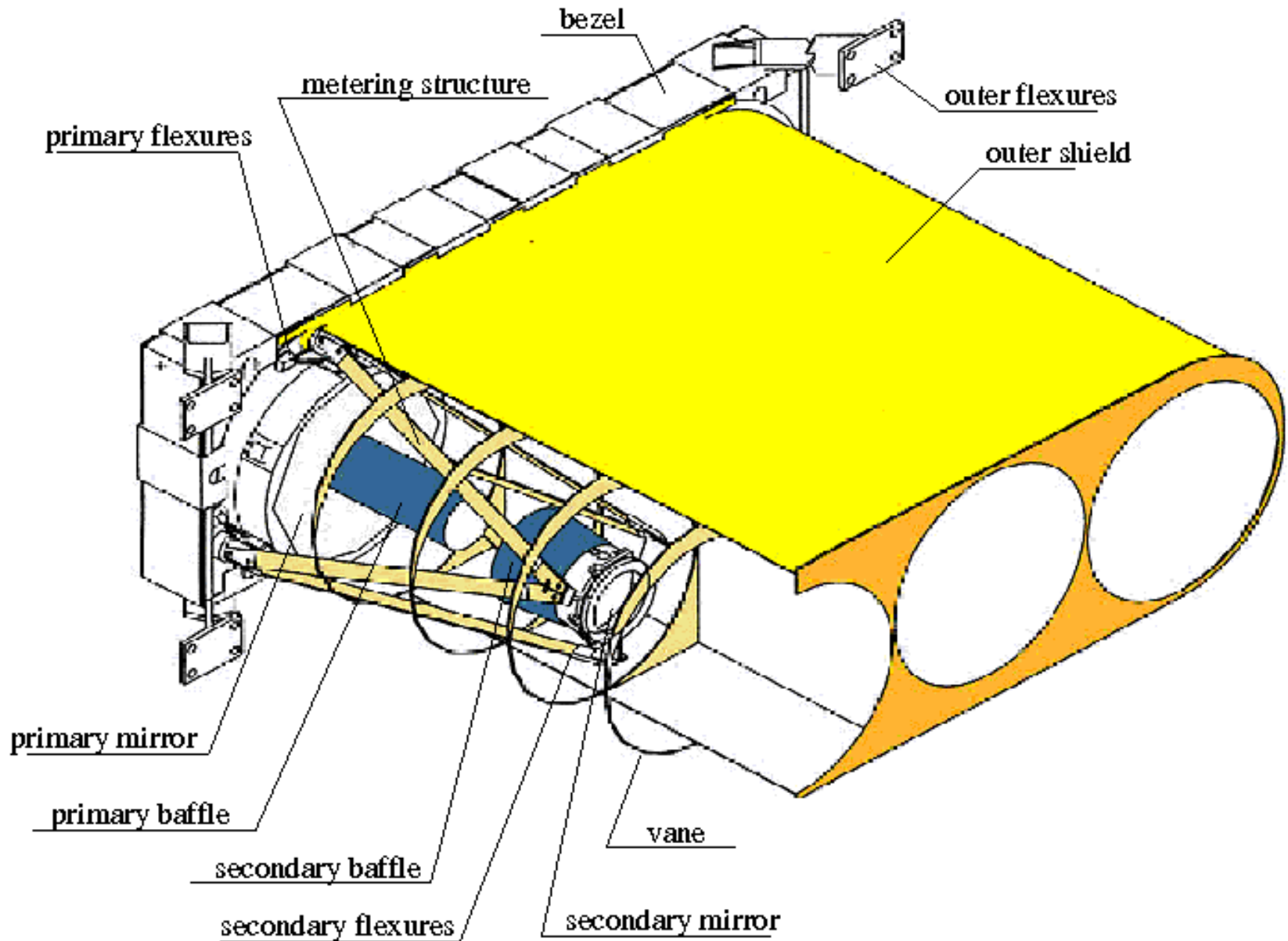
TAUVEX: general design

Two units separated by ~10cm



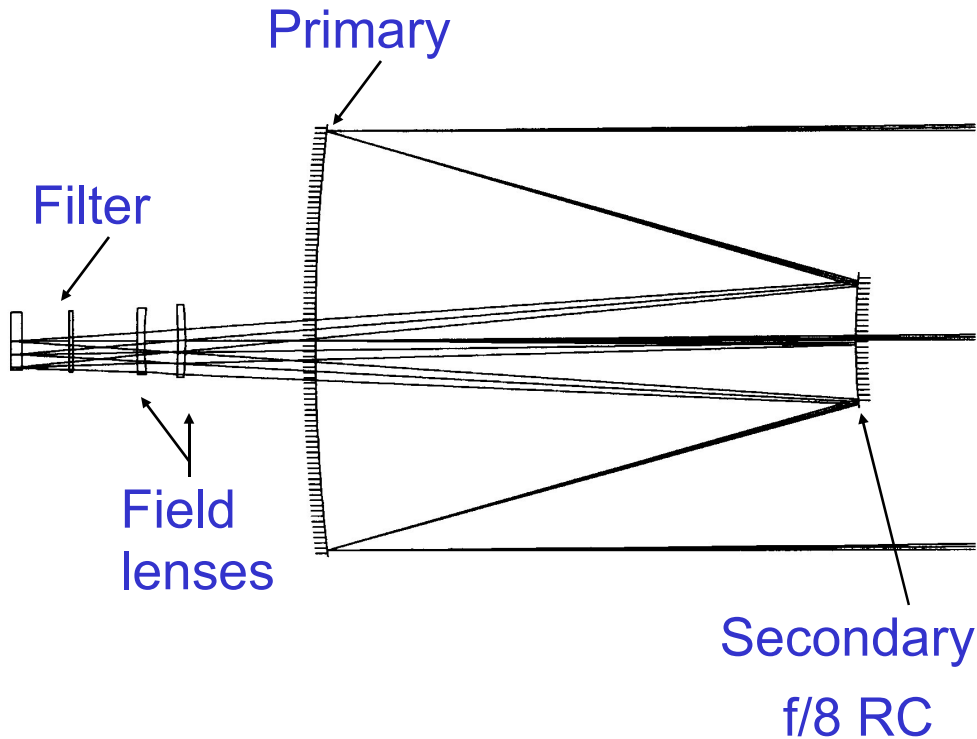


Observatory Cutaway





TAUVEX: optical module

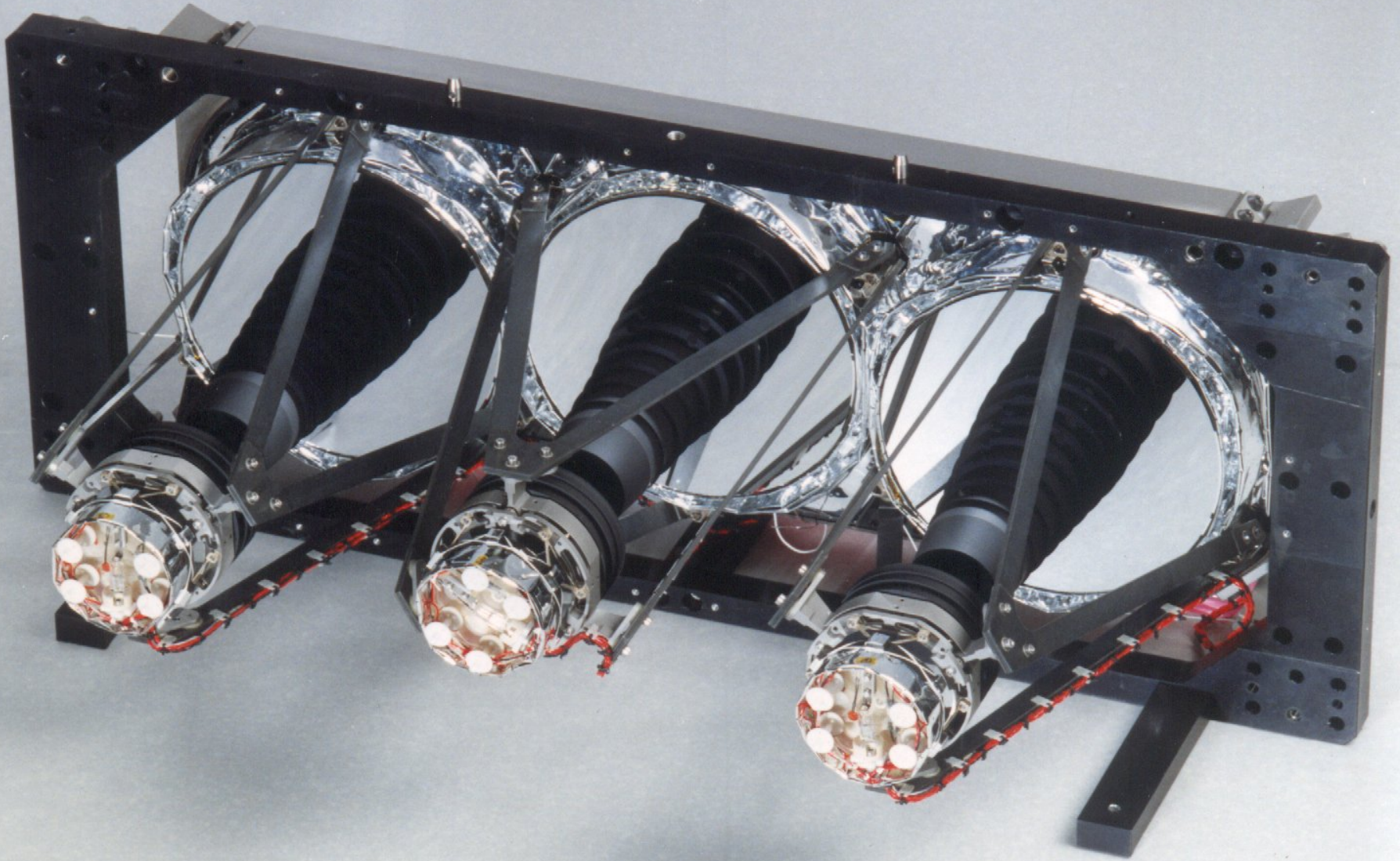


2 mirrors: zerodur substrate,
Al+MgF₂ coating;
2 doublet field corrector lenses;
