Imaging and Spectral Performance of the HRC

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forthcoming CALDB updates

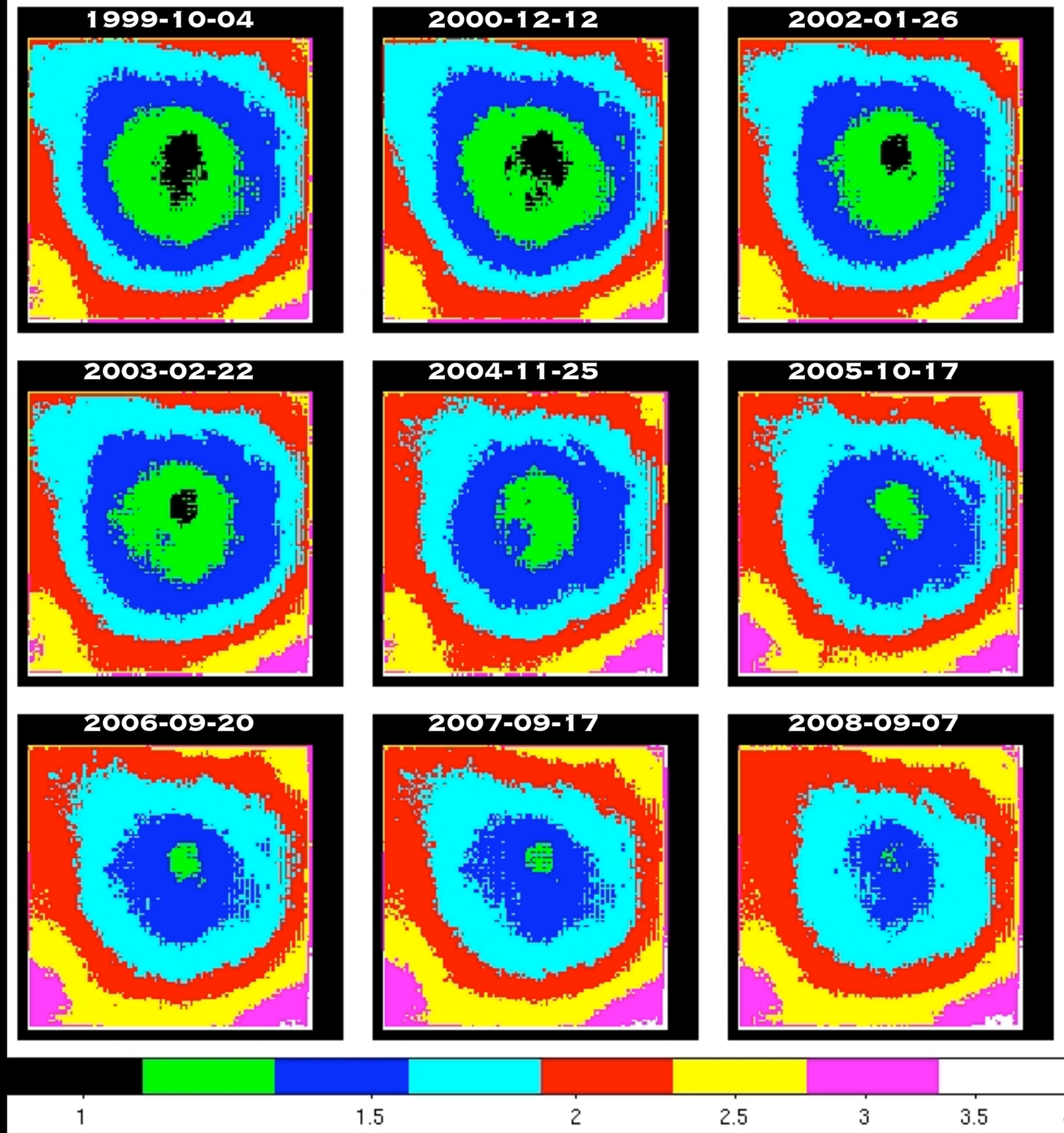
- time-dependent SAMP gainmap for the HRC-S
- time-tagged SAMP gainmaps for the HRC-I
- RMF for use with SPI for the HRC-I
- time-dependent background spectra for the HRC-I
- bad pixel map for the HRC-S

