Two Space High Energy Astrophysics Missions of China: POLAR & HXMT

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2016-02-11, LIGO team announced the shocking news: The gravitational wave predicted 100 yrs ago has been detected!

Courtesy https://www.ligo.caltech.edu/video/ligo20160211v1

A gamma-ray burst with GW150914?

arXiv.org > astro-ph > arXiv:1602.03920

Search or Article

Astrophysics > High Energy Astrophysical Phenomena

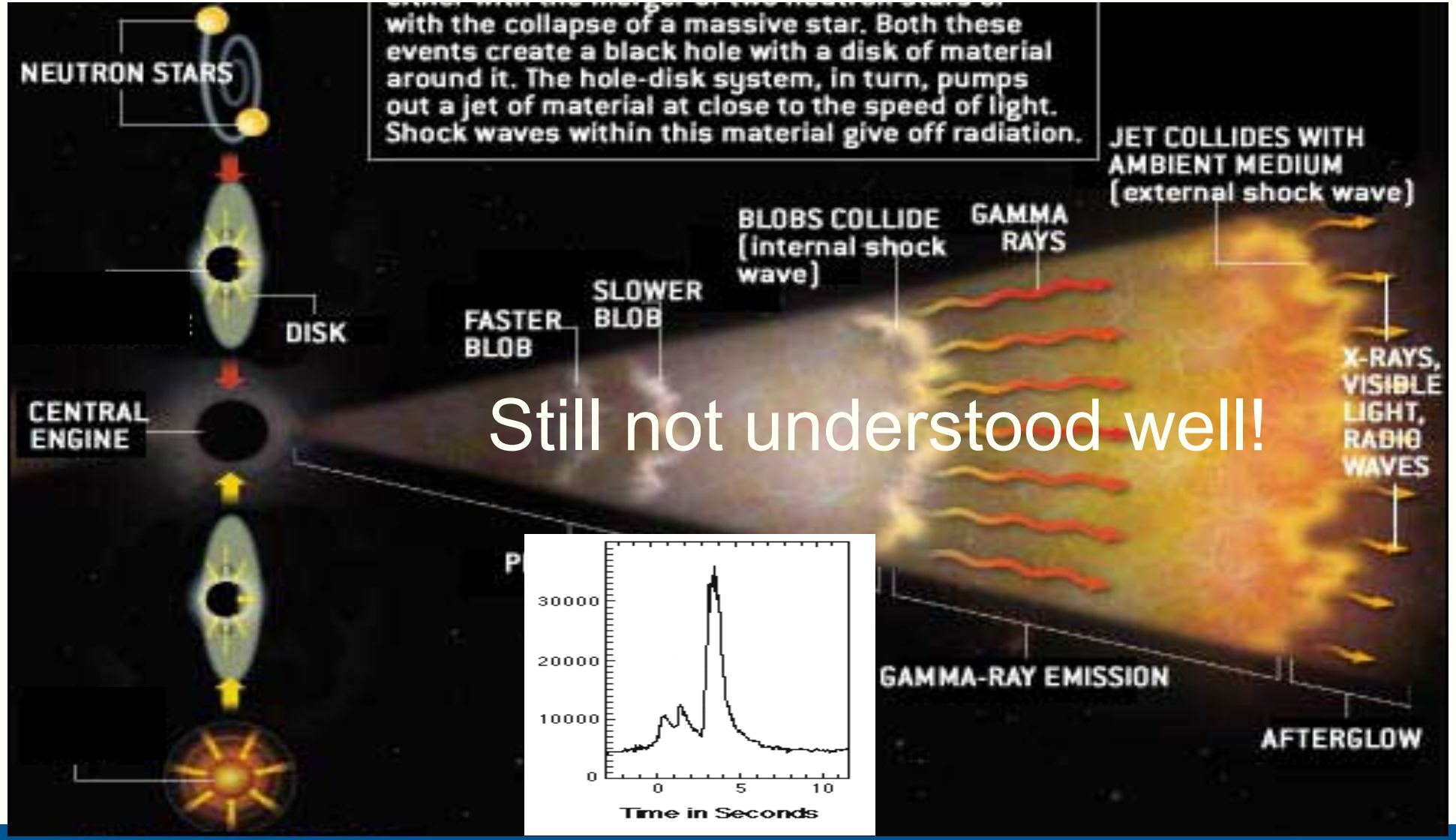
Fermi GBM Observations of LIGO Gravitational Wave event GW150914

V. Connaughton, E. Burns, A. Goldstein, M. S. Briggs, B.-B. Zhang, C. M. Hui, P. Jenke, J. Racusin, C. A. Wilson-Hodge, P. N. Bhat, E. Bissaldi, W. Cleveland, G. Fitzpatrick, M. M. Giles, M. H. Gibby, J. Greiner, A. von Kienlin, R. M. Kippen, S. McBreen, B. Mailyan, C. A. Meegan, W. S. Paciesas, R. D. Preece, O. Roberts, L. Sparke, M. Stanbro, K. Toelge, P. Veres, H.-F. Yu, other authors

(Submitted on 11 Feb 2016 (v1), last revised 16 Feb 2016 (this version, v3))

With an instantaneous view of 70% of the sky, the Fermi Gamma-ray Burst Monitor (GBM) is an excellent partner in the search for electromagnetic counterparts to gravitational wave (GW) events. GBM observations at the time of the Laser Interferometer Gravitational-wave Observatory (LIGO)event GW150914 reveal the presence of a weak transient source above 50 keV, 0.4 s after the GW event was detected, with a false alarm probability of 0.0022. This weak transient lasting 1 s does not appear connected with other previously known astrophysical, solar, terrestrial, or magnetospheric activity. Its localization is ill-constrained but consistent with the direction of GW150914. The duration and spectrum of the

What is a gamma-ray burst?



Still not understood well!

However INTEGRAL did not see anything!

Draft version March 8, 2016
Preprint typeset using LaTeX style emulateapj v. 5/2/11

INTEGRAL UPPER LIMITS ON GAMMA-RAY EMISSION ASSOCIATED WITH THE GRAVITATIONAL WAVE EVENT GW150914

V. Savchenko[1], C. Ferrigno[2], S. Mereghetti[3], L. Natalucci[4], A. Bazzano[4], E. Bozzo[2], S. Brandt[5], T. J.-L. Courvoisier[2], R. Diehl[6], L. Hanlon[7], A. von Kienlin[6], E. Kuulkers[8], P. Laurent[9,10], F. Lebrun[9],

the event had a magnetospheric origin. Eventually, considering that the false alarm probability of the GBM association relatively high (0.2%; Connaughton et al. 2016) and SPI-ACS does not detect it, it is likely that the GBM excess is a random background fluctuation.

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[11]Université Toulouse; UPS-OMP; CNRS; IRAP; 9 Av. Roche, BP 44346, F-31028 Toulouse, France
[12]European XFEL GmbH, Albert-Einstein-Ring 19, 22761, Hamburg, Germany

Draft version March 8, 2016

ABSTRACT

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Contents lists available at ScienceDirect

Physics Letters B

www.elsevier.com/locate/physletb

Exact solutions for shells collapsing towards a pre-existing black hole

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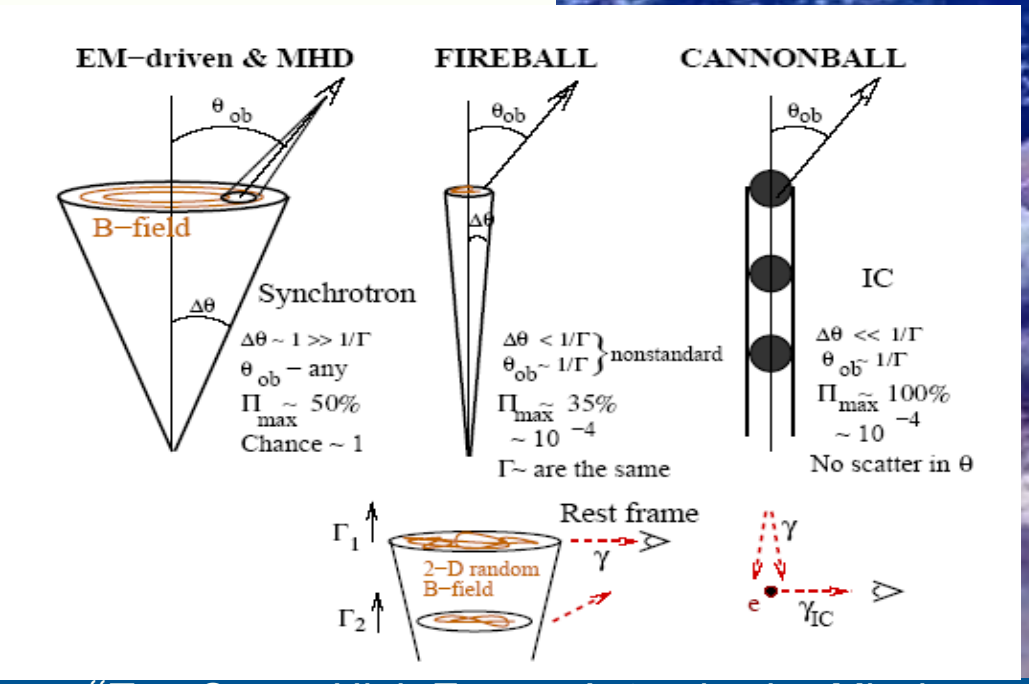
Therefore with full and self-consistent general relativity calculation, we find that the in-falling matter will not accumulate outside the event horizon, and thus the quantum radiation and Gamma Ray bursts predicted in [2] and [3] are not likely to be generated. We predict that only gravitational wave radiation can be produced in the final stage of the merging process of two coalescing black holes. Future simultaneous observations by X-ray telescopes and gravitational wave telescopes shall be able to verify our prediction.

black holes with finite lifetimes their masses are distributed within their event horizons, rather than concentrated at their centers. We also present a worked-out example of the Hawking's area theorem.

