

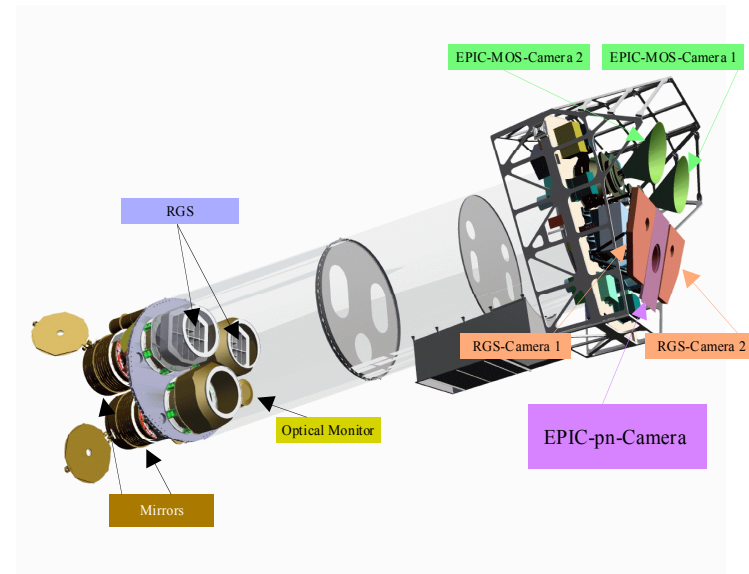
Evaluation of the capabilities of the XMM-Newton SciSim from the EPIC calibration point-of-view

Menu

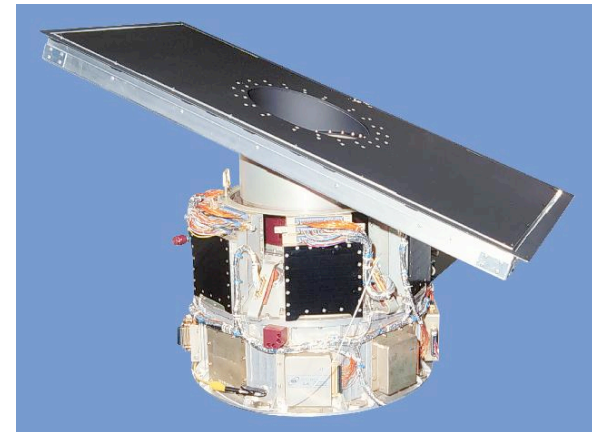
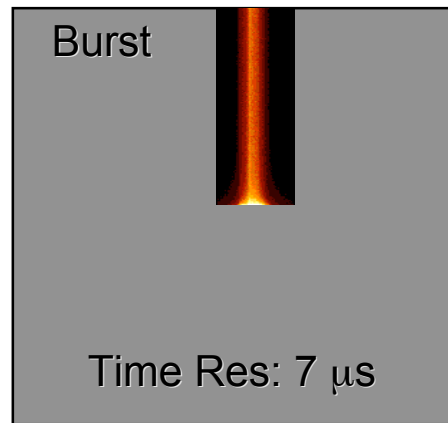
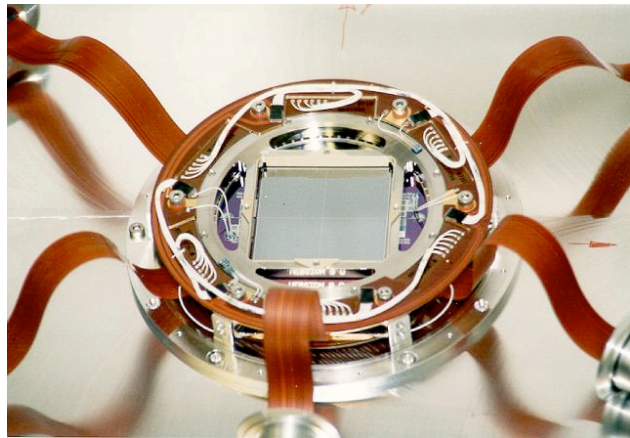
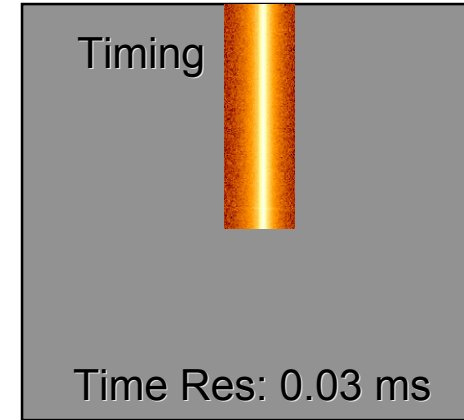
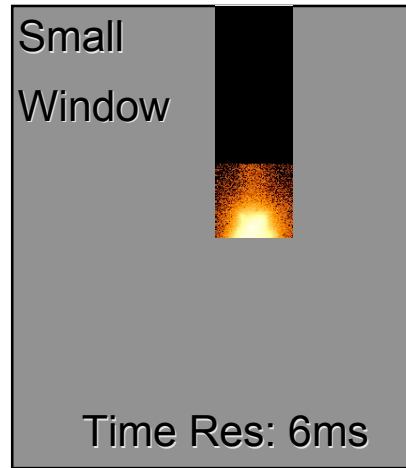
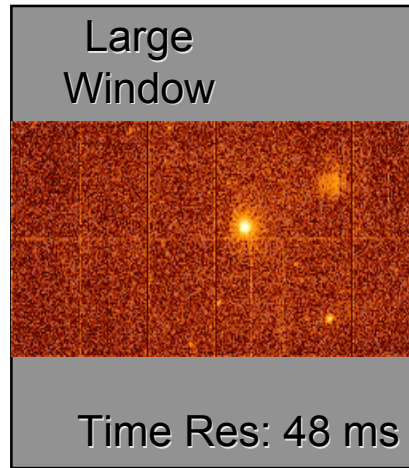
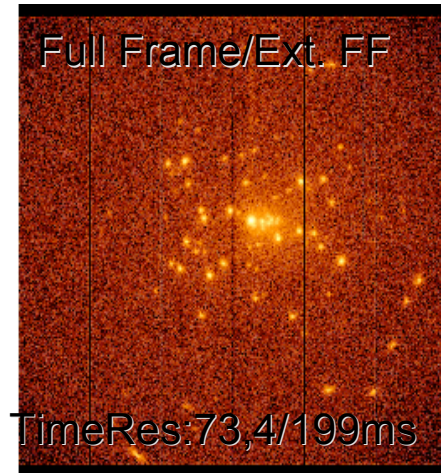
- XMM-Newton and EPIC
- SciSim
- Test
- Results
- Conclusion
- Outlook

