EPIC-pn Large Window Mode fast-shift CTI correction

Status report on NRCO-31

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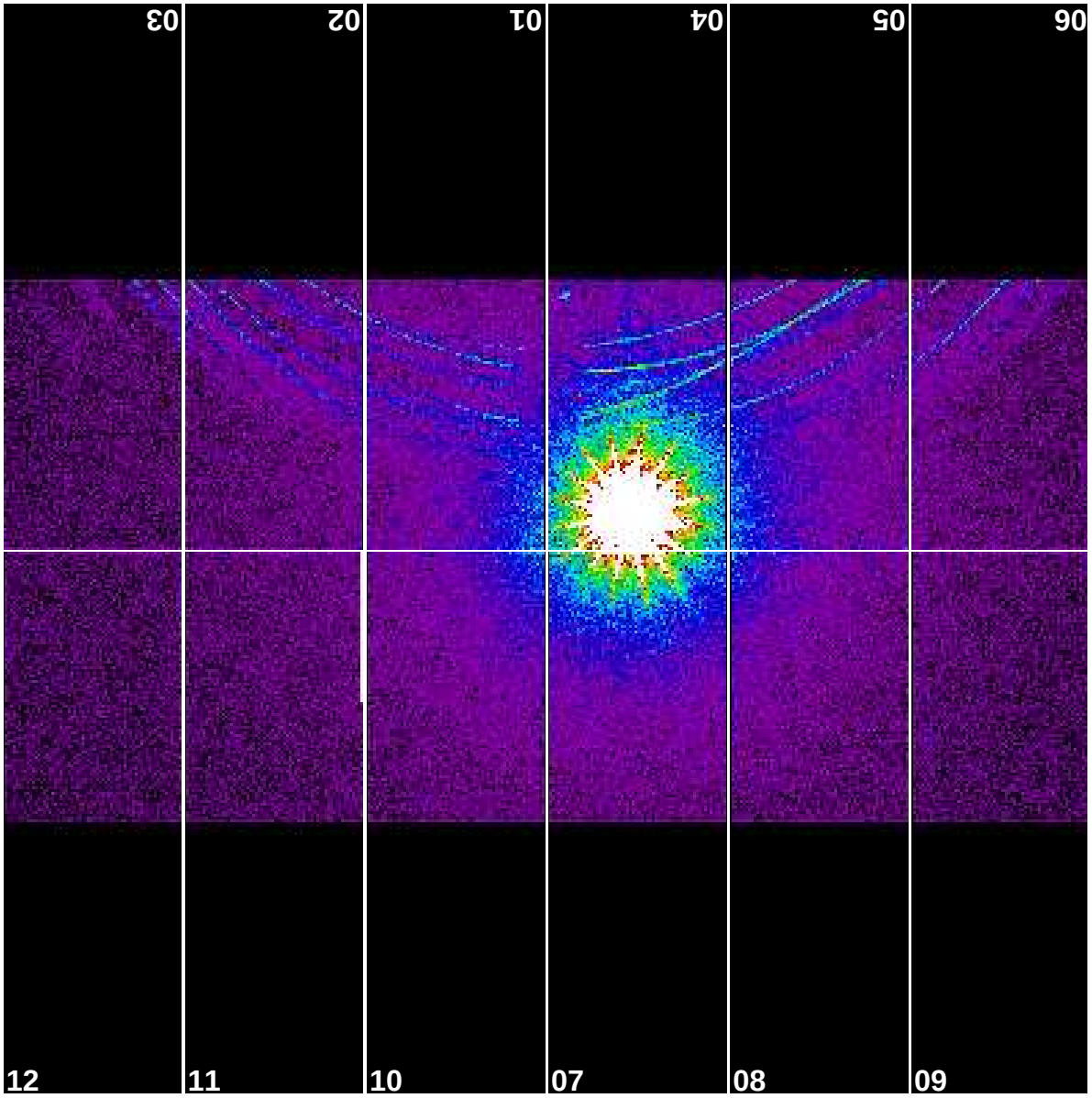
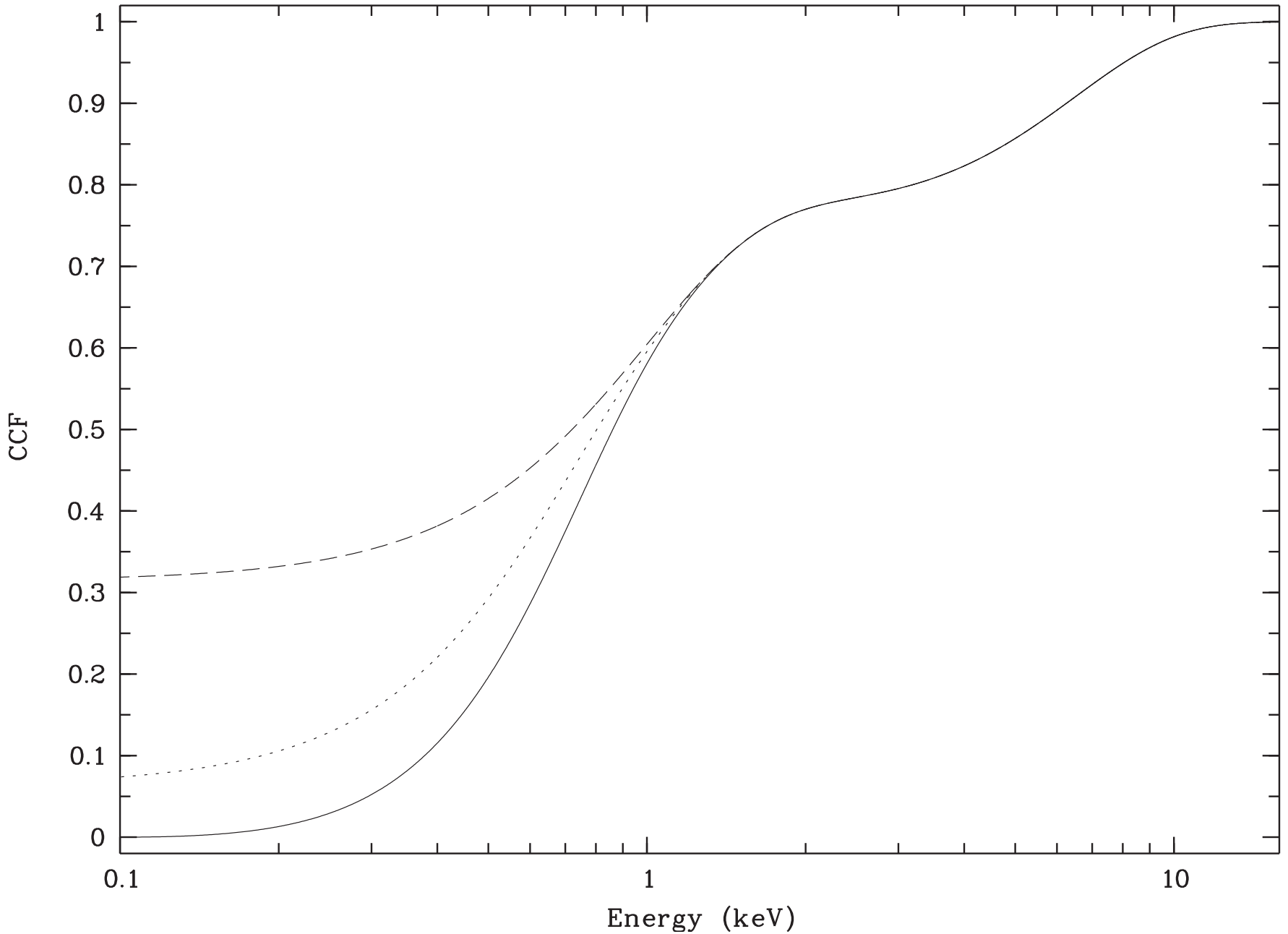
- EPIC-pn window modes: CTI correction
- Measurements at Panter with FM1
- Non-routine calibration observation (N132D) with FS
- Results