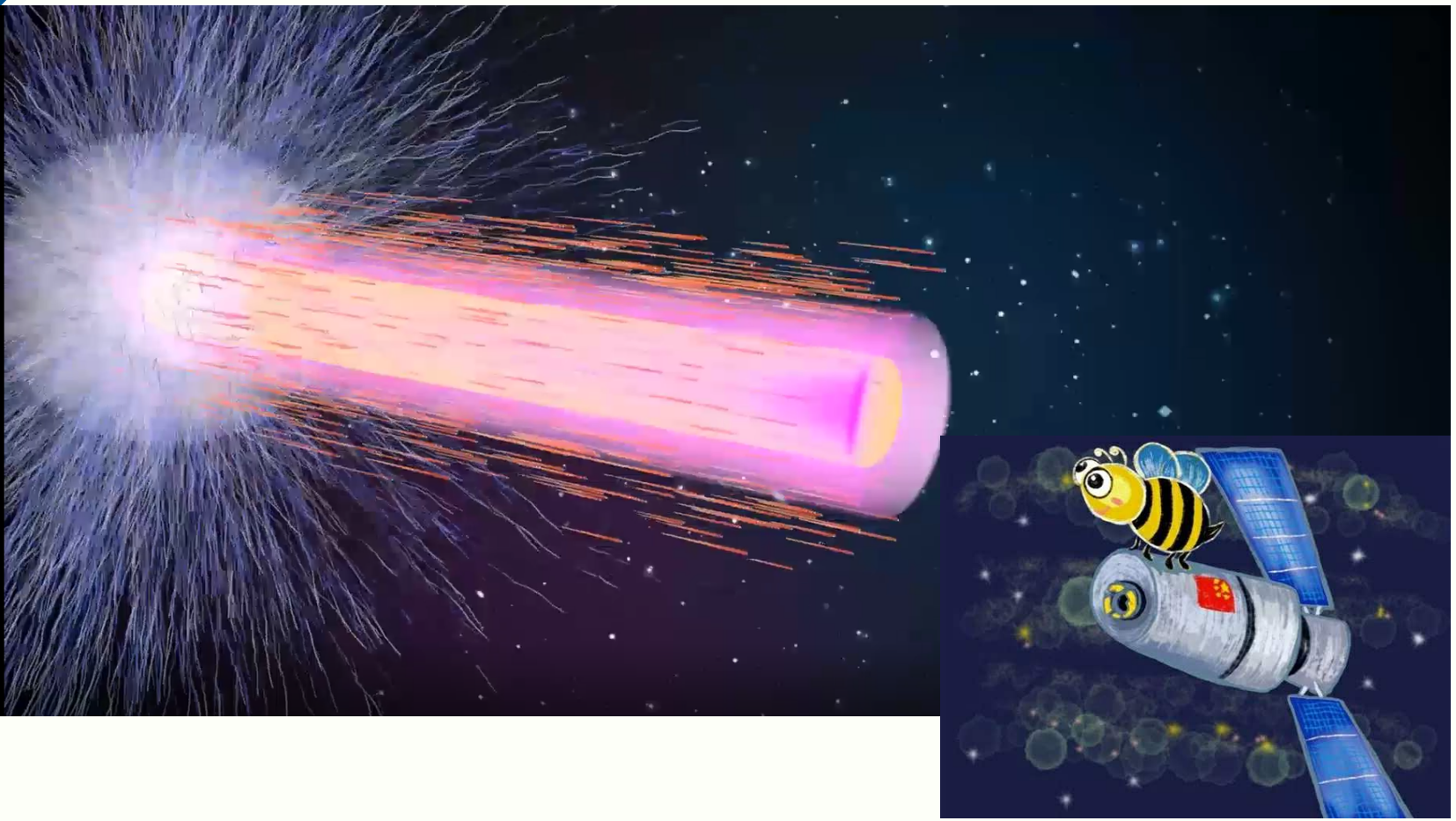
Gamma-ray burst polarization : POLAR

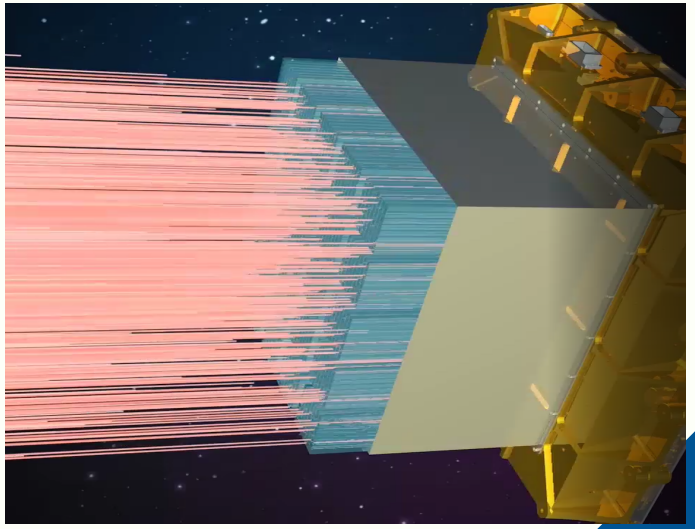
Polarization sensitive to relativistic jet properties

China-Europe collaboration
Science goal: understanding GRB jet with polarimetry
Energy Range：50~500 keV
Launch time：2016-9-15