XMM Newton

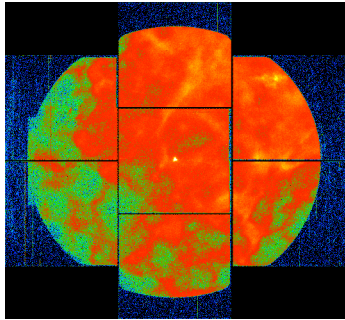
- Launched 10th December 1999 with Ariane Flight 504
- 48 hour high-eccentric orbit (HEO)
 - Apogee 114000 km
 - Perigee 7000 km
 - 40° inclination
 - Eccentricity 0.79
- Europe's X-ray observatory
- EPIC:
 - 3 independent CCD-cameras (2 MOS & 1 PN), observing simultaneously the same field
 - 3 different light filters for both camera types
 - different modes to accommodate brightness and timing



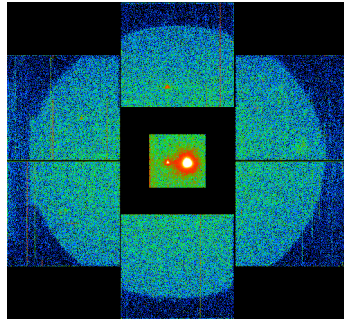
EPIC-pn and operating modes



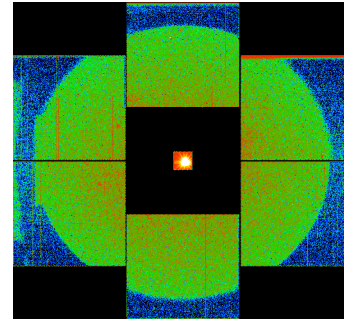
EPIC-MOS and operating modes



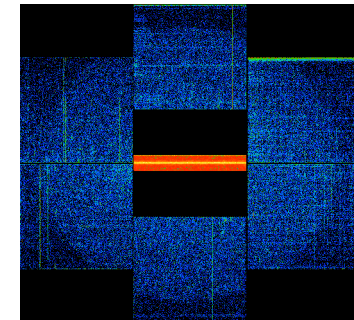
Full Frame
Time Res.:
2.6 s



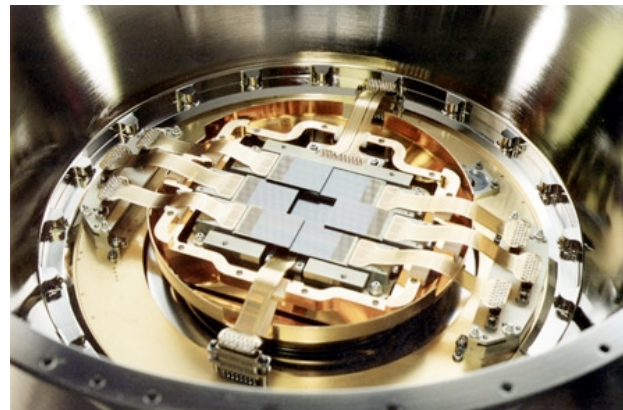
Large Window
Time Res:
0.9 s central CCD
2.7 s outer CCDs



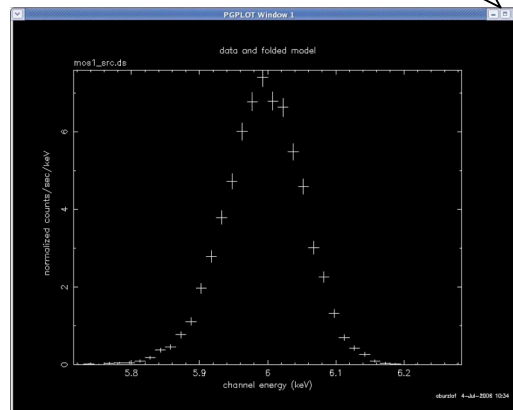
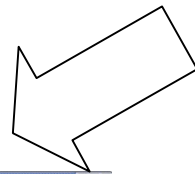
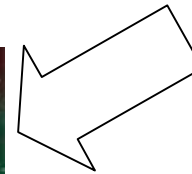
Small Window
Time Res.:
0.3 s central CCD
2.7 s outer CCDs