EPIC-pn window modes: integration, shift, read-out

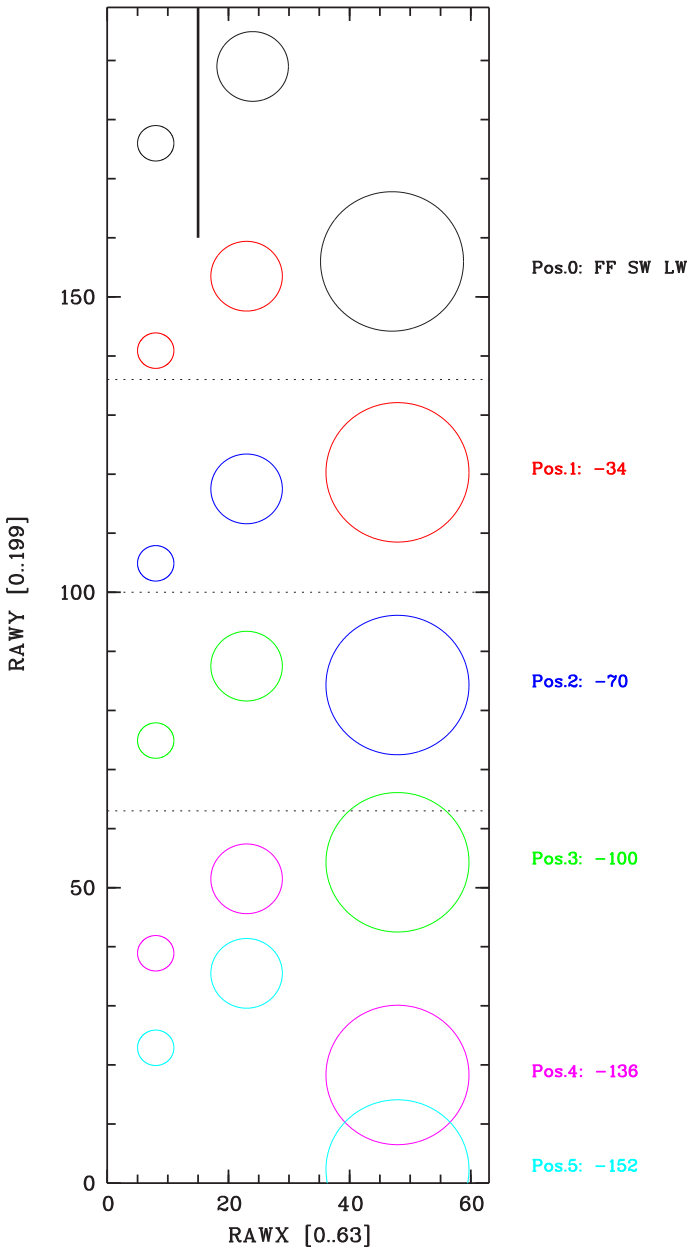


- only parts of CCD used
- integration of 100 (64) rows, 45.14 (3.93) ms
- fast shift of window area toward CAMEX, in 0.072 (0.098) ms
- read-out as in full frame mode, 2.45 (1.64) ms
- fast shift of read-out area