SAMP gainmaps

- scaled SUMAMPs
- better behaved than PHAs
- SPI is the new PI

SAMP gainmaps

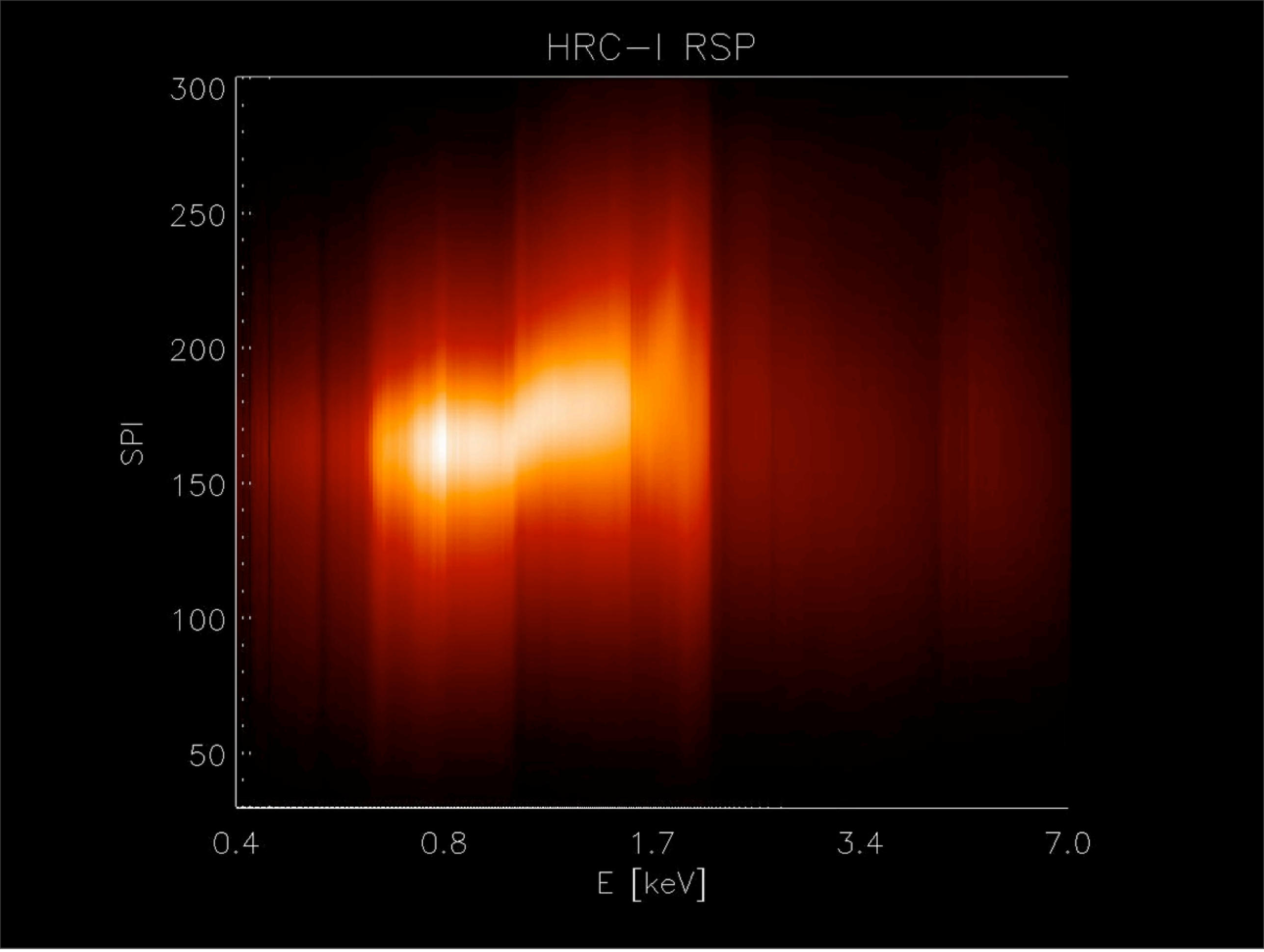
- HRC-S : see Brad's talk [C.13]
  - time-dependence built in, applied in `hrc_process_events`
- HRC-I : see Jenny's poster [C.16]
  - epoch-dependent maps, one per year

