Background Simulations of WXT onboard Einstein Probe mission (EP)

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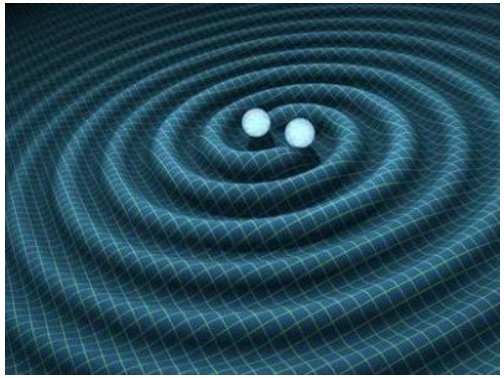
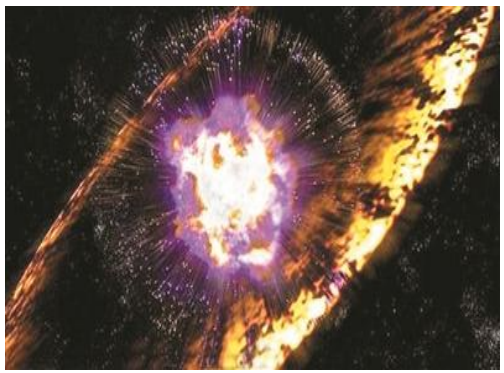
Scientific Objectives of EP



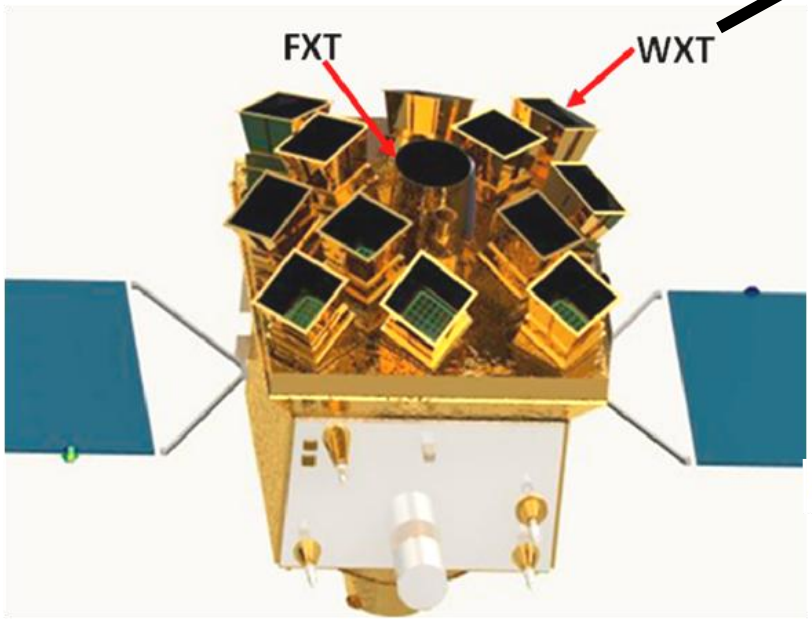


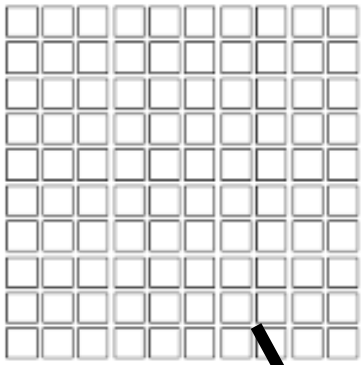
Approved: 2017, Launch Time: 2022

Low Earth orbit: **600-650 km**， Energy Range: **0.5-4 keV**

1. Detect **quiescent black holes** at almost all astrophysical mass scales by detecting transient X-ray flares.
2. Discover the X-ray photonic **counterparts of gravitational-wave** transients and precisely locate them.
3. Discover **faint X-ray transients**, such as high-z GRBs, supernova shock breakout, and new types of transients.