Detectors: 3 chain MCP with
25 mm CsTe photocathode;
Total mass=33.5 kg;
Power consumption <65W

Field corrector lens group, filter substrate, and detector window
all made of CaF₂



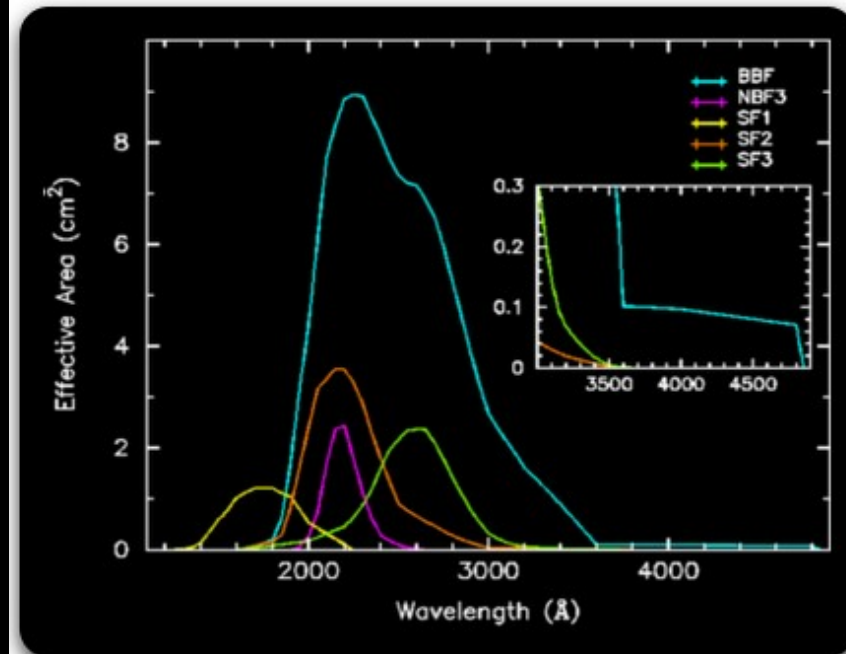
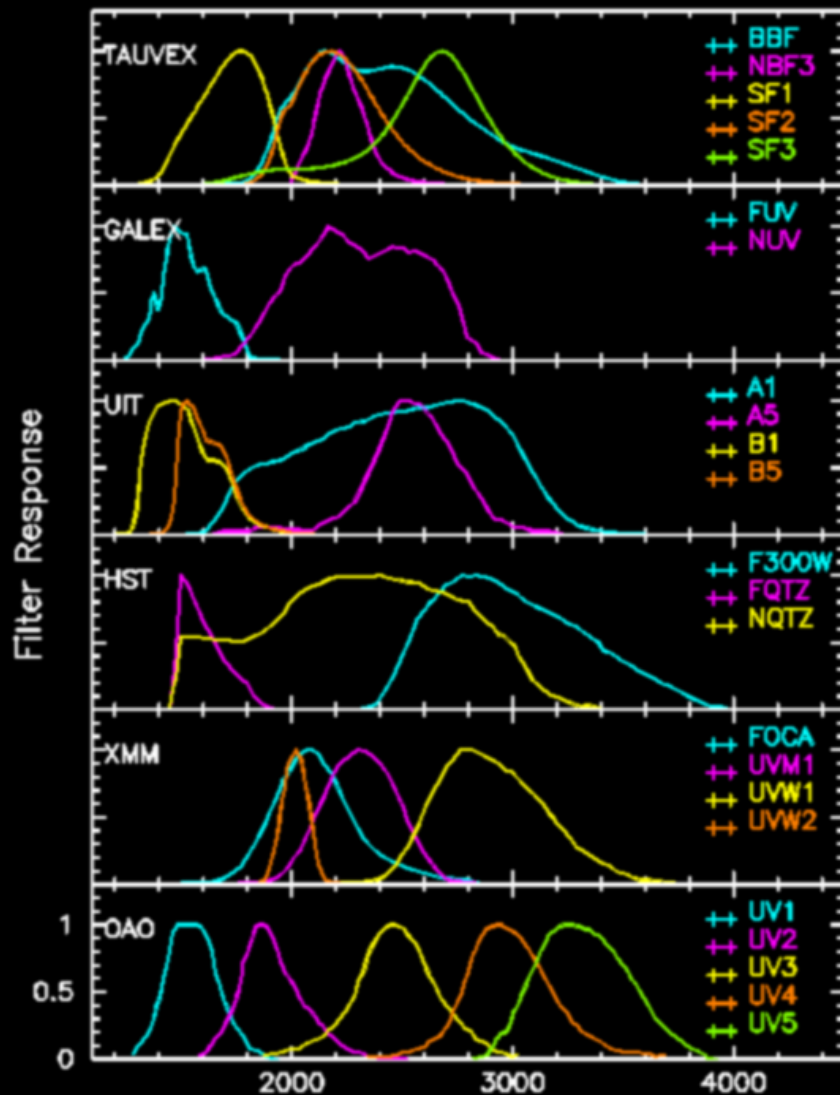
TAUVEX optical module: photo





