



愛因斯坦探針  
einstein probe

## EP Performance Verification (PV) Targets Recommendation Form

**Submission Due Date: 15<sup>th</sup> October 2023**

*NOTE: Please do not change or delete the words marked in blue.*

## 1. TITLE

Verify the discovering and monitoring capability of WXT by the night-sky survey

## 2. ABSTRACT (< 250 words)

Discovering X-ray transients and monitoring the variability of known sources are the key science objectives of EP; therefore, it is necessary to verify these capabilities during the PV phase. We propose a dedicated 4-day night-sky survey with the maximized observing efficiency ( $\sim 70\%$ ) of WXT to define a benchmark for further survey strategy. The sampling cadence for a given sky region ranges from 5 to 25 times per day and the accumulated exposure time after this 4-day survey will be 20 ks to 100 ks, which will enable WXT to probe all sources down to the flux level  $2\sim 4\times 10^{-12}$  erg/cm<sup>2</sup>/s in the visible half sky. This sensitivity is essential for the detection of extragalactic sources (e.g. TDE and QPE). It is expected to detect  $\sim 5$  stellar flares,  $\sim 2$  GRB, and  $\sim 1$  TDE in the dedicated 4-day survey campaign, which will verify the significant discovering potential of EP. The survey data will also build the high cadence light curves of  $\sim 50$  bright known sources and the baseline flux of  $\sim 500$  known sources. FXT will simultaneously conduct deep survey at the survey pointings.

During the regular observing period, FXT will be pointed to some targets; thus the spatial and temporal coverage of WXT will not be uniform and regular. Thus, the canonical survey rule covering the whole night sky is only suitable for the PV phase.

## 3. RECOMMENDERS' INFORMATION

| Principal Recommender       |                                    |
|-----------------------------|------------------------------------|
| *Recommender' Name          | Yuan Liu                           |
| *Recommender' Email Address | liuyuan@bao.ac.cn                  |
| *Recommender' Expertise     | WXT survey and transient detection |

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|   |             |
|---|-------------|
| <b>*Recommender'<br/>STP(s)</b>           | STP 1, 2, 5 |
| <b>Co-Recommendors</b>                    |             |
| <b>*Recommenders'<br/>Names</b>           |             |
| <b>*Recommenders'<br/>Email Addresses</b> |             |
| <b>*Recommenders'<br/>Expertise</b>       |             |
| <b>*Recommenders'<br/>STP(s)</b>          |             |

#### 4. TARGET FORM

- TARGET 1 (*mandatory*)**

|  |                                      |                                  |              |                                  |
|--|--------------------------------------|----------------------------------|--------------|----------------------------------|
| <b>*Target Name</b>  | The whole night sky                  |                                  |              |                                  |
| <b>*Target Type</b>  | survey                               |                                  |              |                                  |
| <b>*Target Coordinates</b>   | <b>*RA:</b>                          | Anti-Sun night sky               | <b>*DEC:</b> |                                  |
| <b>*Expected Flux in 0.3-10 keV</b>  | 2.e-12 to 2.e-11 erg/cm2/s           |                                  |              |                                  |
| <b>*Primary Instrument</b>   | WXT                                  |                                  |              |                                  |
| <b>FXT Configuration</b><br><i>(mandatory if the primary instrument is FXT, optional if the primary instrument is WXT)</i> | <b>FXT-A</b>                         | full-frame model and thin filter | <b>FXT-B</b> | full-frame model and thin filter |
| <b>*Exposure Time</b>  | 4 days or 60 orbits (operation time) |                                  |              |                                  |

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|   |  |
|---|--|
| Suggest Joint Observation with Other X-ray Telescopes |  |
| Other remarks   |  |
| <i>Note: * mandatory items</i>                        |  |

- TARGET 2 and more...**  
*(optional, if there are more than one target in this recommendation, copy the entire target form above to the empty space below; note that this is only for the case that one observing proposal includes multiple targets; for targets of a different proposal with distinct technical and scientific goals, please submit them in separate proposals.)*

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## 5. SCIENTIFIC AND TECHNICAL JUSTIFICATION

*(< 2 pages in total for this session, including figures, tables and references)*

- **Scientific Motivations and Values**

EP's primary goals are to discover high-energy transients and monitor variable objects in the X-ray band. Therefore, it is essential to demonstrate the wide-field imaging capability, unprecedentedly high sensitivity and large Grasp of WXT in the PV phase. It is expected to detect ~5 stellar flares, ~2 GRB, and ~1 TDE in the dedicated 4-day survey campaign, which will verify the significant discovering potential of EP. At the same time, the accumulated sensitivity of WXT will be uniformly across the night sky, which will build the baseline flux of a sample of ~500 known sources as the reference catalogue for future transient identification. About 50 bright sources will be detected every 4.5 hours, which will demonstrate the monitoring capability of WXT in the combination of unprecedentedly high sensitivity and cadences.

During the regular observing period, FXT will be pointed to some targets and the observing efficiency of WXT will be reduced in general cases. Thus, the dedicated survey covering the whole night sky is only suitable for the PV phase to define a benchmark for further survey strategy.

- **EP Capabilities to be Verified**

The dedicated 4-day survey campaign will verify the discovering (stellar flare, GRB, and TDE) and monitoring capability (AGN and XRB) of WXT.