POLAR is a little bee on TG-2

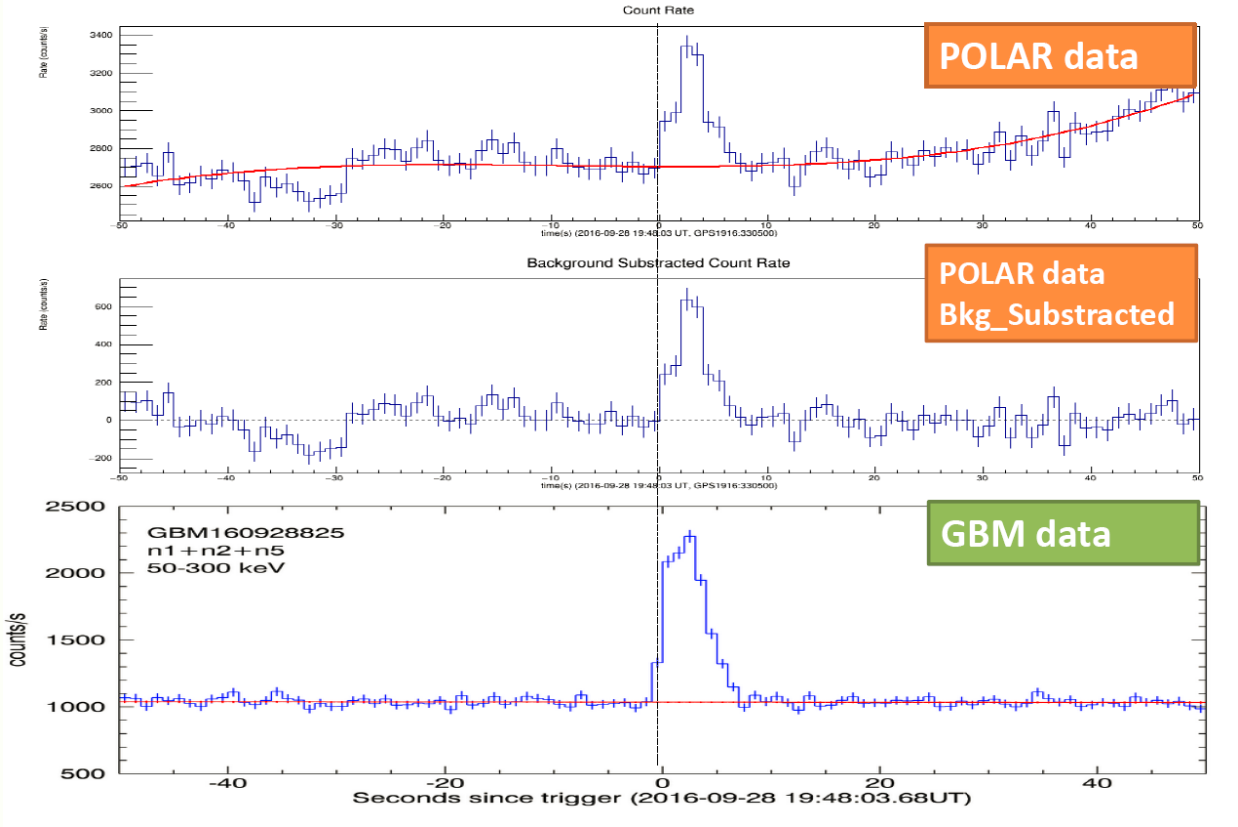




POLAR detected GRBs

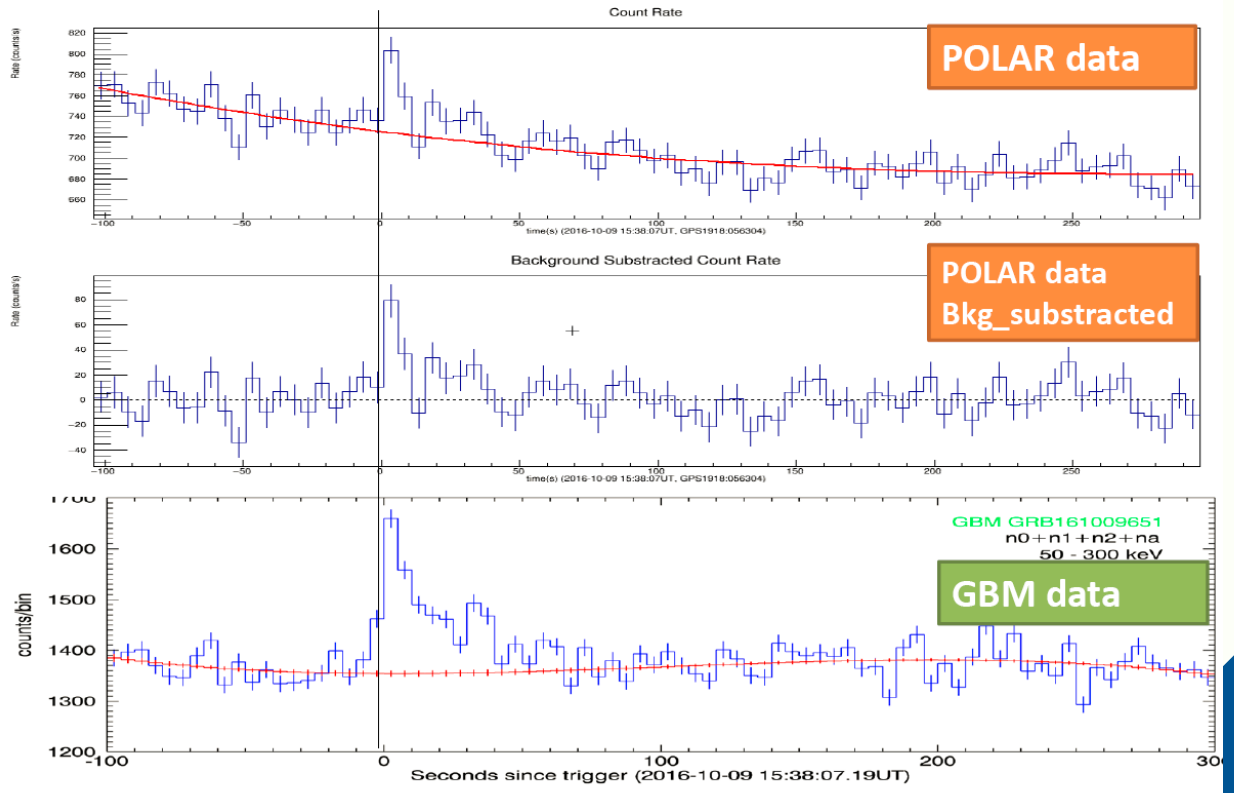
GBM 160928825

2016-09-28 19:48:03UT max_SNR=15.7816 maxSN_timestart=-0.55s maxSN_duration=4.35s

