The impact of low-energy electrons on EP-WXT based on Geant4 simulations

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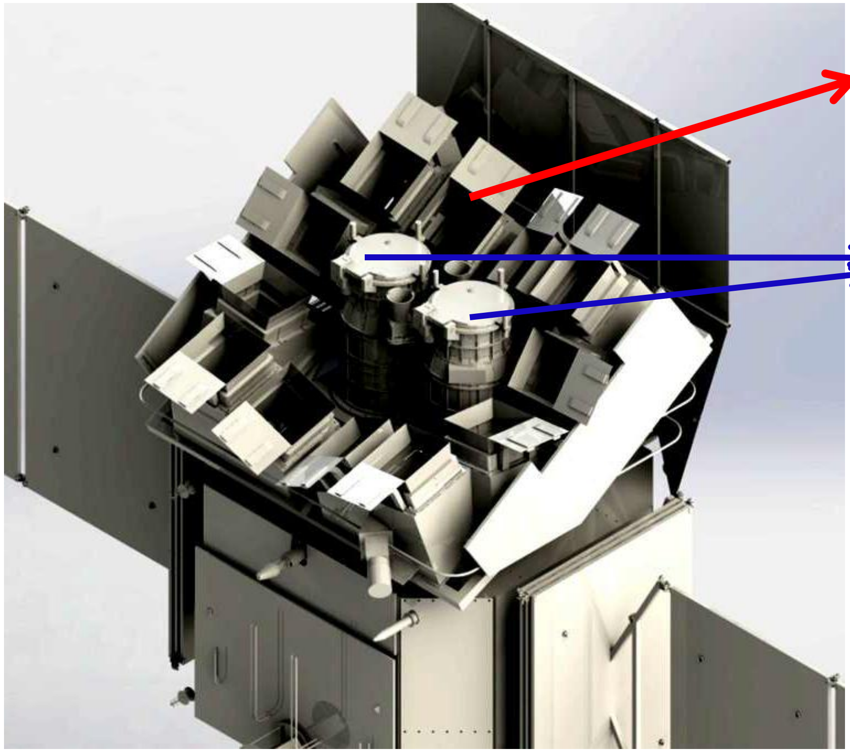
Outline

1. EP mission
2. Low energy electrons
3. Results of electron detections in EP-WXT
4. Magnetic diverter
5. Conclusion and further studies

Einstein Probe (EP)



