

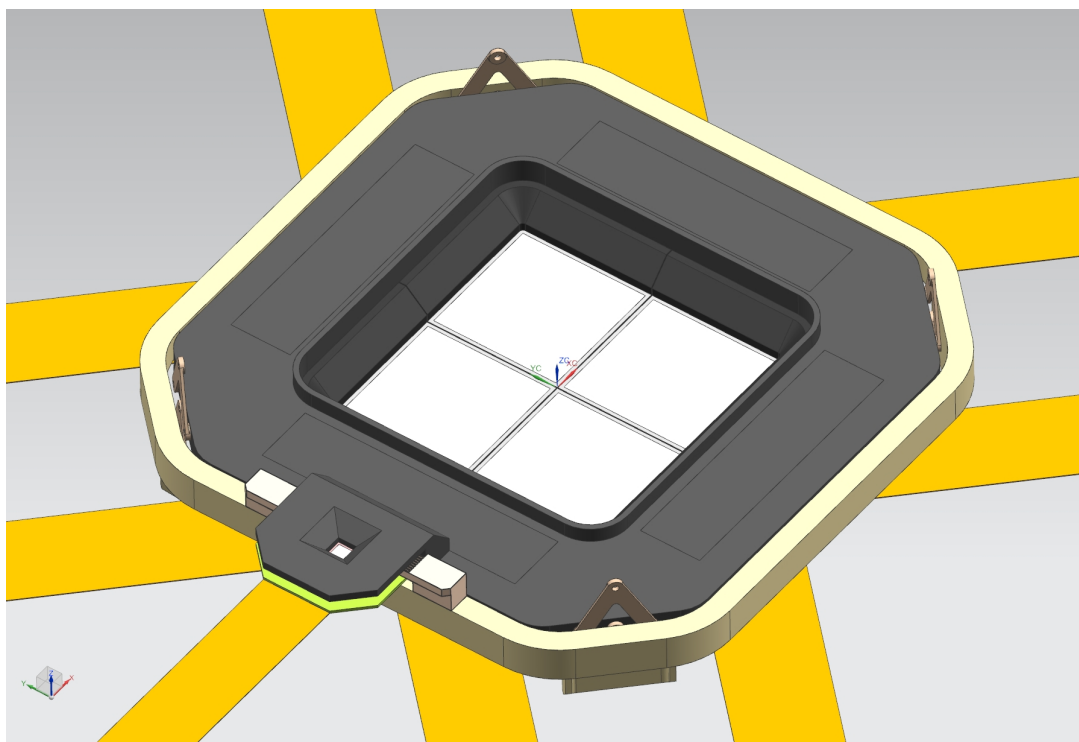
The WFI Detector Model in SIXTE

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Remeis Observatory & ECAP

SIXTE team: Thomas Dauser, Esin Gulbahar, Franziska Haluschka, Christian Kirsch, Maximilian Lorenz, Karan Pal, Jakob Stierhof, Philipp Thalhammer, Jörn Wilms and many others

The Wide Field Imager (WFI)

Large Detector Array (LDA) and Fast Detector (FD, 35 mm defocused)