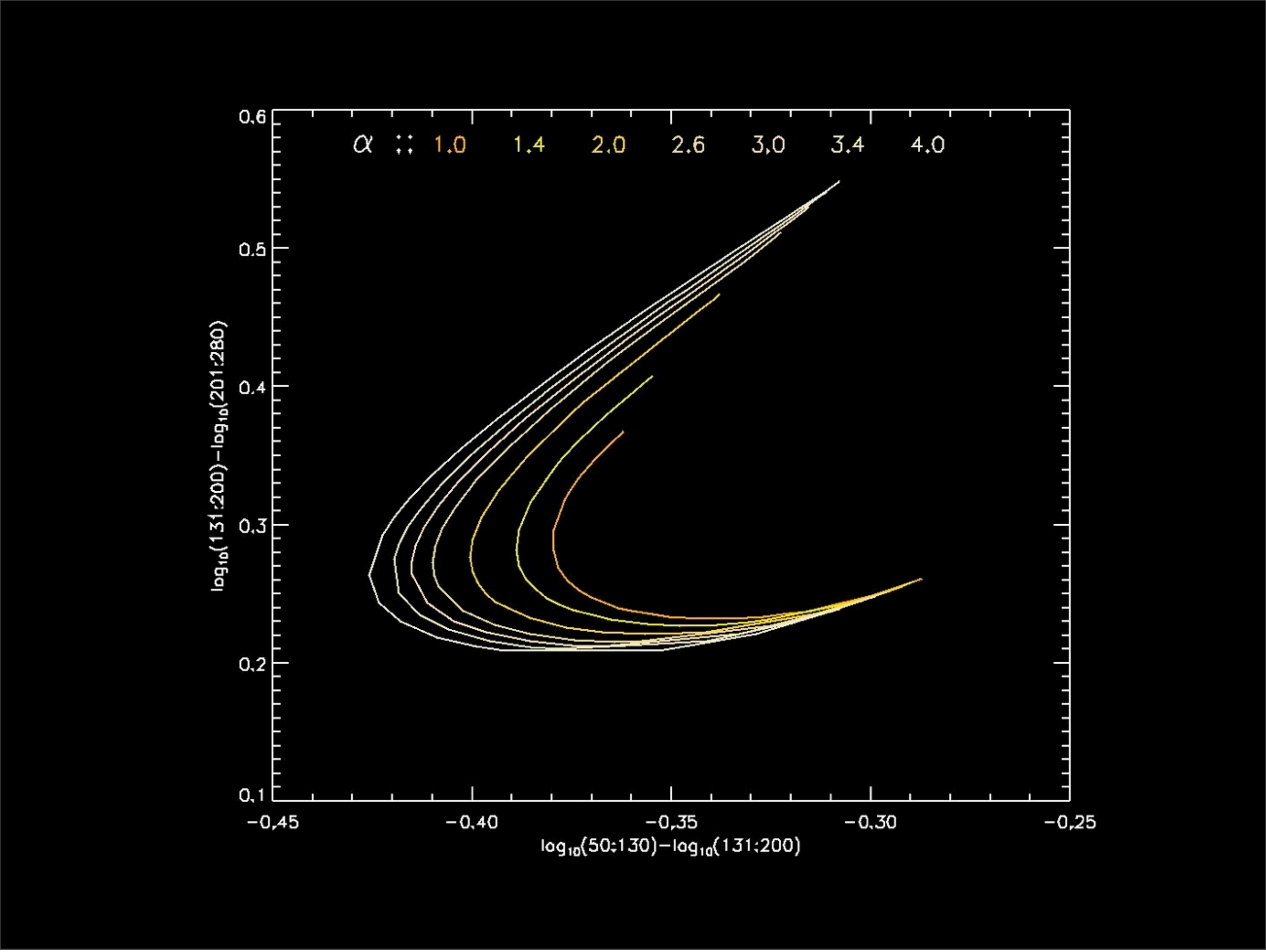

1999-10-04
2000-12-12
2002-01-26
2003-02-22
2004-11-25
2005-10-17
2006-09-20
2007-09-17
2008-09-07
1
1.5
2
2.5
3
3.5