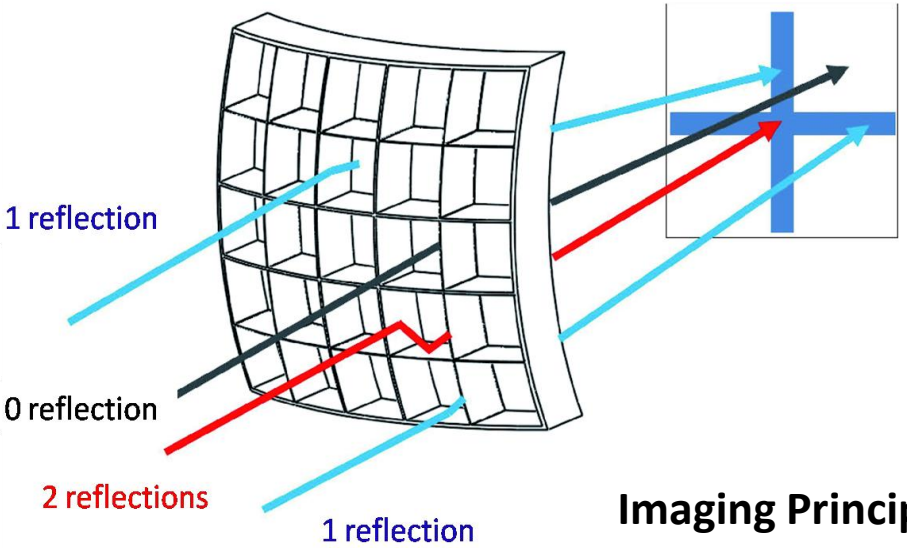
WXT and MPO





Lobster-eye Optics

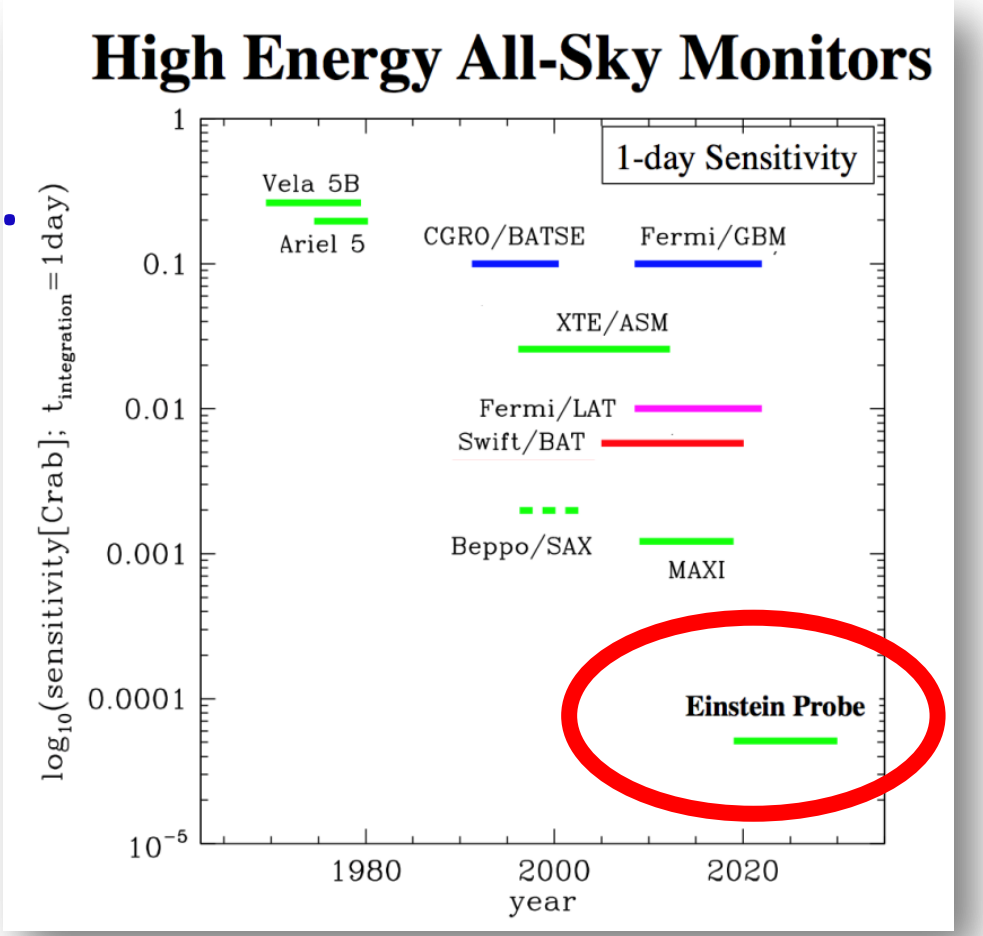
Micro Pores



Imaging Principle

Characteristics of WXT

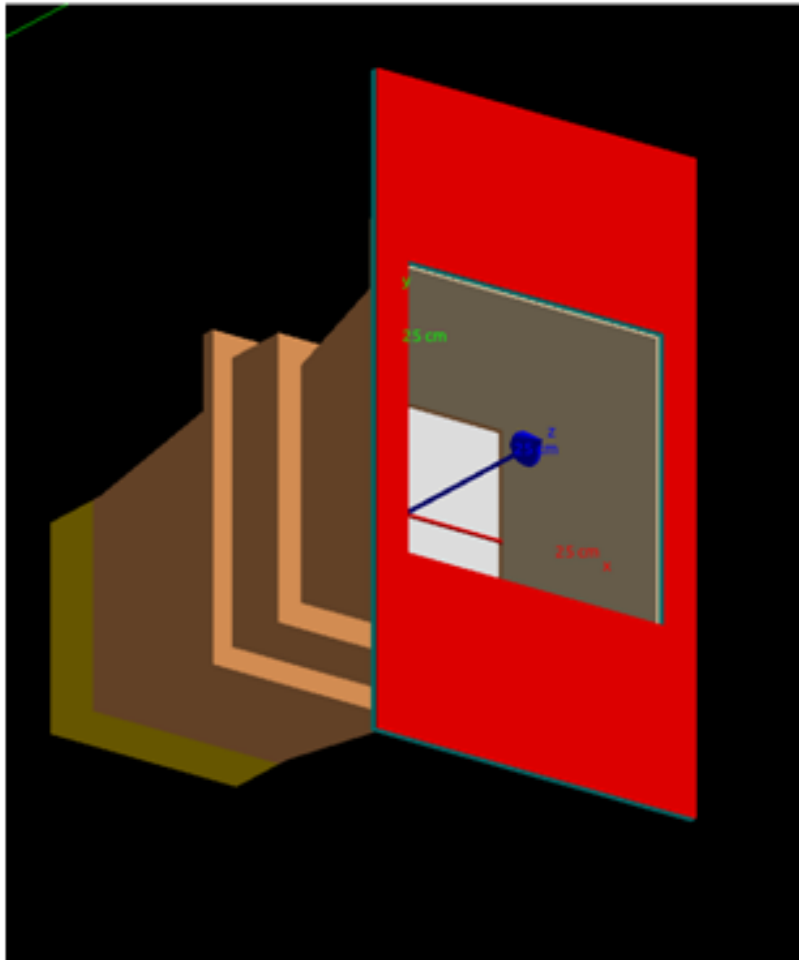
- Focusing telescope
- Largest FOV： >**3600 sqr.deg.**
- **most sensitive** all-sky monitor
- Focal length： **375 mm**

