Youli Tuo (庹攸隶)

Personal Information

Address:	Institute of High Energy Physics, CAS
	No.19 Yuquan Road, Shijingshan District
	Beijing 100049, China
Mobile Phone:	+86 15501262625
Email:	tuoyl@ihep.ac.cn ; youlituo@gmail.com

Education

Sept. 2015 – Present: Ph.D. candidate (Expected Autumn 2020)

Institute of High Energy Physics, Chinese Academy of Science

Thesis title: *Study of the high-energy properties of pulsars observed by Insight-HXMT*

Jun. 2011 – Jun. 2015: B.Sc. in Mathematics and Physics

Yunnan University, Kunming, China

Conference & Workshop

NOV. 2019: Beijing Astronomical Annual Meeting | Bejing,China

Oral Presentation (Award of best presentation)

Title: *Temporal study on HMXB 4U 1901+03 observed by Insight-HXMT*

JUL. 2019: The 8th Fermi Asian Network Workshop Fermi-LAT summer school for FAN8 | Zhuhai, China

JUN. 2019: The Second Insight-HXMT Users Conference | Beijing, China

Oral Presentation

Title: *Timing and spectral analysis using Insight-HXMT data*

Lecturing the usage of Insight-HXMT data analysis software

DEC. 2018: Insight-HXMT Users Workshop | Beijing, China

Oral Presentation

Title: *Quick tour to Insight-HXMT/HE data processing*

Lecturing the usage of Insight-HXMT data analysis software

NOV. 2018: Japan China X-ray Collaboration Workshop | Toyoko, Japan

Oral Presentation

Title: *Insight-HXMT observations of newly discovered XRB Swift J0243.6+6124*

OCT. 2018: Annual Meeting of Chinese Astronomical Society | Kunming, China

Oral Presentation

Title: *Insight-HXMT observations of Crab pulsar*

JUL. 2018: Summer School and Workshop for Nuclear Astrophysics | Enshi, China

JUL. 2018: The 42nd COSPAR Scientific Assembly | Pasadena, U.S.

Poster

Title: *Insight-HXMT observations of newly discovered XRB Swift J0243.6+6124*

Computer Skills

Data Analysis Packages:	HXMTDAS (★★★★★)
	XSPEC (★★★★★)
	FTOOLS (★★★★★)
	Analyzing experiences with NuSTAR, Fermi and MAXI
Scripting languages:	PYTHON (★★★★★)
	GNU BASH (★★★★★)
Programming language:	C++ (★★★★★)

GitLab link: http://code.ihep.ac.cn/tuoyl

GitHub link: https://www.github.com/tuoyl

Developed Software Tools

HXMT Docker Container:	An integrated environment for *Inishgt*-HXMT data analysis
HXMT pipeline:	A pipeline tool that makes your life easier when analyzing HXMT data
HXMT Burst Analysis:	A supplementary toolkit for correcting the saturation effect of LE telespoce on-board HXMT
HXMT CsI Analysis:	A script to search the pulsation signal of CsI detector on-board HXMT
Timing Analysis toolkit:	A toolkit for timing analysis of pulsar and binary

Publication list

Published:

- **Insight-HXMT insight into switch of the accretion mode: The case of the X-ray pulsar 4U 1901+03**

Y.L. Tuo, L. Ji, S.S. Tsygankov, T. Mihara, L.M. Song, ..., and Insight-HXMT collaboration, 2020, Journal of High Energy Astrophysics, 27(38-43)

- **Insight-HXMT observations of the Crab pulsar**

Y.L. Tuo, M.Y.Ge, L.M. Song, L.L. Yan, Q.C.Bu, and J.L. Qu., 2019, Research of Astronomy and Astrophysics, 19(6), 087.

- **The Insight-HXMT observation of the newly discovered transient X-ray pulsar Swift J0243.6+6124**

Y.L. Tuo, and Y. Zhang., 42nd COSPAR Scientific Assembly. Vol. 42. 2018.

- **Time evolution of the X-ray and gamma-ray fluxes of the Crab pulsar**

L.L. Yan, M.Y. Ge, F.J. Lu, S.J. Zheng, ***Y.L. Tuo***, Z.J. Li, J.L. Qu, 2018, The Astrophysical Journal , 865(1), 21.

- **Phase Evolution of the Crab Pulsar between Radio and X-ray**

L.L. Yan, M.Y. Ge, J.P. Yuan, S.J. Zheng, F.J. Lu, ***Y.L. Tuo***, H. Tong, S. N. Zhang, Y. Lu, J.L. Han, and Y.J. Du, 2017, The Astrophysical Journal, 845(2), 119.