Timing
Time Res.:
1.8 ms central CCD
2.6 s outer CCDs



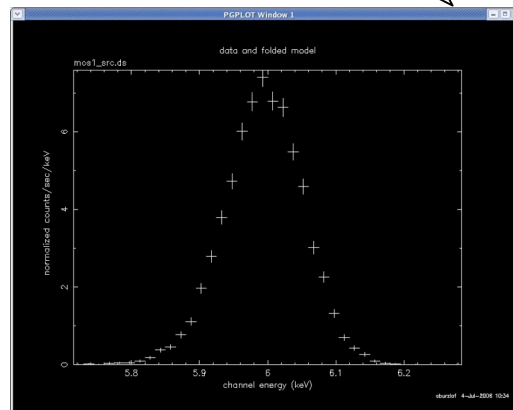
Reality



Simulation



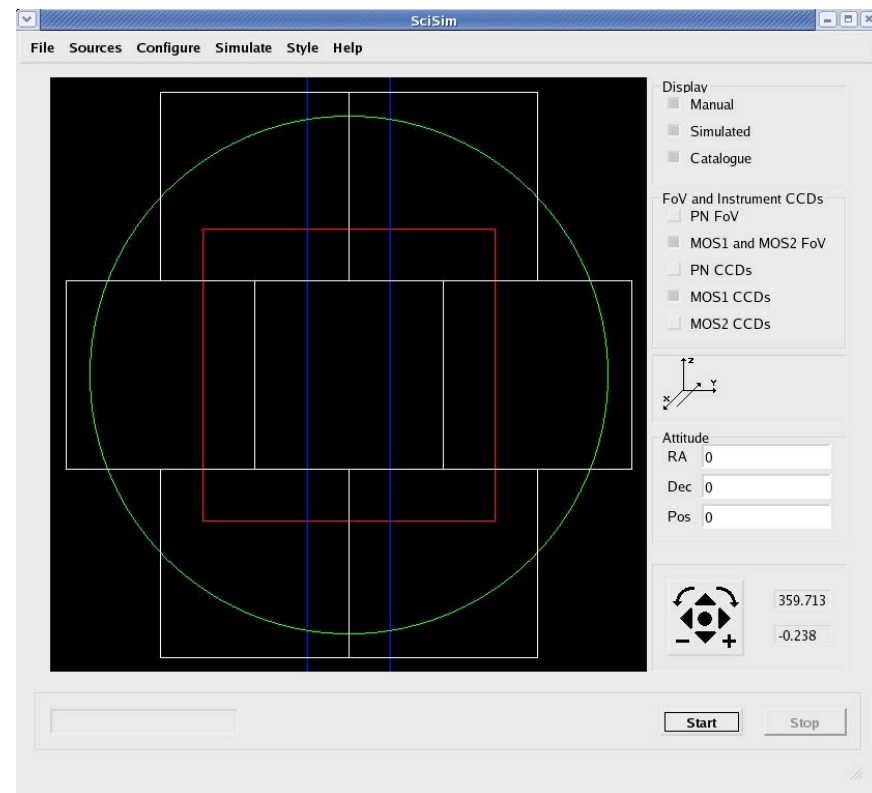
SciSim



The XMM-Newton Science Simulator

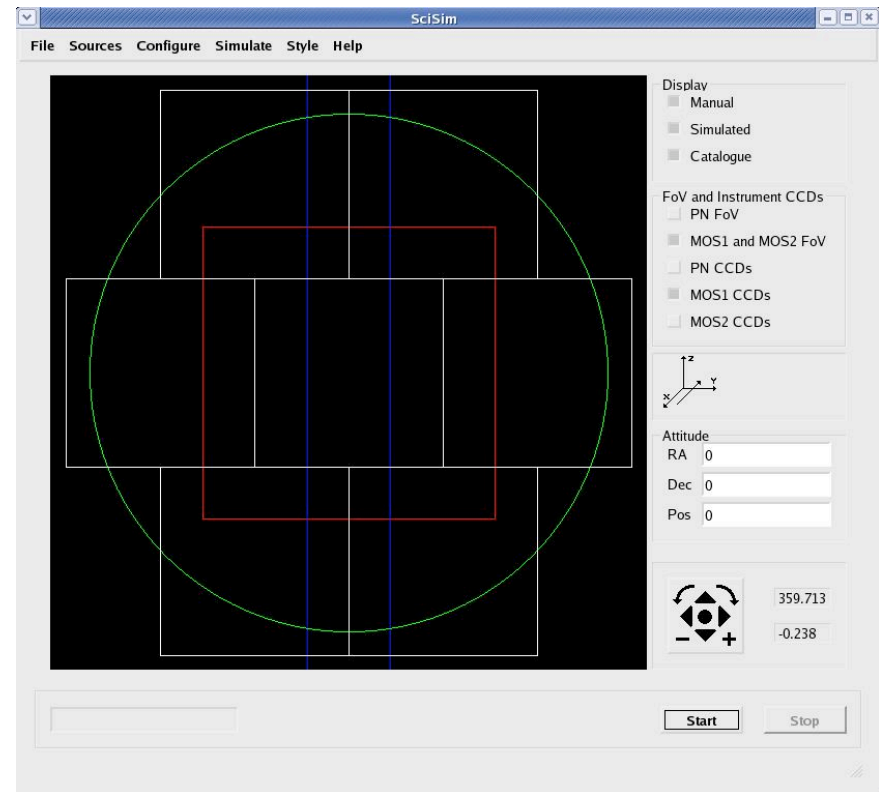
- Programmed before launch of XMM-Newton
- Capability to simulate
 - all instruments (EPIC, RGS, OM)
 - multiple sources with various energies and fluxes (manual input or catalogue data)
 - cameras with filters in all modes

SciSim Graphical User Interface



Tests

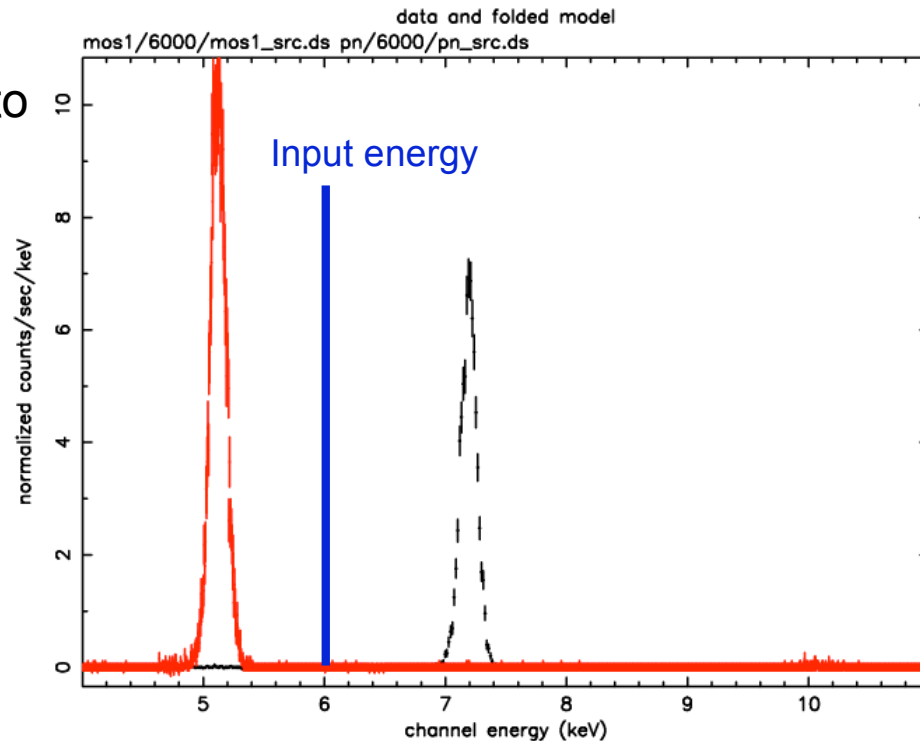
- EPIC-pn and EPIC MOS
- Monochromatic light
 - Various Energies
 - Various Rates
 - Different CCD positions
- PSF
- Automatic runs by perl- and shell scripts
- Data processing with SciSim-CCFs and public CCFs