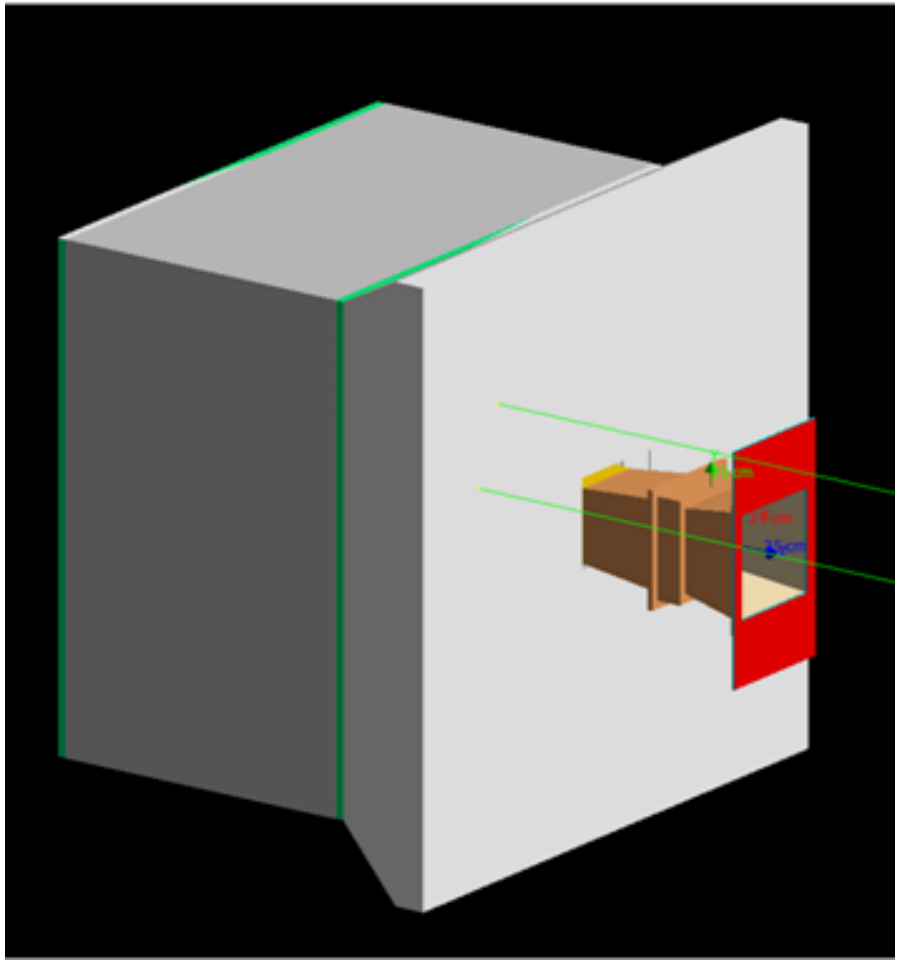


Background Simulations

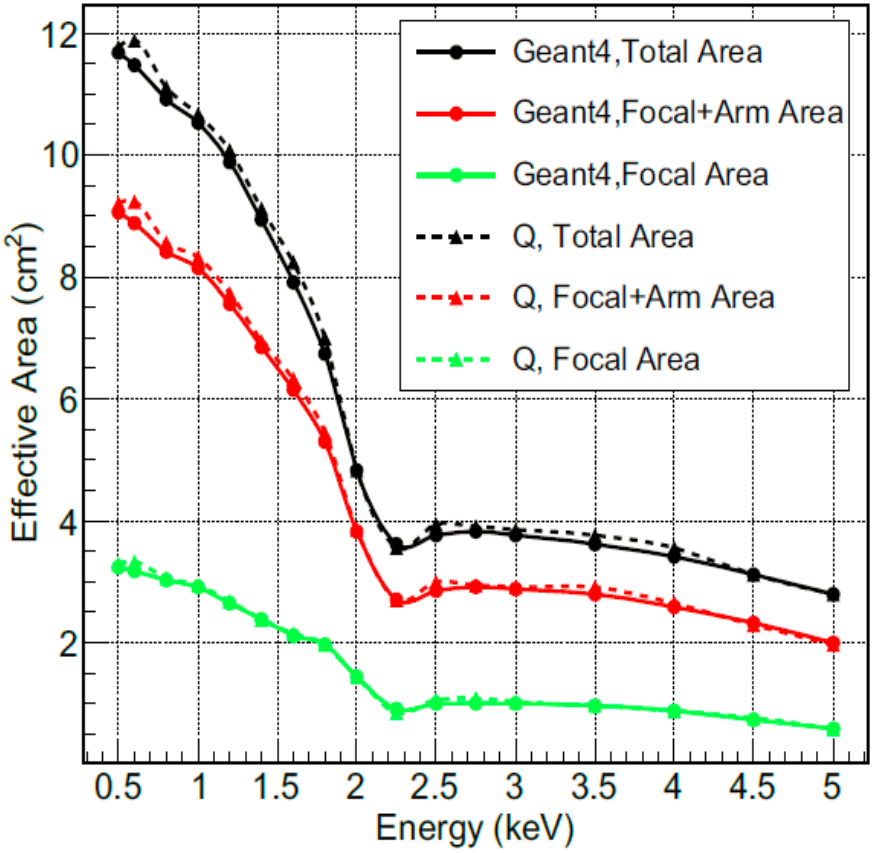
- Geant4: Build up WXT model, Set up physical processes
- X-ray background simulations
- Particle background simulations
- Other background sources

WXT model with Geant4





X-ray grazing scattering



Crucial process to simulate X-ray focusing.

Geant4 **does not** include this process.

