EP Performance Verification (PV) Targets Recommendation Form

Submission Due Date: 15th October 2023

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

1. TITLE

Use the final-stage merging cluster A3571 to verify the angular resolution and energy resolution of FXT

2. ABSTRACT *(< 250 words)*

(summarize the target properties, the EP capabilities to be verified, and justify why the proposed observations and targets should be considered for the PV phase)

A3571 is a nearby (z=0.04) hot (~7 keV) and massive (6 x 10^{14} $M_{\odot}$) galaxy cluster, locating in the Shapley supercluster. From the optical data, it appears to be merging with A3572 and A3575. While its X-ray morphology is regular. Since its bright central gas does not show a temperature drop, it might be a merging cluster in the final stage.

A3571 has both Chandra (35ks, ACIS-S) and XMM-Newton (33ks) observations in the central region. But their field of view (FoVs) are too small to cover the whole cluster (r200=2.5 Mpc, corresponding to 52 arcmin). EP-FXT is an ideal equipment to explore its gas properties and kinematic status in the outskirts, where the merging activities might still last.

For the PV phase, It is bright enough that scientific goals can be achieved with a relatively short exposure time. XMM-Newton and Chandra observations provide ideal high resolution data for the verification and calibration. It is also observed by eROSITA. We could evaluate the response and effective area of EP-FXT.

3. RECOMMENDERS' INFORMATION

Principal Recommender	
***Recommender' Name**	Heng Yu
***Recommender' Email Address**	yuheng@bnu.edu.cn
***Recommender' Expertise**	Yu is an expert of the multiband observational study of galaxy clusters. He is good at analysis of merging systems.
***Recommender' STP(s)**	STP5

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Co-Recommenders	
***Recommenders' Names**	Yong Chen, Shu-Mei Jia, Cheng-Kui Li, Weimin Yuan
***Recommenders' Email Addresses**	ychen@ihep.ac.cn, jiasm@mail.ihep.ac.cn, lick@ihep.ac.cn, wmy@nao.cas.cn
***Recommenders' Expertise**	Chen, Jia, and Li are from research and development team of EP-FXT, and also experts in X-ray Galaxy cluster. Yuan is the PI of EP.
***Recommenders' STP(s)**	STP4, STP5

4. TARGET FORM

- **TARGET 1 *(mandatory)***

***Target Name**	A3571			
***Target Type**	Galaxy cluster			
***Target Coordinates**	***RA:**	13h47m36.67s	***DEC:**	-33d02m04.71s
***Expected Flux in 0.3-10 keV**	1.2e-10 erg/s/cm^2			
***Primary Instrument**	FXT			
FXT Configuration ***(mandatory if the primary instrument is FXT, optional if the primary instrument is WXT)***	**FXT-A**	full-frame thin	**FXT-B**	full-frame thin
***Exposure Time**	35 ksec			
Suggest Joint Observation with	NO			

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Other X-ray Telescopes	
Other remarks	(any other remarks)
*Note: * mandatory items*	

- **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**

A3571 is a nearby (z=0.04) hot (~7 keV) and massive (6 x 10^{14} $M_{\odot}$) galaxy cluster. It has two neighbouring clusters (A3572 and A3575) but a regular x-ray morphology without substructures or any signs of disturbance. Since its bright central gas does not show a temperature drop, it could be a merging cluster in the final stage, which is quite rare. This makes it a special target that could help us understand the complete process of merging events.

A3571 has both Chandra (35ks, ACIS-S) and XMM-Newton (33ks) observations in the central region. But their field of view(FoVs) are too small to cover the whole cluster (r200=2.5 Mpc, corresponding to 52 arcmin). With the 1 degree FoV of EP-FXT, we could go beyond r500 to explore its gas properties and kinematic status in the outskirts and the region of A3572, where the merging activities might still last.

With the brightness residual, 2D maps of temperature, metallicity, pressure and entropy, we could check the dynamical status of A3571 in much large scale. That would be comparable with the distribution of member galaxies.