Example of monochromatic line at 6 keV

- Input data:
 - x-ray flux $2 \cdot 10^{-5}$ photons/cm²/s
 - background flux 0.005 photons/cm²/s
 - integration time 4000s
 - input energy from 0.5 keV to 10 keV in steps of 0.5 keV

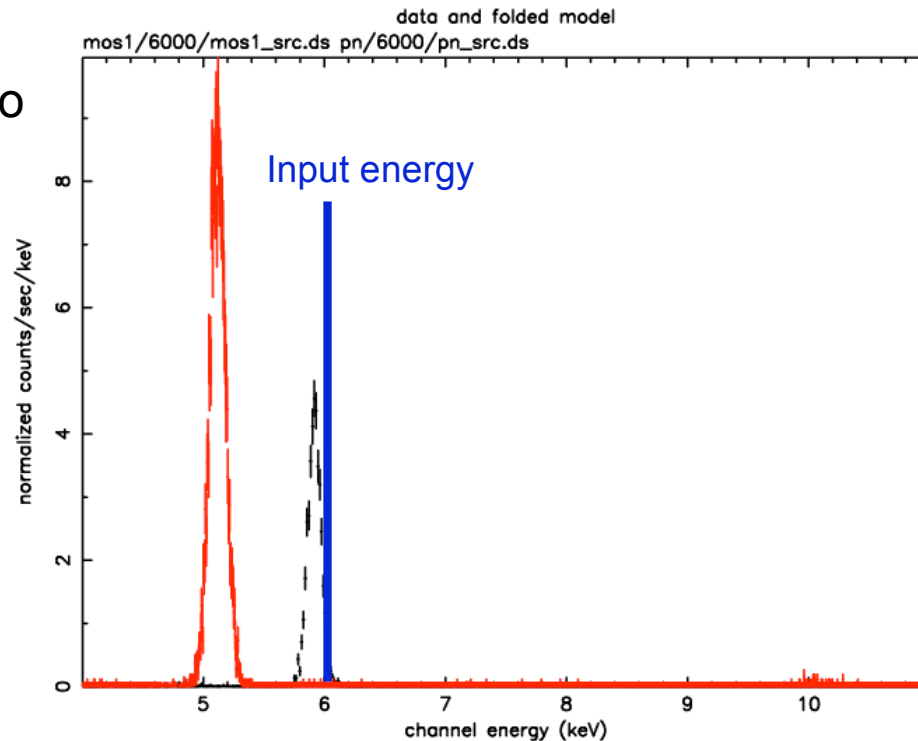
EPIC-pn and
MOS with SciSim CCFs



Example of monochromatic line at 6 keV

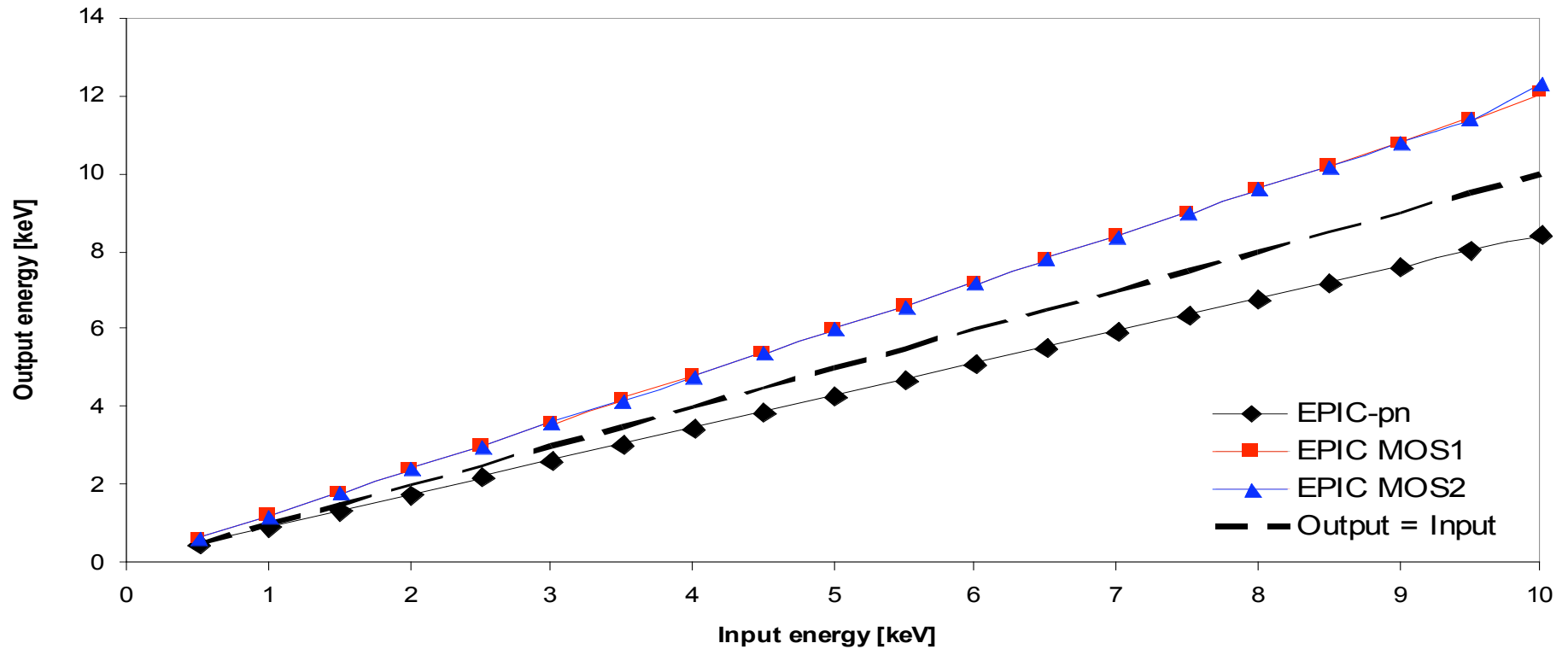
- Input data:
 - x-ray flux $2 \cdot 10^{-5}$ photons/cm²/s
 - background flux 0.005 photons/cm²/s
 - integration time 4000s
 - input energy from 0.5 keV to 10 keV in steps of 0.5 keV