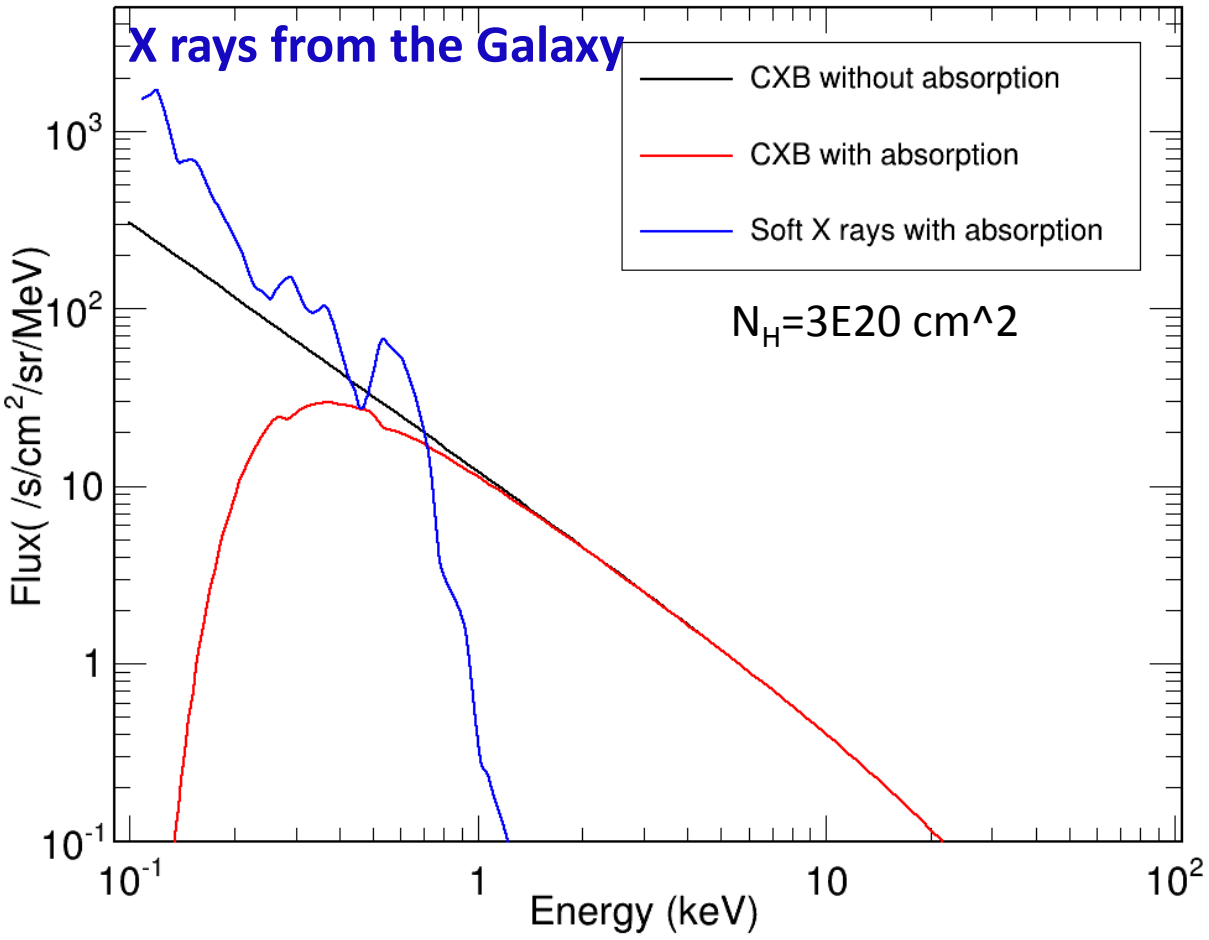
◆**XRTG4:** Buis and Vacanti 2009.

◆ **Q software:** Richard Willingale at Leicester Univ.

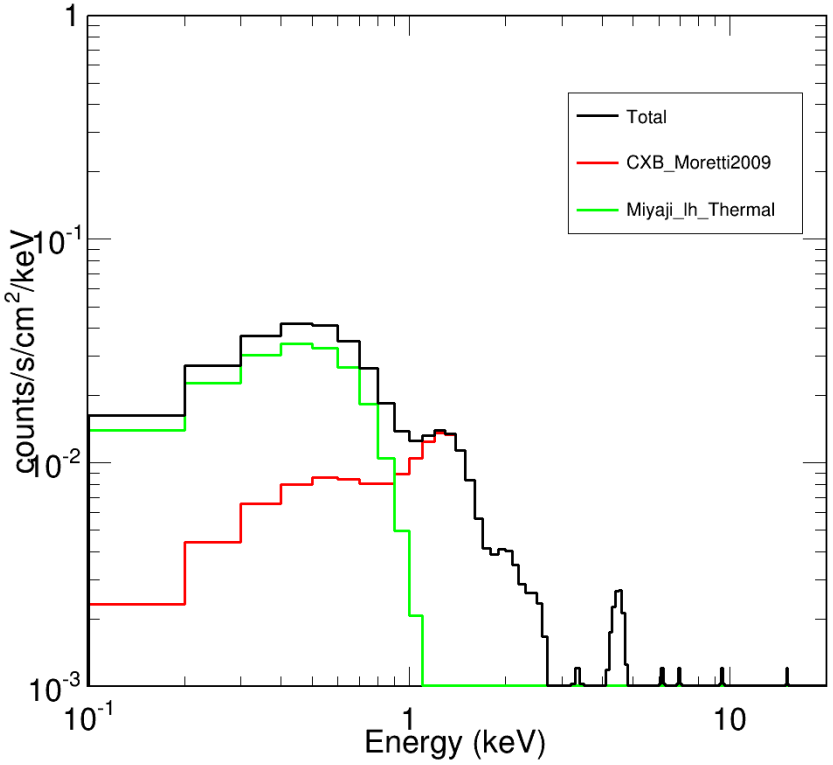
◆ Results from Geant4 and Q agree well with each other.