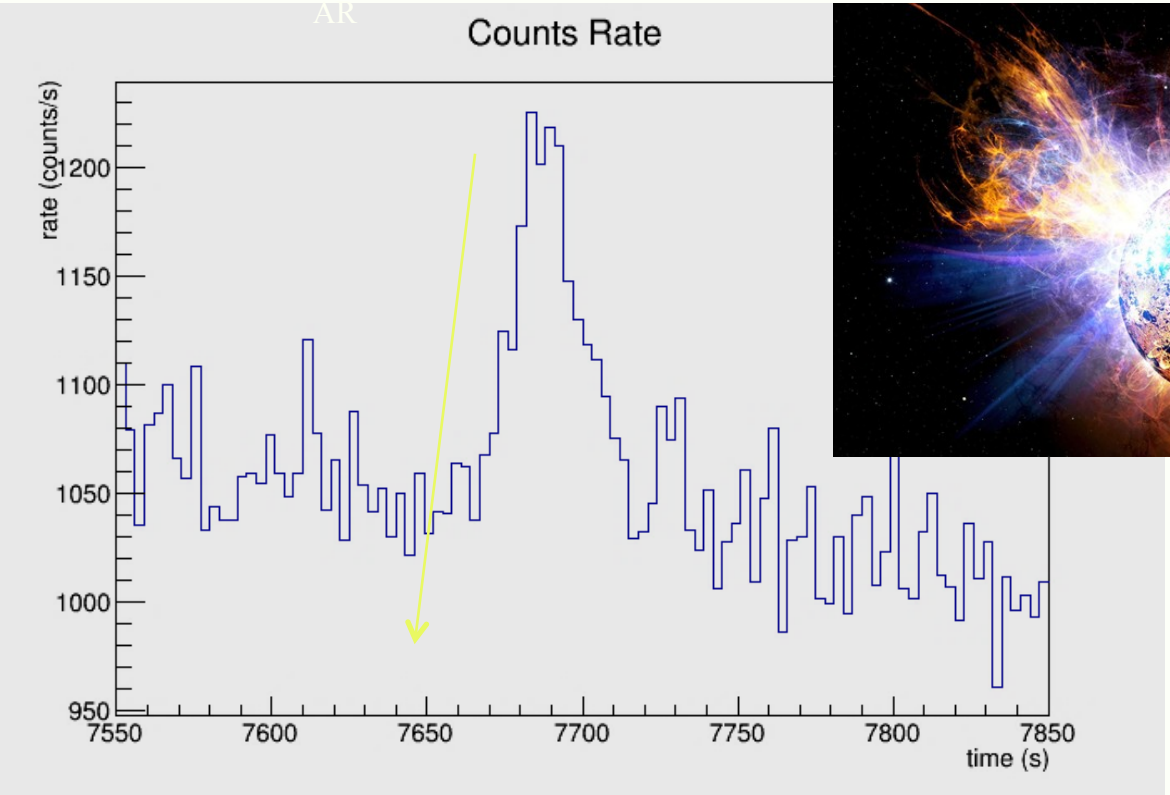


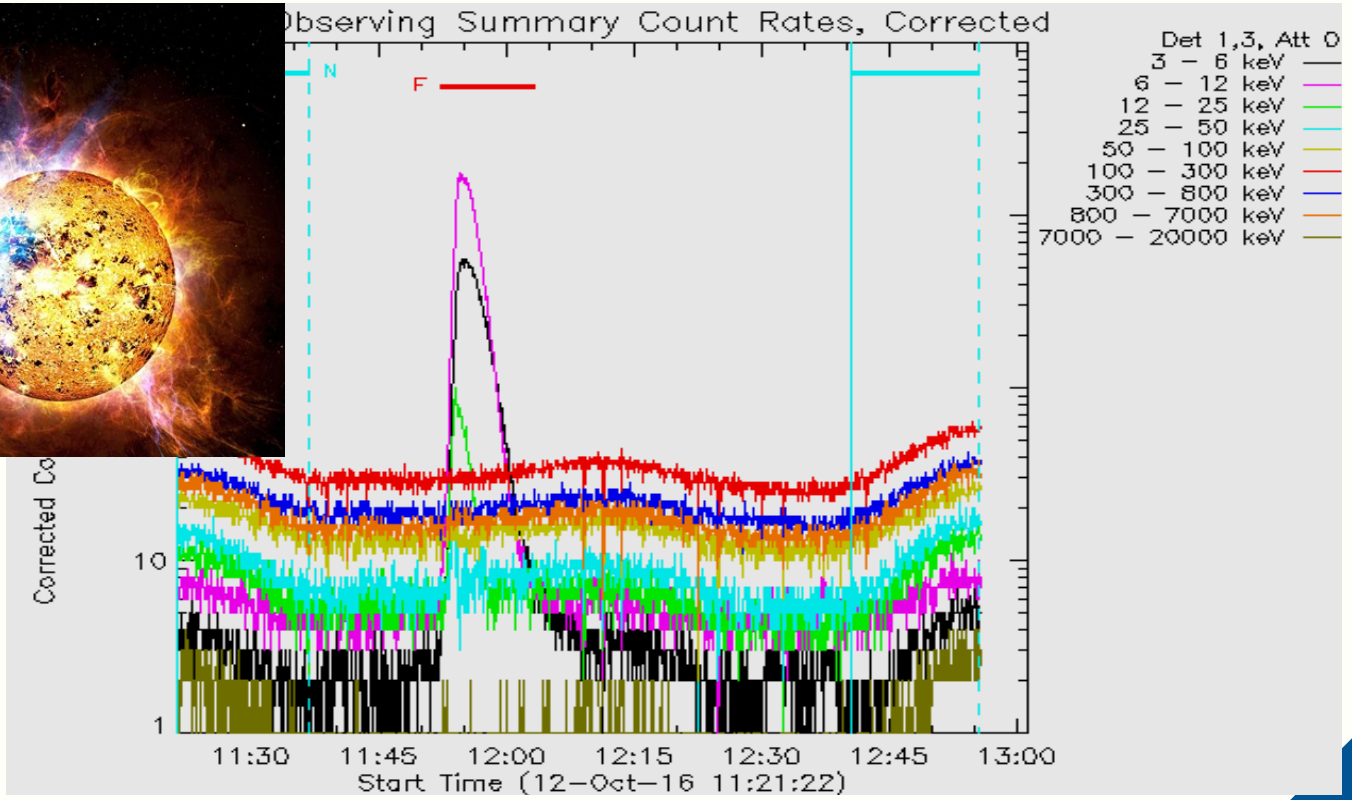
GBM 161009651

2016-10-09 15:38:07 UT POLAR maxSNR=7.94619 maxSNR_timestart=-12s maxSNR_duration=40s