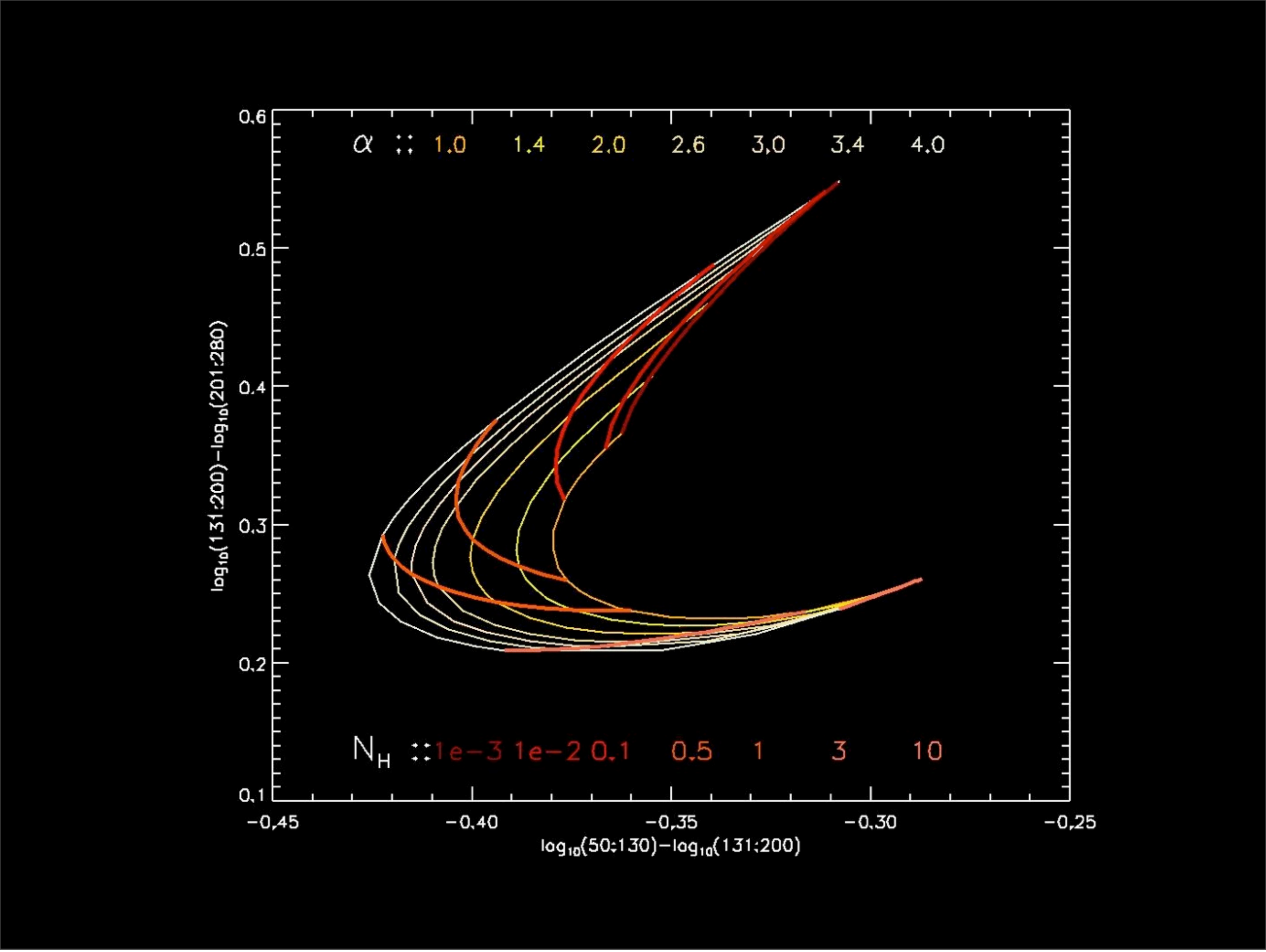
HRC-I RMF

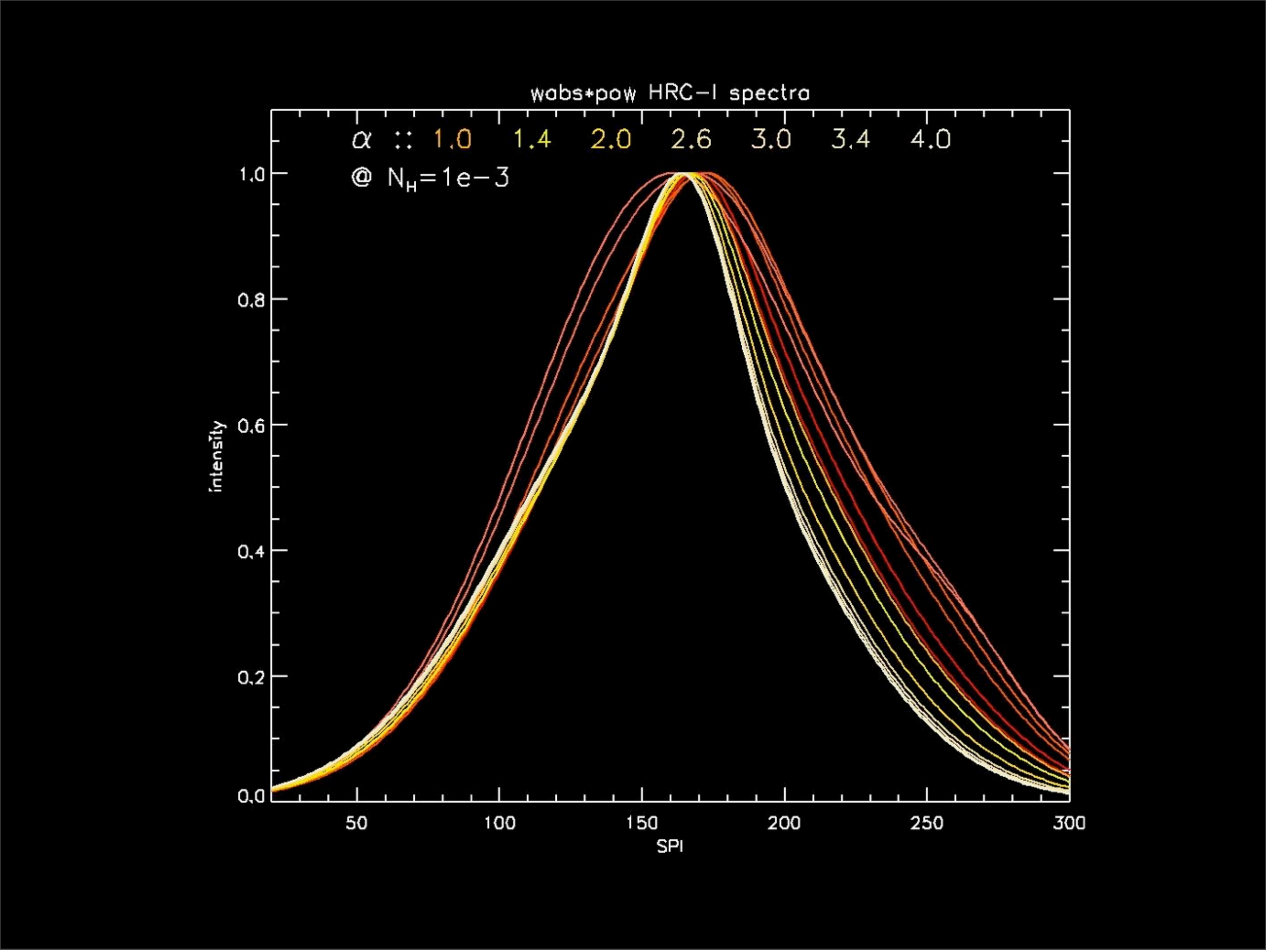
- new "SPI" requires new RMF
  - see Jenny's poster [C.16]

- why?
  - hardness ratios
  - filtering to reduce background


HRC−I RSP
300
250
200
150
100
50
SPI
0.4
0.8
1.7
3.4
7.0
E [keV]