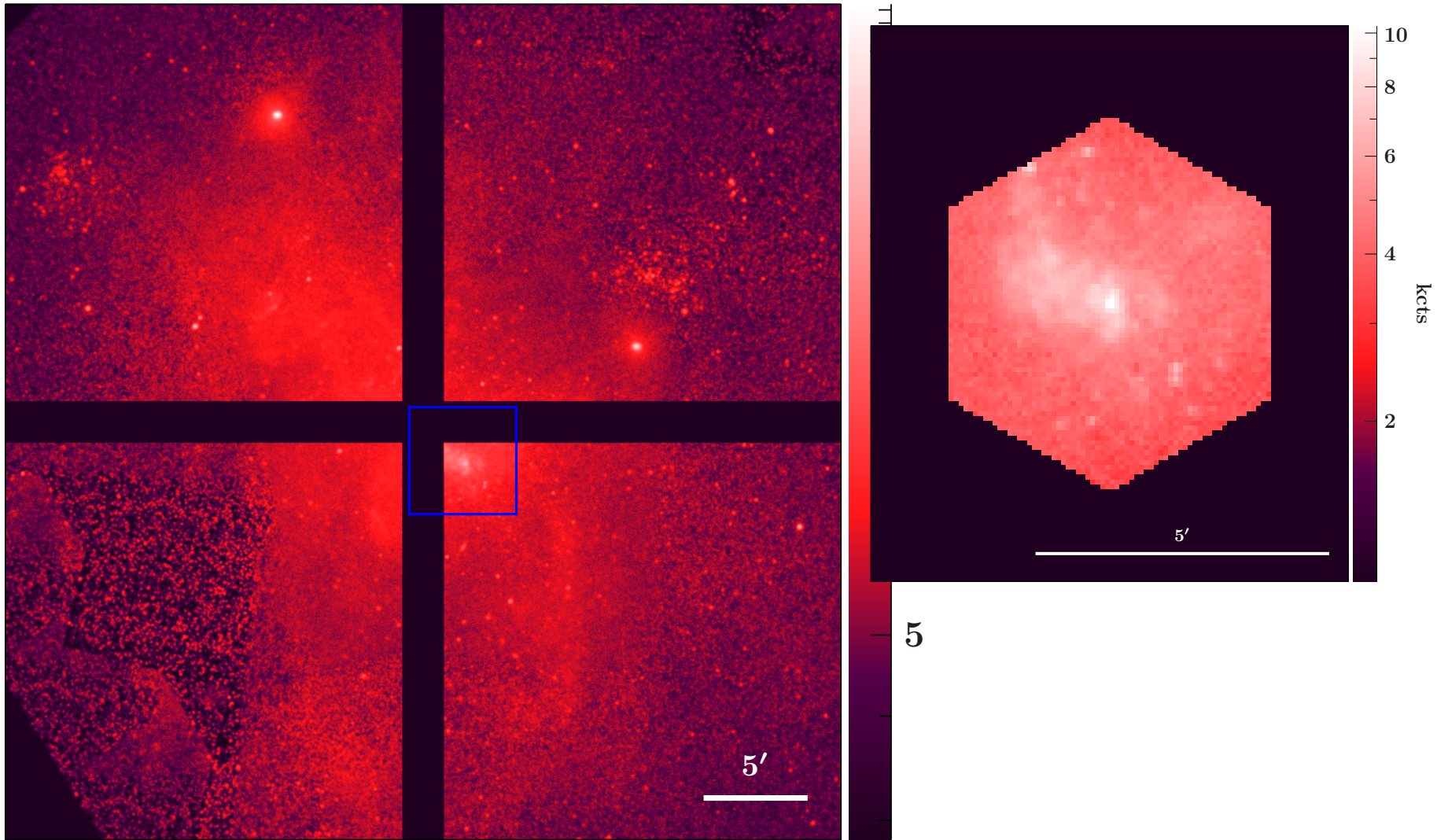


MPE

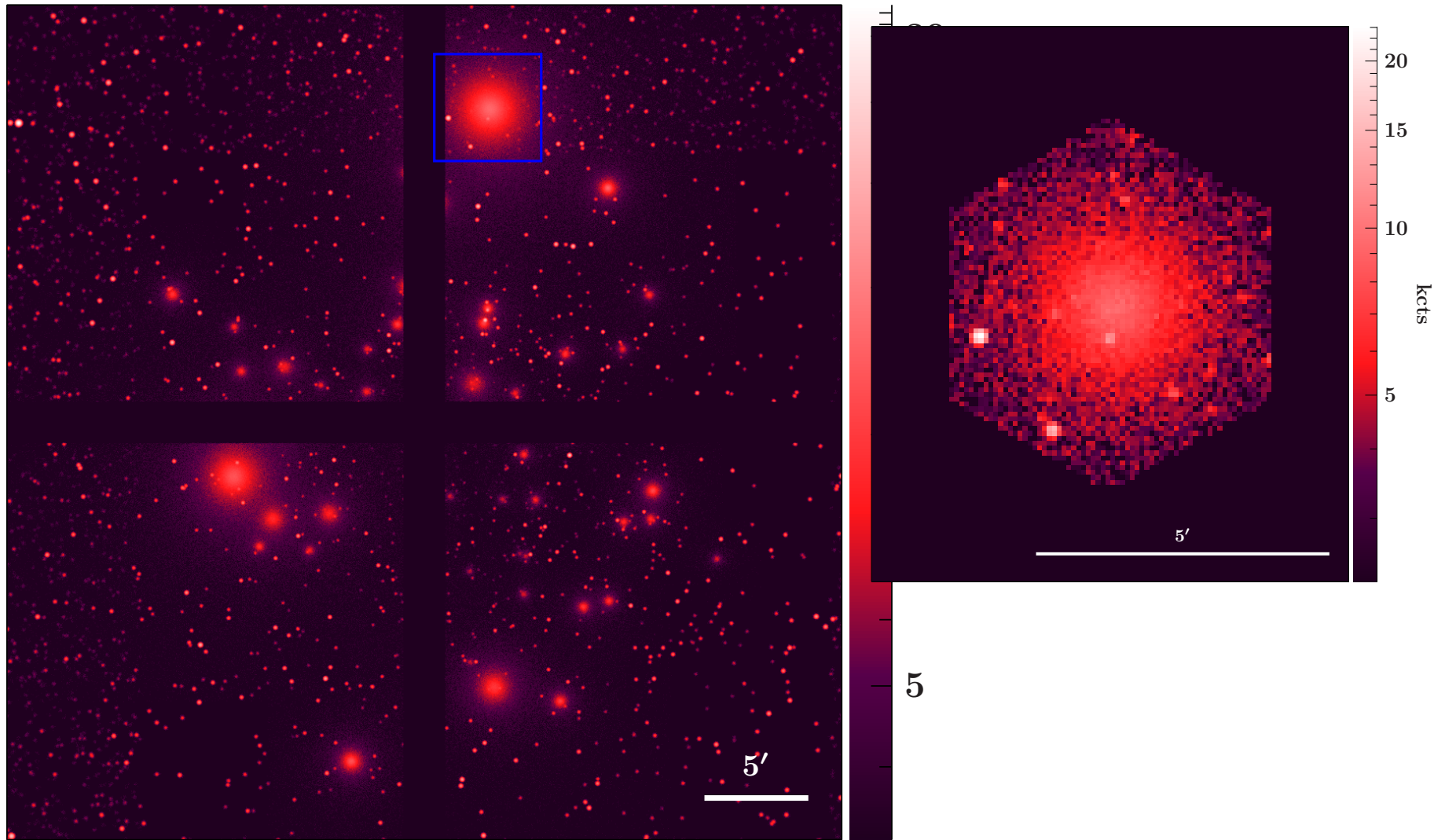
- DePFET active pixel technology (similar to CCD with line-by-line readout)
- Energy resolution: $\leq 160 \text{ eV @ } 7 \text{ keV}$
- Large FOV: $40' \times 40'$
- High count-rate capabilities (10 Crab)

Meidinger et al. (2020)

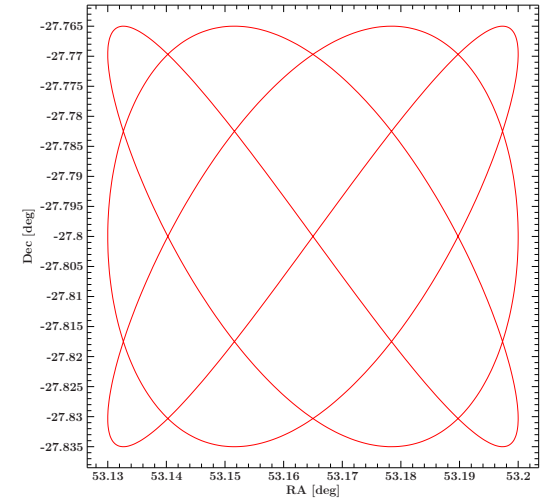
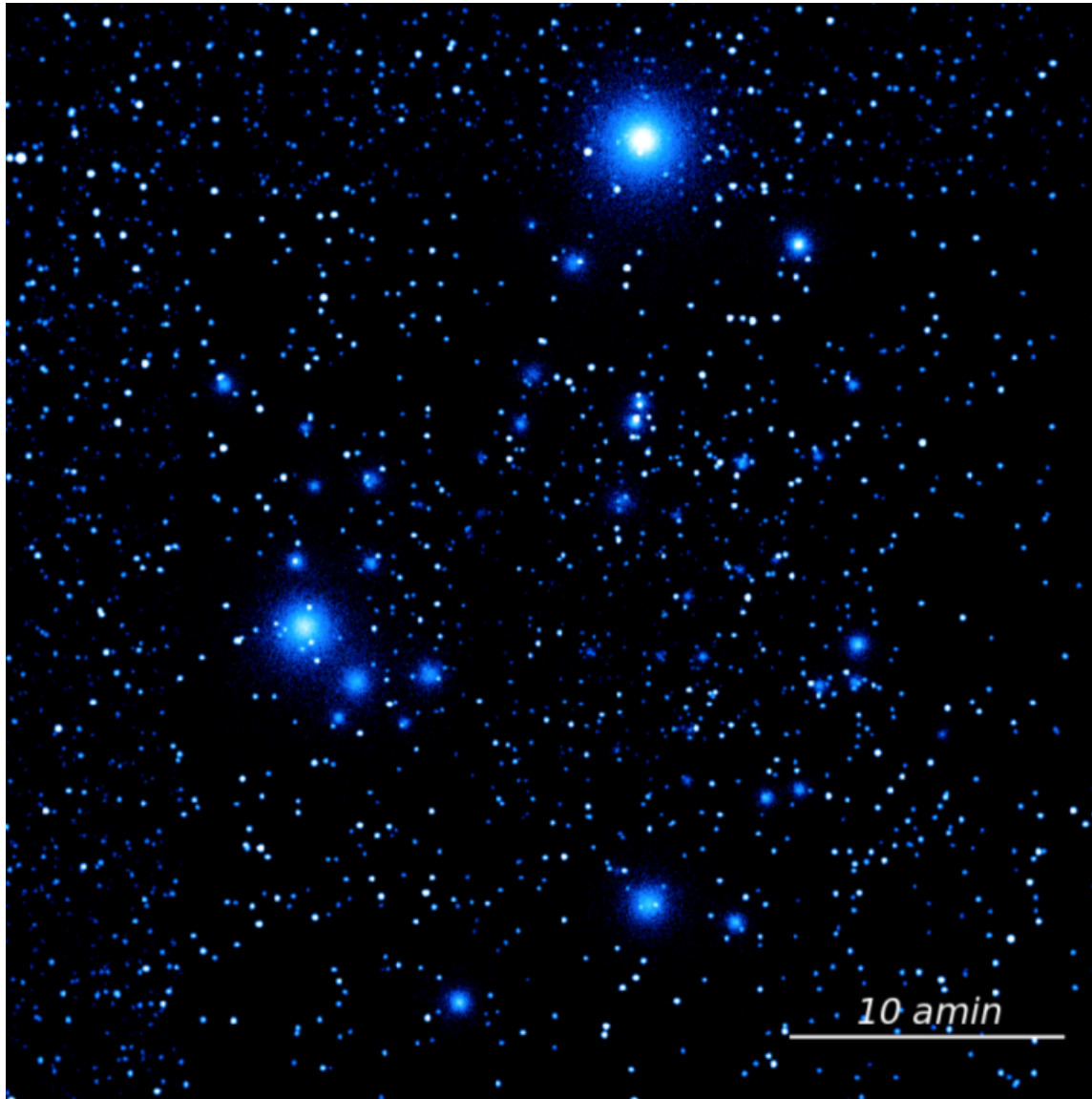
Example: Galactic Center with *NewAthena*