TAUVEX filters

5 filters



- BBF (blue cutoff at <200 nm)
- SF2, NBF (unique possibility to study interstellar dust band at 217.4 nm)

Standard mode of operation

3-band photometry:

1700 ± 250 , 2150 ± 210 , 2530 ± 225

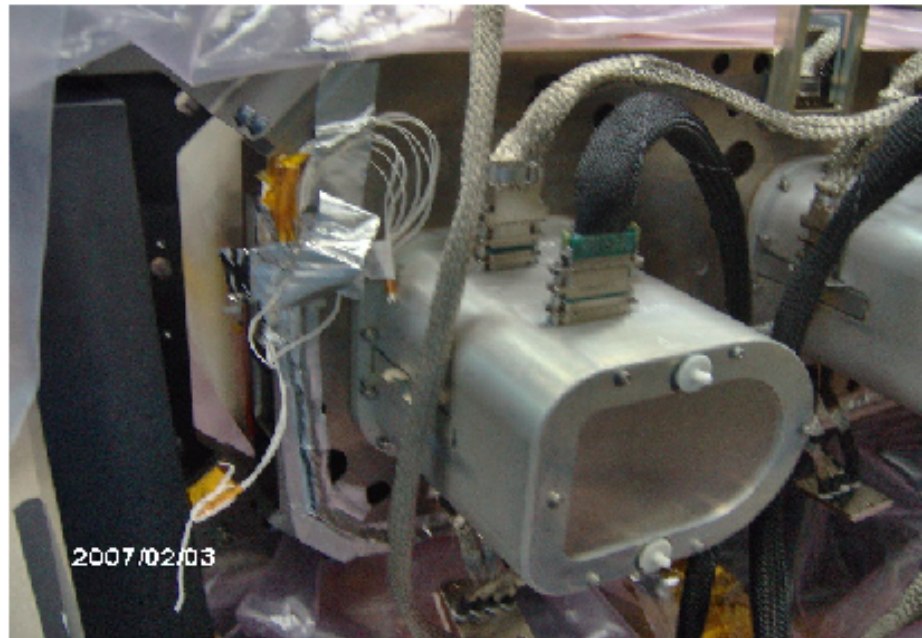


TAUVEX: electronic module

TAUVEX Detectors and Brightness Protection

Details in the online document:

<http://tauvex.iap.res.in/guest/documents/>



Prepared by

Margarita Safonova
TAUVEX Project Scientist
rita@iiap.res.in

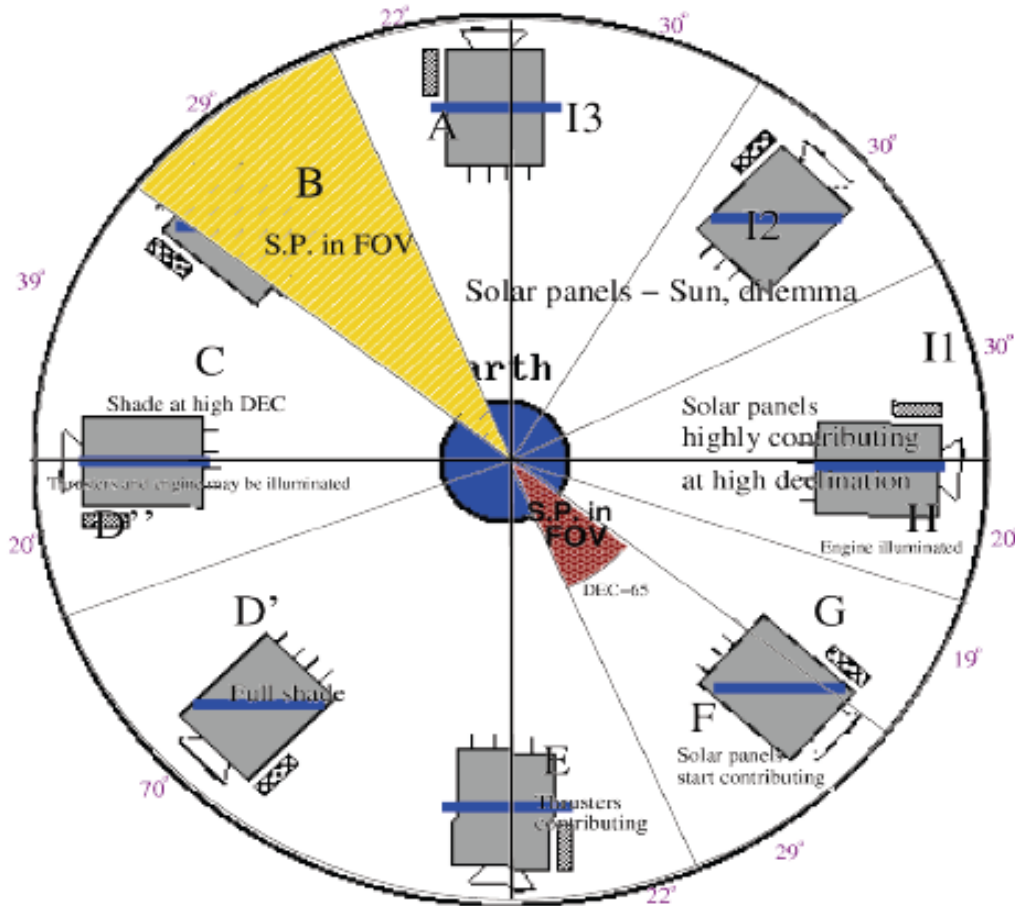


light from Sun

90° Sun avoidance

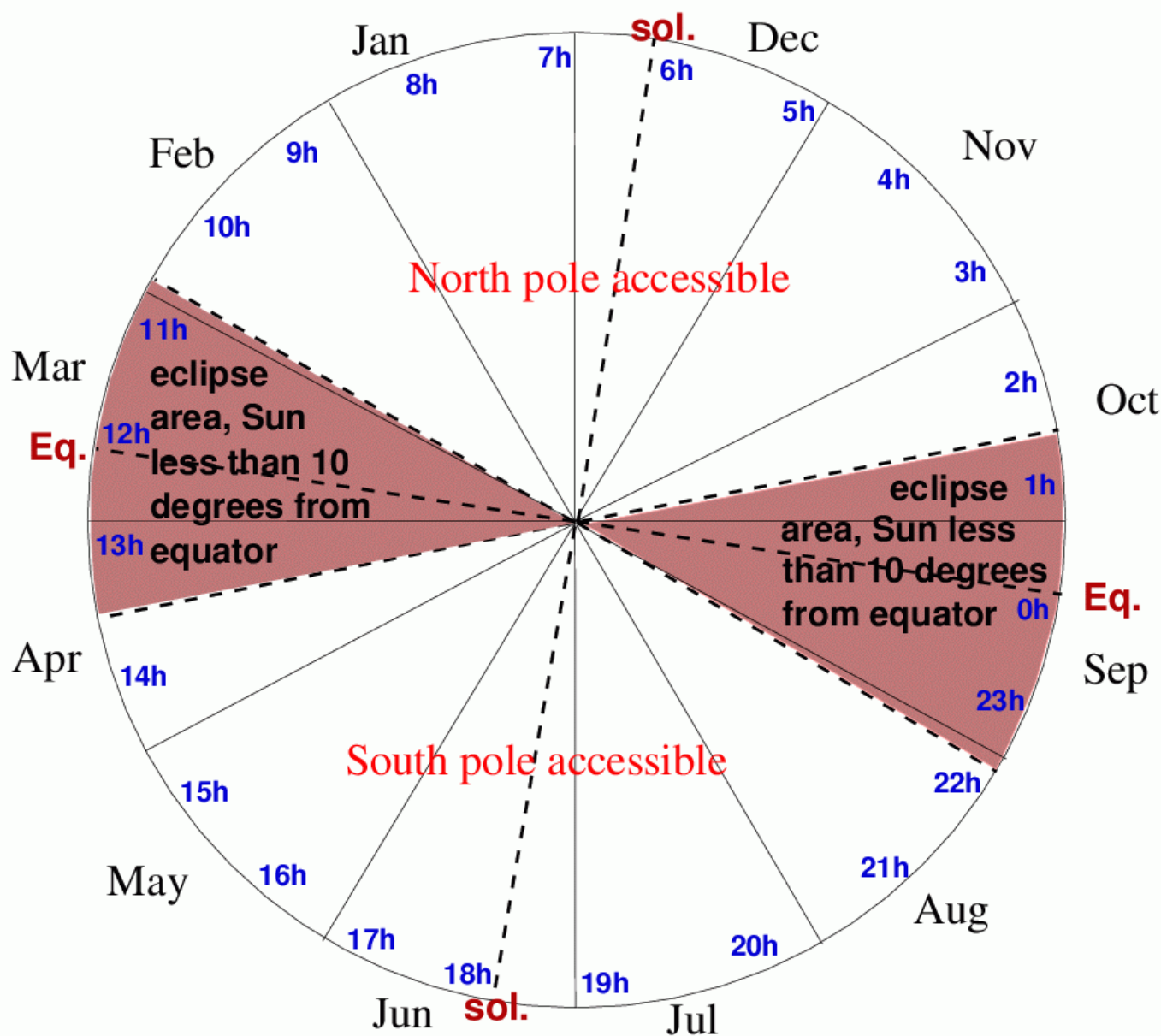
Moon (5°), Mars (2°),
Jupiter (3°), bright stars

- limits the time
- restricts the orbit
- requires complicated mission planning





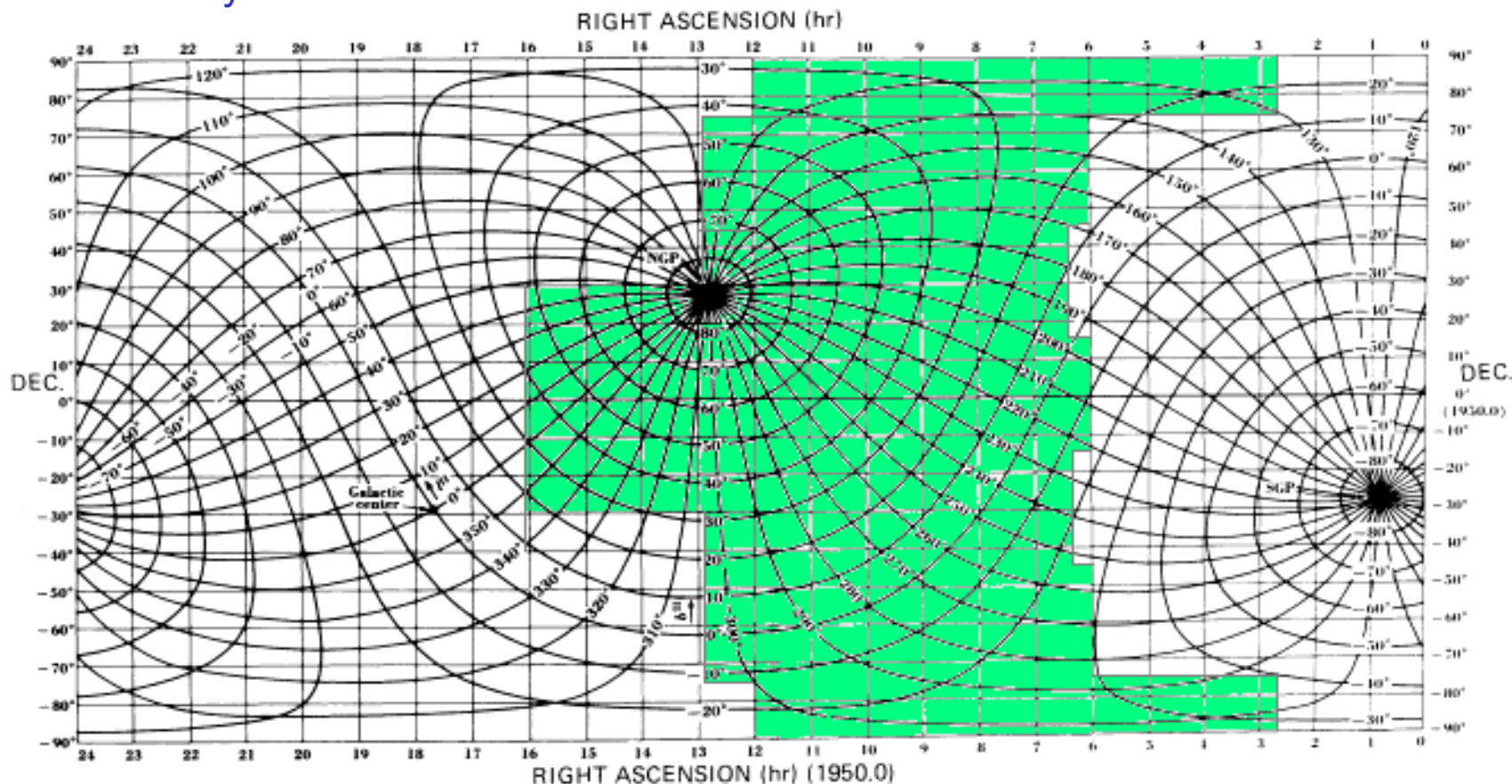
Operational Constraints: a year





Observational Windows

Based on the straylight parameters, the observable windows are decided for 15-days bins



Observable hours (in green) from Mar 21 to Apr 6

The full description available on <http://tauvex.iap.res.in> under *Guest Observer*



Main Science Themes

RESEARCH CATEGORIES

- ❖ The Core Science Program (TAUVEX Science Team)
- ❖ Individual Observations Program (small programs from TST)
- ❖ First Science Survey (TAUVEX Core Group)
- ❖ Archival Research Program (Once archive is open; proposals to be sent to PIs)



Main Science Themes

The Core Science Program Key Areas

Deep Surveys

Galactic UV Astronomy

Studies of Supernovae

Studies of Interstellar Dust

Studies of AGNs

Galaxies in UV

Galactic and Extragalactic GCs

Submitted proposals, plans and planned surveys available on
<http://tauvex.iap.res.in> under *Guest Observer*

More on Key Areas in *Pre-Launch Call for Proposals* (issued online)

Special BASI issue

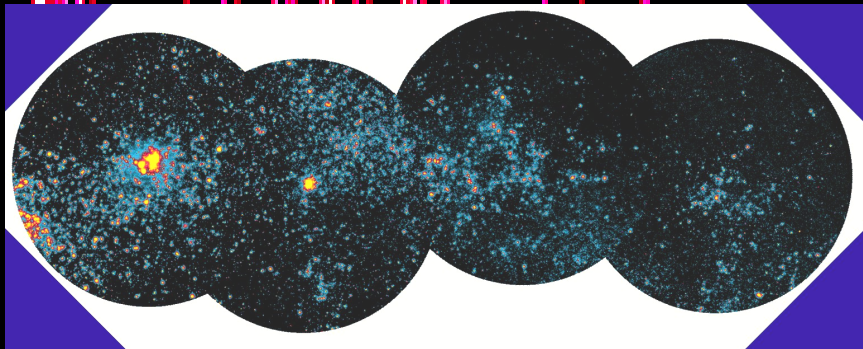
(June 2007)