EPIC-pn and
MOS with public CCFs



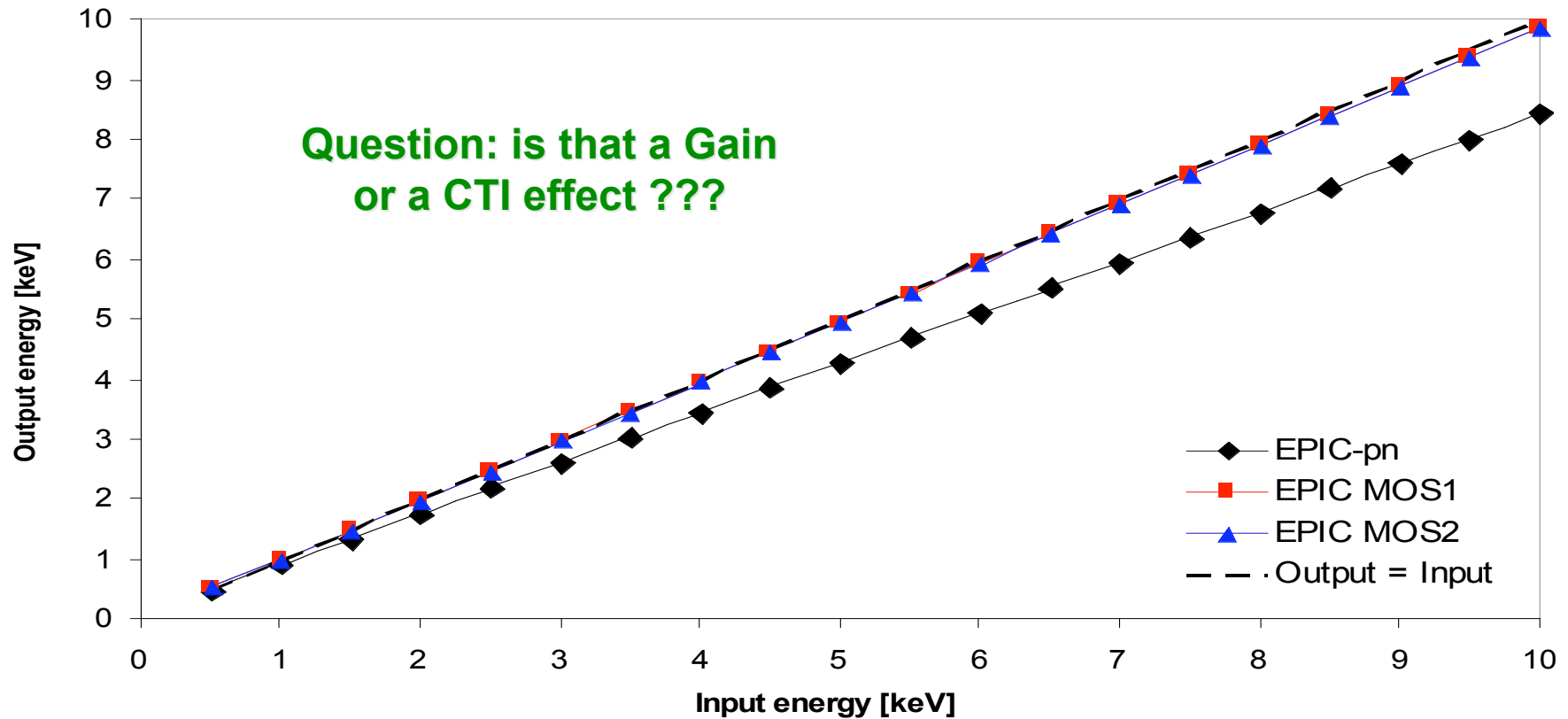
Results for various energies - SciSim CCF

0.5 - 10 keV output over input energy with SciSim CCFs



Results for various energies – public CCF

0.5 - 10 keV output over input energy with public CCFs

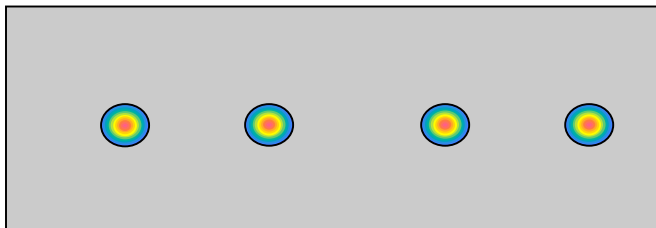


Results for various positions

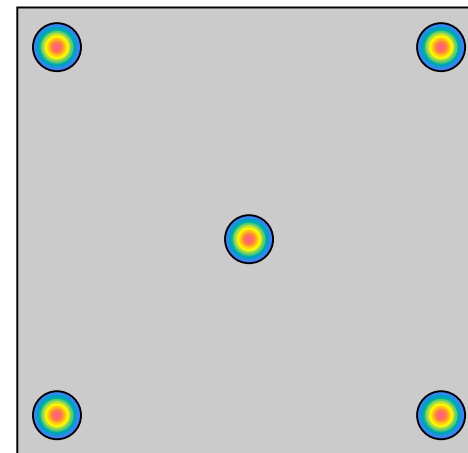
- Input data:
 - energy 6 keV
 - background flux 0.005 photons/cm²/s
 - x-ray flux $2 \cdot 10^{-5}$ photons/cm²/s
 - integration time 4000 s