WXT: Wide-Filed X-ray Telescope,

Lobster-eye Optics， 0.5 -4 keV

FXT: Follow-up X-ray telescope,

Wolter I Optics， 0.3-10 keV

Launch Time: **2022**

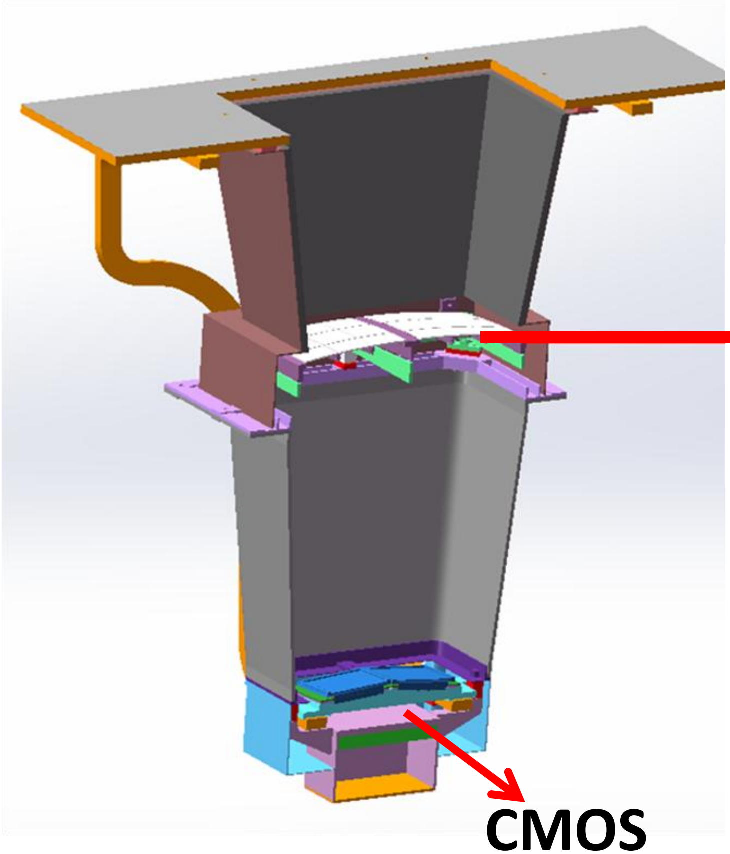
Altitude : **600 km**

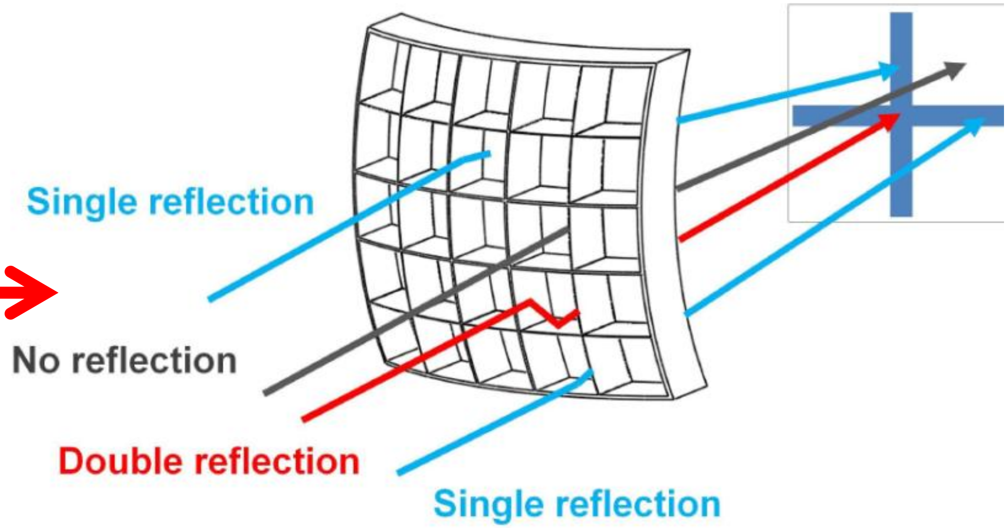
Inclination: **29°**

Objectives：

1. To survey the soft X-ray sky
2. To detect **TDEs** and quiescent **black holes**
3. To discover the EM counterparts of **GWEs** and locate them.