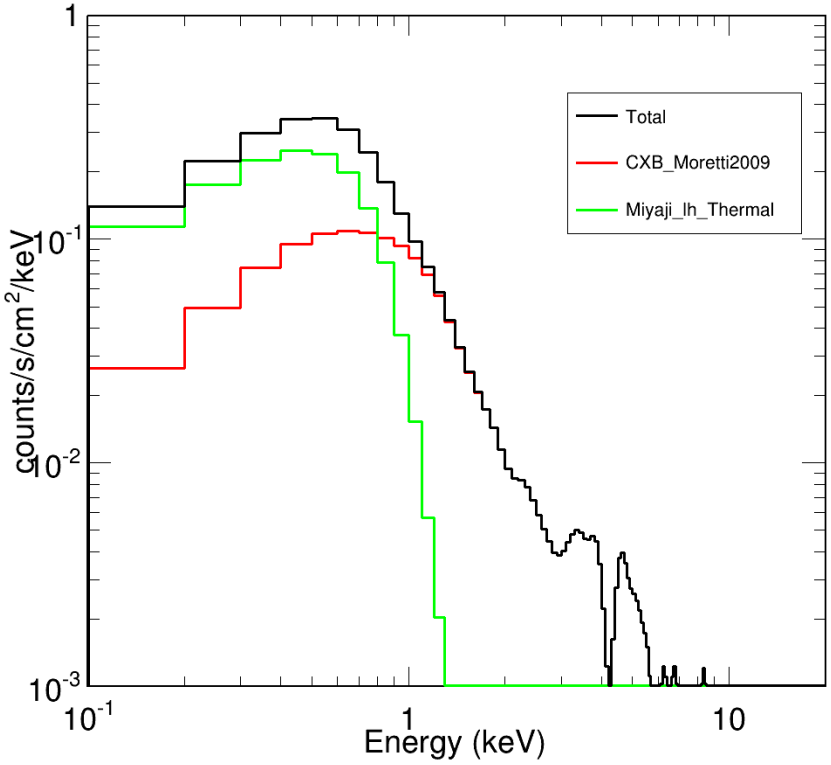
Zhao, et al., 2017

X-ray background sources



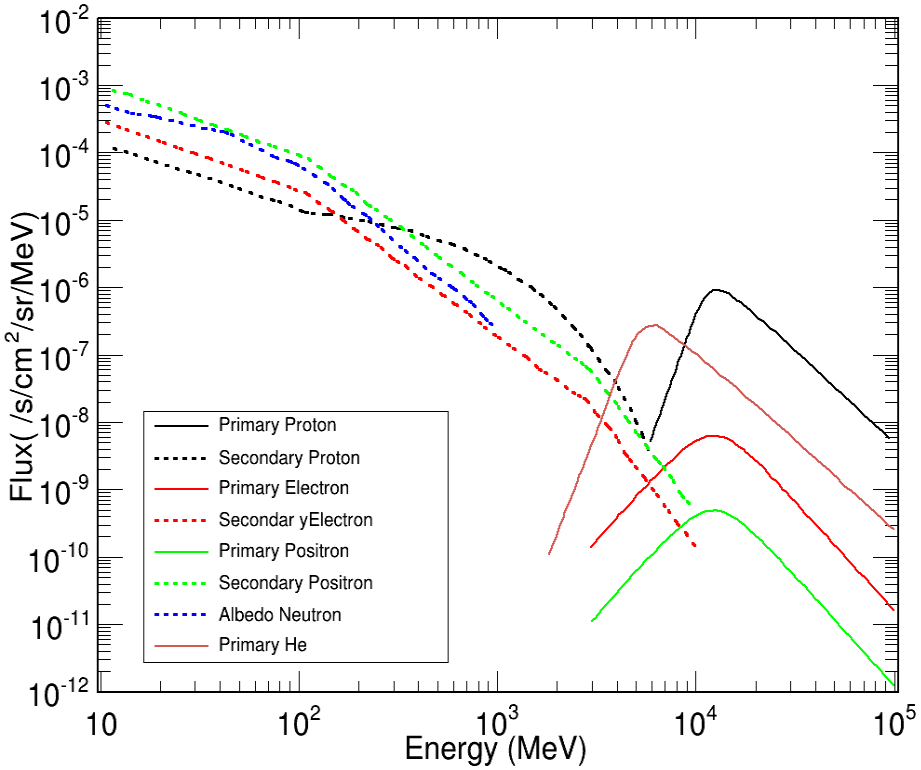
Impact of grazing scattering

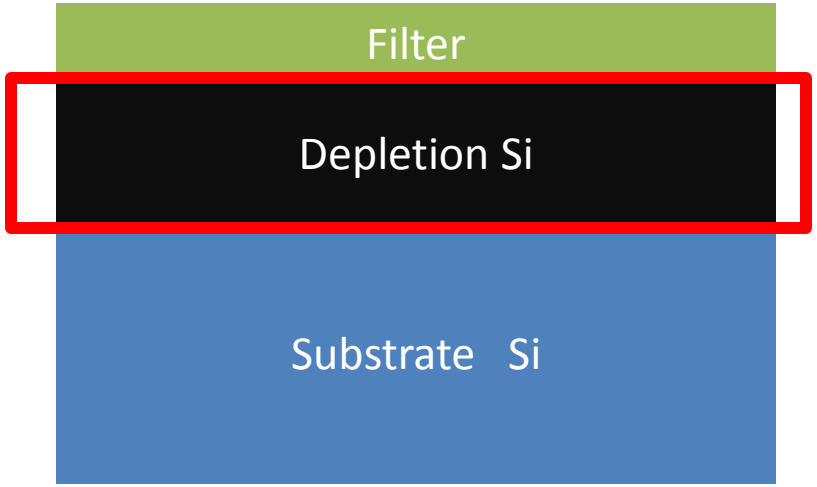




Physics process	Energy range	X rays
No grazing scattering	0.5-4keV	**0.027**
With grazing scattering	0.5-4keV	**0.173**