Example: Chandra Deep Field South with *NewAthena*

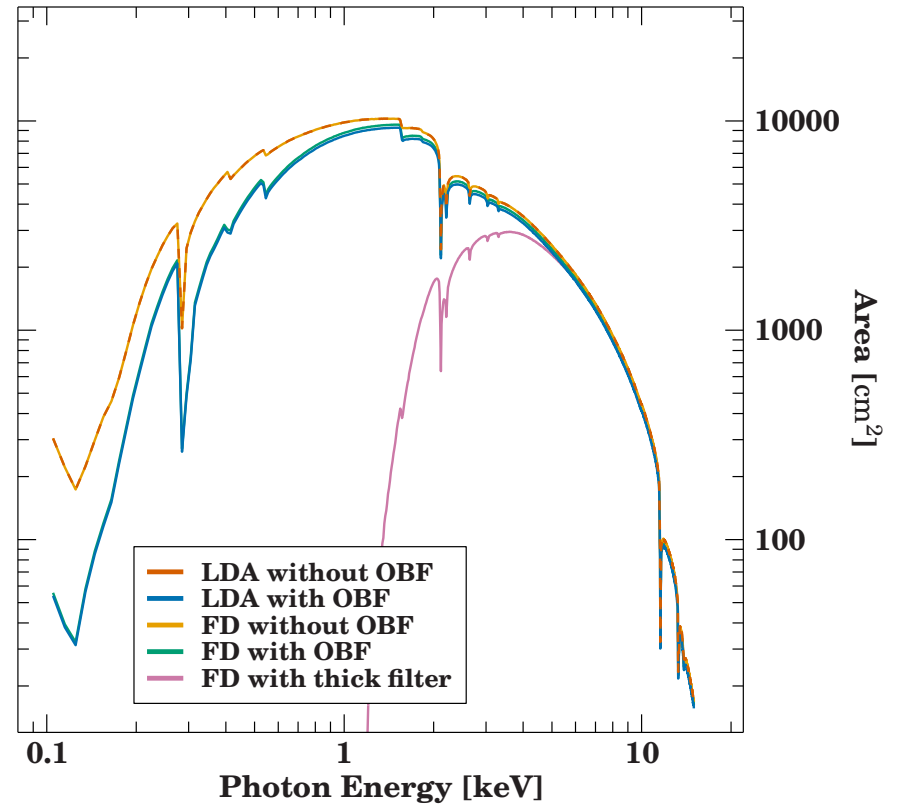
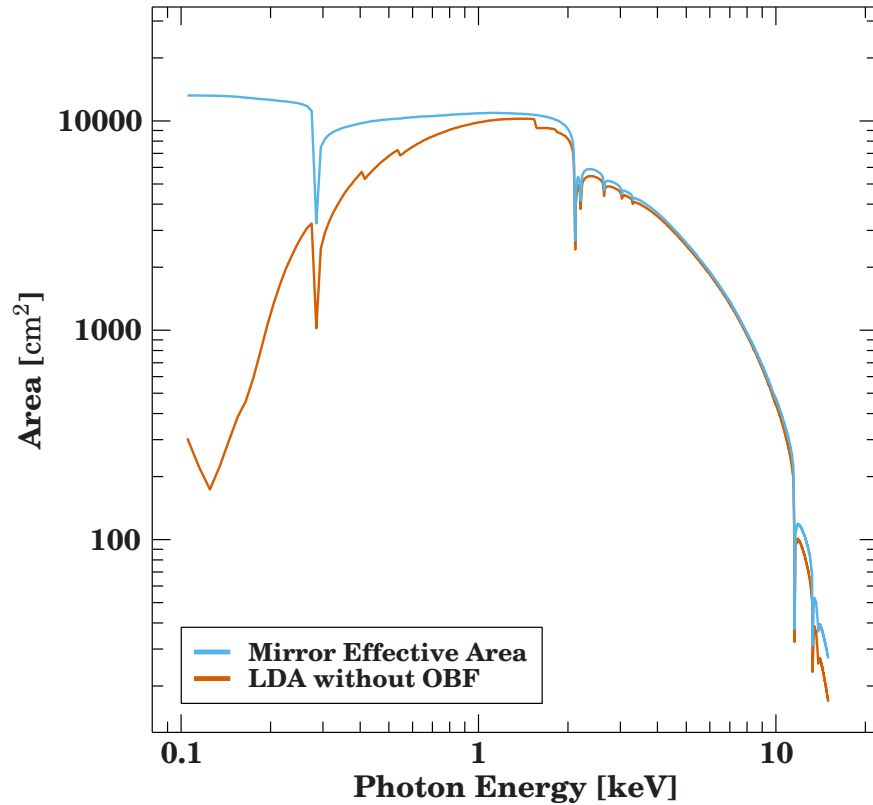