EP payload——WXT

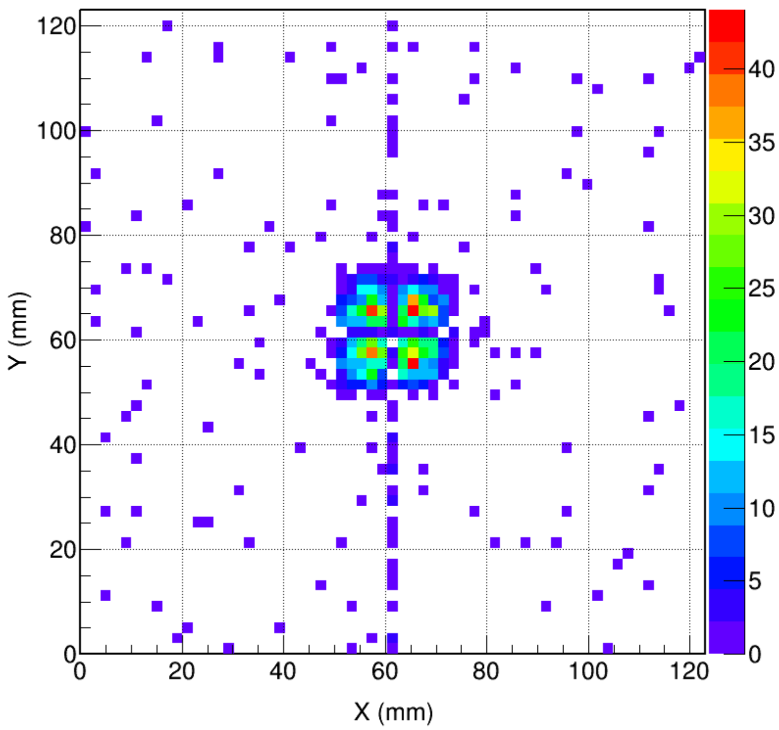


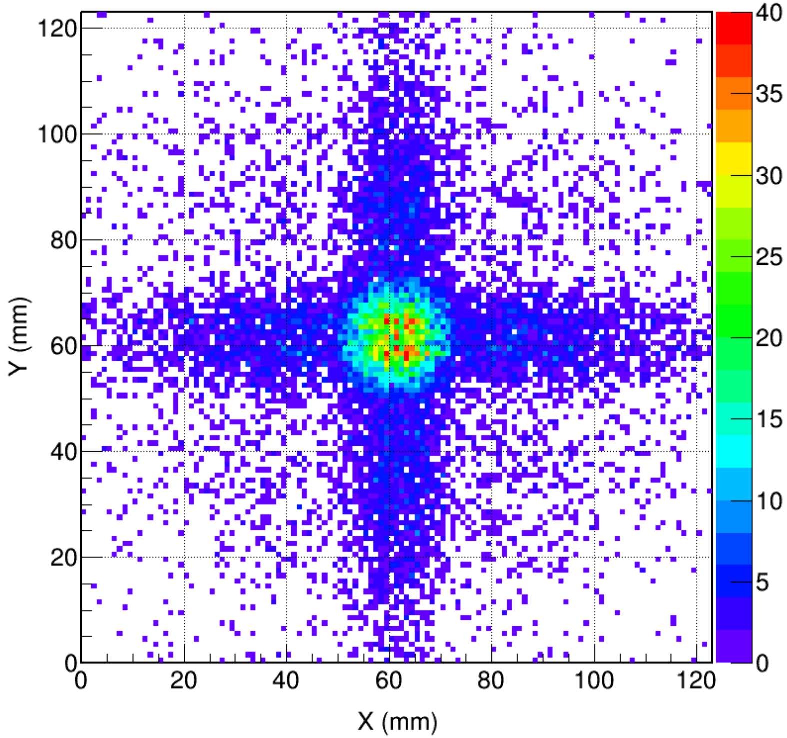


Micro-Pore lobster-eye Optics

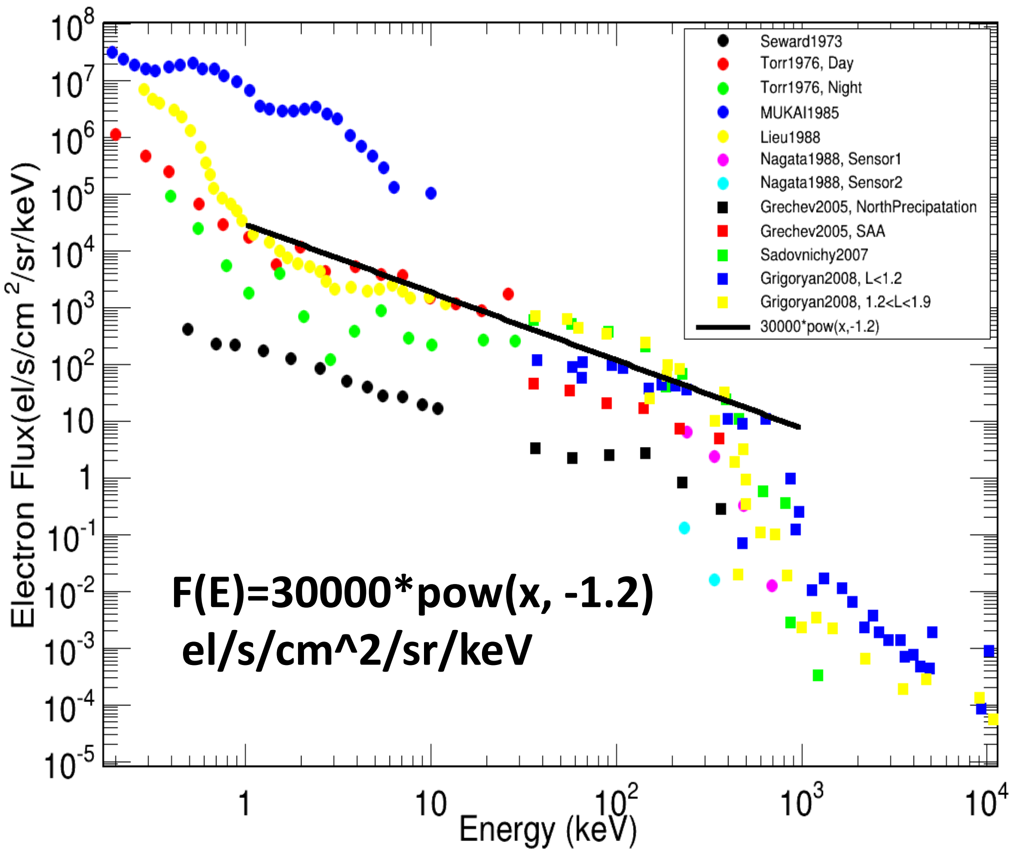
Low mass, large FOV

Concentration of e- in WXT





Low-Energy Electrons <1 MeV



Nagata 1988:
Ground-based radio-transmitters

Kuznetsov and Myagkova 2002:
Global thunderstorms activity

High flux, Large fluctuation

Firsov Scattering Model

Firsov 1967:

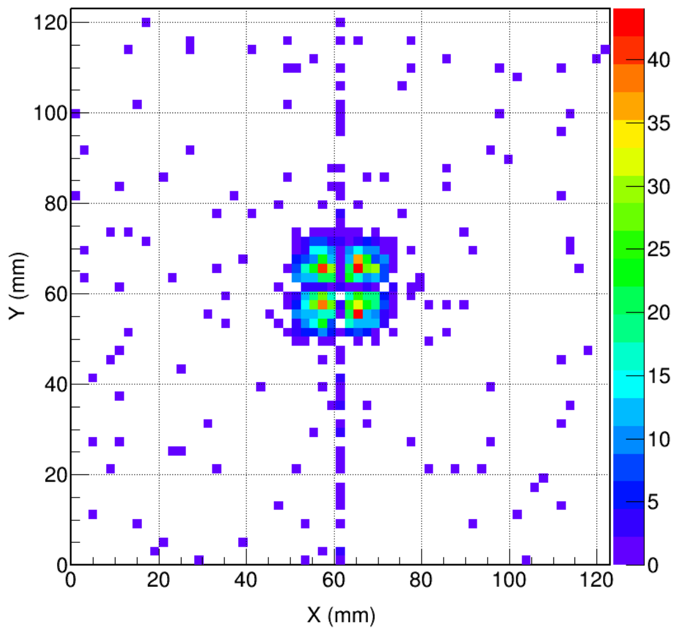
$$N(\phi, \theta) = \frac{3}{2\pi\phi} \frac{(\phi\theta)^{3/2}}{(\phi^3 + \theta^3)}$$

Φ：incident angle，ϑ：reflection angle

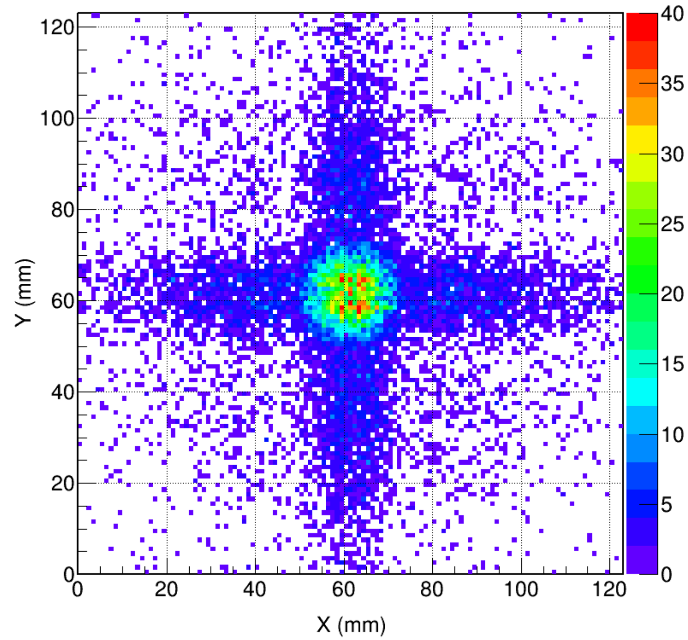
Fan Lei et al. 2004：　G4FirsovScattering

e- through WXT optics

MSC



G4FirsovScattering



Process	Spectrum 1	Spectrum 2
MSC	7.2	4.1
Firsov1deg	**17**	**9.4**
Firsov10deg	64.7	32.3