Check:
Gain effect → no change
for different positions
CTI effect → energy
should vary with position

EPIC-pn

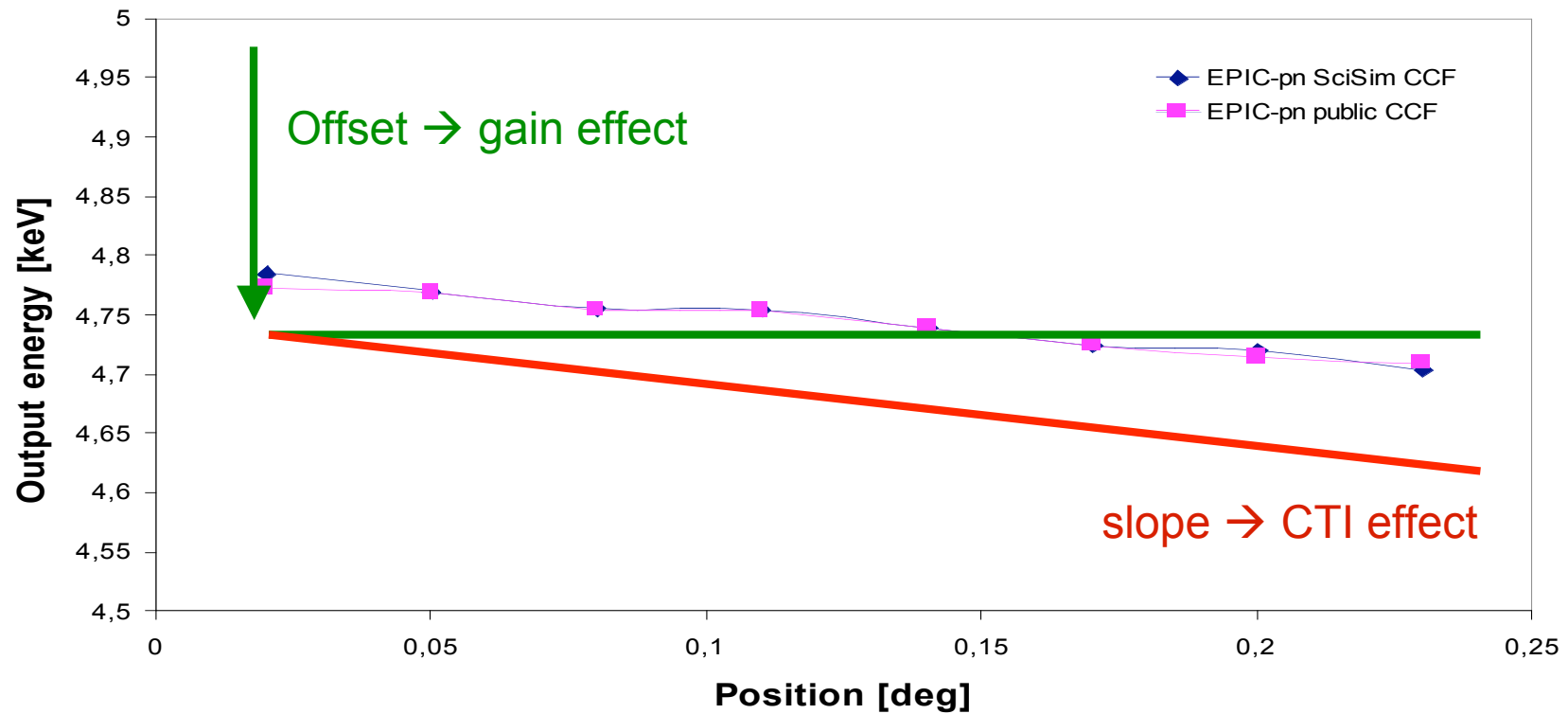


EPIC MOS



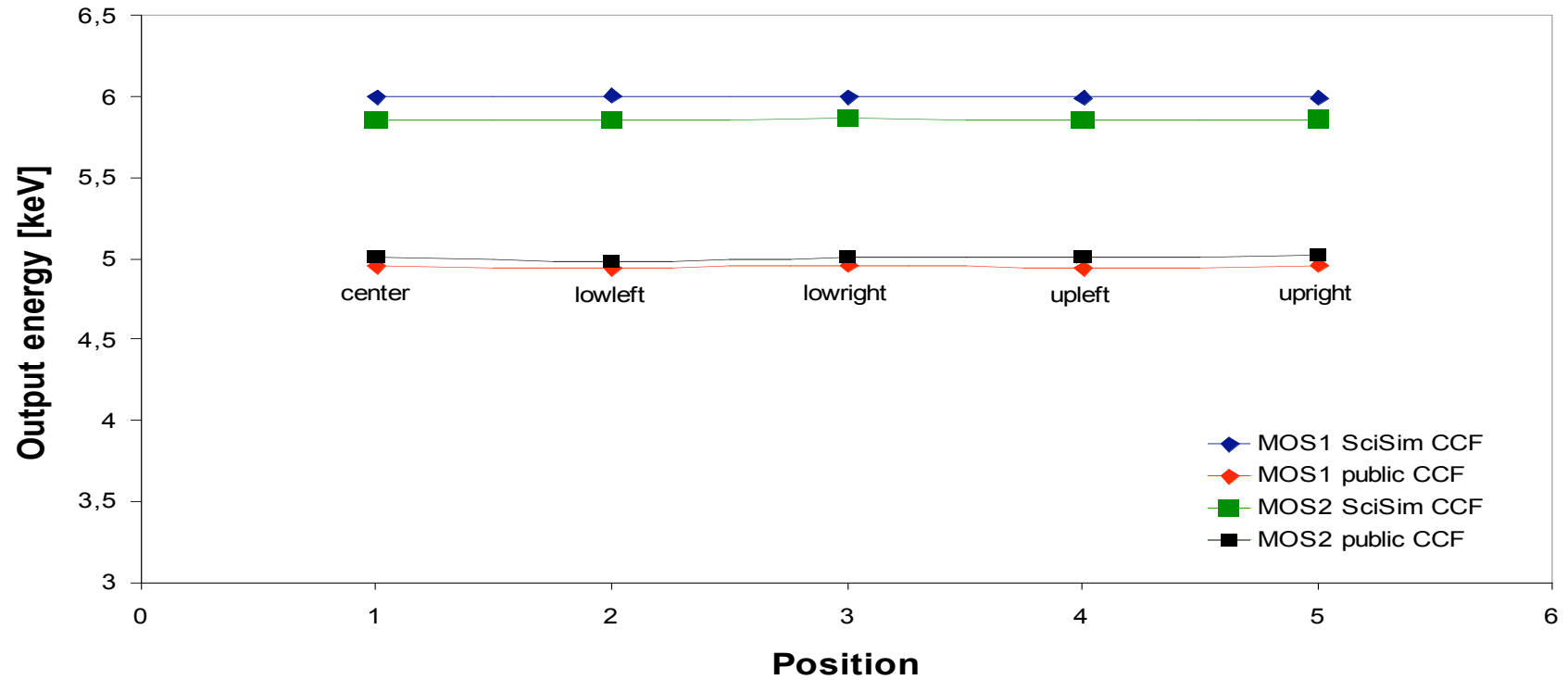
Results for various positions - pn

6 keV at variable positions on CCD10



Results for various positions - MOS

6 keV at variable positions on CCD1