EPIC-pn window modes: CTI correction function

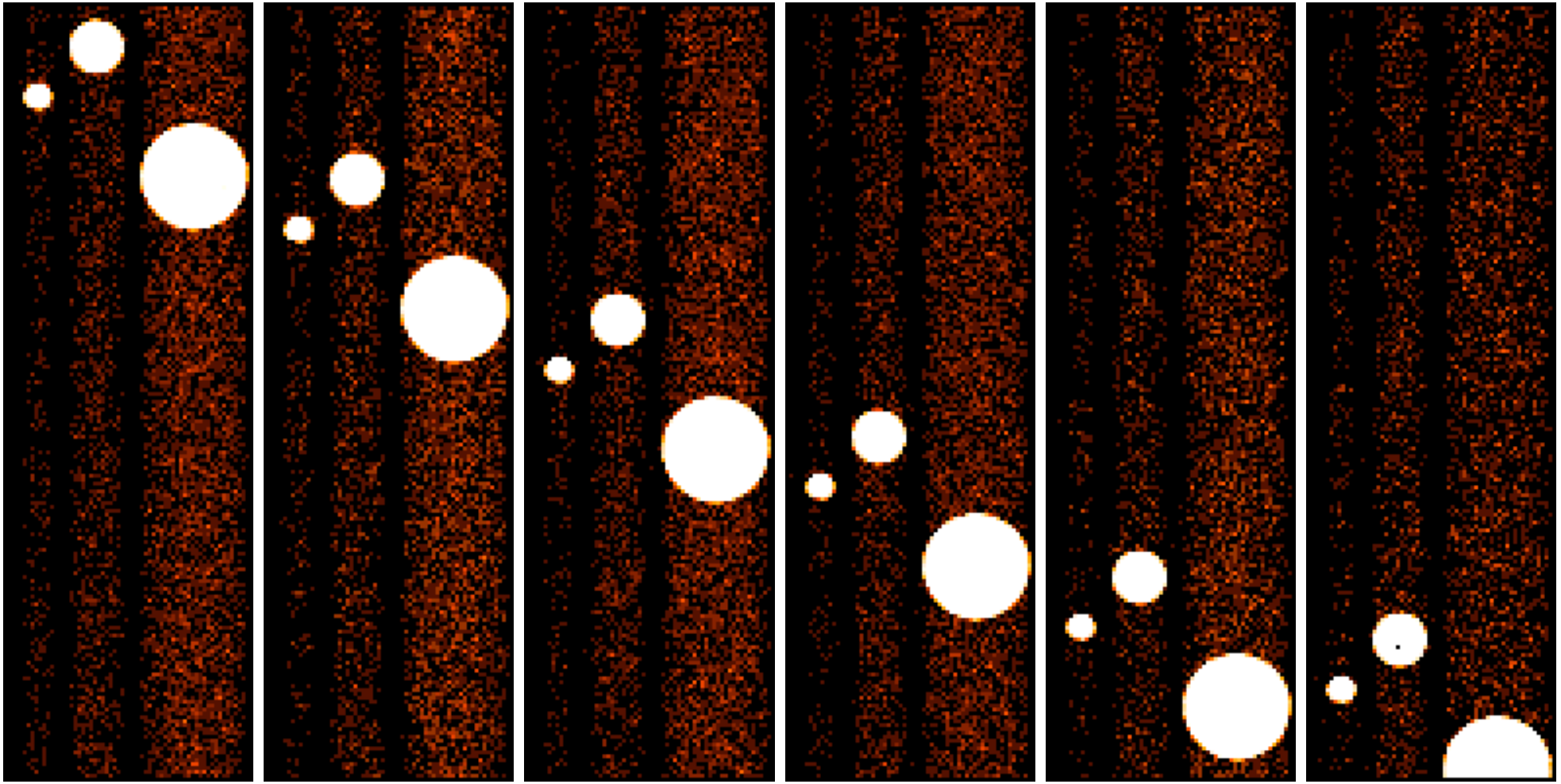


EPIC-pn: pinhole measurements: design

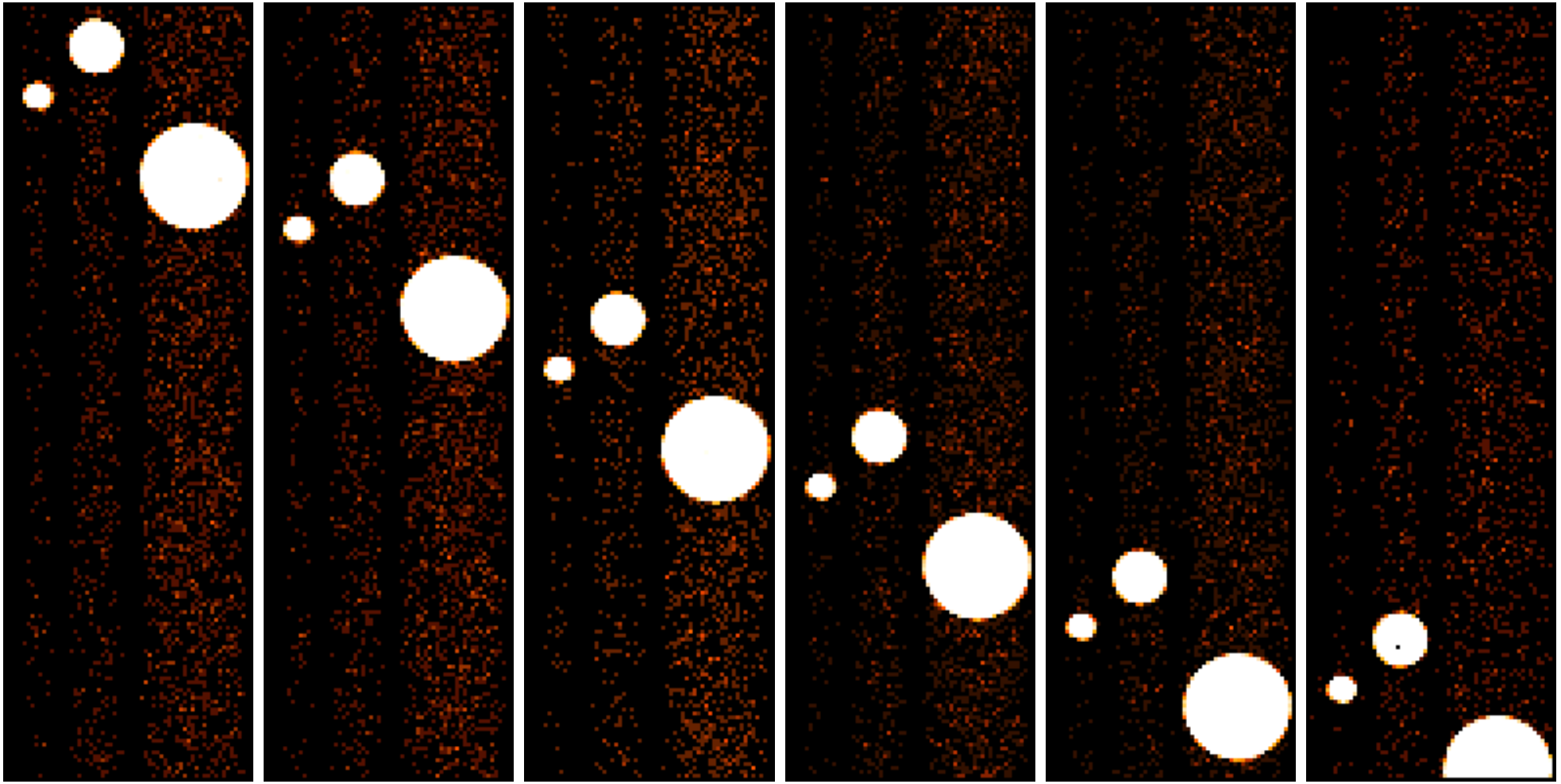


- pinhole mask in X-ray beam, fixed (2 mm Al), in front of EPIC-pn spare camera
- 3 holes: 1 mm, 2 mm, 4 mm diameters (27.5″, 55″, 110″), CCD: 9.6 mm × 30 mm
- move EPIC-pn camera up and down behind mask to avoid possible beam effects (like energy dispersion of monochromator etc.)
- holes disjunct in RAWX and RAWY projections so that they can be considered as independent
- avoid one bad column piece
- observe (gain-corrected) line positions [adu] of monochromatic input as function of position
- derive charge losses from one position to another, e.g. for LW mode:
- $Y > 100: \ \mathtt{PHA}(Y) = \mathtt{PHA}_0 \times \mathtt{CTE}_{\mathrm{fast}}^{100} \times \mathtt{CTE}_{\mathrm{slow}}^{Y-100}$
- $Y < 100: \ \mathtt{PHA}(Y) = \mathtt{PHA}_0 \times \mathtt{CTE}_{\mathrm{slow}}^{Y}$
- $\rightarrow \ \mathtt{PHA}(Y)/\mathtt{PHA}(Y-100) = \mathtt{CTE}_{\mathrm{fast}}^{100}$