WXT 's background due to e-

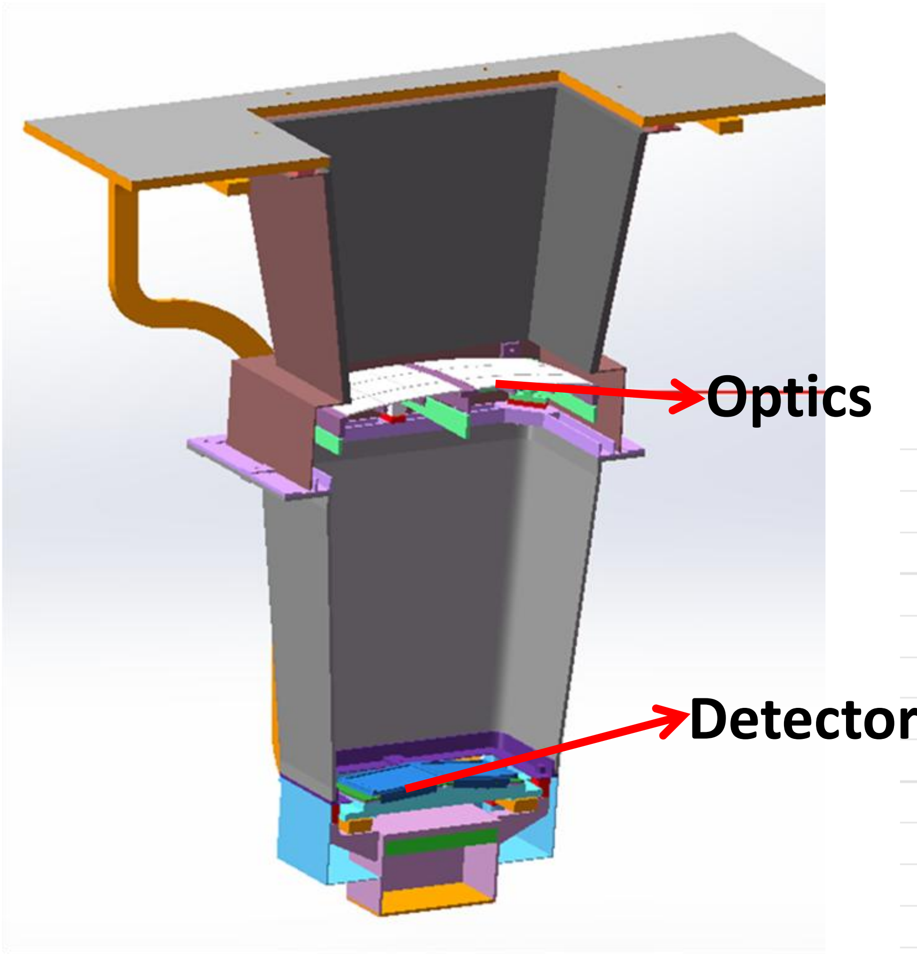
物理模型	Leicester model		New model	
	cts/s/WXT	cts/s/cm^2	cts/s/WXT	cts/s/cm^2
Firsov1deg	6810	**45**	2708	**18**

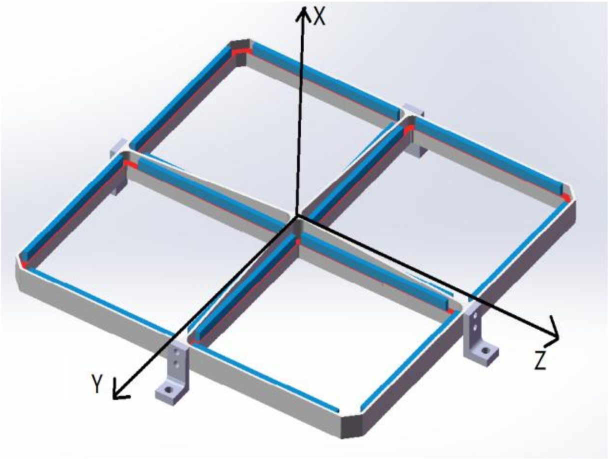
Other Background (CXB and cosmic rays)) : **0.2** cts/s/cm^2

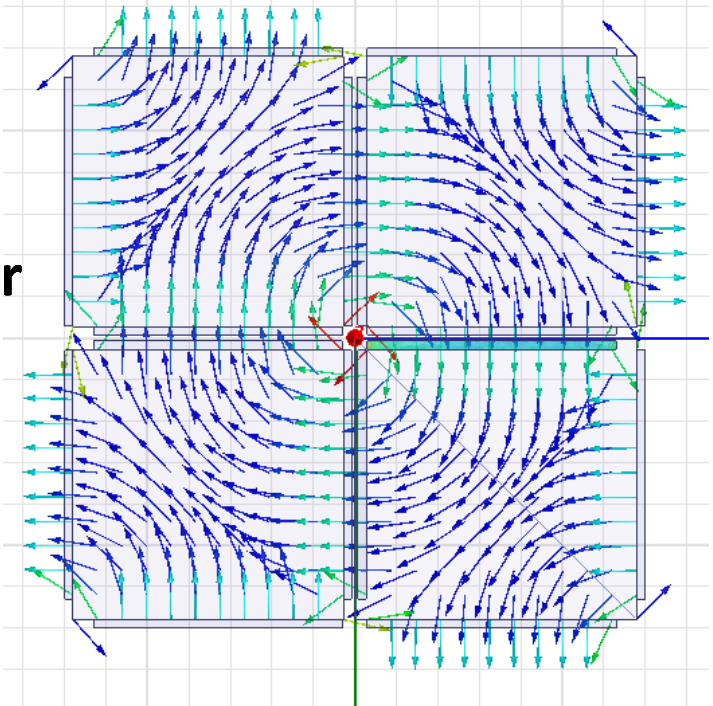
物理模型	1-3 keV	3-150 keV	150-300 keV	300-1000 keV
Leicester model	0	78.9%	0.3%	20.8%
New model	0	70.4%	0.9%	28.7%