Example: Chandra Deep Field South with *NewAthena*



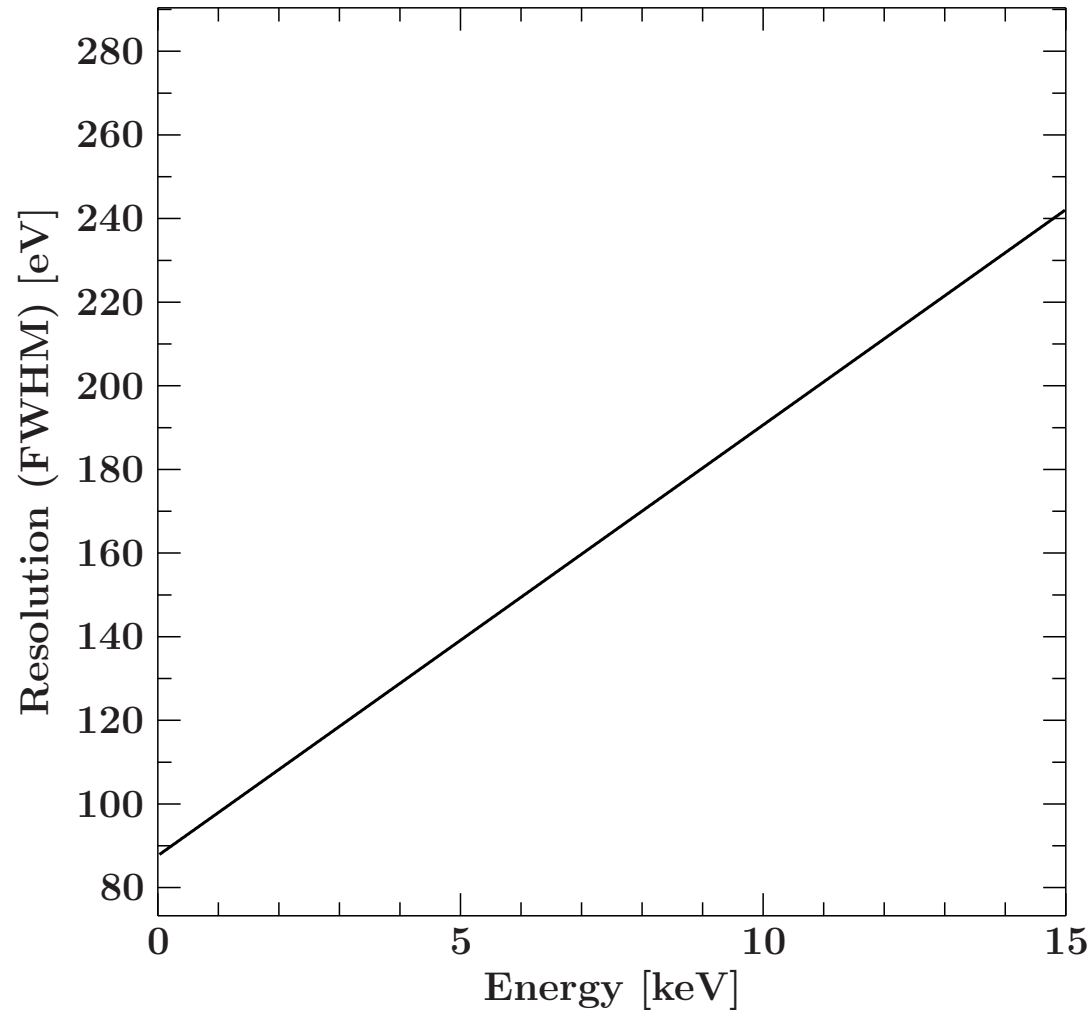
Dithering efficiently removes gaps between the chips.

WFI Mirror Area and Ancillary Response File (ARF)



Thick filter ⇒ removes photons below 2 keV

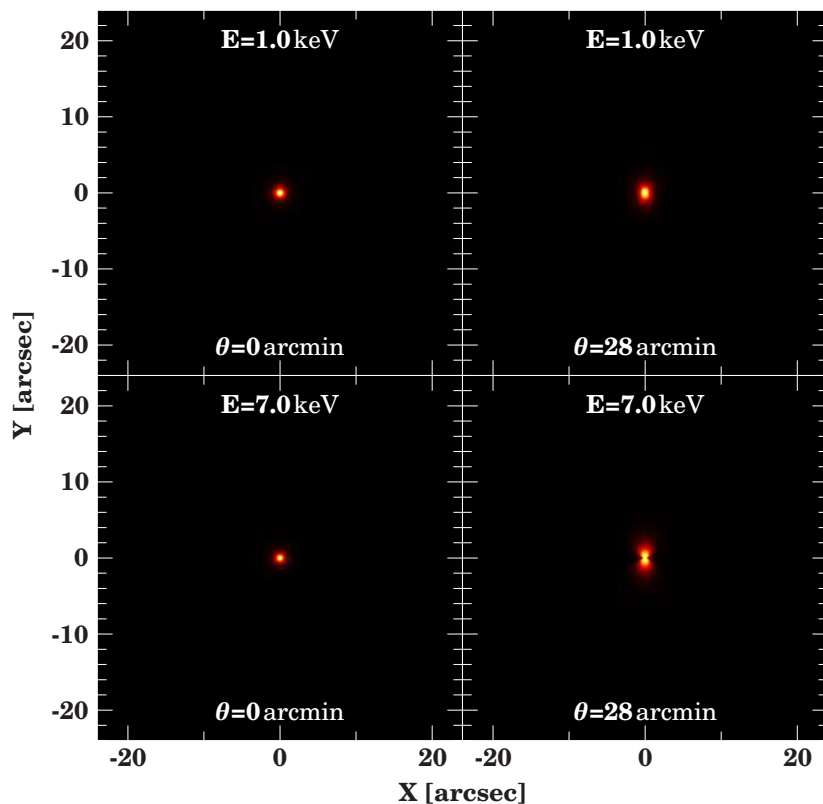
WFI Redistribution Matrix File (RMF)