<http://www.ncra.tifr.res.in/~basi/toc07june.htm>

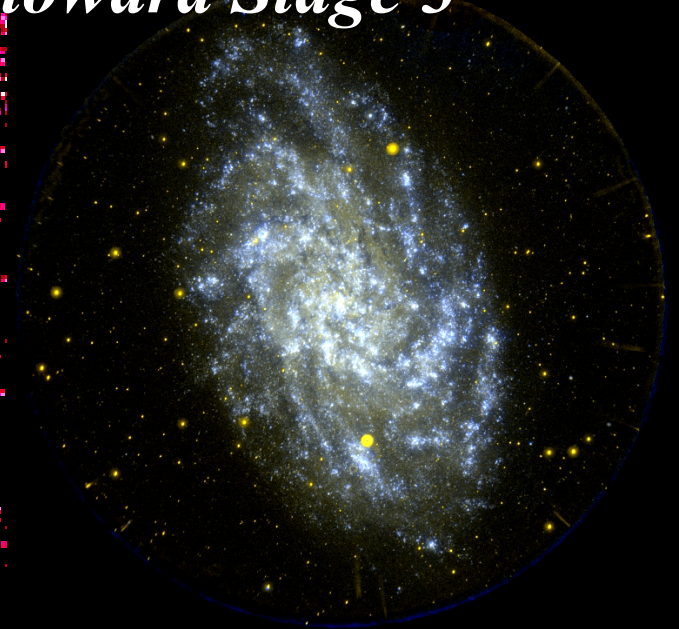
Papers from March 2006 TAUDEX Science meeting

Lots of proposals for TAUDEX science

- *A good place to look for ideas toward Stage 3*



A nearby dwarf irregular in the
UV (SMC/GALEX)



M33 (FUV=blue, NUV=yellow)



Main Science Themes

First Science Survey – inaugural TAUVEEX program

❖ Has galactic and extragalactic components. Will take place at the end of PV phase. Intended to:

- Provide early sample of reliable UV data
- Rapidly process data and make publicly available in time for Cycle 2
- Plans and Proposals corrections

❖ Galactic Component

Source counts at low b ; to help guide Gal Plane Survey project;
Zodiacal light; Scan through a molecular cloud

❖ Extragalactic Component

Main Polar Survey, deep cover of the area, $4^\circ \times 4^\circ$, centered on the pole;
Verification survey, to cover small part of the Main with greater depth and
Redundancy: concentrate on the Pole



Main Science Themes

Individual Observations Program

C Sivaram (IIA) & 2 Co-Investigators

UV flashes from planetary collisions

M.Safonova, C. Sivaram & J. Murthy; astro-ph/0712.3354v1

M Safonova (IIA) & 2 Co-Investigators

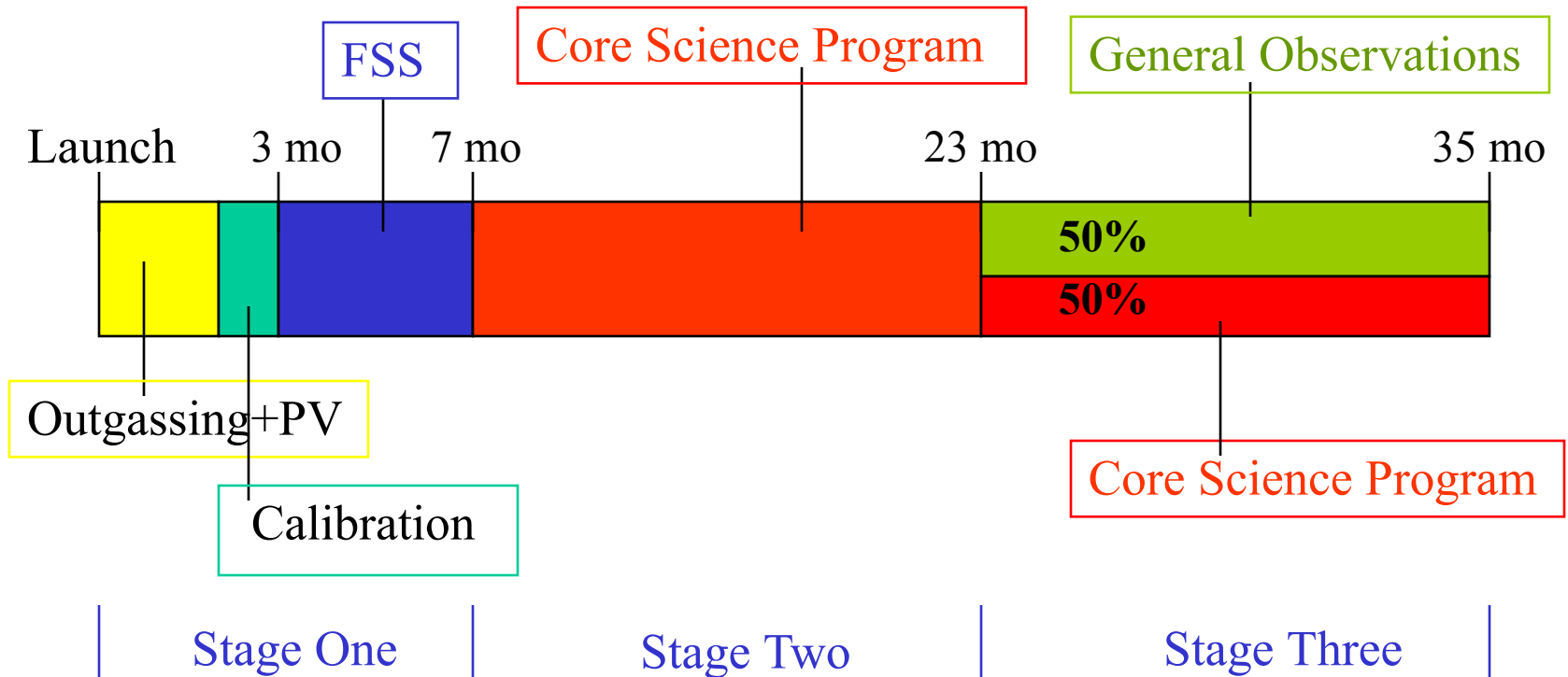
UV observations of ULXs

Gangadhara (IIA) & 1 Co-I

Detecting pulsars in UV



Proposed Schedule





Observer's Support

<http://tauvex.iiap.res.in/>

TAUVEX proposal planning resources:

- Documentation:

- Pre-Launch Call for Proposals (**issued**)
- TAUVE X Data Agreement and Policies (**issued**)
- TAUVE X Observer's Manual (TOM) (**issued; to be updated after ground calibrations, ongoing**)
- TAUVE X Detectors and Brightness Protection (**issued**)
- Pipeline Cookbook (**to be issued**)

- Tools:

- TAUVE X ETC = Exposure Time Calculator (cps, S/N, time, background, SL)
- Online Sky Simulator (simulates UV sky as seen by TAUVE X)
- Stellar Flux Calculator (Kurucz model)
- Coordinate Converter
- Observation Planning Tool (TOP) is being developed

Questions? Contact us: tauvex@iiap.res.in





Observer's Support

<http://tauvex.iap.res.in/>

TAUVEX GUEST INVESTIGATOR PROGRAM

Welcome to the TAUVEX Guest Investigator Program

This is the page for scientists wishing to plan their observations with TAUVEX. Here we put out the documents and available tools (in the form of tables, graphs and online software) to help scientists to plan their observations with TAUVEX.