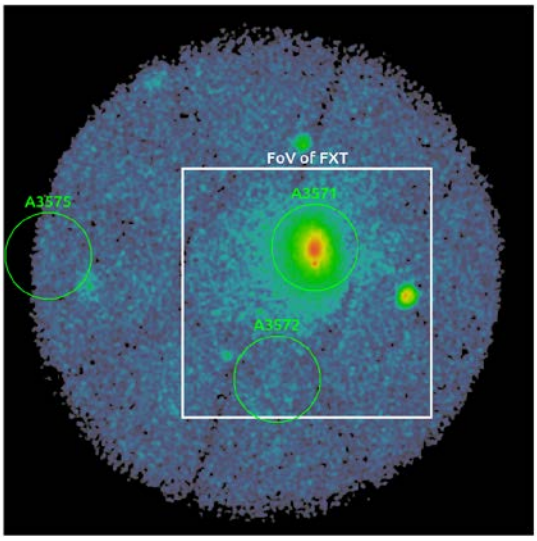

Fig 1. ROSAT image of A3571 and FXT FoV

For the PV phase, A3571 is bright enough that scientific goals can be achieved with a relatively short exposure time. XMM-Newton and Chandra observations provide ideal high resolution data for the verification and calibration. It is also observed by eROSITA. We could evaluate the response and effective area of EP-FXT.

- **EP Capabilities to be Verified**

The observation of A3571 could be used to verify the energy response, the effective area and the vignetting effect of EP-FXT. The point sources near the edge could be used to check the location error of the field.

With the XMM-Newton, Chandra, and eROSITA observations, we could evaluate the angular and energy resolution of our data, and cross-check our calibration and fitting procedure.

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- **Immediate Objectives**
  (listed the main objectives of the recommended targets and observations)

The main objective of the A3571 observation are:

1, explore the general physical properties of the cluster, which is still unclear.

2, analyze the X-ray gas properties of outskirts to understand details of the merging stage.

3, compare the X-ray morphology with the optical galaxy distribution (Legacy Survey DR10) to unveil the kinematic status of the cluster.

4, check the activity of a TDE candidate host galaxy LEDA 095953 (close to the BCG of A3571).

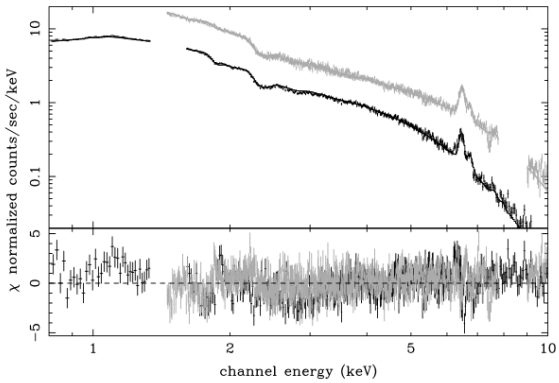

Fig 2. XMM spectra of A3571

- **Technical Justification (e.g. target visibility during the PV phase)**
  (Briefly justify the technical feasibility of the recommended target and observation, such as the target visibility during the PV phase, brightness, variability, etc.)

Of all galaxy clusters visible in February 2024, A3571 is the brightest within redshift 0.05. It is visible (>90 deg) between 2024-01-27 and 2024-7-29. Its flux is 1.2e-10 erg/cm^2/s.

- **References**

(1) Hudaverdi, M.; et al. Study of the Structure of Abell 3571: An XMM-Newton View. *Advances in Space Research* 2005, 36, 643–649.
(2) Venturi, T.; et al. Radio Emission from the A3571 Cluster Complex: The Final Stage of a Cluster Merger? *Astronomy and Astrophysics* 2002, 385, 39–54.
(3) Nevalainen, J.; et al. Temperature and Total Mass Profiles of the A3571 Cluster of Galaxies. *Astronomy and Astrophysics* 2001, 369, 459–466.
(4) Bonamente, M.; et al. ROSAT and BeppoSAX Evidence of Soft X-Ray Excess Emission in the Shapley Supercluster: A3571, A3558, A3560, and A3562. *The Astrophysical Journal* 2001, 552, L7–L11.
(5) Nevalainen, J.; et al. X-Ray Total Mass Estimate for the Nearby Relaxed Cluster A3571. *The Astrophysical Journal* 2000, 536, 73–78.
(6) Cappelluti, N.; et al. A Candidate Tidal Disruption Event in the Galaxy Cluster Abell 3571. *Astronomy and Astrophysics* 2009, 495, L9–L12.

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