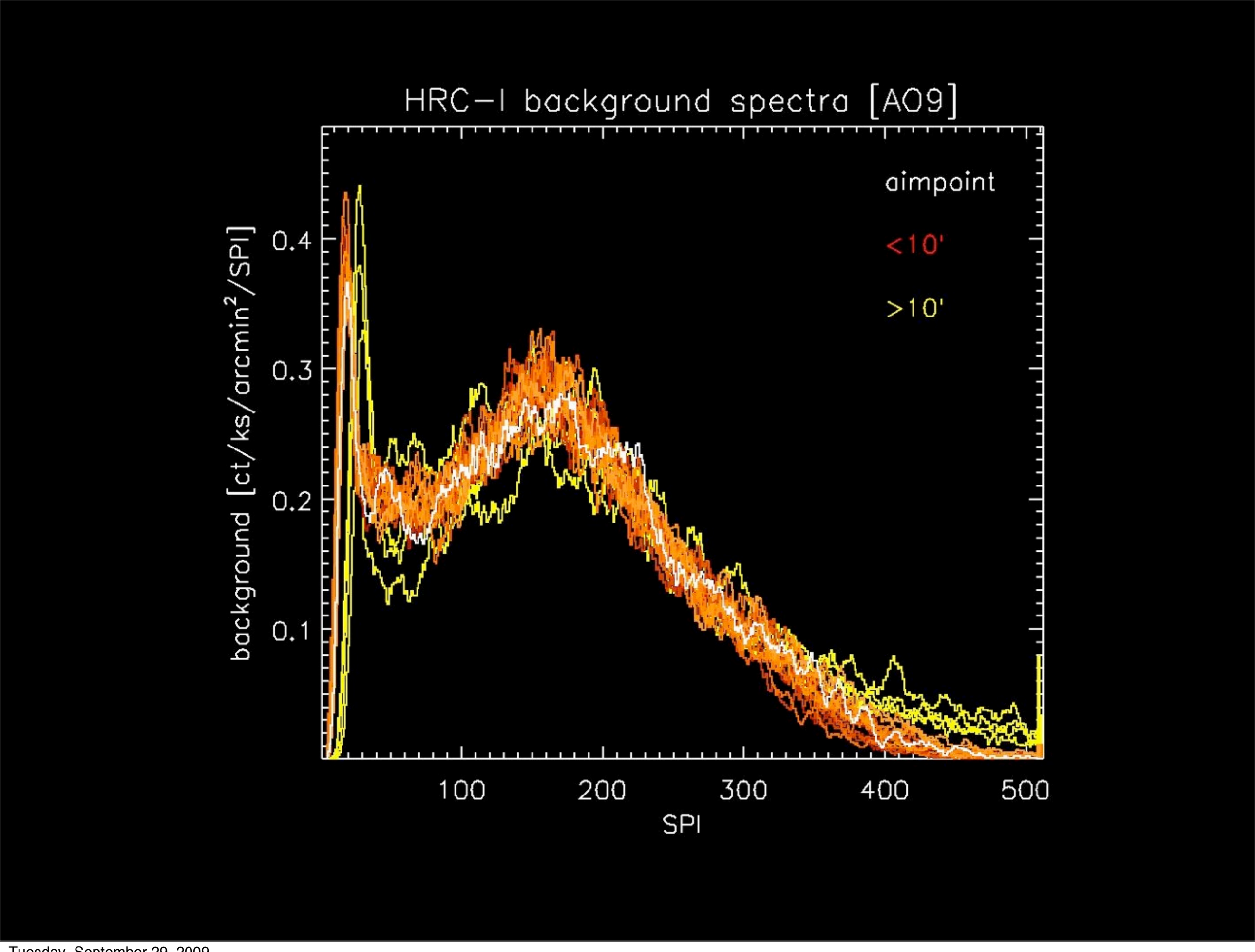

α : 1.0 1.4 2.0 2.6 3.0 3.4 4.0
0.6
0.5
0.4
0.3
0.2
0.1
log10(131:200)−log10(201:280)
−0.45
−0.40
−0.35
−0.30
−0.25
log10(50:130)−log10(131:200)