We would like to encourage the interested scientists to write their proposals and/or letters of intent (still possible at this stage) to us. As per our current policy, the successful proposer(s) are guaranteed exclusive right to data for a period of one year after the observation date, provided they have joined the [TAUVEX Science Team](#).

In order to facilitate the preparation of proposals, we suggest the strategy, which is depicted in [Proposal Checklist](#).

Strong observational constraints—the necessity to avoid Sun at 90° and only a scanning mode—limit the observable time. The solar straylight also limits the observable magnitudes by increasing the background noise and contributing to the S/N ratio, which results in differential limiting magnitude values over the sky and over the year. Observable Windows and Limiting Magnitude Maps are graphically presented on the [Sky Visibility](#) pages.

Status

Guest Observer

[Announcements](#)

[Science Schedule](#)

[Proposals Checklist](#)

[Observing Programs](#)

[TAUVEX Documents](#)

[Sky Visibility](#)

[Publications Acknowledgment](#)

[Contacts](#)

Science

Software

Online Tools

Uploads

Downloads

TauWIKI

CVS

Bugzilla

Mailing Lists

Private

Press

Index

[Announcements](#)



Observer's Support

<http://tauvex.iap.res.in/>

TAUVEX GUEST INVESTIGATOR PROGRAM Science Planning and Observing Programs

- ♥ [Science Planning--TAUVEX Science Team](#)
- ♥ [Core Science Program Surveys](#)
- ♥ [Submitted Proposals](#)
- ♥ [Reserved Projects](#)
- ♥ [Calibration Targets](#)

We have identified a number of key areas with interested astronomers who will take the lead in defining the science problems and how the TAUVE X can address that problems. The general considerations in this science planning is that:

1. *The observations further our understanding of front-line problems of astronomy and astrophysics.*
2. *The scientific goals are feasible given our observational and instrumental constraints.*
3. *The data are unique; i.e., they have not been better addressed by other satellite data, such as that from GALEX.*
4. *The problems are of interest to the Indian scientific community.*

To follow these principles, TAUVE X Core Group has created the Core Science Program (CSP). The Program constitutes projects under few broad Key Science Areas defined by the TAUVE X Science Committee. These projects are distinguished by the following fundamental principles:

Status

[Guest Observer](#)

Observing Programs

[TAUVEX Documents](#)

[Sky Visibility](#)

[Publications Acknowledgment](#)

[Contacts](#)

[Announcements](#)

[Science Schedule](#)

[Proposals Checklist](#)

Science

Software

Online Tools

Uploads

Downloads

TauWIKI

CVS

Bugzilla

Mailing Lists

Private

Press



Observer's Support

<http://tauvex.iap.res.in/>

TAUVEX GUEST INVESTIGATOR PROGRAM Core Science Program Surveys

About 80% of observing programs was chosen to be surveys. The data from these surveys will be used by the TAUVE X Science Team to extract results useful in all the above-mentioned key science areas. The details of these surveys will be given once the Core Science Plan is finalized.

◦ **Deep Exposure Polar Survey (DEPS)**

This survey will cover with deep exposure of 5000 sec the ~ 1400 square degrees around each Celestial Pole and will be repeated on the second year. The principal filters will be SF1, SF2 and SF3 in most of the orbit, and SF1, BBF and SF3 during the darkest part of the orbit. This survey will be performed during Winter and Summer Cycles of the first two years. According to the main Solar constraint (always keep TAUVE X at 90° from the Sun), TAUVE X can observe the Northern Hemisphere in winter and Southern Hemisphere in summer (in ecliptic coordinates). This decides the dates for the surveys. The schedule and other details for DEPS are given below:

- [Northern DEPS](#)
- [Southern DEPS](#)

◦ **Galactic Plane Survey (GAPS)**

This survey will cover ~ 1500 square degrees of Galactic Plane with the average exposure time of 1000 sec. It will be conducted during each Spring and Fall Cycles for the first two years.

◦ **Mid-declination Galaxies Surveys (MIDGAS)**

This survey is intended to investigate nearby galaxies at mid-celestial latitudes. These galaxies are so large that they cannot be observed in their entirety by an instrument such as HST with its exquisite resolution but a small field of view. This program will use the three survey principal filters, SF1, SF2 and SF3, which span the spectral region from somewhat longer than Ly α to 320 nm with three well-defined bands. These three filters define two UV colours and the combination of these measurements with data from the optical and infrared allows determination of even more colour indices.

[Instrument](#)

[Status](#)

[Guest Observer](#)

[Science](#)

[Software](#)

[Online Tools](#)

[Uploads](#)

[Downloads](#)

[TauWIKI](#)

[CVS](#)

[Bugzilla](#)

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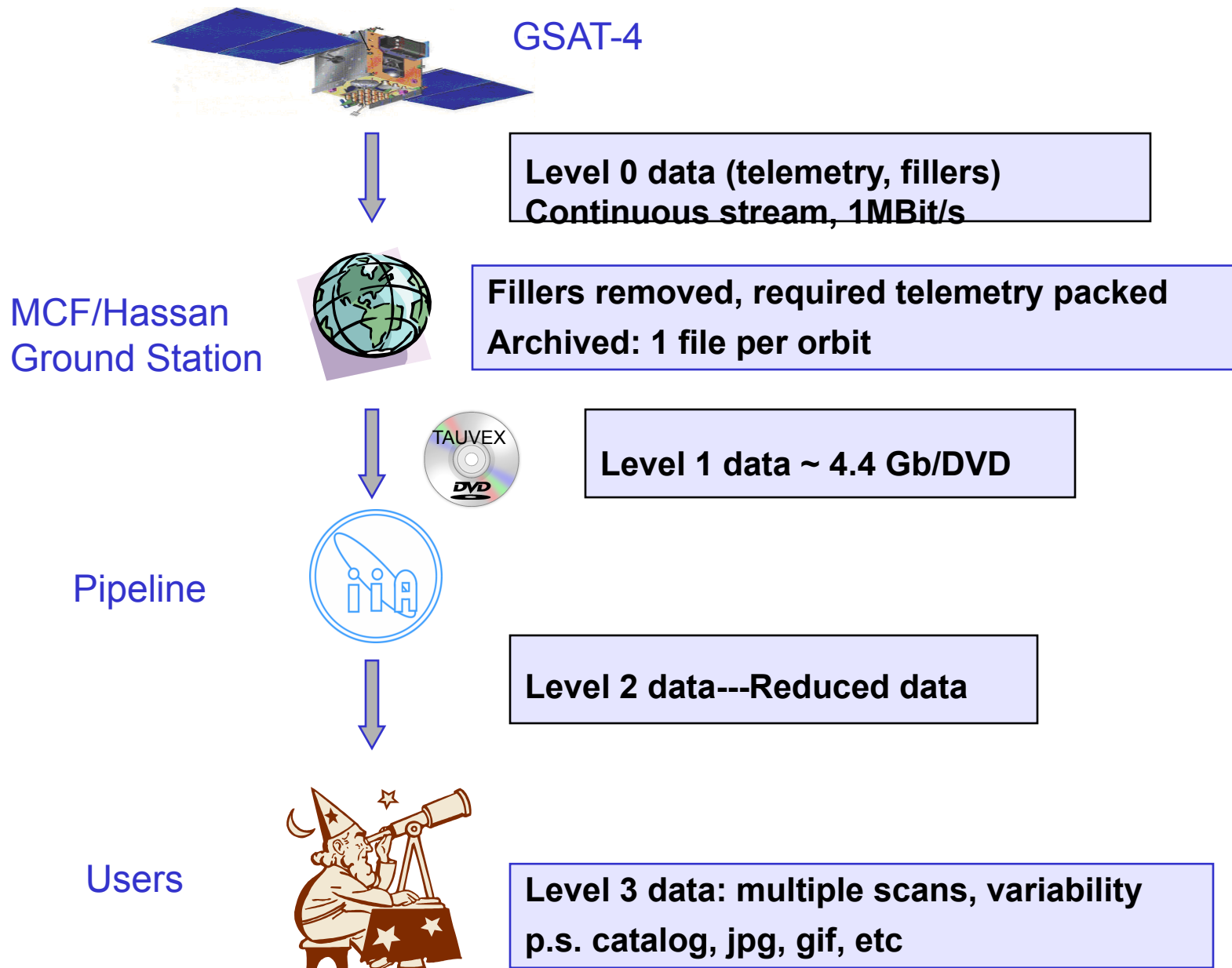
[Press](#)