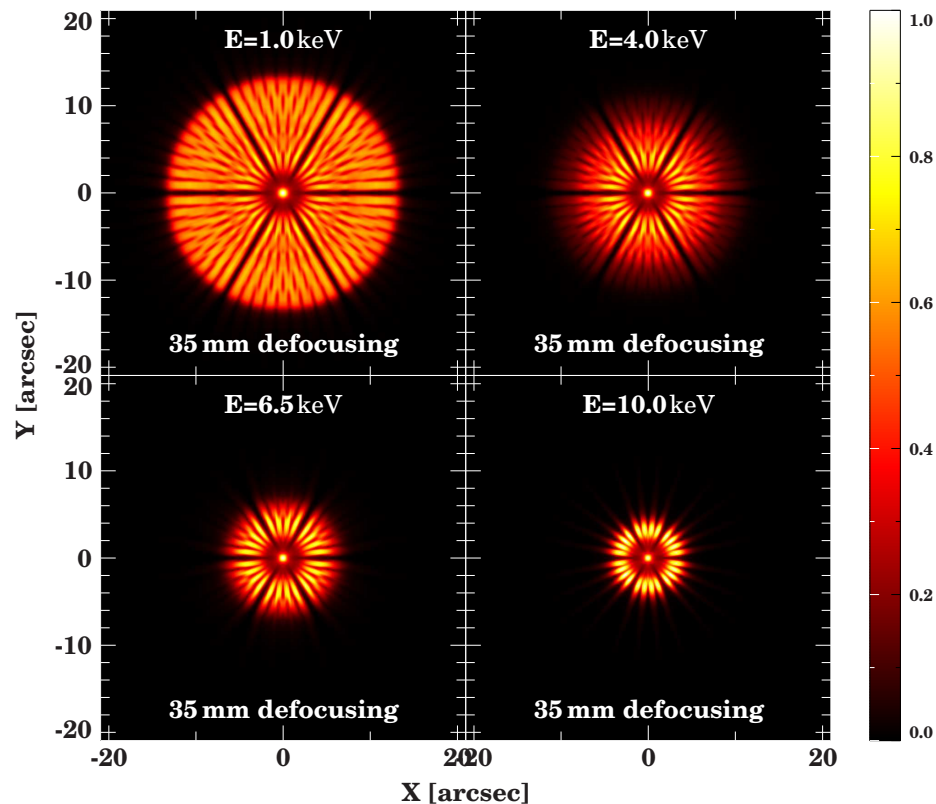
RMF composed of Gaussian with a width fit to lab measurements.

WFI Point Spread Function (PSF)

PSF at different energies and off-axis angles

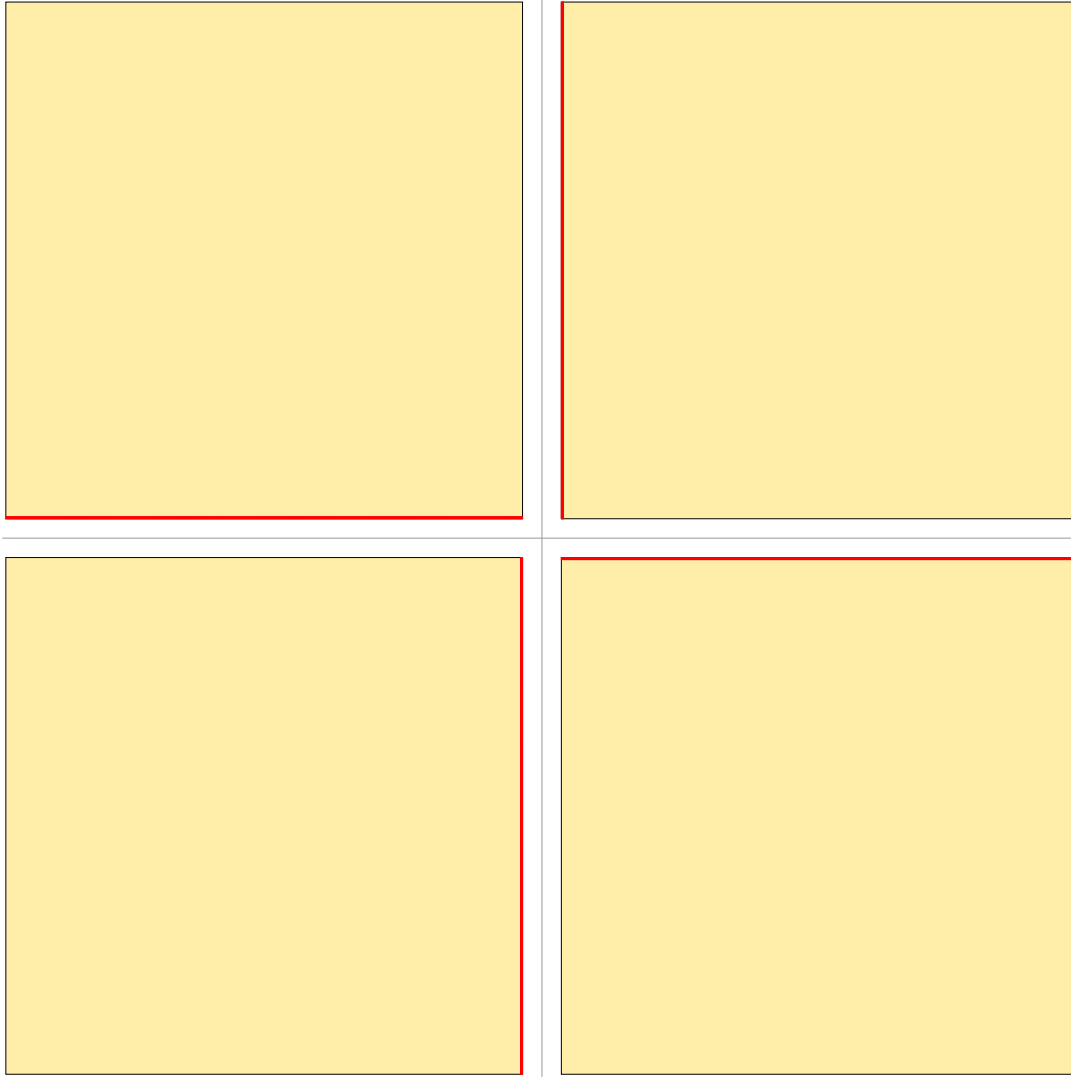


Defocused PSF (35 mm)