In Process:

- **Identification of a non-thermal X-ray burst with the Galactic magnetar SGR 1935+2154 and a fast radio burst with Insight-HXMT**

C.K. Li, L. Lin, S.L. Xiong, M.Y. Ge, X.B. Li, T.P. Li, F.J. Lu, S.N. Zhang, ***Y.L. Tuo***, ..., and the Insight-HXMT collaboration, (arXiV pre-print: https://arxiv.org/abs/2005.11071v1)

- **The jet-like corona in a black hole X-ray binary observed by Insight-HXMT**

B. Y, ***Y.L. Tuo***, C.Z. Li, W. Wang, S.N. Zhang, S. Zhang, M.Y. Zhang, ... and the Insight-HXMT collaboration, (Revised and Resubmitted to Nature Communication)

Research Experience

My career as a Ph.D. student accompanied the launch and first three years of operation of the HXMT. I have participated in the in-flight calibration of HXMT, software development and maintenance, and some of the studies of its scientific targets, including pulsars, black holes, and the gamma-ray burst. I have experience in data analysis of timing and spectral of various astronomical sources. Moreover, I have developed tools to support the analysis of HXMT data.

Observational studies of compact objects

Insight-HXMT observations of the Crab pulsar

The Crab pulsar has been used in the calibration of multi-band astronomy instruments because of their stable and high luminosity, and relatively stable time characteristics. We used HXMT's observations in the first year after the launch of the Crab pulsar to perform the timing and spectral analysis. In terms of timing, we report timing residuals of less than 50 µs for HXMT observations of Crab pulsar, which verifies the correctness of the HXMT time system. A good time performance then allows the study of the pulse profiles of Crab pulsars. Since the HXMT covers a broad X-ray energy band, 1 keV–250 keV, we analyze the evolution of the pulse profile with energy and obtain the spectrum for each rotating phase. This work provides additional data on pulsars to help constrain emitting models in the hard X-ray energy band. The detailed observational study of Crab also provides data to support the calibration of the instrument's systematic errors, and the PSF calibration.

Insight-HXMT insight into the switch of the Accretion mode: The case of the X-ray. pulsar 4U 1901+03

An important scientific goal of the HXMT is to study the behavior of X-ray binary star systems during their outbursts. 4U 1901+03 is a binary system in which the central compact object is a neutron star. MAXI, *Swift*/BAT, and *Fermi* monitored this source during its 2019 outburst. HXMT has carried out observations during its outburst decline. Using data from HXMT and *Fermi*/GBM, we analyzed the periodic evolution of its binary stars, updated the orbital parameters of the system, and rotation parameters of the neutron star.

We analyze the evolution of its pulse profile during the outburst. The X-ray luminosity of the accretion powered pulsar changes as the absorption rate changes. At the same time, changes of radiation pressure within the absorption column leads to a switch of the accreting mode, which also a variation in the shape of the pulse profile (varies between double and single peaks). We have observed changes in the pulse profile in both HXMT

and NuSTAR data. From this, we can establish the correlation between bolometric luminosity and magnetic field, while the flux is known by observations. Thus the correlation between the distance and the magnetic can be obtained.

Meanwhile, the luminosity of the accretion powered pulsar corresponds to the variation of the accreting rate. The variation of the accretion rate is directly responsible for the effect of the accreted material on the acceleration of the neutron star's rotation ($\dot{\nu}$). Based on the torque model of the accreting process, we obtain the equation containing the $\dot{\nu}$, magnetic field, and the distance of the source. Since the optical observations of this source do not provide good constrain to the distance of this source, we suggest the distance of $12.5 \pm 0.2\,\mathrm{kpc}$, and the magnetic field of $4.3 \times 10^{12}\,\mathrm{G}$.

Spectroscopic study of the black hole binary MAXI J1820+070

I participated in a study of black hole X-ray binary MAXI J1820+070, contributing to spectral analysis and interpretation of results. HXMT observations of MAXI J1820+070, covering a complete outburst of the source. Kara et al. (2019) suggested a reduction in the spatial extent of the corona during the hard-state of the black hole. A consequence of this process is that the proportion of photons reflected from the corona reaching the accretion disk increases as the flux decreases. Using data from HXMT, we find that the fraction from the reflected component is decreasing. We suggest that this is caused by the outflow from the corona. The main part of my contribution is the analysis of HXMT data as well as the spectral. The MCMC method is used to simulate the parameter in the parameter space. The credit intervals of the parameters are determined using the posterior distributions of the parameters. Because the height of the corona decreases physically, in the reflection model the corona height increases, we fit the responsed fake spectra by simulating a reflection model with an outflow in the velocity of β. The results confirm that the outflow leads to the height increasing of the corona in the model, which explains the observation well.