~96% of e- at 300-1000 keV need to be deflected to reduce the e- background to 0.2 cts/s/cm^2.

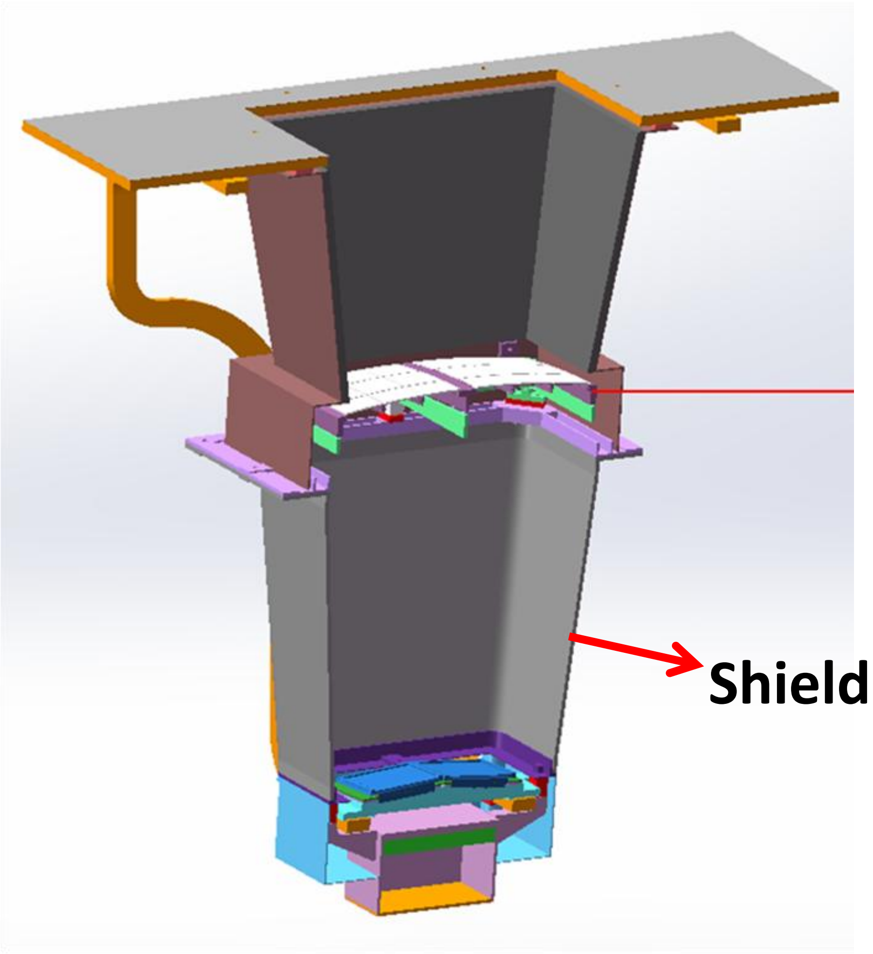
Magnetic diverter

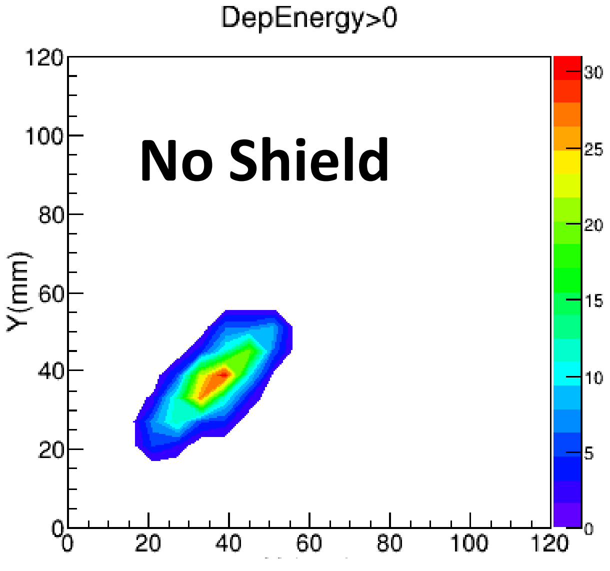


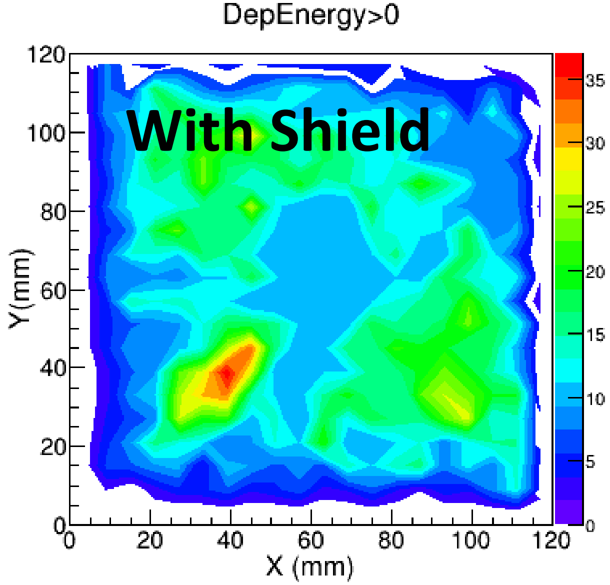




A problem of the shield







Impact of different shield materials

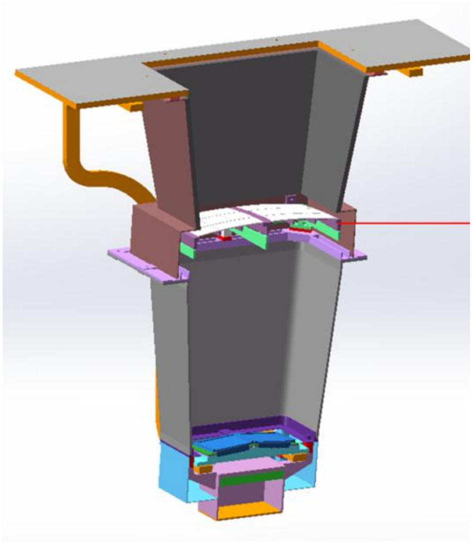
