SWG6: Ancillary and Observatory Science

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For SWG6 (50 members)

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Introduction

- Sensitive IR/X-ray space telescope is a rare opportunity.
- In the era of LSST/Rubin, WFIRST/Roman, likely post-JWST, alongside Athena.
- Visit cadence is flexible
- Majority of orbit time could be spent on pointed targets
- Unblocked by atmosphere for IR spectroscopy of relatively bright objects
- SXI performance estimates positive for meeting prime GRB goal
 - Assists flexibility for observatory and ancillary science.

Opportunities

- Many more potential interesting targets that can be accommodated
- Solar system objects, comets. Spectroscopic capabilities in groundblocked windows. Planetary monitoring.
- Active stars, XRBs, exoplanet spectroscopy, transit follow-up.
 - More sensitive than ARIEL.
- SN "ToOs" for spectroscopy.
- Galaxy samples blocked by atmosphere, redshifted Halpha at z~1
- AGN: changing-look, variability, TDEs, year-timescale events

Relative drawbacks

- ToO rate, and alert time.
- Slitless spectroscopy limits target brightness
- Resolution R~3-500 favours "detection level" spectroscopy
- IR sensitivity (inevitably) way down on JWST, WFIRST-Roman, ELTs in atmospheric windows.
- X-ray sensitivity vs Athena, likewise much lower.
 - In context of operating eROSITA, and all-sky survey.
 - Variability of sources on ~8 year timescale
 - Ongoing monitoring of this excellent background catalogue

Pointing/survey strategy

- Potential targets all over sky.
 - Galactic plane has an excess
 - Tension with GRB search
 - ALTHOUGH SXI field wide enough not to negate Galactic fields.
 - Sensitivity estimates suggest 50 z>6 GRB target should be comfortably met.
 - Central IRT field to edge of SXI costs ~2 in factor of time to reach a sensitivity
- Sensitivity suggests ~1/2, 1/3 orbit dwell times are reasonable
 - Little tension with GRB search
- Cadence for monitoring, transit observation suitable for large samples. Order of 1000 listed is plausible for regular coverage.
 - Unusual AGN, known exoplanet systems.

Example: THEIC, Castro-Tirado & Caballero-Garcia

- Based on Integral/OMC catalogue.
 - Will be interesting to compare and revise from eROSITA's growing catalogue.
 - Also XMM and Swift and serendipitous catalogues are growing.



Figure 2.1: Number of sources per OMC FOV contained in the OMCIC (100 level means $\gtrsim 100$ sources within each FOV). Galactic coordinates with the origin at the center of the plot.

THEIC

Global characteristics of the THEIC: contents

Standard reference sources:

25134	astrometric standard stars
37586	astrometric and photometric standard stars
210108	photometric standard stars
368	faint photometric standard stars (actually not observed -i.e.
	field R15 has been removed-)

Scientific sources:

1225	priority 1 (high energy sources)
596	priority 2 (high energy sources)
<i>18332</i>	priority 3 (X-ray sources – ROSAT All-Sky Survey Bright Source
	Catalogue –)
858	priority 4 (candidates to classical T-Tauri stars)
40492	priority 5 (candidates to cool dwarfs of G-K-M spectral type)
21797	priority 6 (isolated optical variable sources)
62496	priority 7 (the rest of optical variable sources)
105525	priority 8 (X-ray sources – ROSAT All-Sky Survey Faint Source
	Catalogue –)
17285	null priority (field R16 empty)

Global characteristics of the THEIC

• Reference stars

- Astrometric standards
 - Available: 61941 stars
 - * from Hipparcos ²: 7020 stars
 - * from Tycho ³: 17488 stars
- Photometric standards

Available: 205 697 stars

- * from Hipparcos: 5677 stars
- $\ast\,$ from Tycho: 200 020 stars
- * faint stars: 369 stars
- Total (astr. + phot.)
 267 638
 (36 950 stars are both astrometric and photometric standard stars)

• High energy sources ⁴

- $-\gamma$ -ray from our compilation85- High energy sources (from HEC at ISDC)1513
- X-ray 123 857

• Additional sources

- $-\,$ Optical variables (not classified as cold G-K-M or CTT star candidates) $84\,293$
- Candidates to Classical T-Tauri stars
 858
- Candidates to G-K-M spectral type 40 492
- Objects without any priority 22 843

541 579

Total number of entries

WG contributions

- More required. More concrete/quantitative cases in all science areas.
- Some reluctance to commit given the toy Operation models miss people's favourite fields.
 - Hopefully this is retired as a problem, both from study performance revisions and getting people's work out.
- The THESEUS performance as an observatory is not way ahead of existing and planned facilities, so people are a bit daunted to see where it will fit in post-LSST, eROSITA, and ELTs.
 - These facilities' products can address some interesting current questions.

Yellow Book

- Flexibility of survey-mode pointings crucial for Observatory and Ancillary Science.
 - Encouraging from study updates to performance
 - Ground-segment/downlink capability to compile X/gamma-ray time-series catalogue.
- Unique THESEUS features
 - IR space telescope for spectroscopy. SN, comets
 - Exoplanet transits, perhaps spectroscopy. 1000s of potential targets
 - X-ray/IR monitoring of chosen interesting XRBs, AGN
- Catalogue size can overfill the mission ~30 sources per day, ~1000 per year. Have at least 10,000 interesting targets.

Links to other WGs.

- Time-domain visits are a THESEUS strength, so need to carefully interface with SWG3 in the document.
- Significant future capabilities are coming online prior to THESEUS SWG5. LSST/Rubin, SKA