POLAR detected solar flares

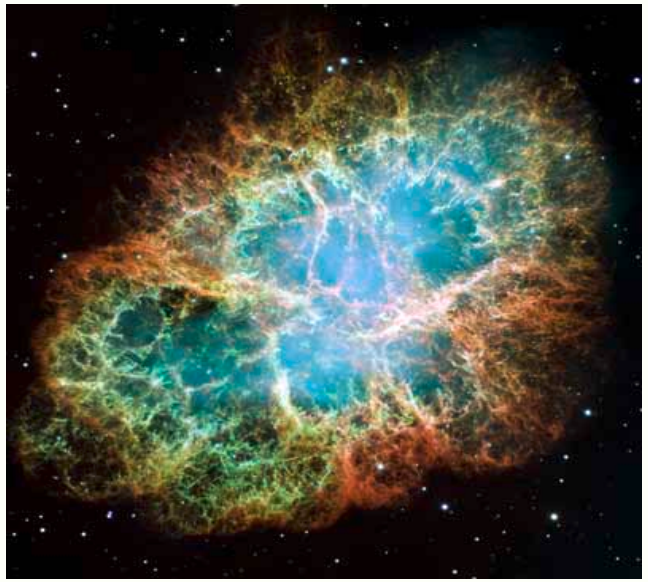


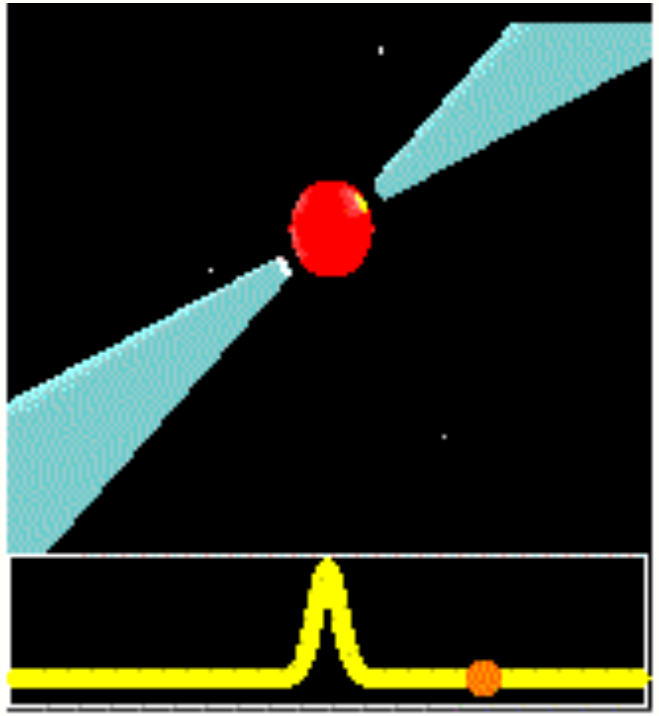


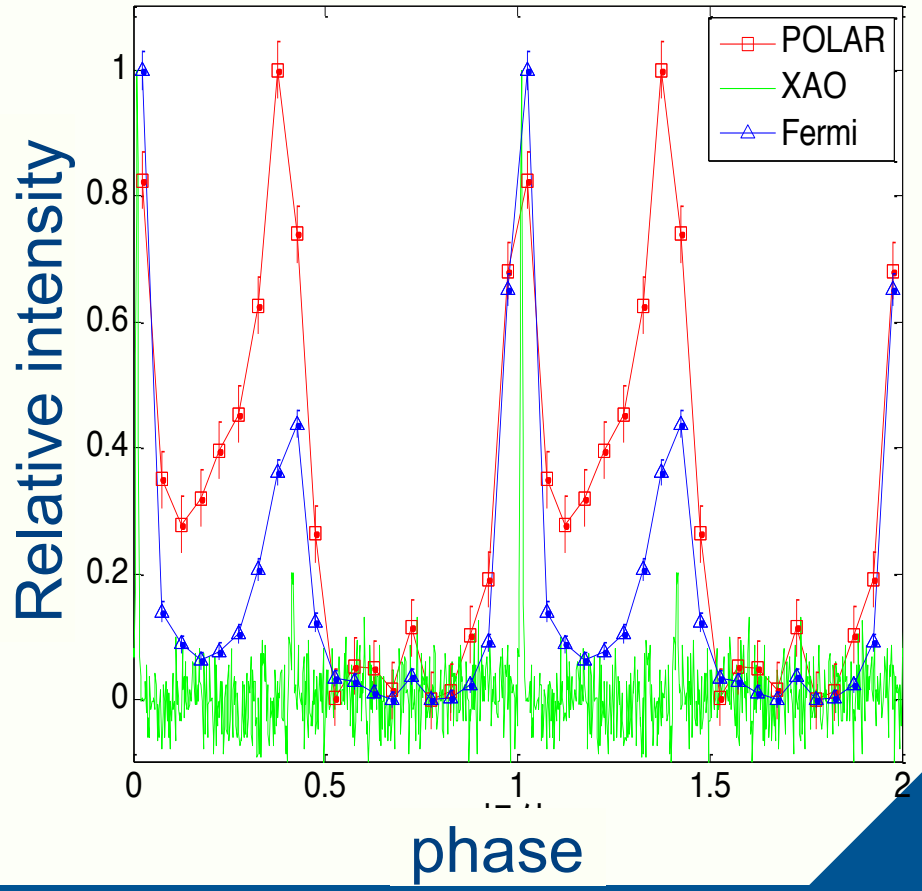
POLAR

US RHESS Satellite

POLAR also detected the Crab pulsar

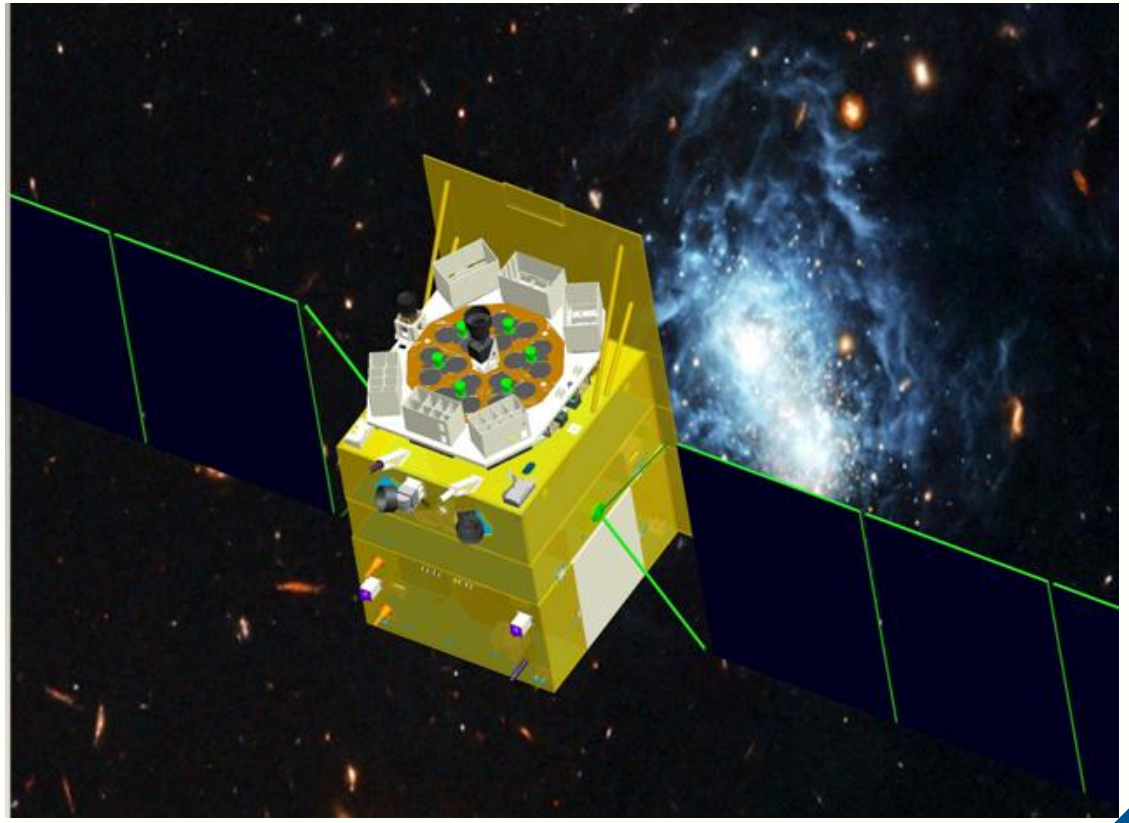






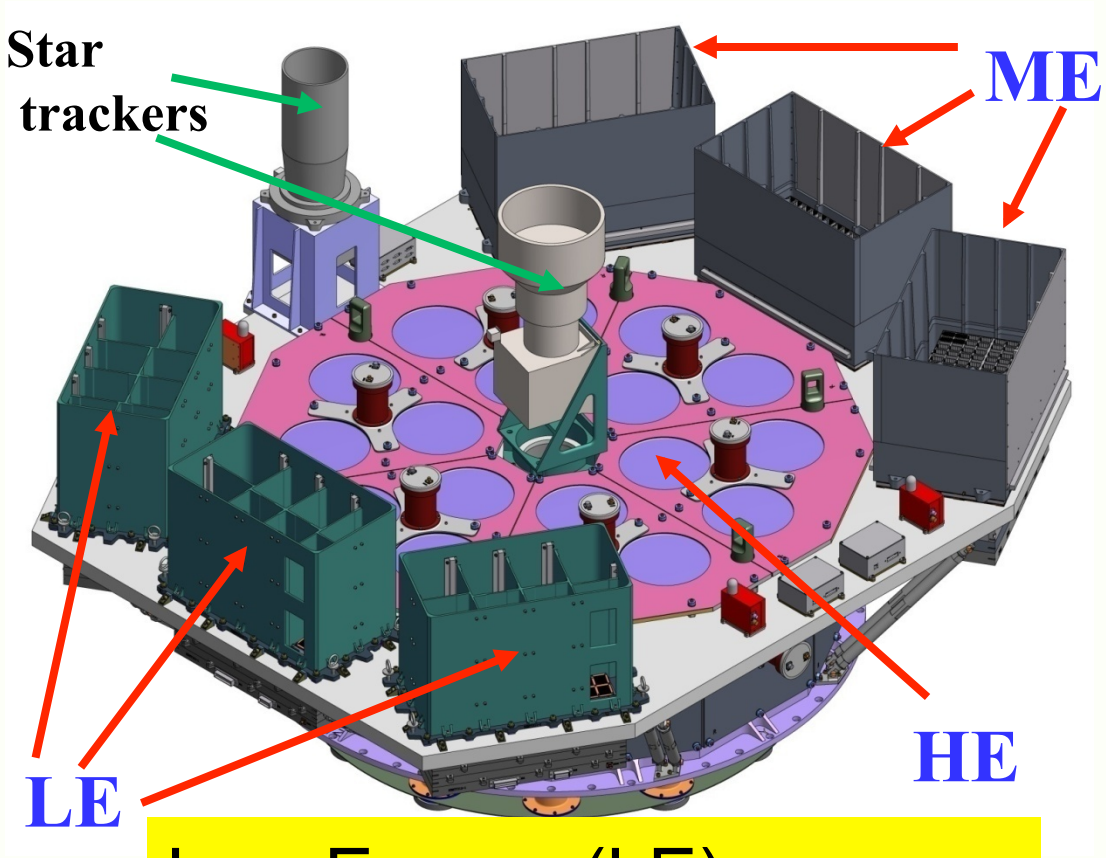
Hard X-ray Modulation Telescope (HXMT) satellite

- China's 1st X-ray astronomy satellite
- Selected in 2011
- Total weight ~2500 kg
- Cir. Orbit 550 km, incl. 43°
- Pointed, scanning and GRB modes
- Designed lifetime 4 yrs
- Launch in 1st half of 2017



- Welcome international cooperation, especially radio and optical observations on ground and from the southern hemisphere.

HXMT Payloads



Medium (ME):

Si-PIN,5-30 keV, 952 cm^2

High Energy (HE): Normal Mode

NaI, 20-250 keV, ~5000 cm^2

CsI, 50-700 keV, ~5000 cm^2

High Energy (HE): GRB Mode

NaI, 100-300 keV, 5000 cm^2

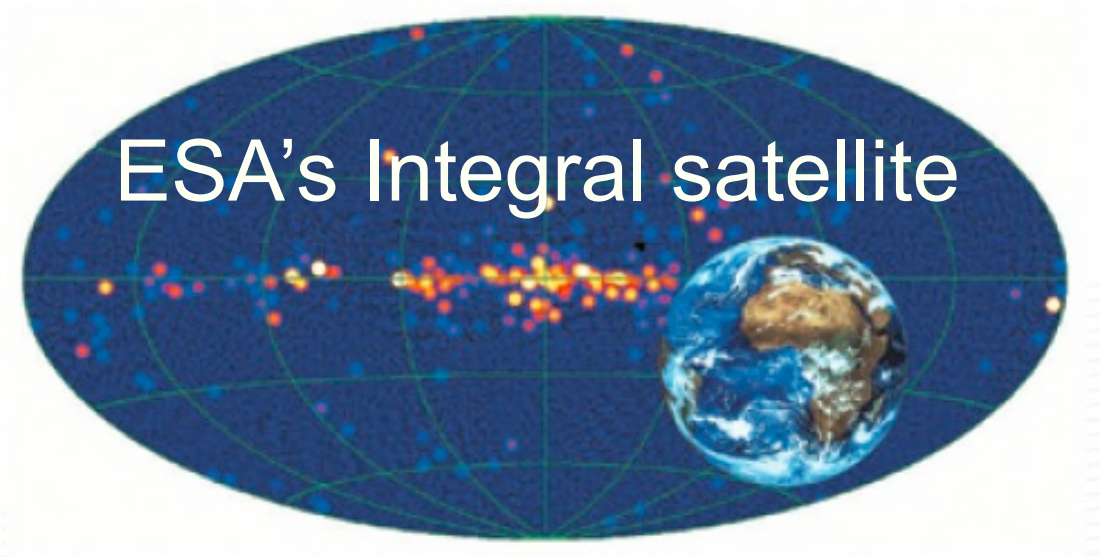
CsI, 250-3000 keV, 5000 cm^2

Low Energy (LE):