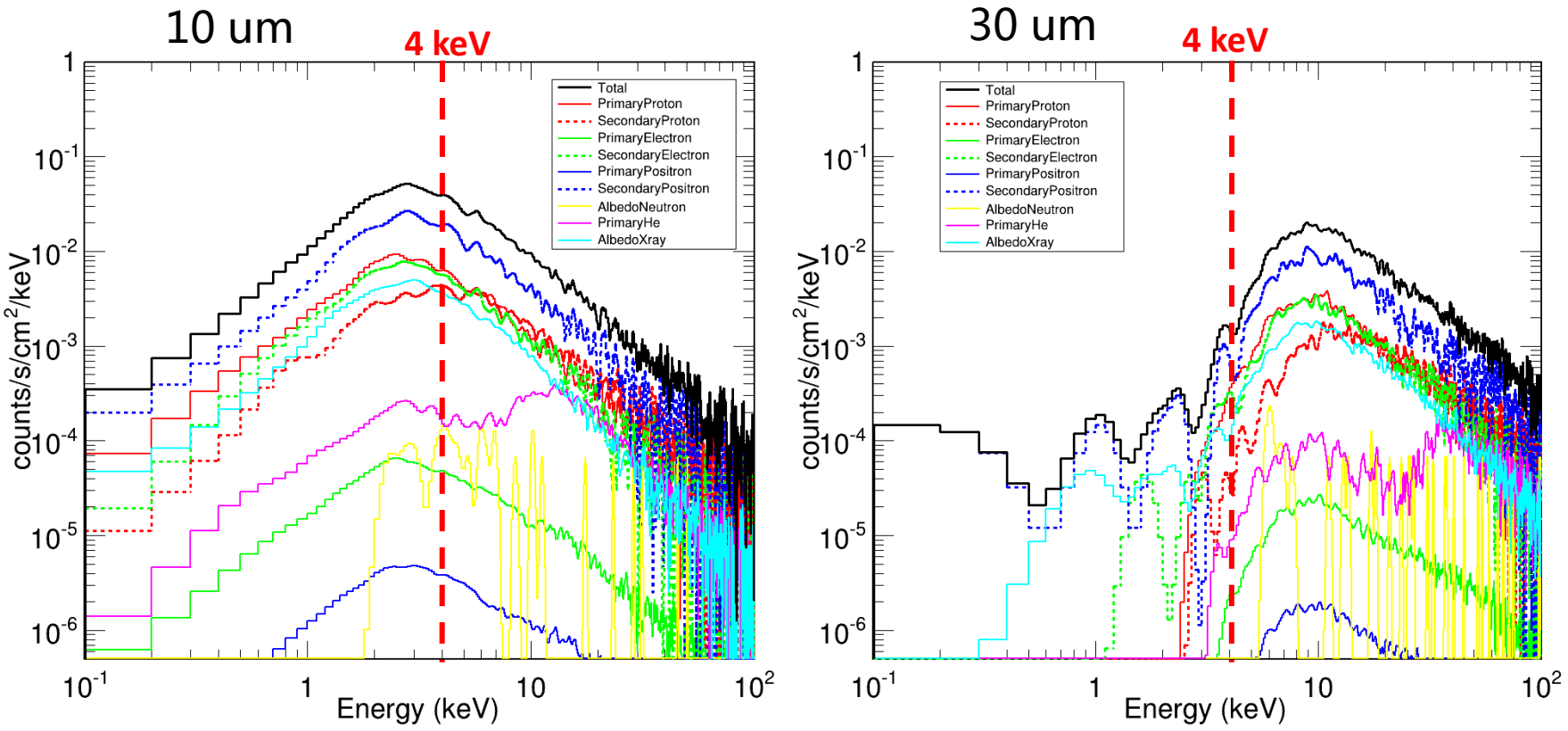
Particle background sources





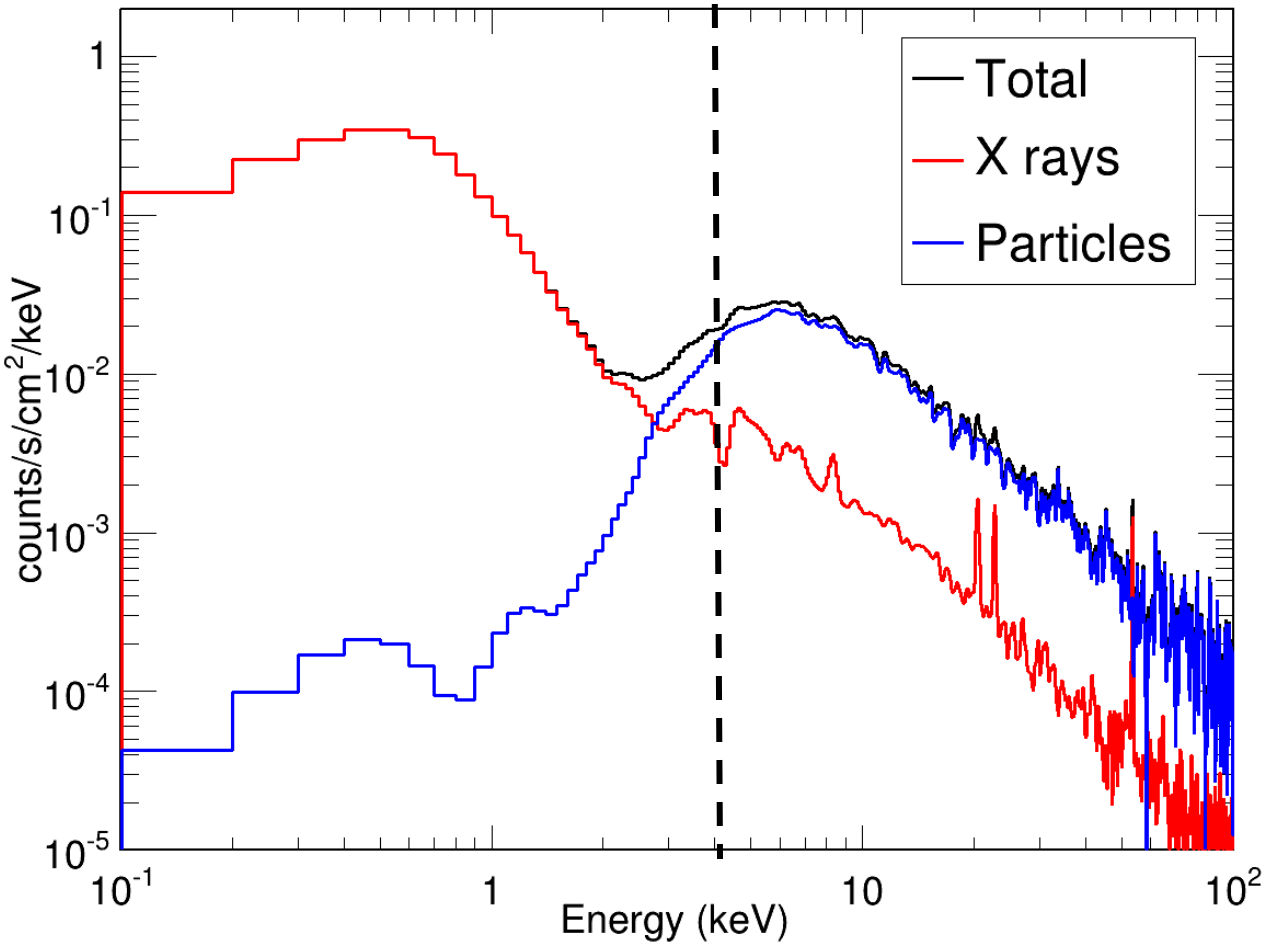
CMOS structure

Impact of detector thickness