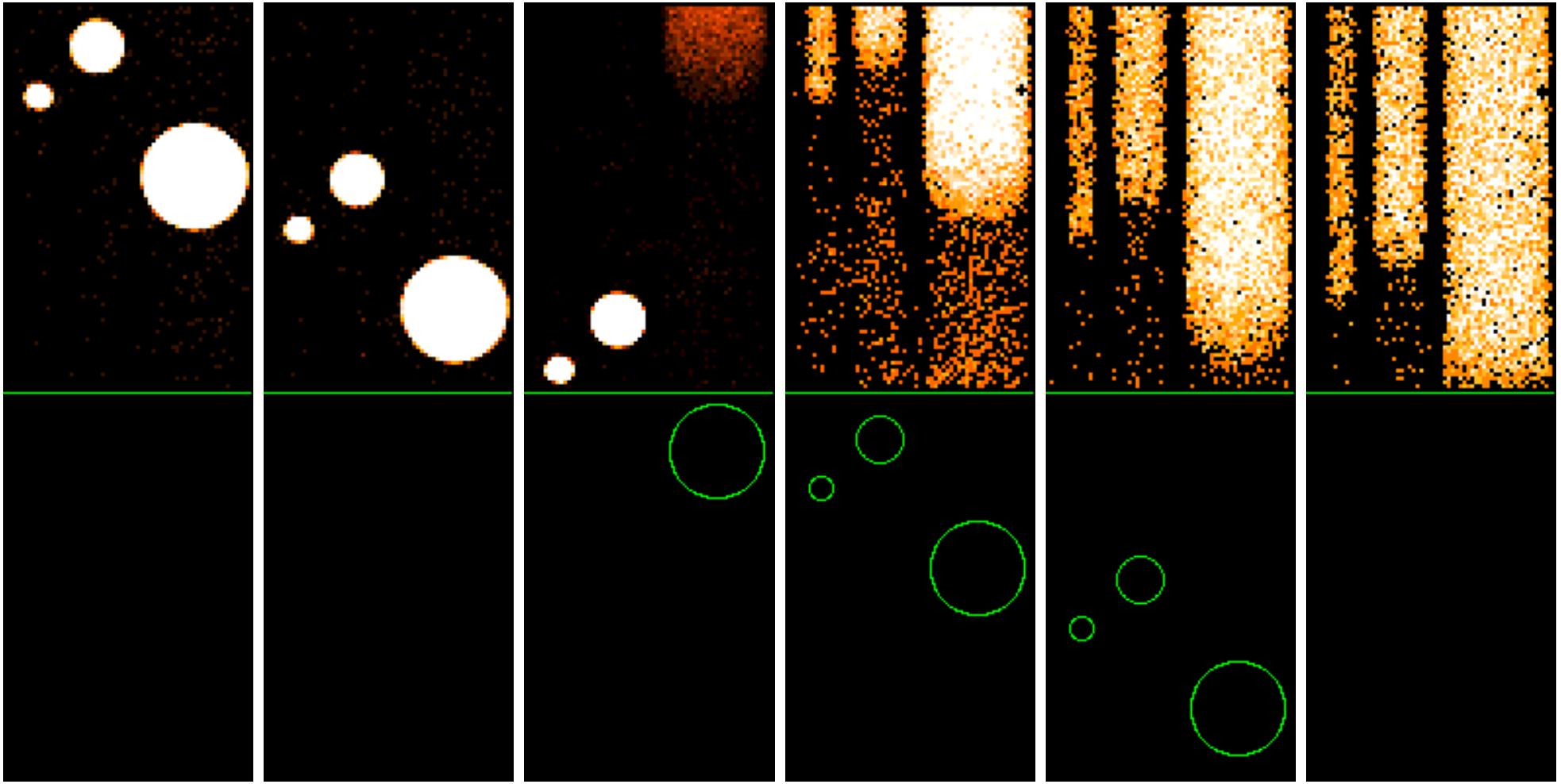
EPIC-pn: pinhole measurements: FF mode



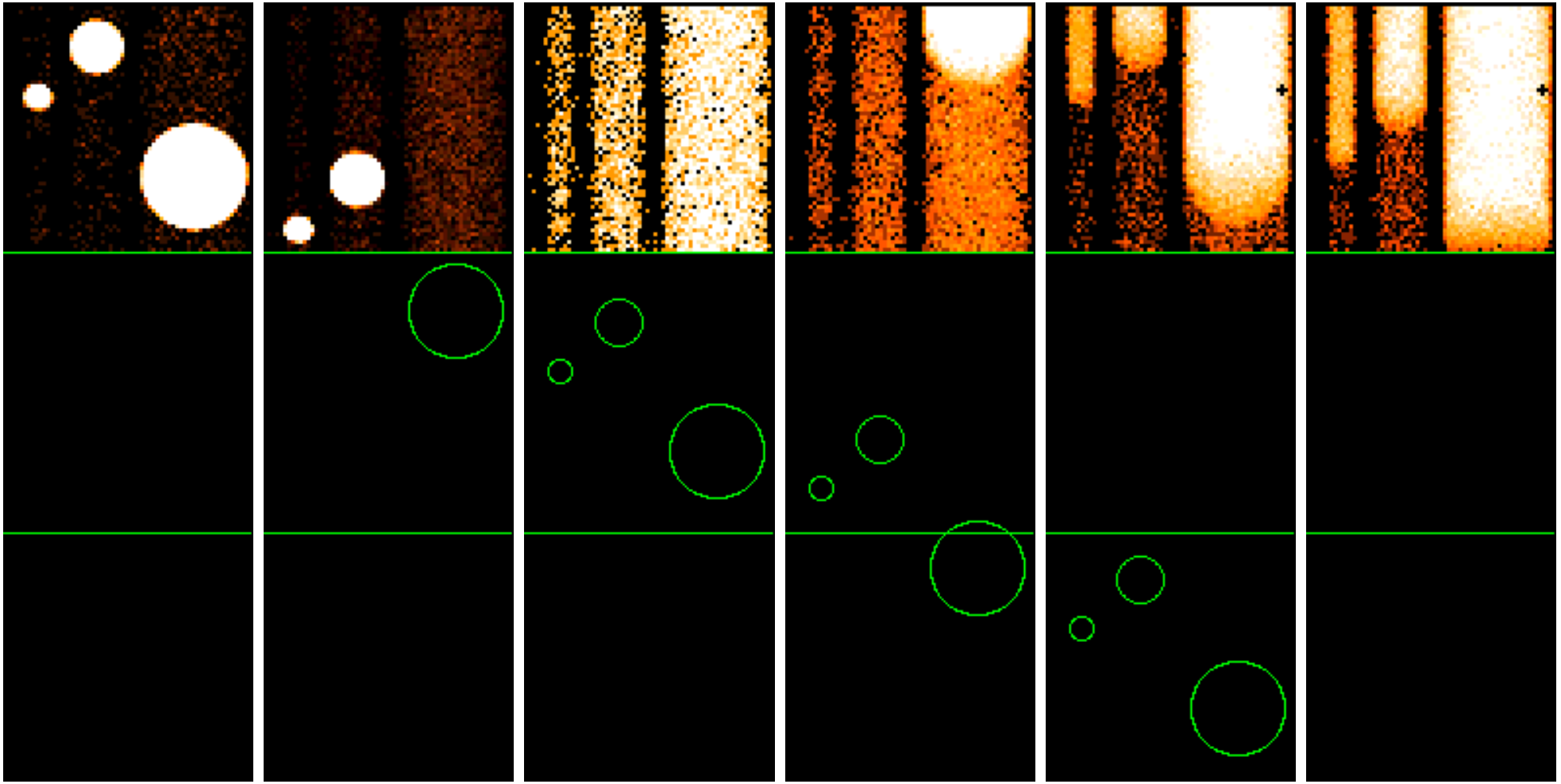
EPIC-pn: pinhole measurements: eFF mode



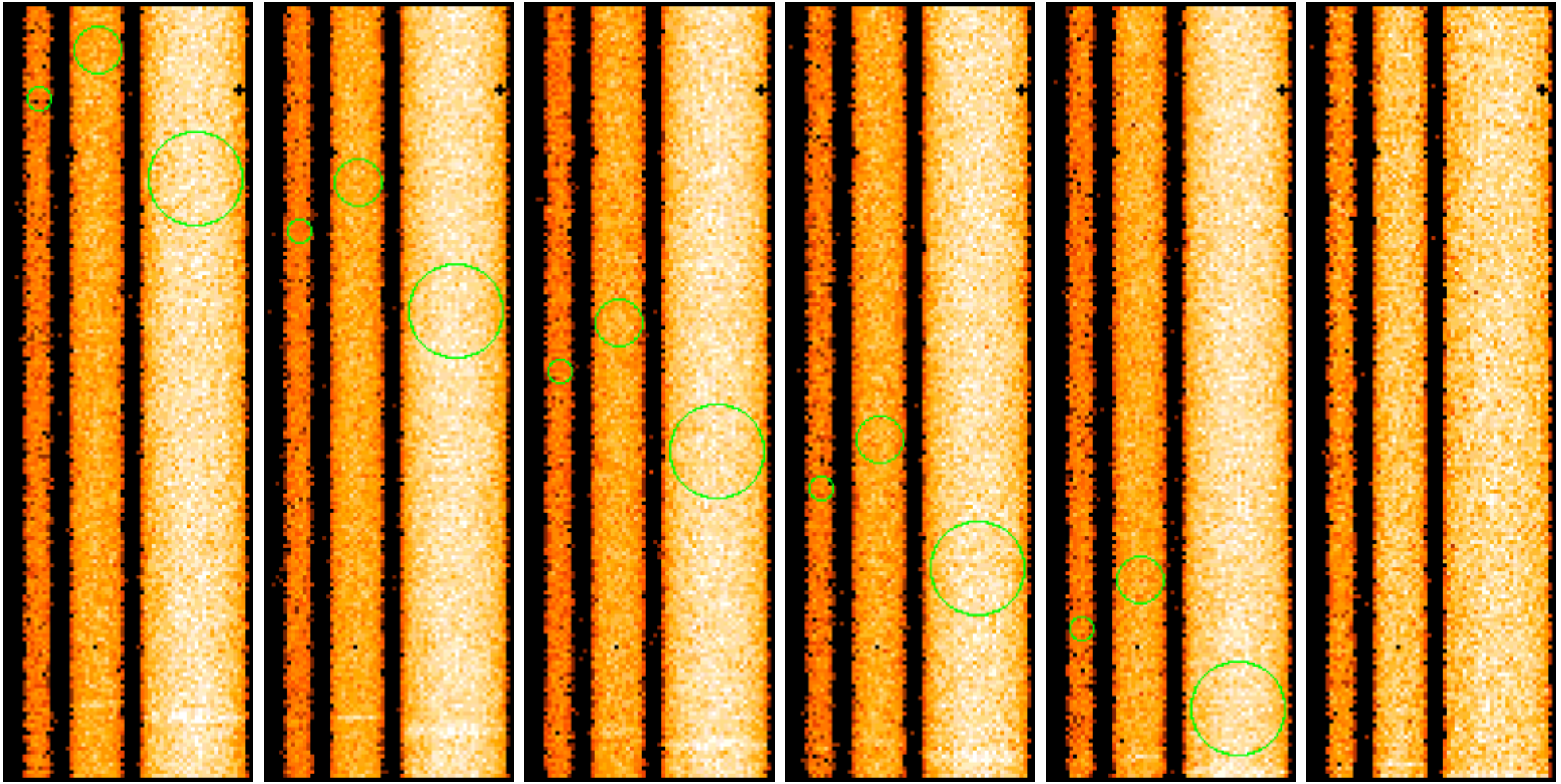
EPIC-pn: pinhole measurements: LW mode



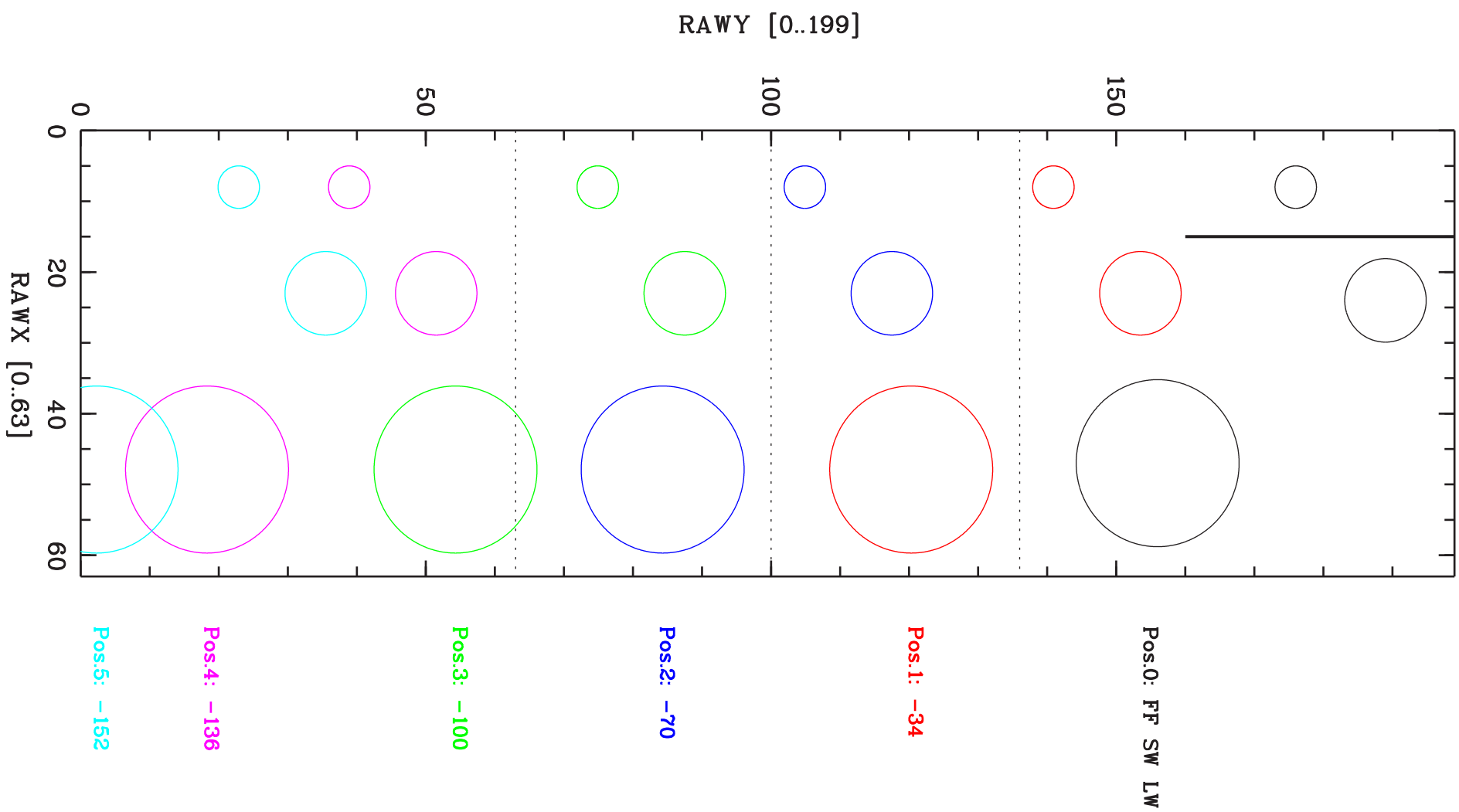
EPIC-pn: pinhole measurements: SW mode