The percentage(％)of e- at 300-1000 keV that are detected
in different deposit energy range.

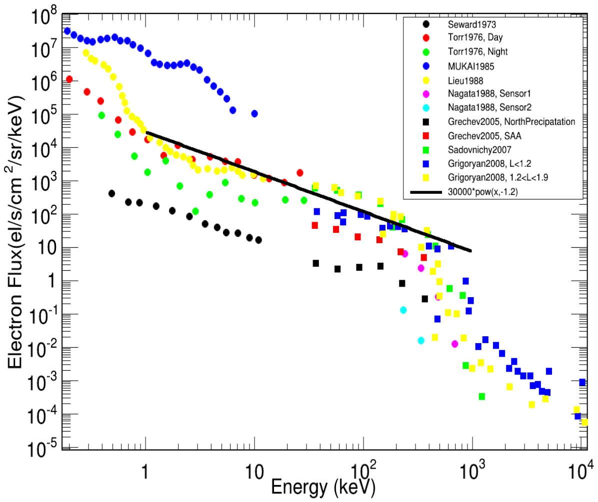
Shield Materila	0.5<En<6 keV	0.5<En<8 keV	En>8keV	En>0
Cu 29	3.0	4.6	5.6	10.2
Al 13	2.4	4.0	4.4	8.4
C 6	2.2	3.7	4.4	8.1
No	1.4	1.7	0.5	2.2

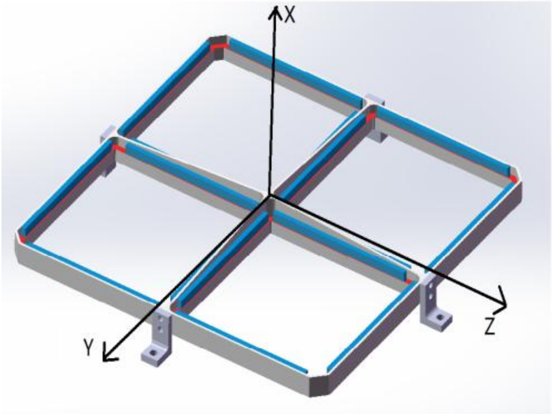
WXT Structure: No diverter → diverter → Diverter + Shield