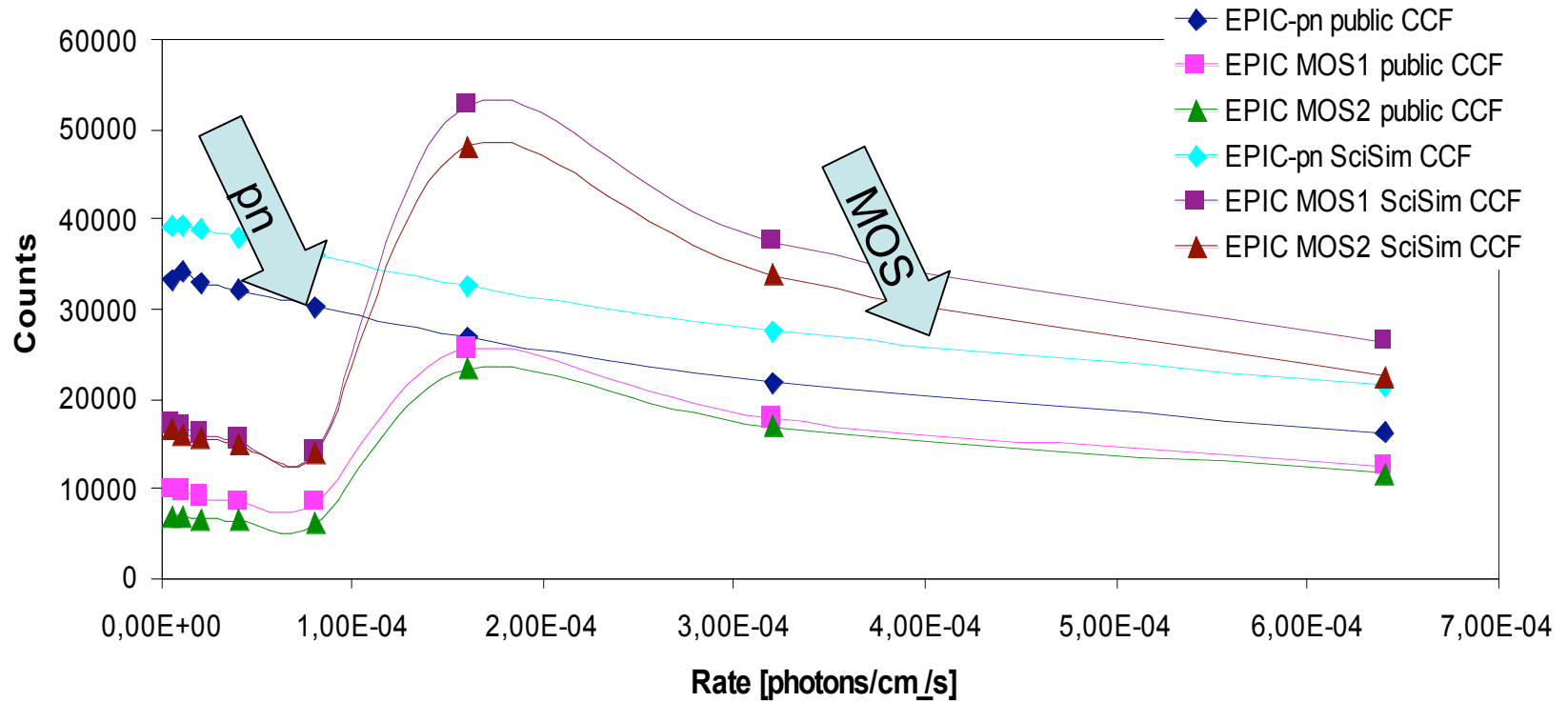


Results for various rates

- Input data:
 - background flux 0.005 photons/cm²/s
 - x-ray flux variabel from $5 \cdot 10^{-6}$ photons/cm²/s to 0.00064 photons/cm²/s
 - integration time variabel from 64000 s to 500 s
 - **total counts = flux · t_{int} = const**
 - input energy 1.5 keV and 6 keV