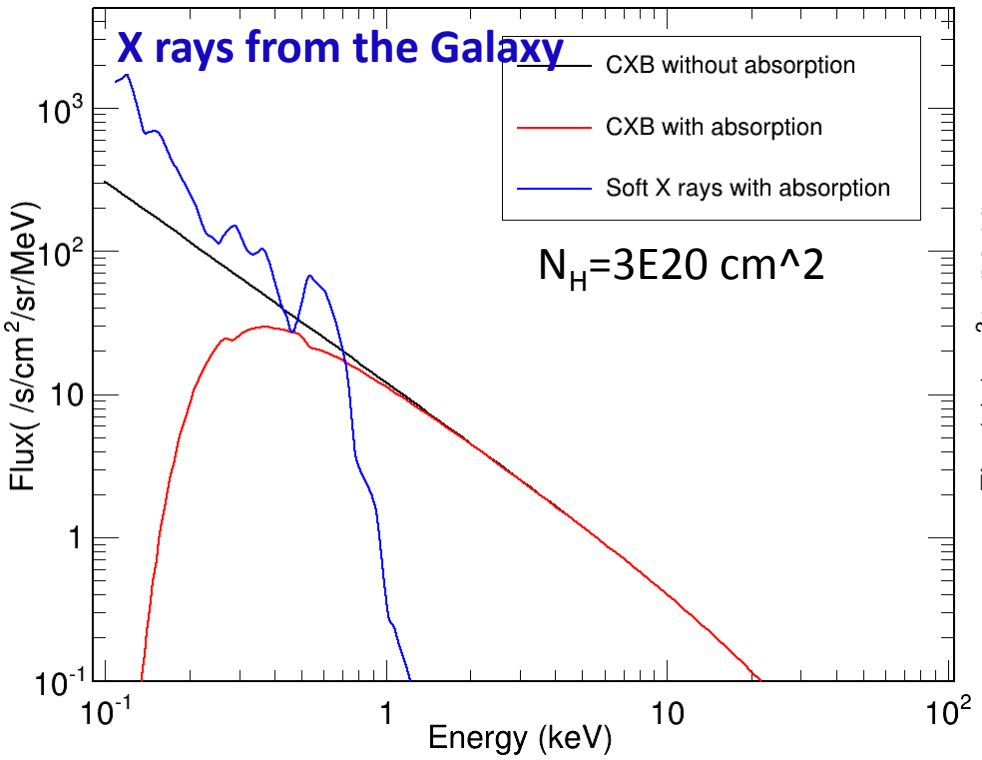
Thickness	X rays	**Particles**	Total(cts/s/cm^2)
10 um	0.180	**0.108 (37 %)**	**0.288**
30 um	0.156	**0.001 (0.4%)**	**0.157**