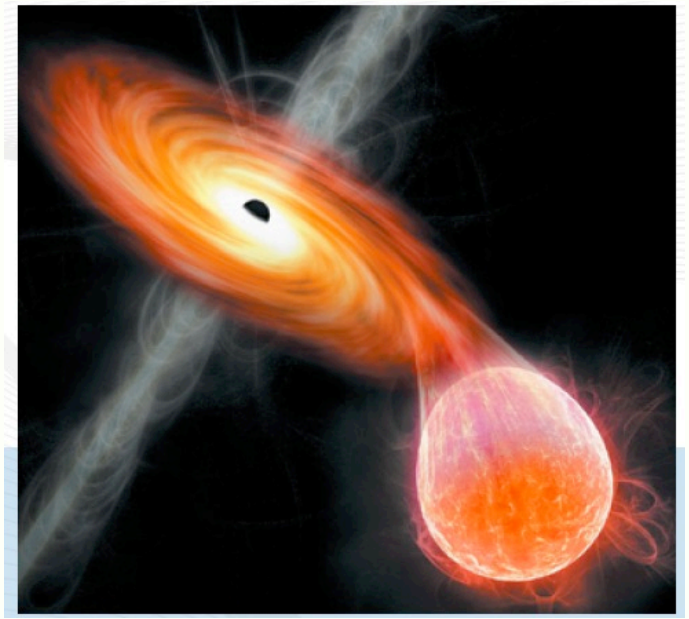
SCD,1-15 keV, 384 cm^2

HXMT Scientific Objectives

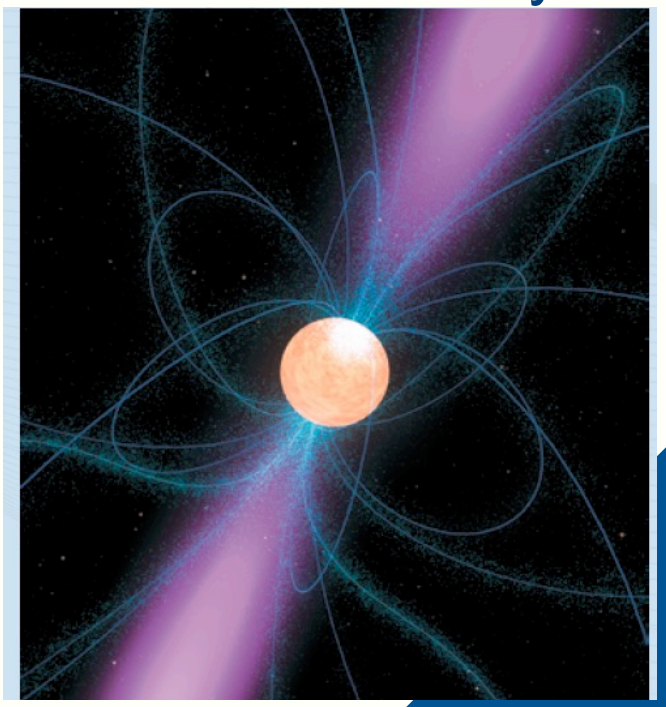
Scanning survey of the Milky Way: new sources and activities of known sources



Most bright X-ray sources in the Milky Way are variable: black holes and neutron stars.

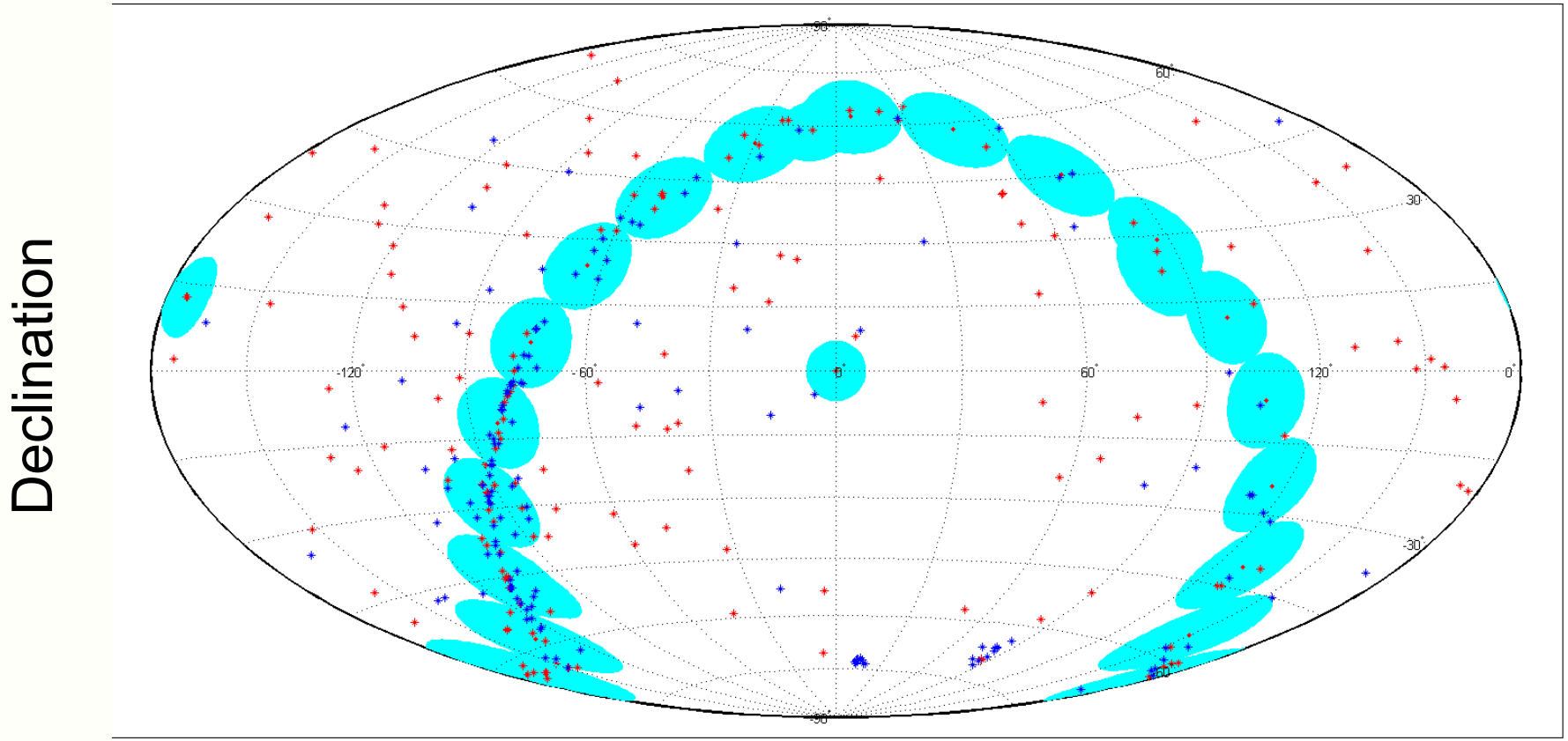


A black hole/neutron stars engulfs matter from its companion and generates bright and variable X-rays.



A rapidly spinning neutron star with the strongest magnetic field in nature generates bright X rays.