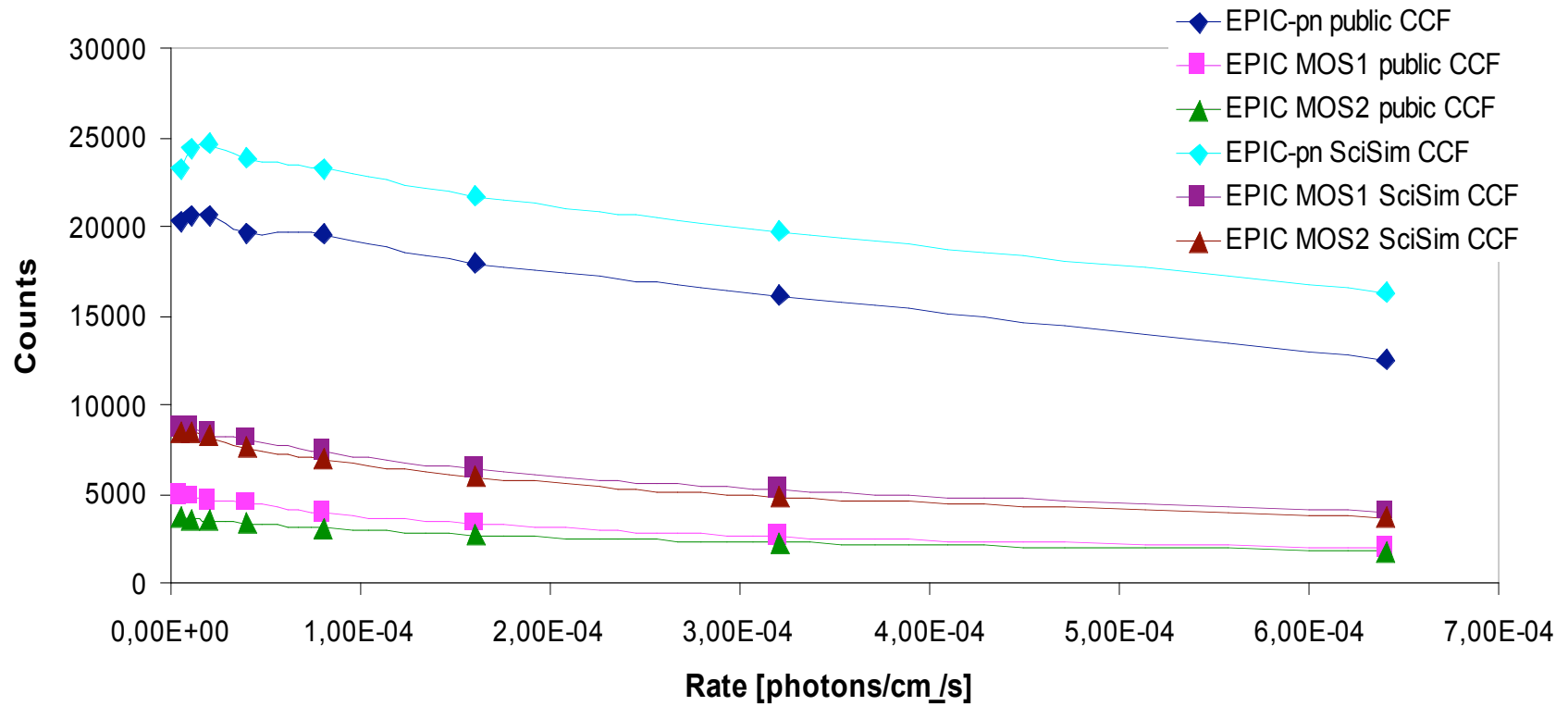
Results for various rates- 1.5 keV

Counts at variable rates and 1.5 keV



Results for various rates – 6 keV

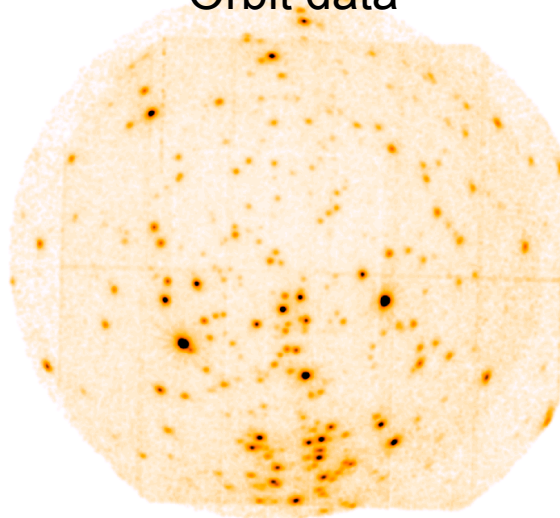
Counts at variable rates and 6 keV



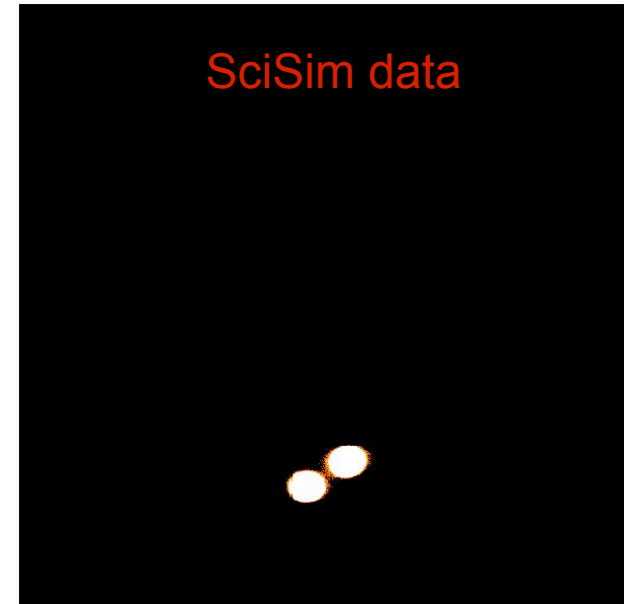
Preliminary result for pn PSF

- Input data:
 - 2 sources with radius of 1 arcmin
 - energy 5 keV
 - x-ray flux $6.0212 \cdot 10^{-6}$ photons/cm²/s
 - integration time 60000 s

Orbit data



SciSim data



Conclusions

- Gain
 - MOS: ok SciSim CCF, public CCFs cause under correction of energy
 - pn: not modelled correctly for both public and SciSim CCFs
- CTI
 - MOS: ok for SciSim but not for public CCFs
 - pn: effects not fully corrected in SciSim and public CCF
- Flux
 - Total counts differences for different energies
- PSF
 - one dimensional PSF implemented

Outlook

- Redistribution
- Contamination effects
- Pile-up effects on powerlaw sources

- Questions to be discussed with SciSim S/W team:
 - What should SciSim produce using SciSim CCFs to process data?
 - What should SciSim produce using public CCFs to process data?