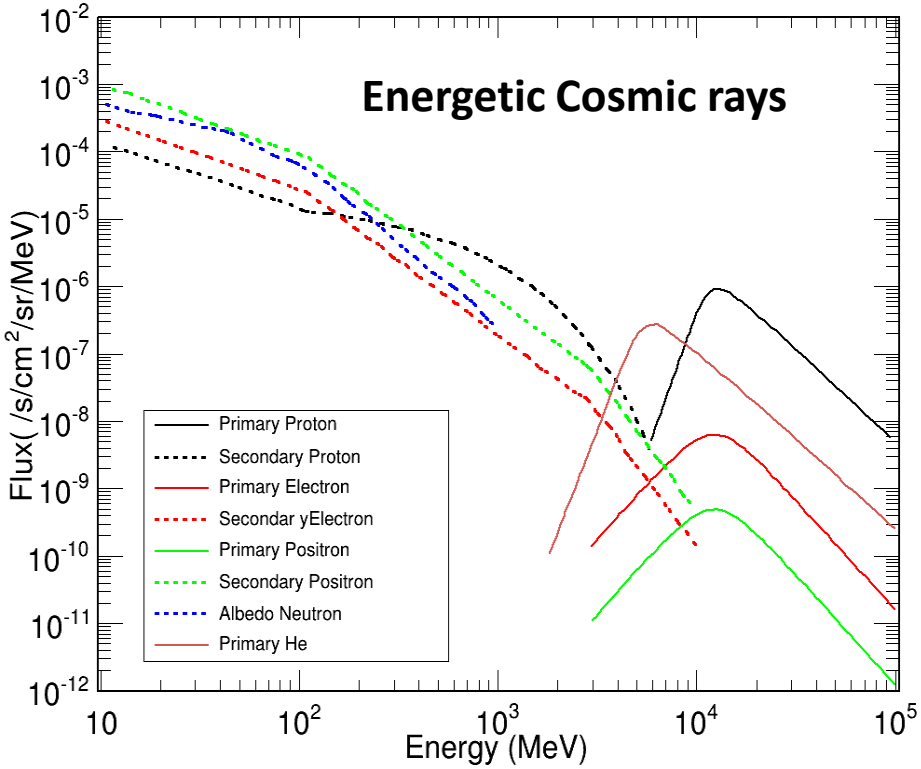
WXT background



20 um CMOS: ~0.2 cts/s/cm^2

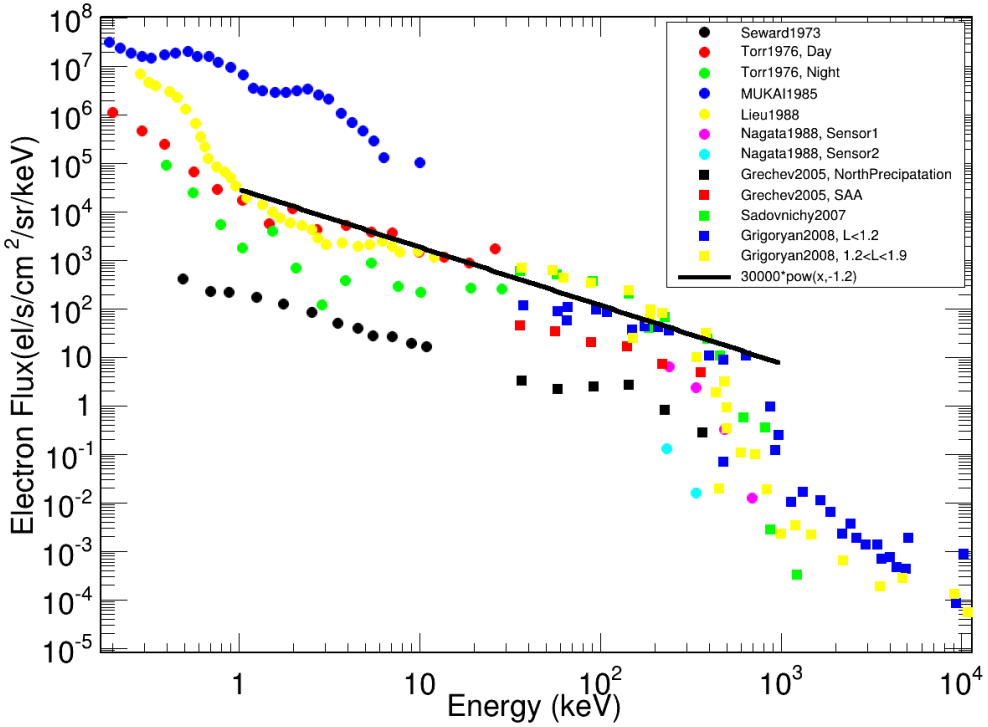
Other background sources





Low-Energy Electrons

High flux， Large fluctuation



20 counts/s/cm2

↓

Magnetic diverter

↓

<0.1 counts/s/cm2

↓

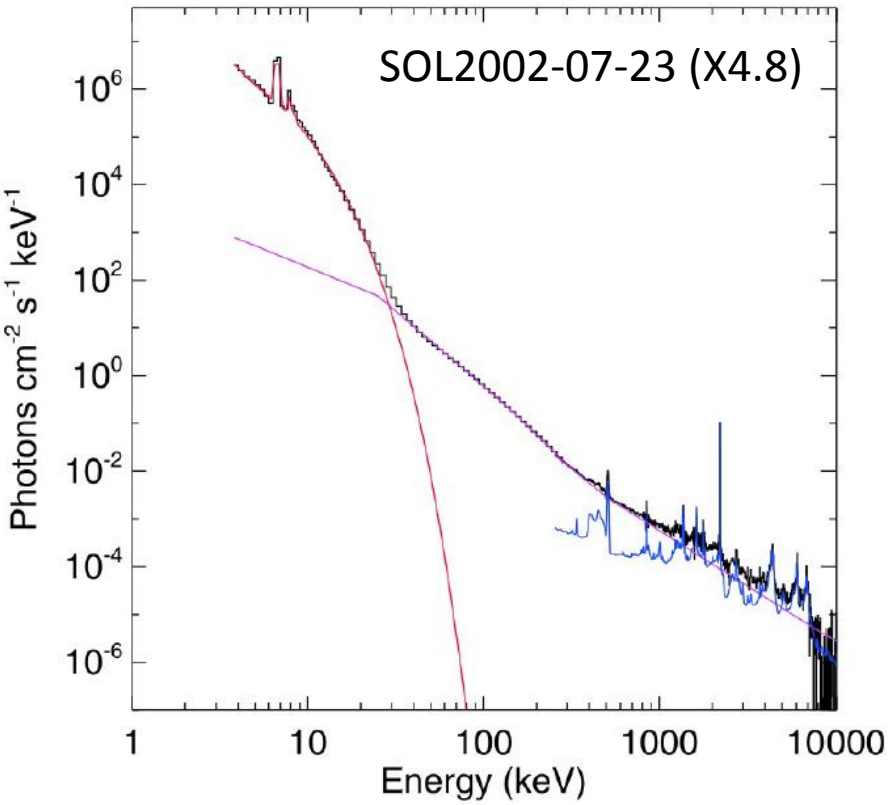
To block 98% of e- in 300-1000 keV

Energy Range	1-3 keV	3-300 keV	300-1000 keV
Contribution (%)	0	71.3	28.7

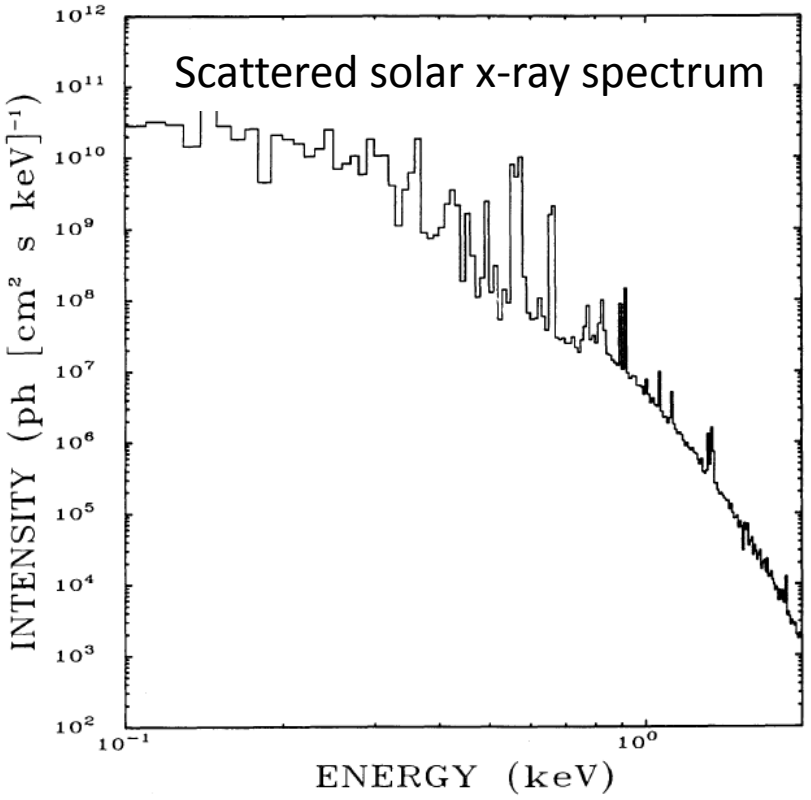
Diverter is optimizing.

Final e- contribution is under studies.

Solar X rays



R.P. Lin 2011



S.L. Snowden 1993

Further Work

- Background changing with satellite orientation and position on the orbit.
- Other sources that may contribute significant background.
- Calibrate the background with simulation data.

THANK YOU

Your comments and suggestions are welcome ！

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Backup Slide

PSF and effective area of WXT