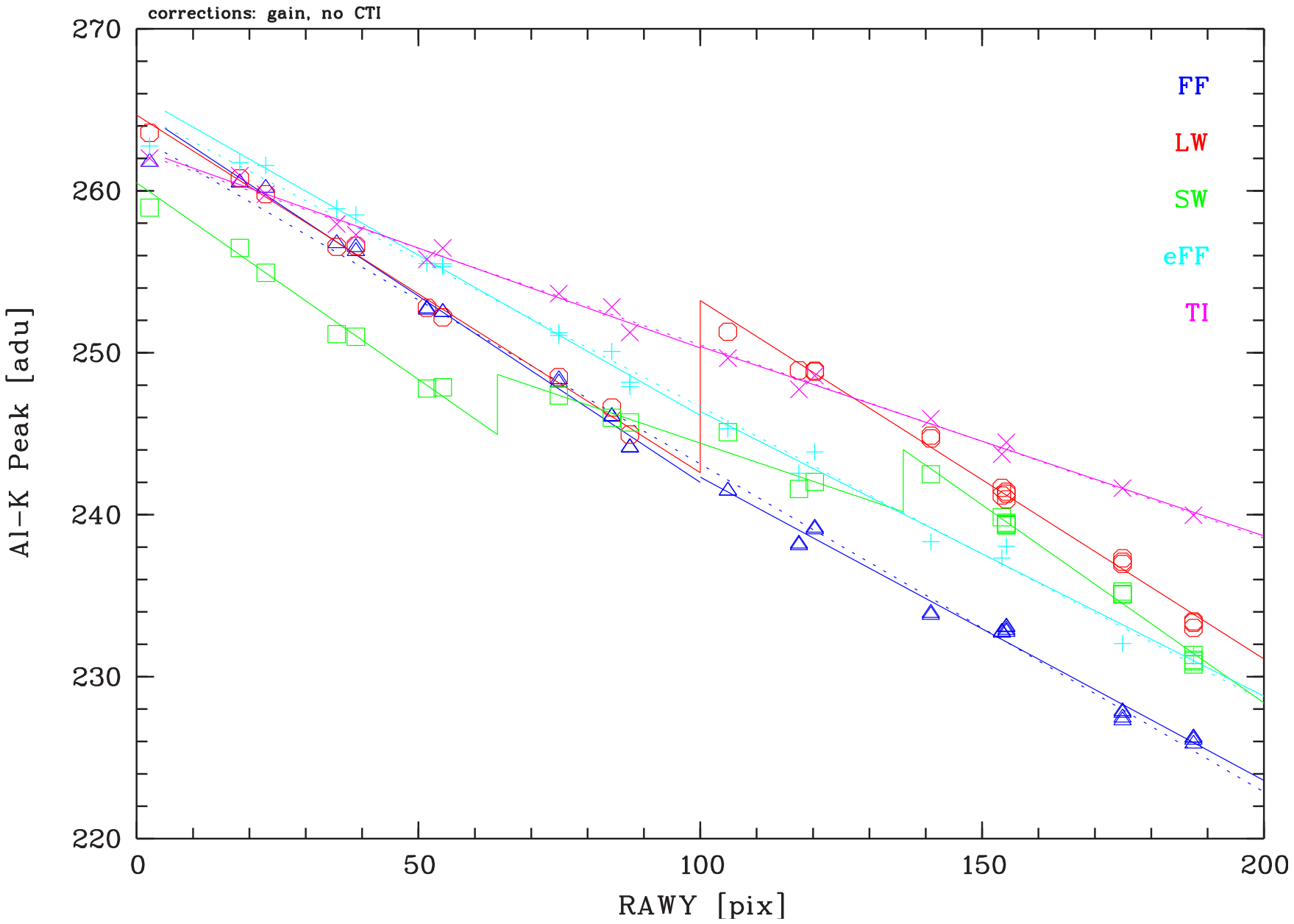
EPIC-pn: pinhole measurements: TI mode



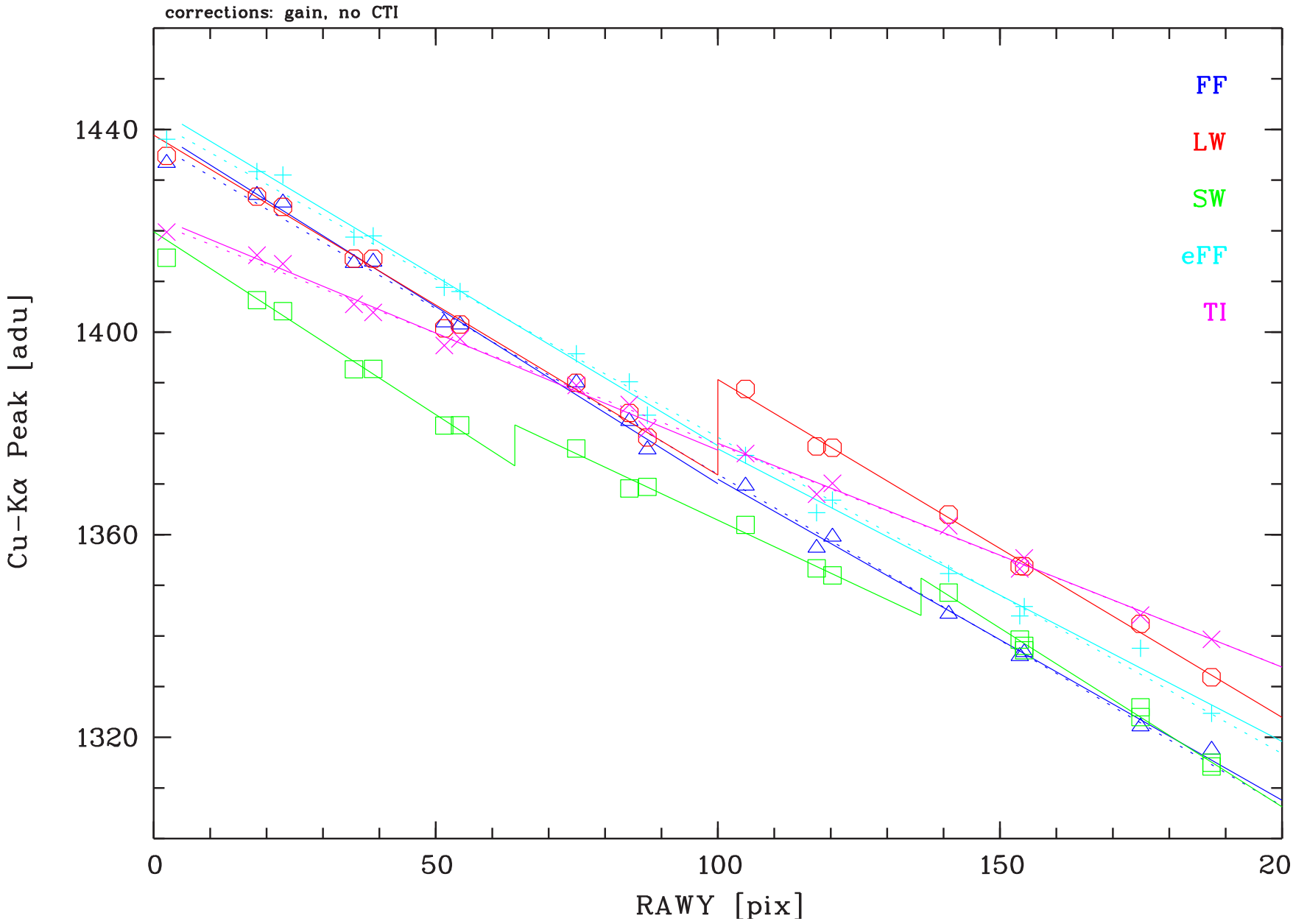
Reminder: pinhole measurements: design



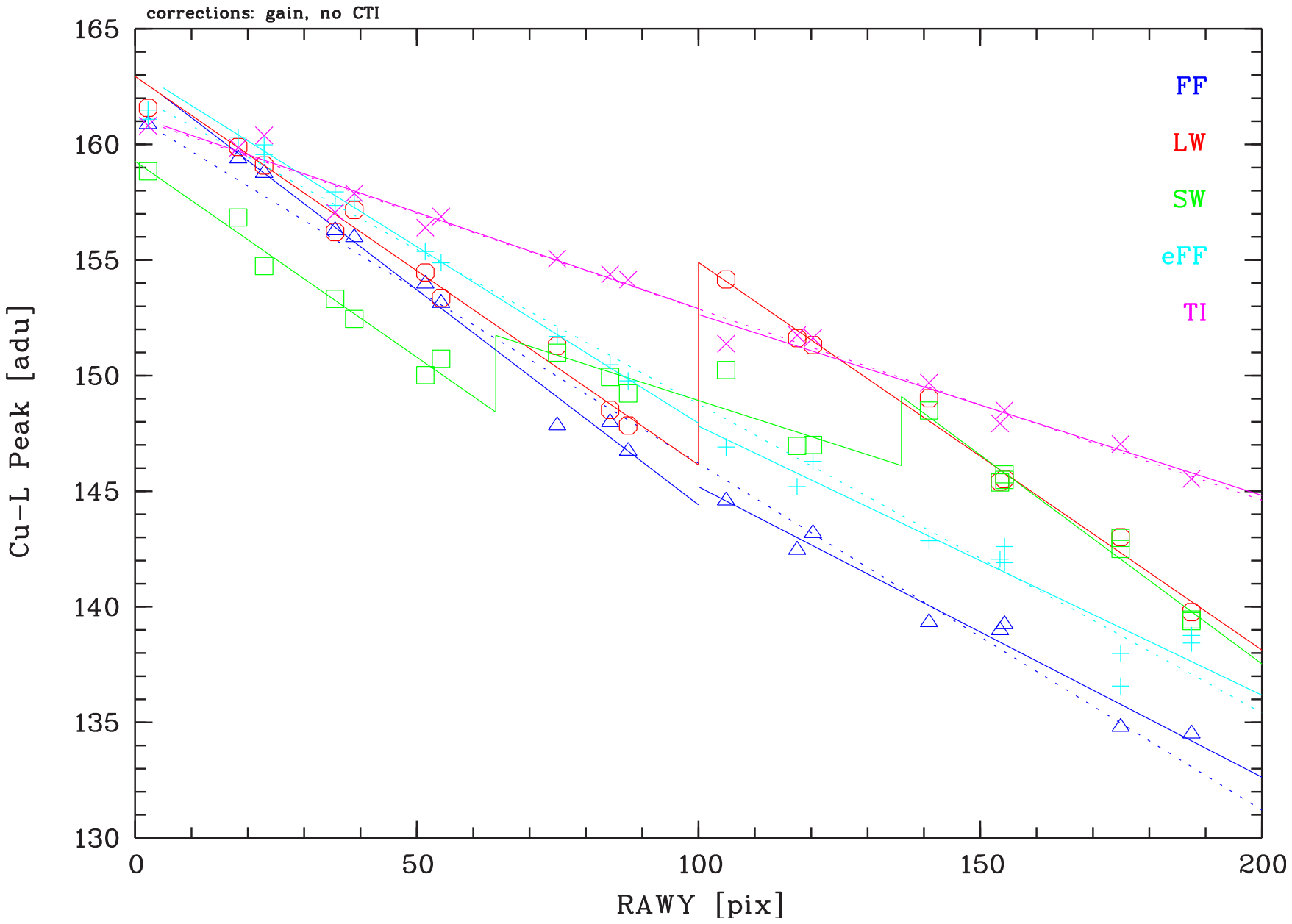
Pinhole measurements: all modes, Al-K



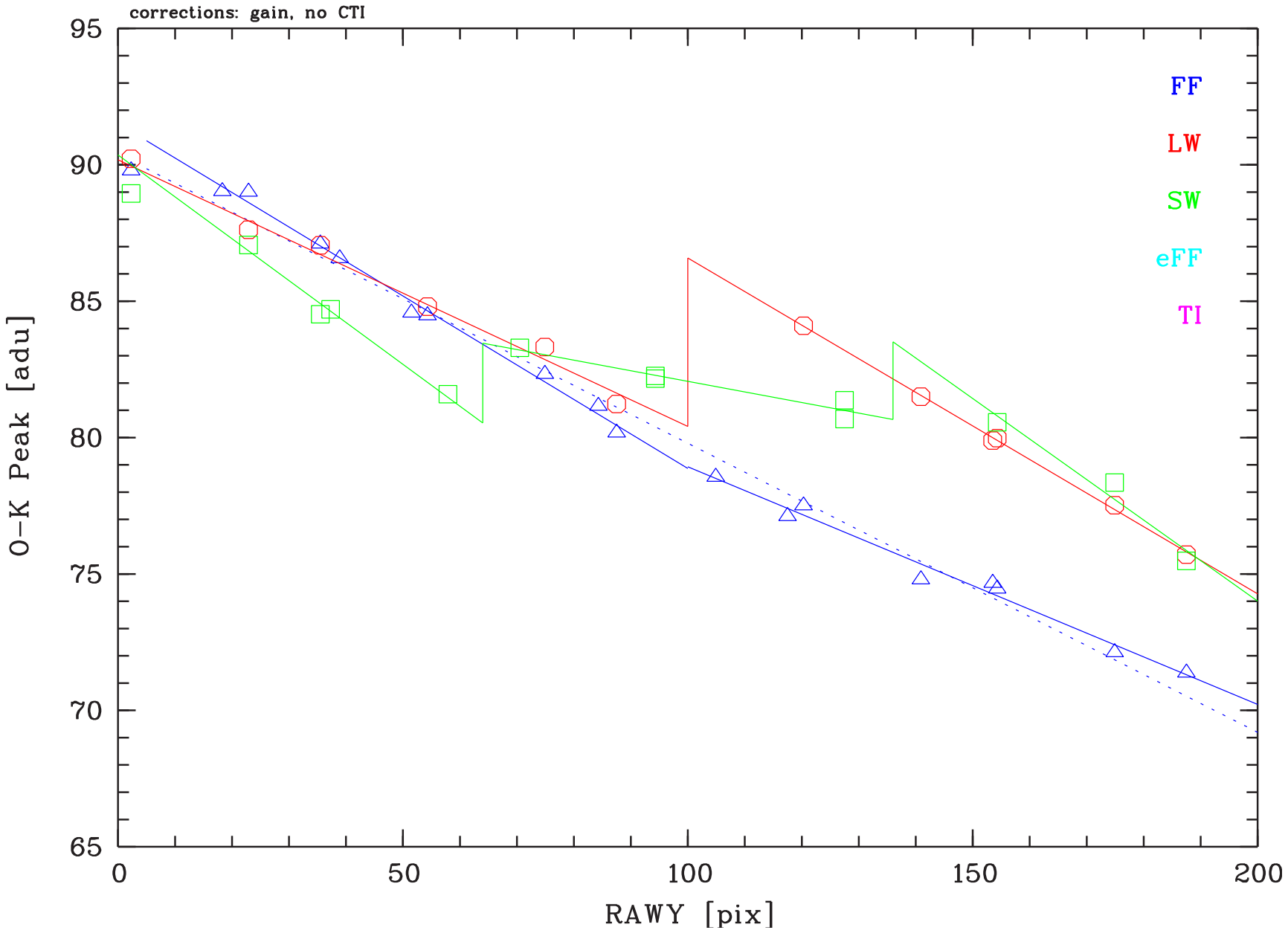
Pinhole measurements: all modes, Cu-Kα