[People](#)

[Site map](#)

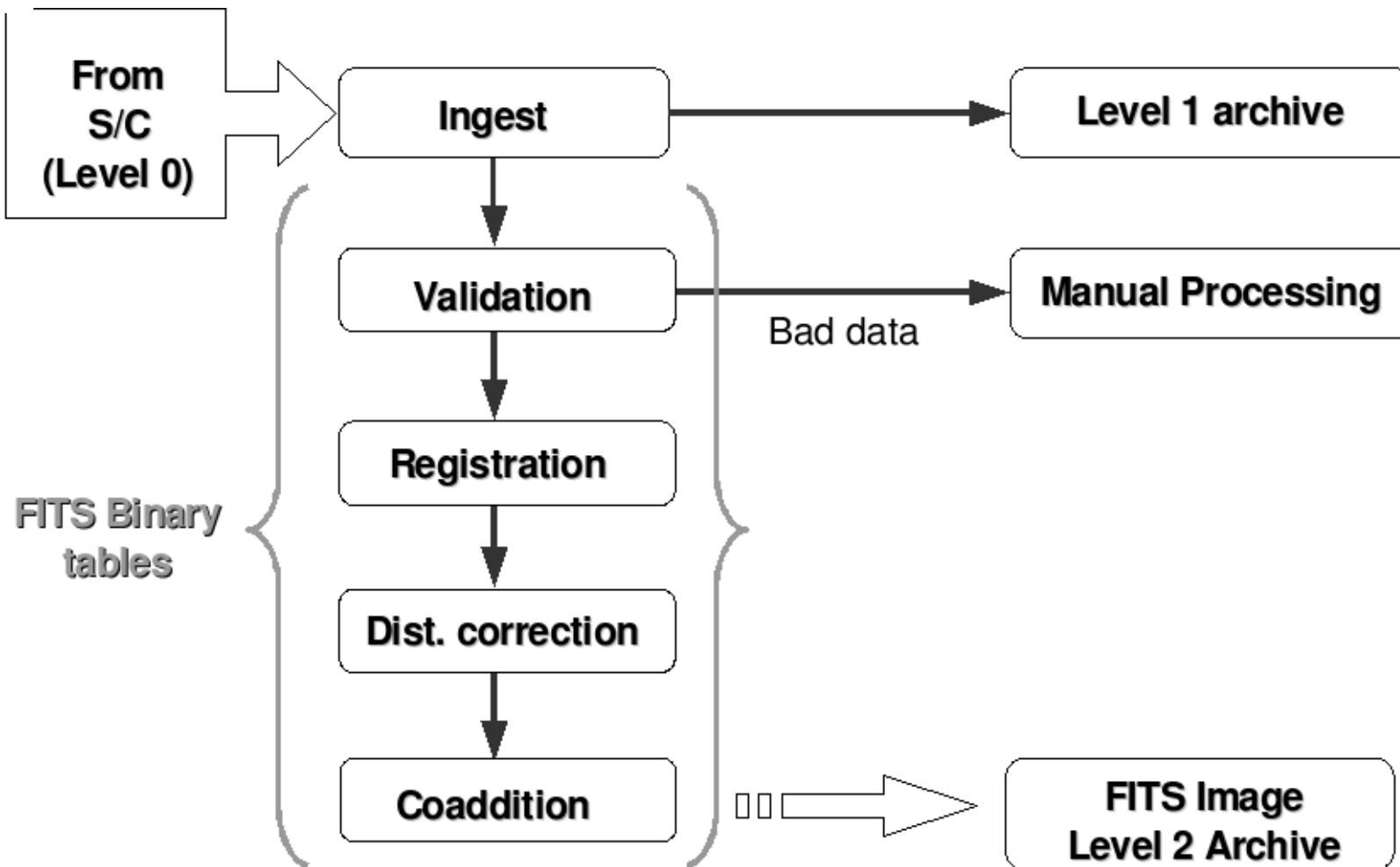


TAUVEX Data Flow





TAUVEX Pipeline Outline



The full description available on <http://tauvex.iap.res.in> under *Software* and in “*TAUVEX Pipeline Cookbook*” (to be published)



TAUVEX Final Products

■ **Pipeline direct products (Stable Version release: end Feb '07)**

Level 2 data: FITS images of individual scans, calibrated event lists, sky and detector images

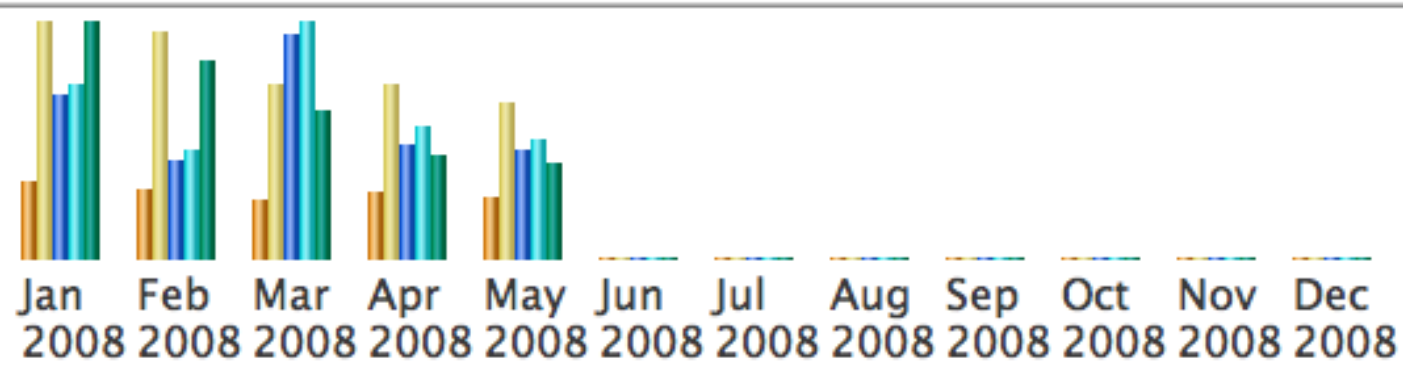
■ **Post-Pipeline products**

Level 3 data: FITS images from multiple scans, light curves, point source catalogue