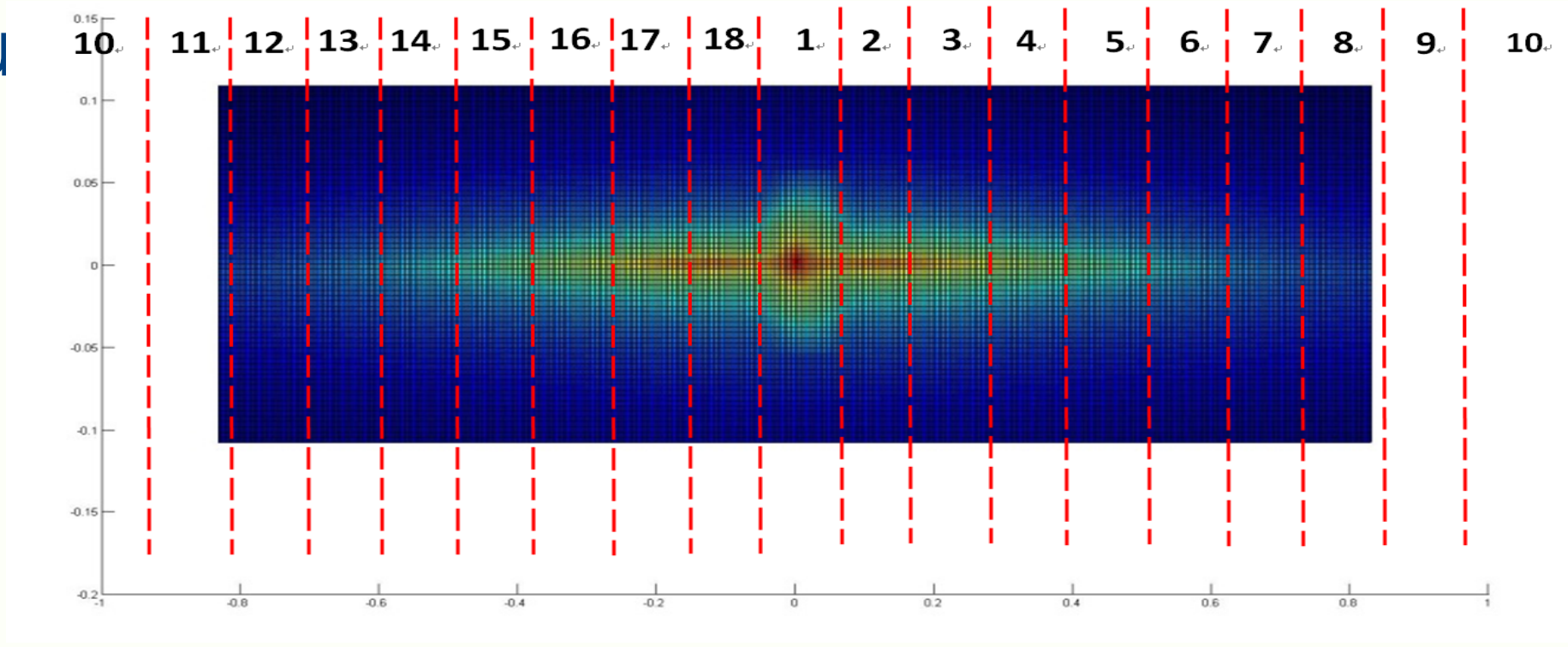
1st yr observation program: July, 2017



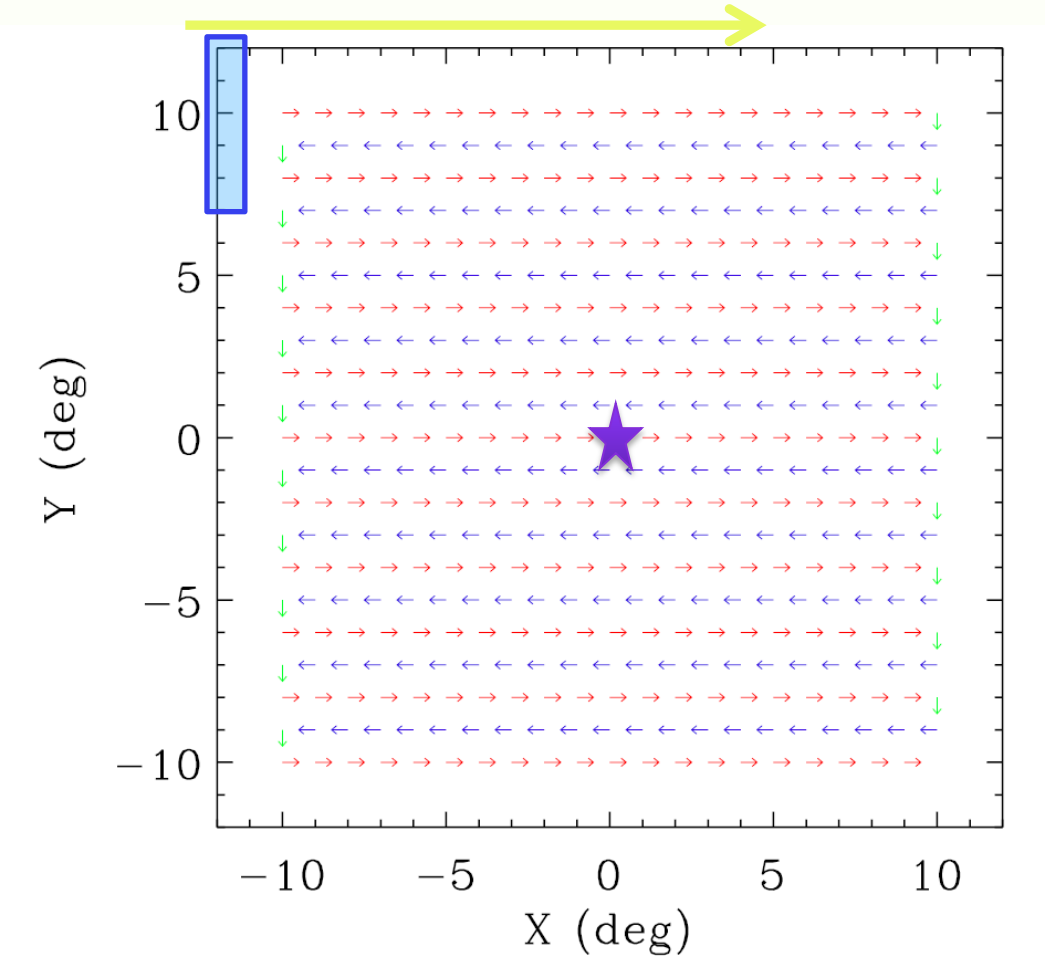
Most HXMT sources are visible from SA, but not from China!

HXMT scanning survey of the Milky Way

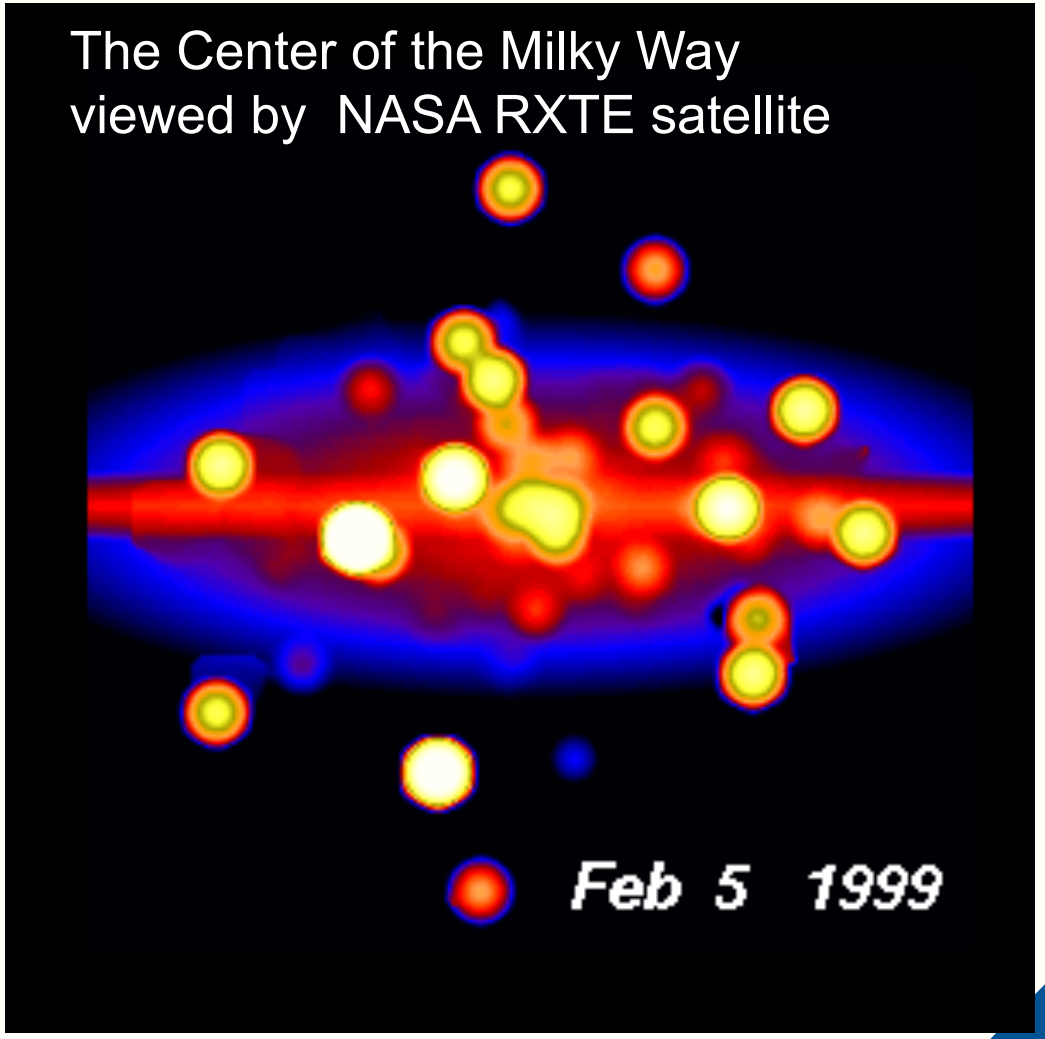
⊙Repeatedly scanning the whole Milky Way, to discover new variable black holes and neutron stars, and monitor activities of the known X-ray sou



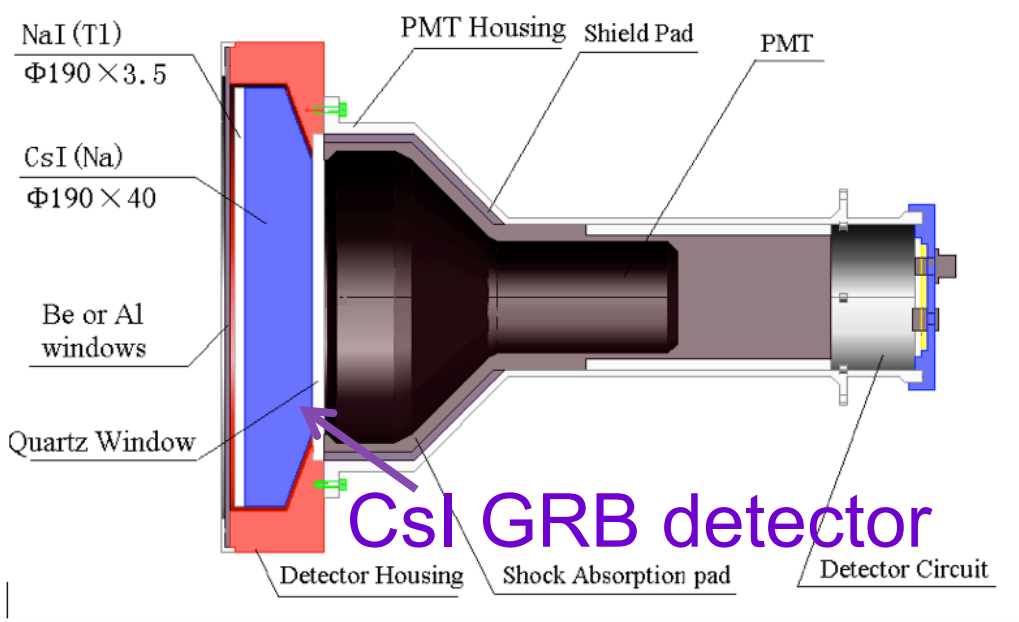
The Milky Way is highly variable in X-ray eyes!