Pinhole measurements: all modes, Cu-L



Pinhole measurements: all modes, O-K



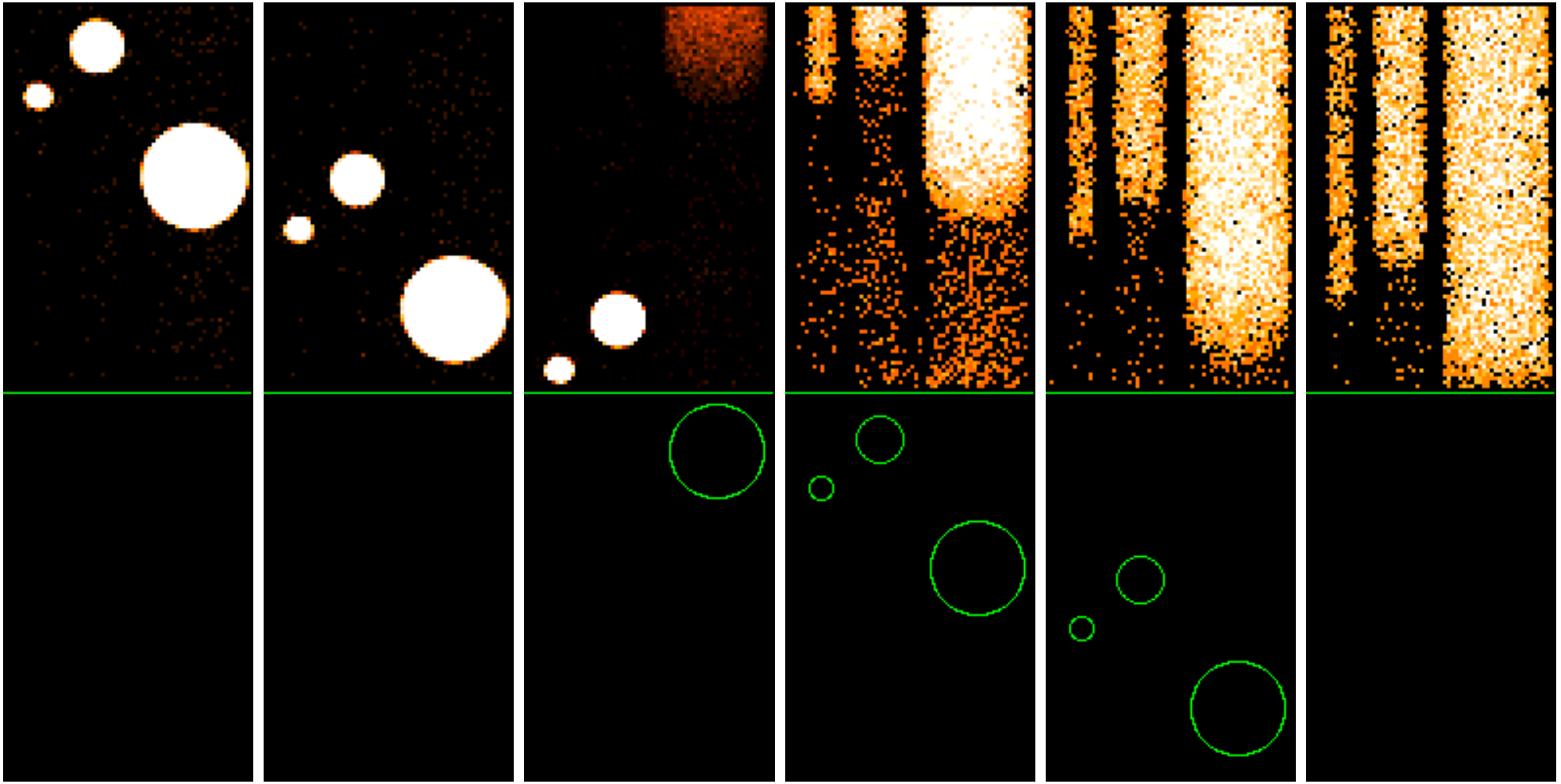
EPIC-pn CTI losses for FM1: adu/pixel

	Cu-K	Al-K	Cu-L	O-K	C-K
all					
eFF	0.625	0.182	0.134		
FF	0.655	0.203	0.150	0.106	0.090?
LW	0.667	0.221	0.168	0.123	0.064?
SW	0.706	0.244	0.181	0.149	0.149?
TI	0.439	0.119	0.083		