- **Immediate Objectives**

- Discover a demonstrating sample of transients by WXT;
- Build the long-term monitoring sample and its baseline flux of WXT;
- Verify the on board triggering function of WXT by real transient;

- **Technical Justification (e.g. target visibility during the PV phase)**

During one orbit, three patches of the night sky will be observed with WXT. The pointing directions will be optimized to maximize the observing efficiency of WXT, which will result an exposure time ranging from 15 to 40 minutes of different modules of WXT during one pointing and an average observing efficiency about 70% (the exact value depends on the boundary of SAA and the threshold of the elevation angle of the earth).

Over three successive orbits almost the entire night sky will be covered. In this way, the sampling cadence for a given sky region ranges from 5 to 25 times per day. Figure 1 shows the exposure time after one day survey. Thus, the accumulated

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exposure time after 4-day survey will be 20 ks to 100 ks, which will enable WXT to probe the source at the flux level  $2\sim 4\times 10^{-12}$  erg/cm<sup>2</sup>/s according to the sensitivity of WXT (Figure 1).

Since the during of this survey is about 1% of 1 yr, we also expect to detect about 1% of the total transient sample of 1 yr.

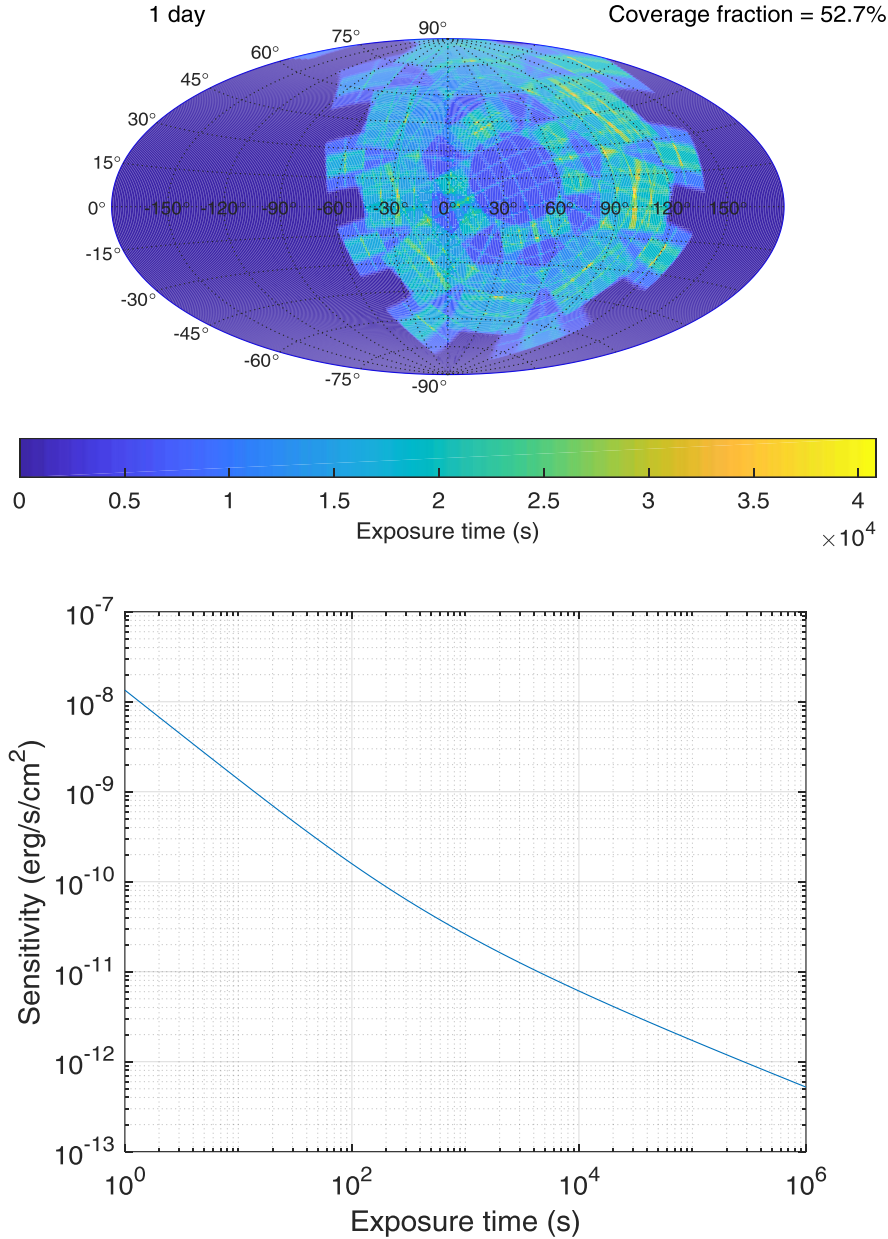


Figure 1 the expected exposure map of WXT after 1 day survey (upper) and the sensitivity as the function of exposure time (lower).

- References**

Yuan, W., Zhang, C., Chen, Y., et al. 2022, The Einstein Probe mission in Handbook of X-ray and Gamma-ray Astrophysics, 86. doi:10.1007/978-981-16-4544-0151-1

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