Count Rate cts/s/cm^2: Tens → <0.01 → 0.1 ~1

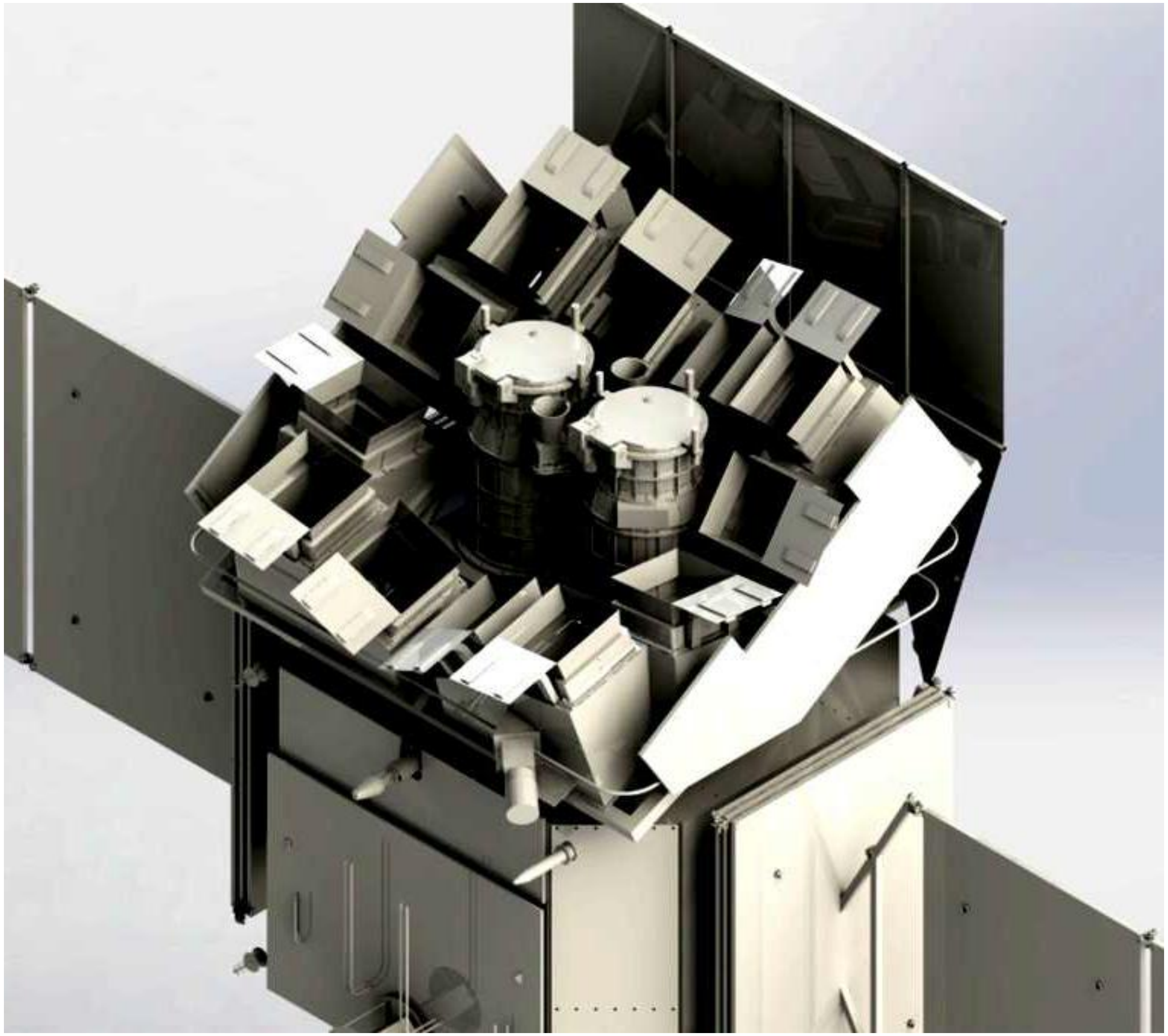
Conclusion and further studies







- Diverter can significantly reduce e- to an acceptable level
- To test the diverter deflection efficiency
- To test the shielding structure influence
- Further studies on e- impact with the diverter



Thank you for your attention