camex					
FF	0.699	0.230	0.186	0.126	
LW	0.671	0.221	0.168	0.098	
SW	0.723	0.243	0.170	0.153	
shift					
SW	0.523	0.118	0.078	0.039	

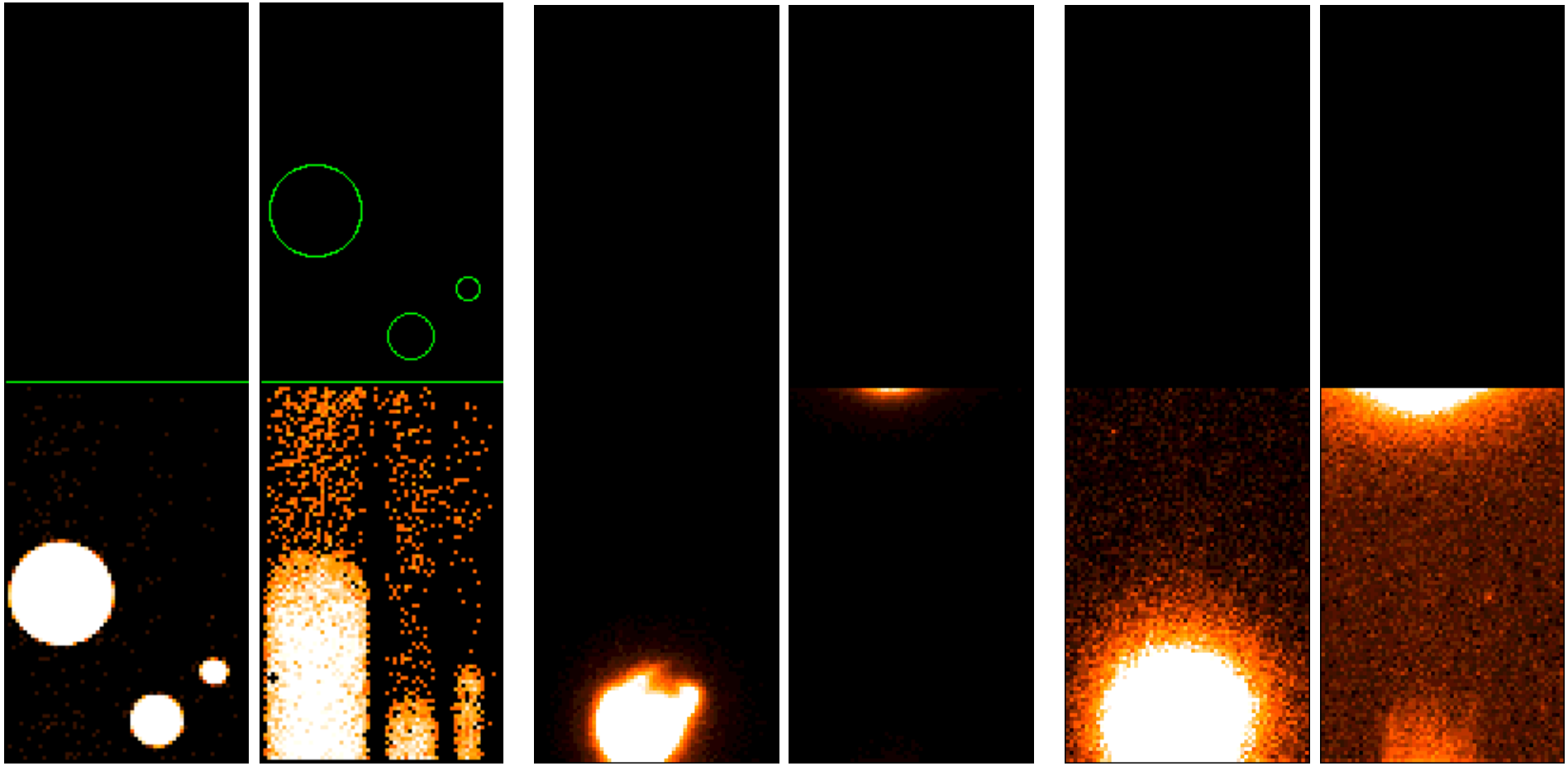
EPIC-pn CTI jumps for FM1: adu

LW	Cu-K	Al-K	Cu-L	O-K
Loss	67.13	22.09	12.56	9.77
Jump	18.87	10.62	9.70	6.18
frac.	0.28	0.48	0.77	0.63
func.	0.72	0.52	0.23	0.38