■ **Web interface for data access**

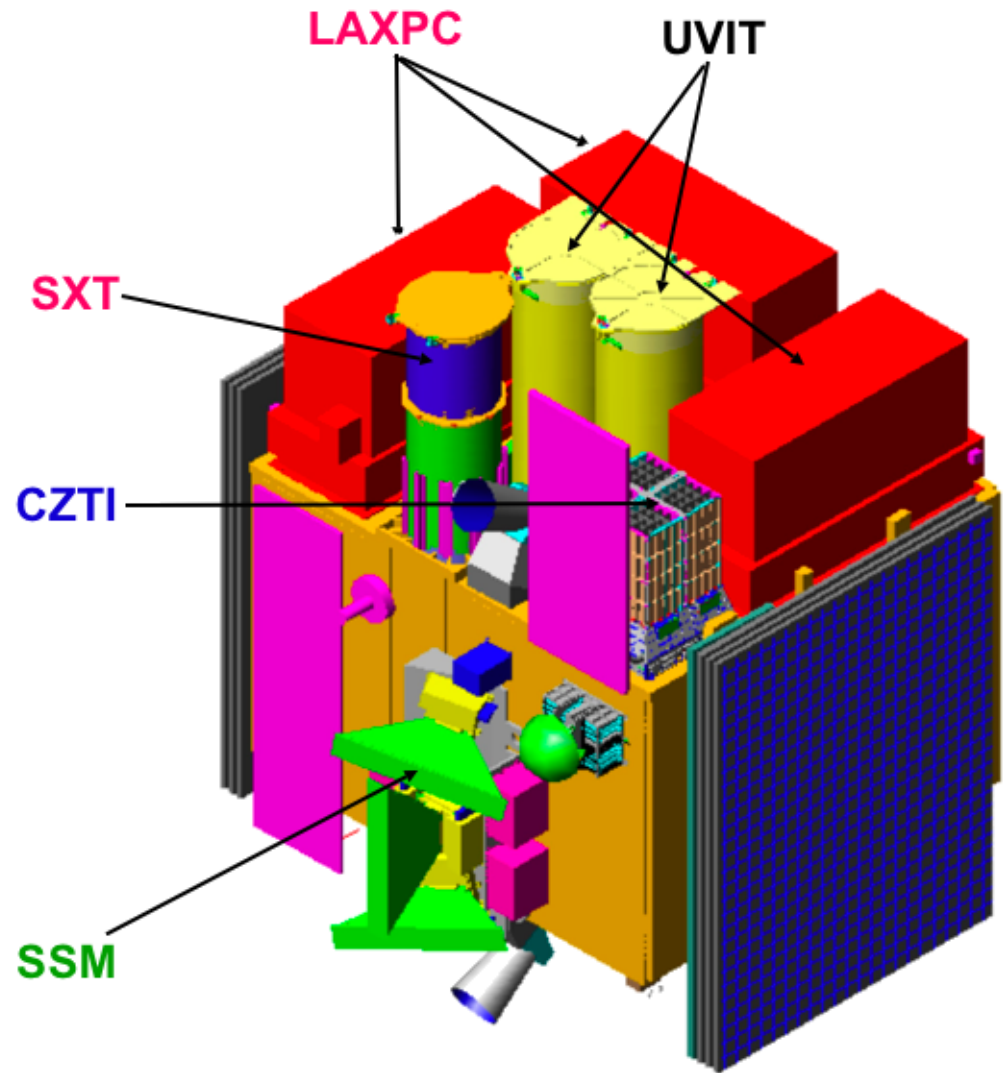
Data at all levels are archived by TCG

Monthly history



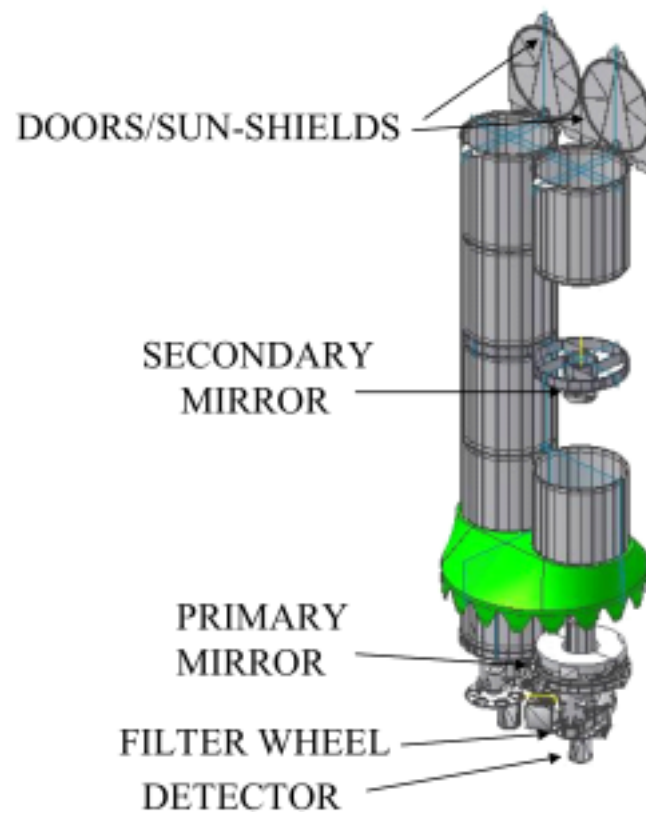
Month	Unique visitors	Number of visits	Pages	Hits	Bandwidth
Jan 2008	6061	18361	147123	157952	3.29 GB
Feb 2008	5323	17621	89183	97877	2.76 GB
Mar 2008	4667	13569	202942	213539	2.08 GB
Apr 2008	5252	13497	103360	120066	1.44 GB
May 2008	4780	12185	97874	108898	1.34 GB
Jun 2008	0	0	0	0	0
Jul 2008	0	0	0	0	0
Aug 2008	0	0	0	0	0
Sep 2008	0	0	0	0	0
Oct 2008	0	0	0	0	0
Nov 2008	0	0	0	0	0
Dec 2008	0	0	0	0	0
Total	26083	75233	640482	698332	10.92 GB

ASTROSAT



<http://meghnad.iucaa.ernet.in/~astrosat/>

CONFIGURATION OF UVIT



	UVIT/OPT	SXT	LAXPC	CZTI	SSM
Detector	UV: photon counting CCD Opt: CCD photometer	X-ray CCD (at the focal plane)	Proportional Counter	CdZnTe detector array	Position-sensitive proportional counter
Imaging property	imaging	imaging	non-imaging	imaging (< 100 keV)	imaging
Optics	Twin Ritchey-Chretien 2 mirror system	Conical foil (~Wolter-I) mirrors	Collimator	2-D coded mask	1-D coded mask
Bandwidth	130-320 nm	0.3-8 keV	3-100 keV	10-150 keV	2-10 keV
Geometric Area (cm²)	1250	250	10800	1000	180
Effective Area (cm²)	60 (depends on filter)	125@0.5 keV 200@1-2 keV 25@6 keV	6000@5-30 keV	500 (<100 keV) 1000 (>100 keV)	~40@2 keV 90@5 keV (Xe gas)
Field of View	0.50° dia	0.35° (FWHM)	1° x 1°	6° x 6° (< 100 keV) 17° x 17° (> 100 keV)	
Energy Resolution	<100 nm (depends on filter)	2%@6 keV	9%@22 keV	5%@10 keV	19%@6 keV
Angular Resolution	1.8 arcsec	3-4 arcmin (HPD)	1-5 arcmin in scan mode only	8 arcmin	~10 arcmin
Time resolution	10 ms	2.6s, 0.3s, 1ms	10 microsec	1 ms	1 ms
Typical obs. time per target	30 min	0.5 - 1 day	1 - 2 days	2 days	5 min
Sensitivity (Obs. Time)	21 st magnitude (5 σ) (1800s)	10 microCrab (5 σ) (10000s)	0.1 milliCrab (3 σ) (1000s)	0.5 milliCrab (3 σ) (1000s)	~30 milliCrab (3 σ) (300s)

THANK YOU !