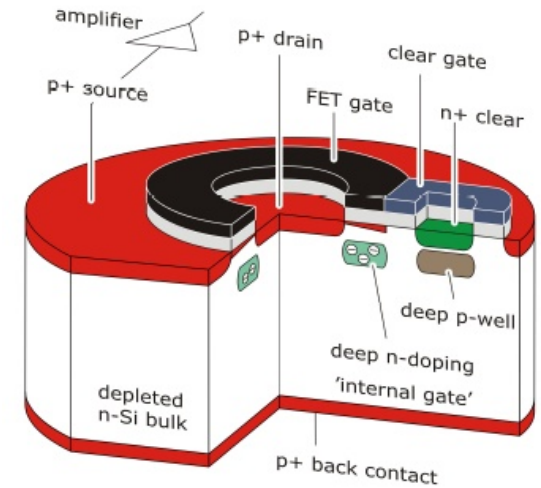
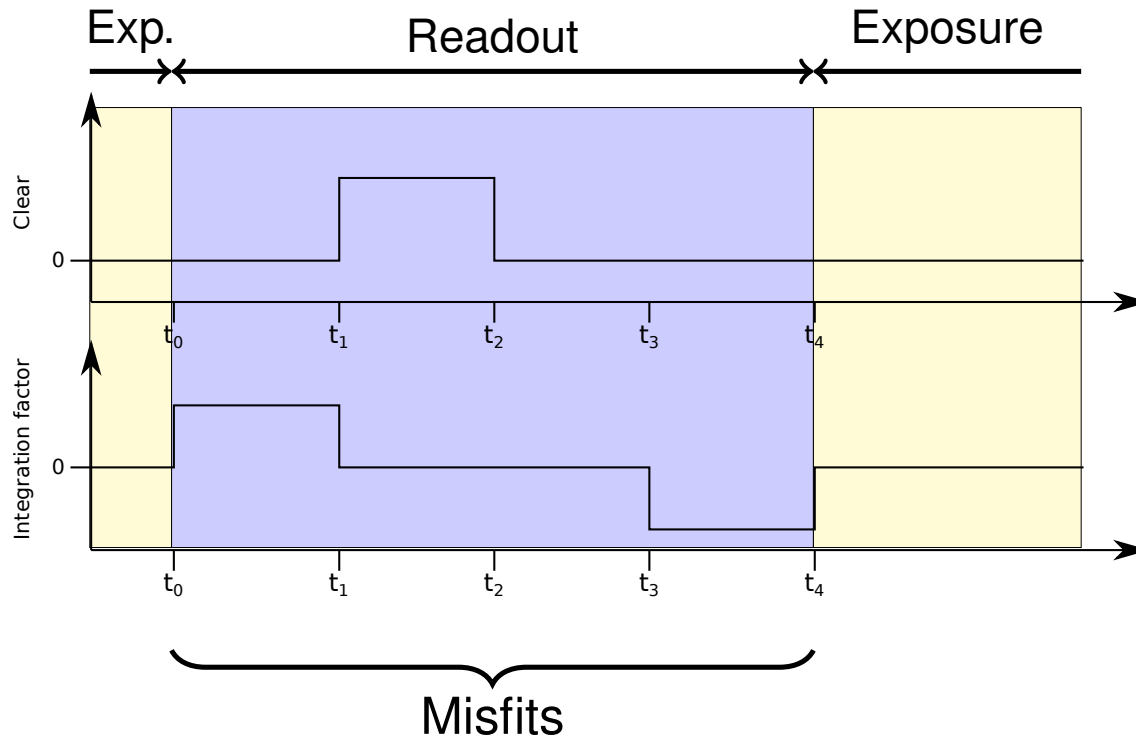
⇒ Defocusing distributes photons over larger area

LDA Chip Geometry



- Aim point at LDA center.
- 5 mm gap between chips.

WFI DePFET read-out implementation in SIXTE



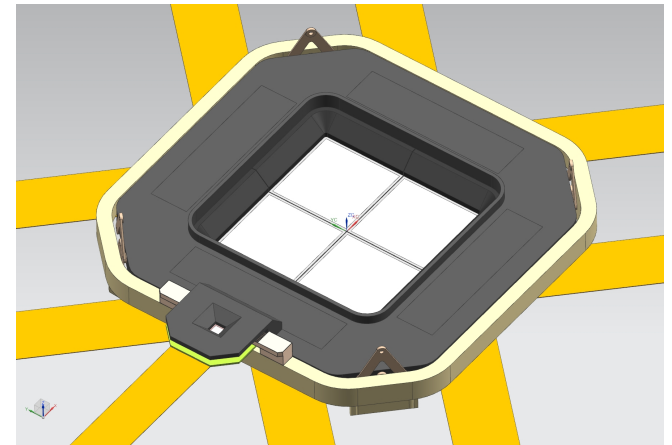
If photon hits during the read-out: measured charge is affected
⇒ Wrong energy (“Misfit”)

this is most relevant for window modes or the fast detector

Different modes of the WFI (in SIXTE)

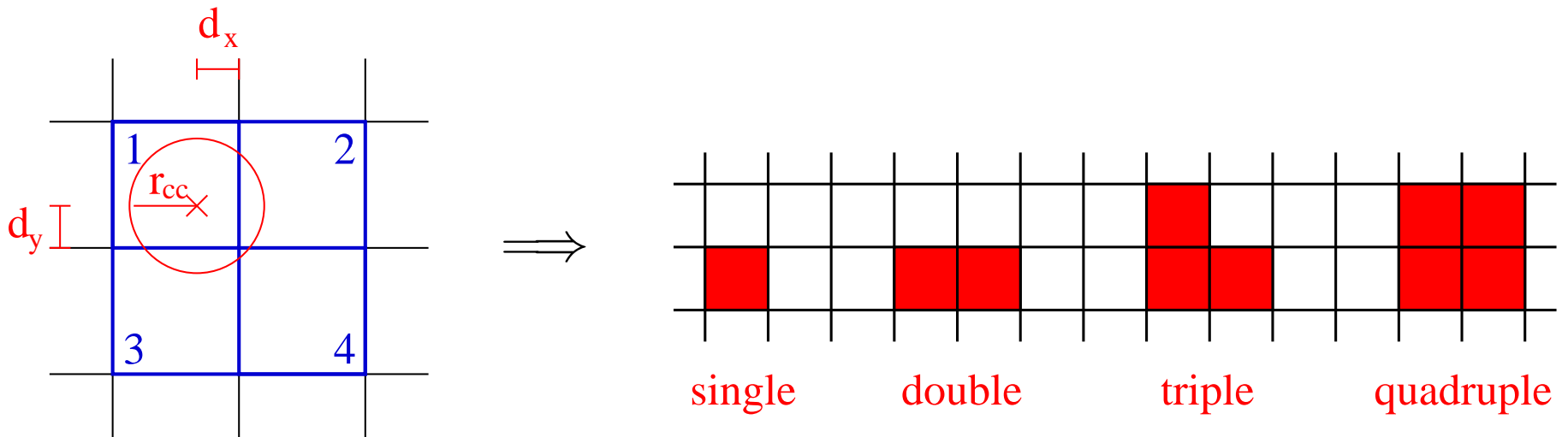
Name	Filename	Size (rows × columns)	time resolution	defocusing	filter
<i>full</i>	ld_wfi_ff_all_chips.xml	(4×) 512 × 512	1997 μ s	—	wo/w
<i>single</i>	ld_wfi_ff_chip[0,1,2,3].xml	512 × 512	1997 μ s	—	wo/w
<i>large</i>	ld_wfi_ff_large.xml	512 × 512	1997 μ s	—	wo/w
<i>w128</i>	ld_wfi_w128.xml	128 × 512	499 μ s	—	wo/w
<i>w256</i>	ld_wfi_w256.xml	256 × 512	998 μ s	—	wo/w
<i>fast</i>	fd_wfi_df35mm.xml	64 × 64	80 μ s	35 mm	wo/w
<i>fastThickFilter</i>	fd_wfi_df35mm_thick_filter.xml	64 × 64	80 μ s	35 mm	w

- Large Detector Array configurations available w/wo optical blocking filter.
- Fast Detector defocused by default.
- Option for a thick filter.