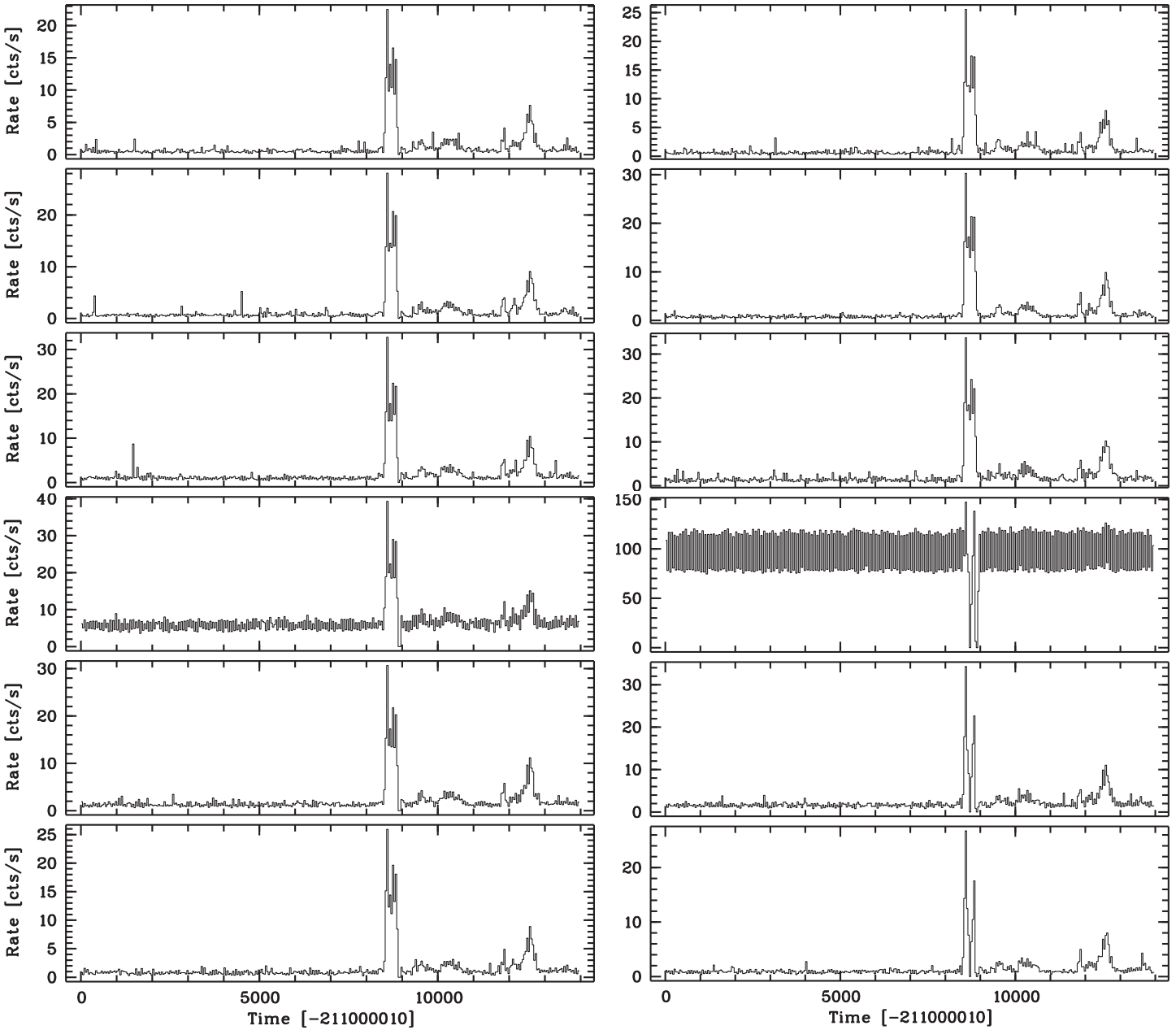
EPIC-pn: pinhole measurements: LW mode



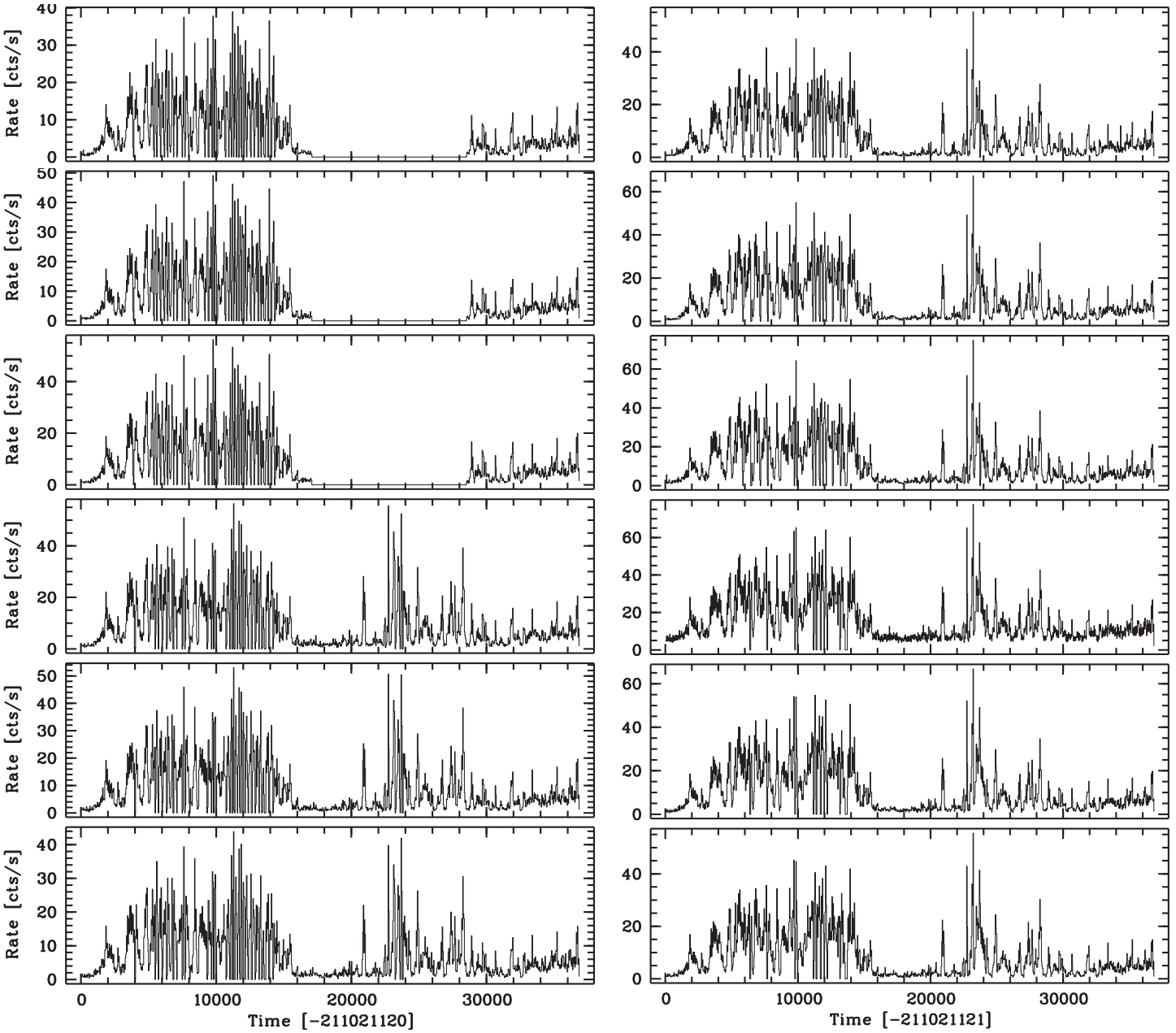
NRCO-31: 0870_0137551101 0870_0137551201, 8-Sep-2004



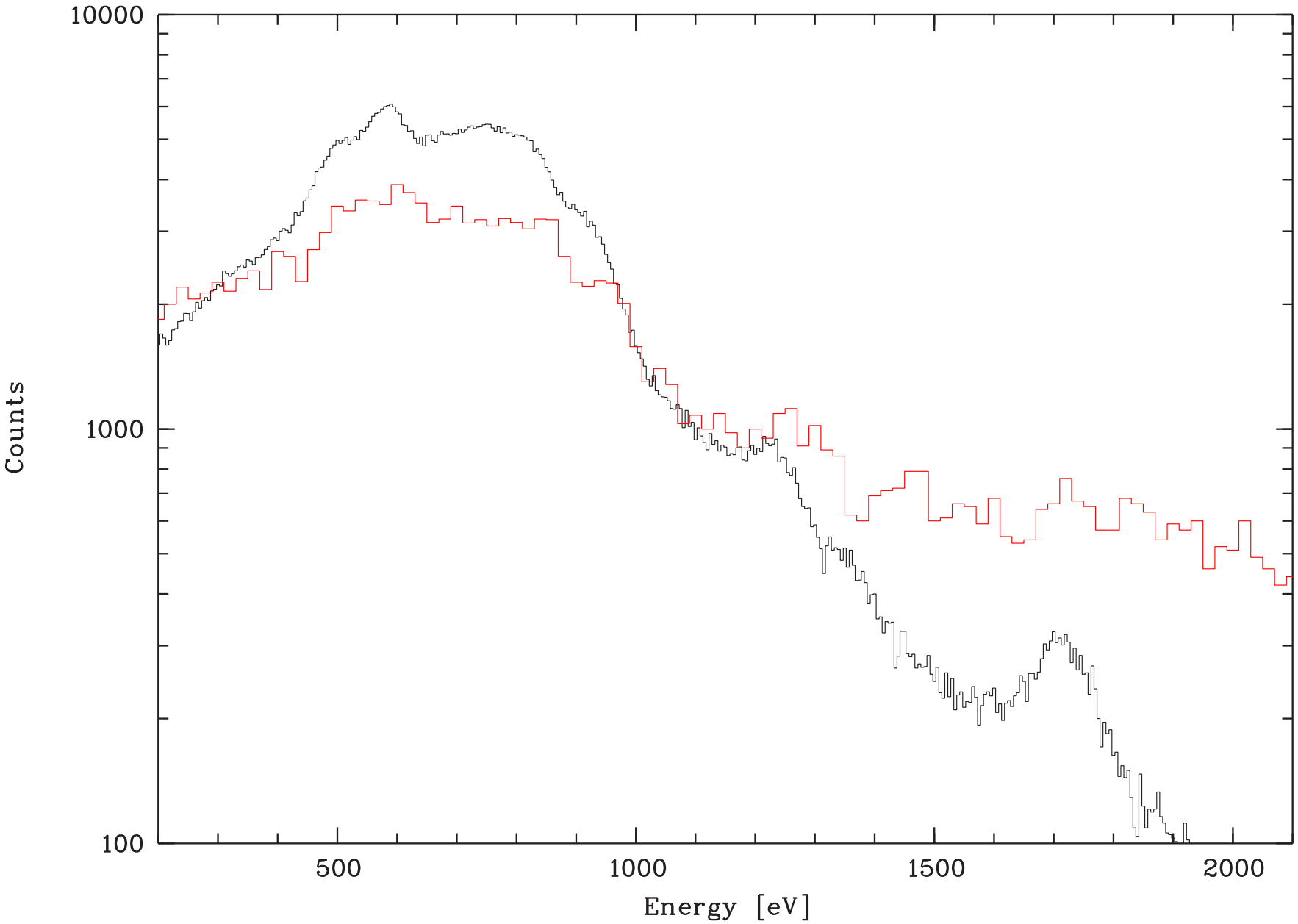
NRCO-31: 0870_0137551101_PNU001



NRCO-31: 0870_0137551201_PNU002



NRCO-31: spectra of N132D



Conclusions

- Method can be used to derive calibration parameters for FM1
- Gain seems to be mode-dependent ($\rightarrow$ SAS-6.1)
- Calibration parameters for FM1 differ from implementation for FS
- In-orbit calibration (NRCO-31):
  e.g. N132D in nominal position and in "-100"
- Repeat NRCO-31 observation with :
  – small coordinate adjustment
  – low background ;-)