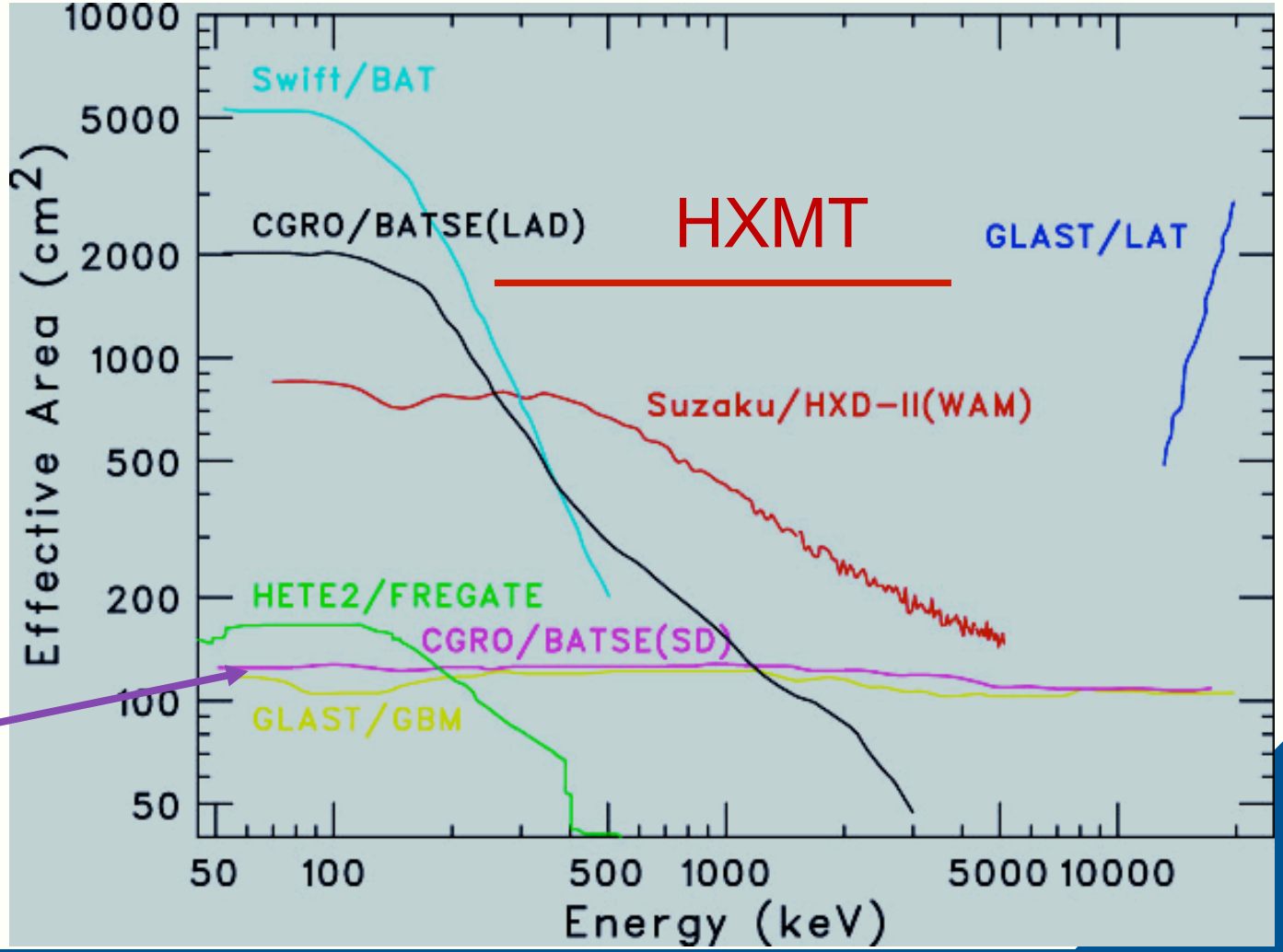
HXMT scan mode



HXMT's new capability: GRBs



The most sensitive in soft gamma-rays (MeV), 10X larger than GBM on-board Fermi satellite.



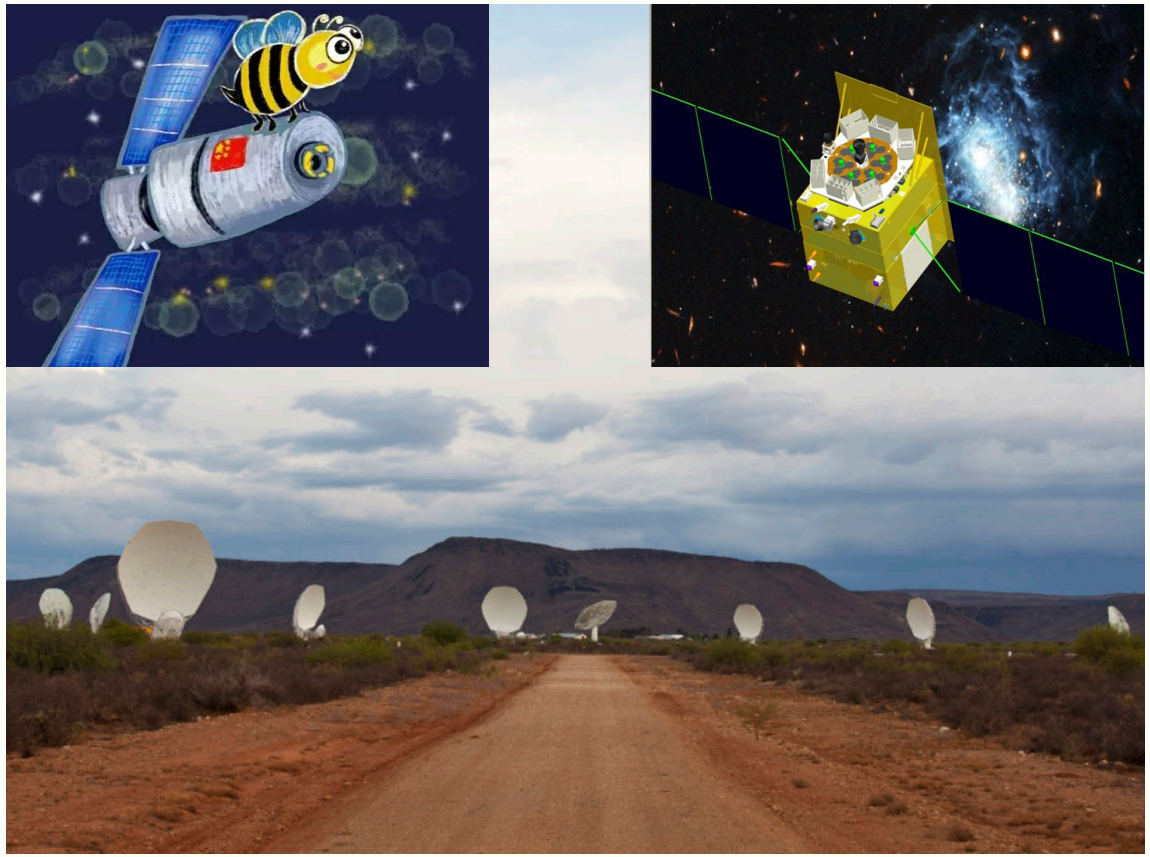
Comparison of the two GRB detectors

	HXMT satellite	TG-2 POLAR
launch	2017	2016.09
Field of View	~2/3 sky	~1/2 sky
Energy: keV	100-2000	50-500
Location	~10 deg	~5 deg
GRB Parameters	Energy Spectra	Polarization
Advantage	**γ-ray area**	**γ-ray pol.**
No. of GRBs	200/year	50/year

Unique advantages of HXMT&POLAR in detecting GRBs possibly associated with Gravitational wave bursts!

We are very lucky in this exciting era!

POLAR&HXMT need helps of MeerKAT&SALT!



Many thanks for your attention!