Example: CCD Effects – Patterns and Pileup

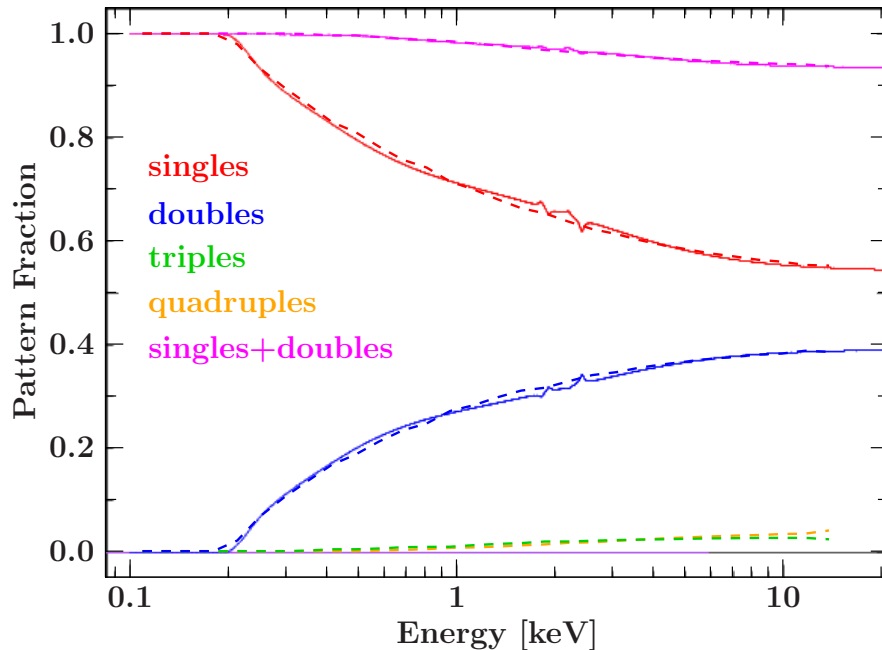
SIXTE includes charge cloud model, event patterns, and pileup.



Example: CCD Effects – Patterns and Pileup

SIXTE includes charge cloud model, event patterns, and pileup.

Pattern fractions *XMM Newton*



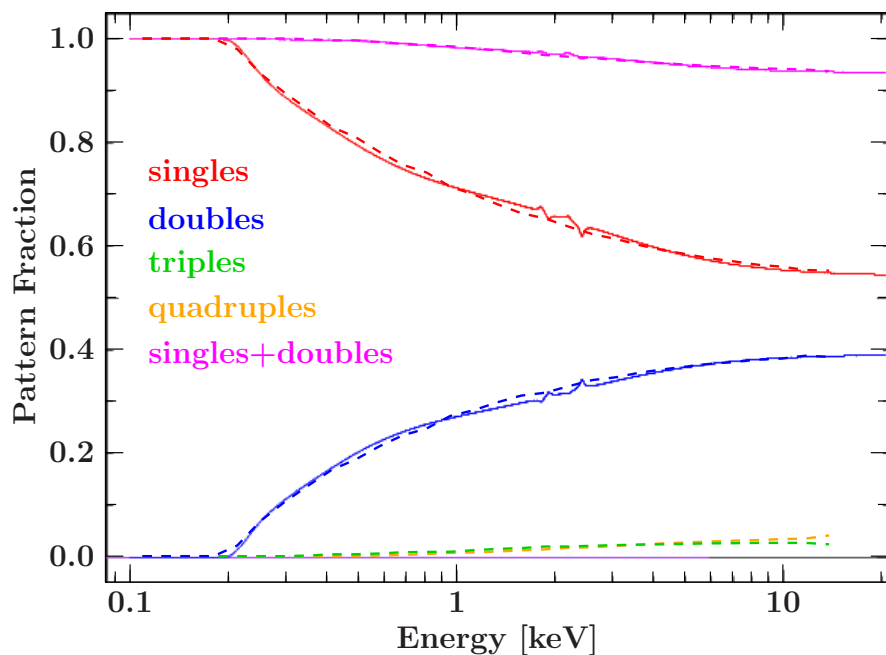
⇒ Simulated distribution matches
very well

Dauser et al. (2019)

Example: CCD Effects – Patterns and Pileup

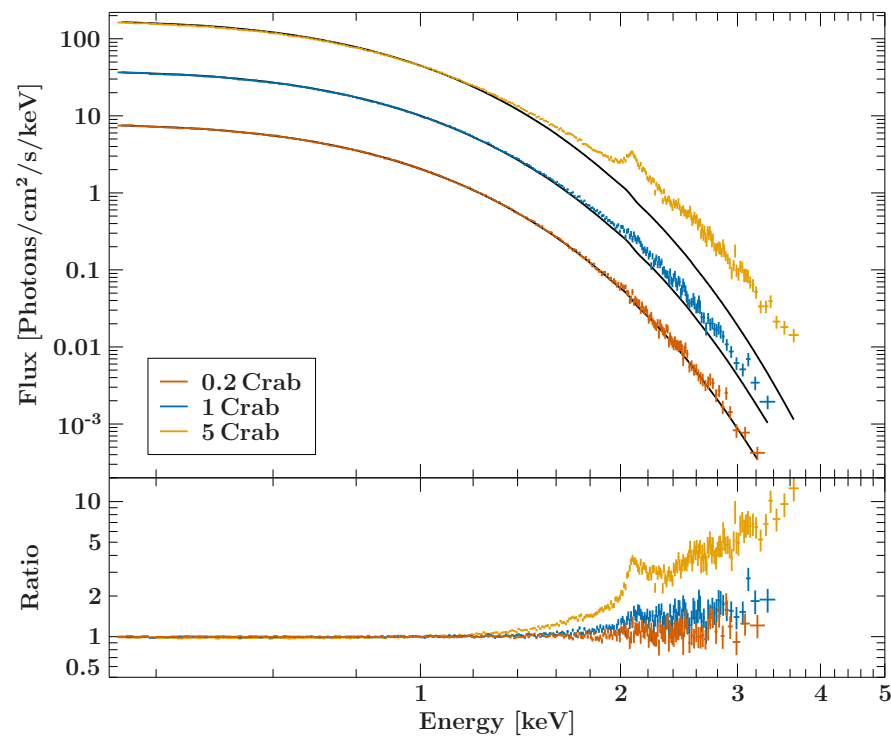
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Pattern fractions *XMM Newton*



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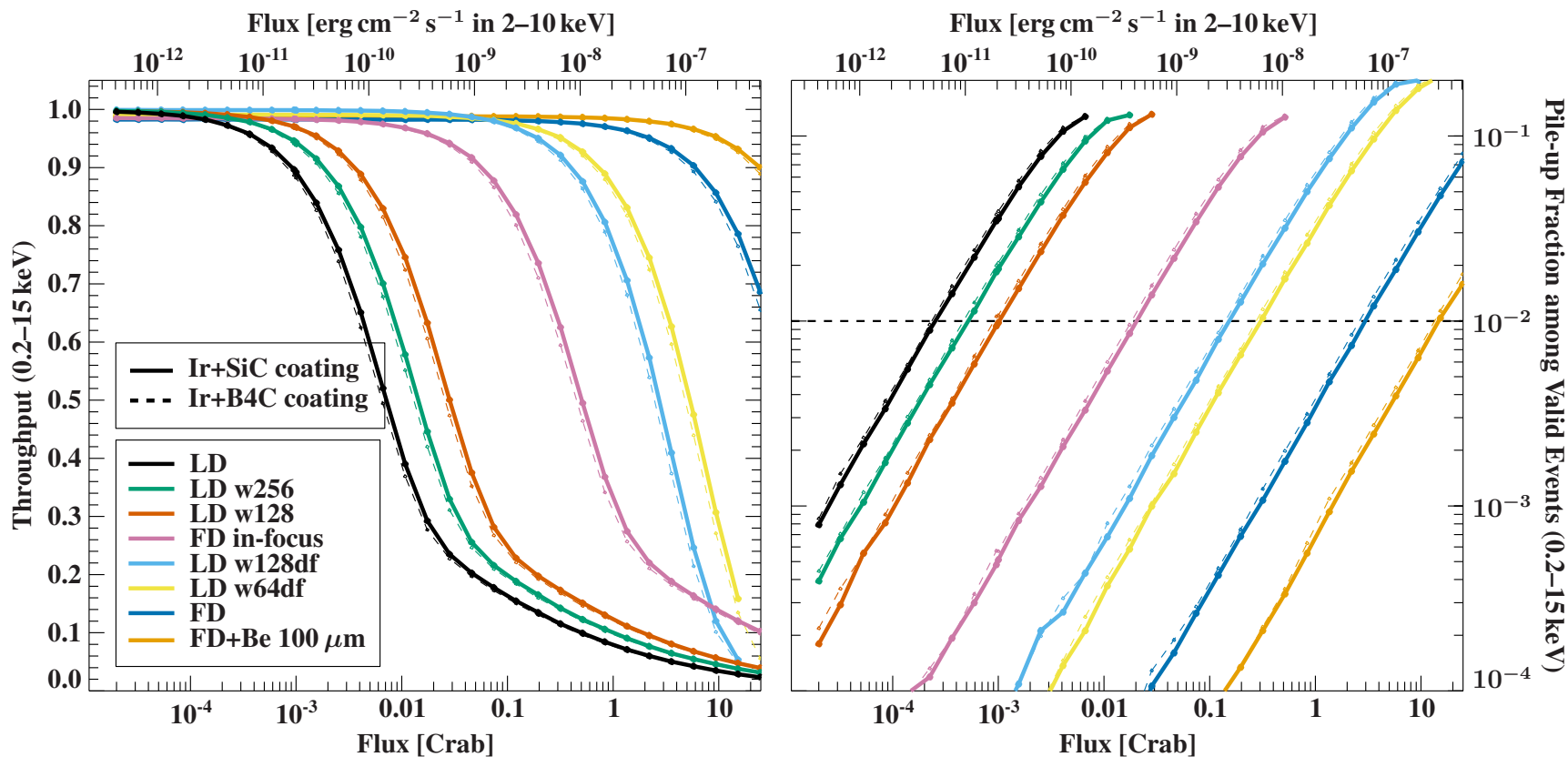
Pileup *NewAthena WFI*



Dauser et al. (2019)

Example: CCD Effects – Patterns and Pileup

SIXTE includes charge cloud model, event patterns, and pileup.



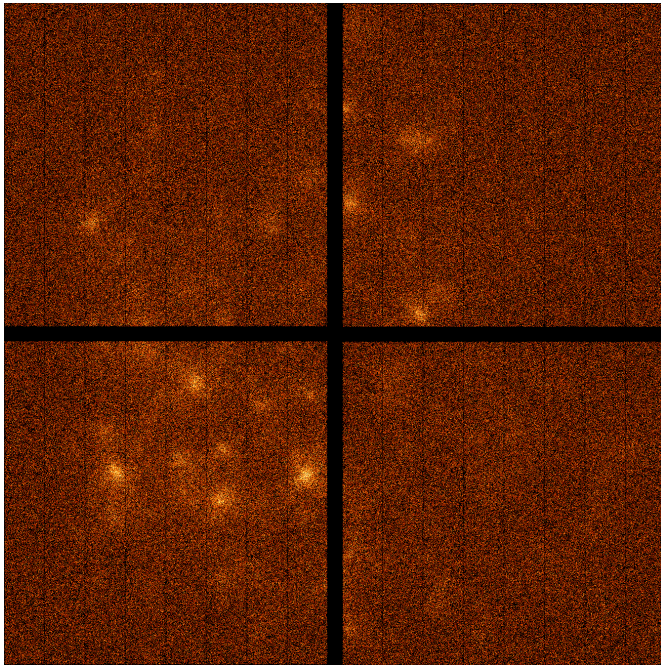
WFI BSR 2022

Example: Chandra Deep Field South with XRISM Xtend

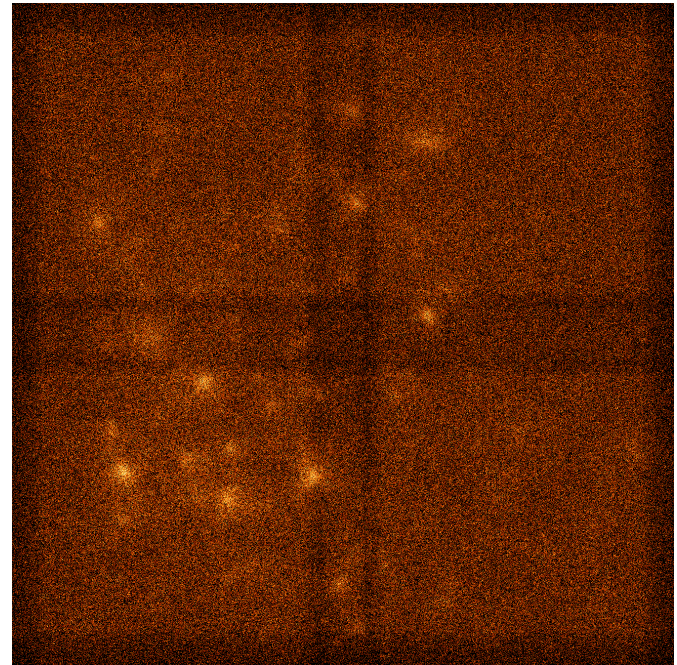
XRISM

- JAXA/NASA X-ray observatory, launched in 2023
- Two instruments: Xtend & Resolve

⇒ Use same SIMPUT, just switch the instrument files!



Without dithering



With dithering

Summary: The WFI with SIXTE

- **DePFET** technology: active pixels, no line shifts → **misfits** if pixel is hit during read-out
- Observations possible up to a few Crab, plus a thick filter for even brighter sources.
- Large 40' FoV made of 4 chips → requires **dithering**
- Simulations possible for the full 4 chip LDA, or only a single chip (LD, or the 35 mm defocused FD).