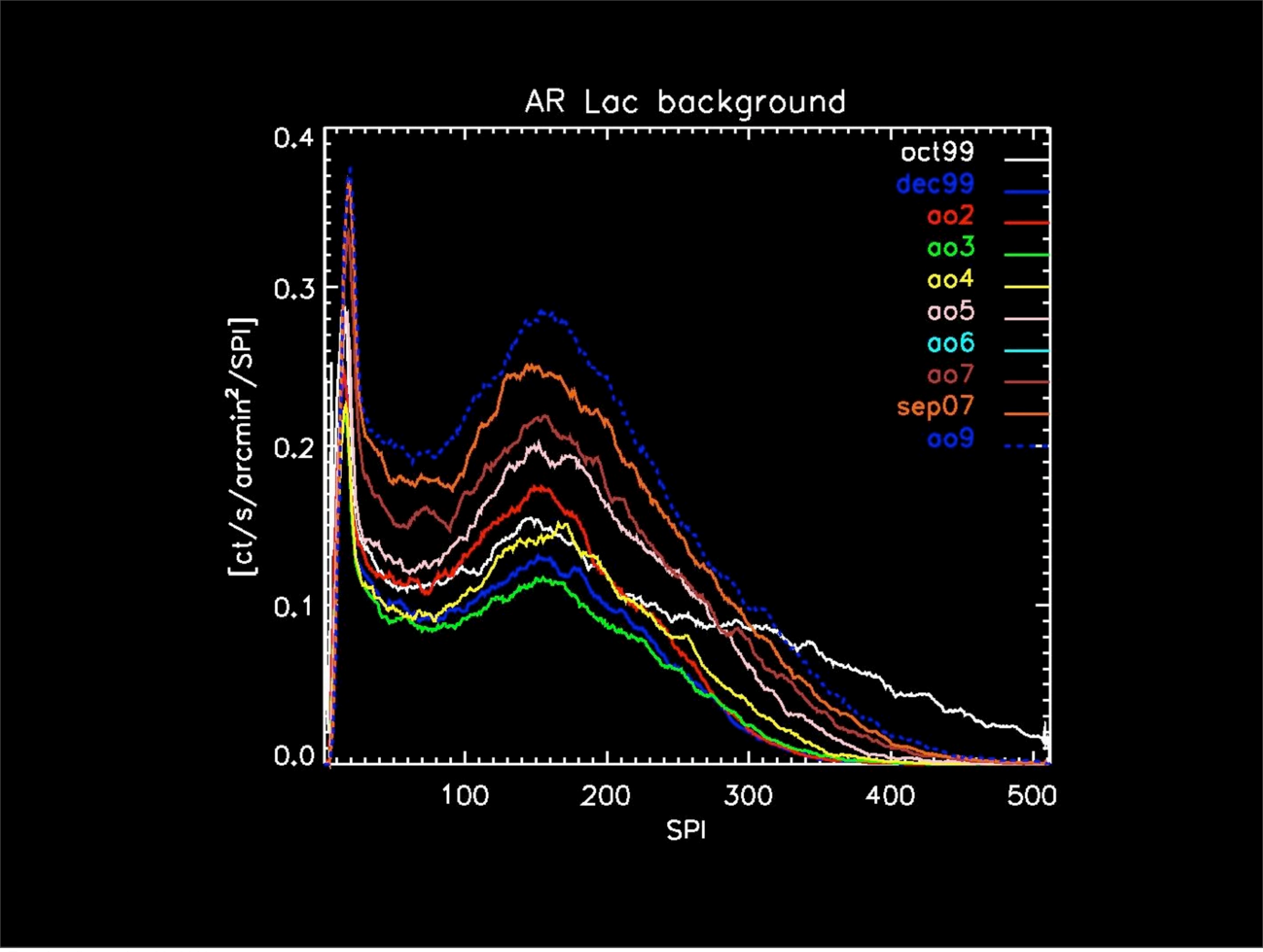

α :: 1.0 1.4 2.0 2.6 3.0 3.4 4.0
N_H :: 1e−3 1e−2 0.1 0.5 1 3 10
0.6
0.5
0.4
0.3
0.2
0.1
−0.45
−0.40
−0.35
−0.30
−0.25
log10(131:200)−log10(201:280)
log10(50:130)−log10(131:200)

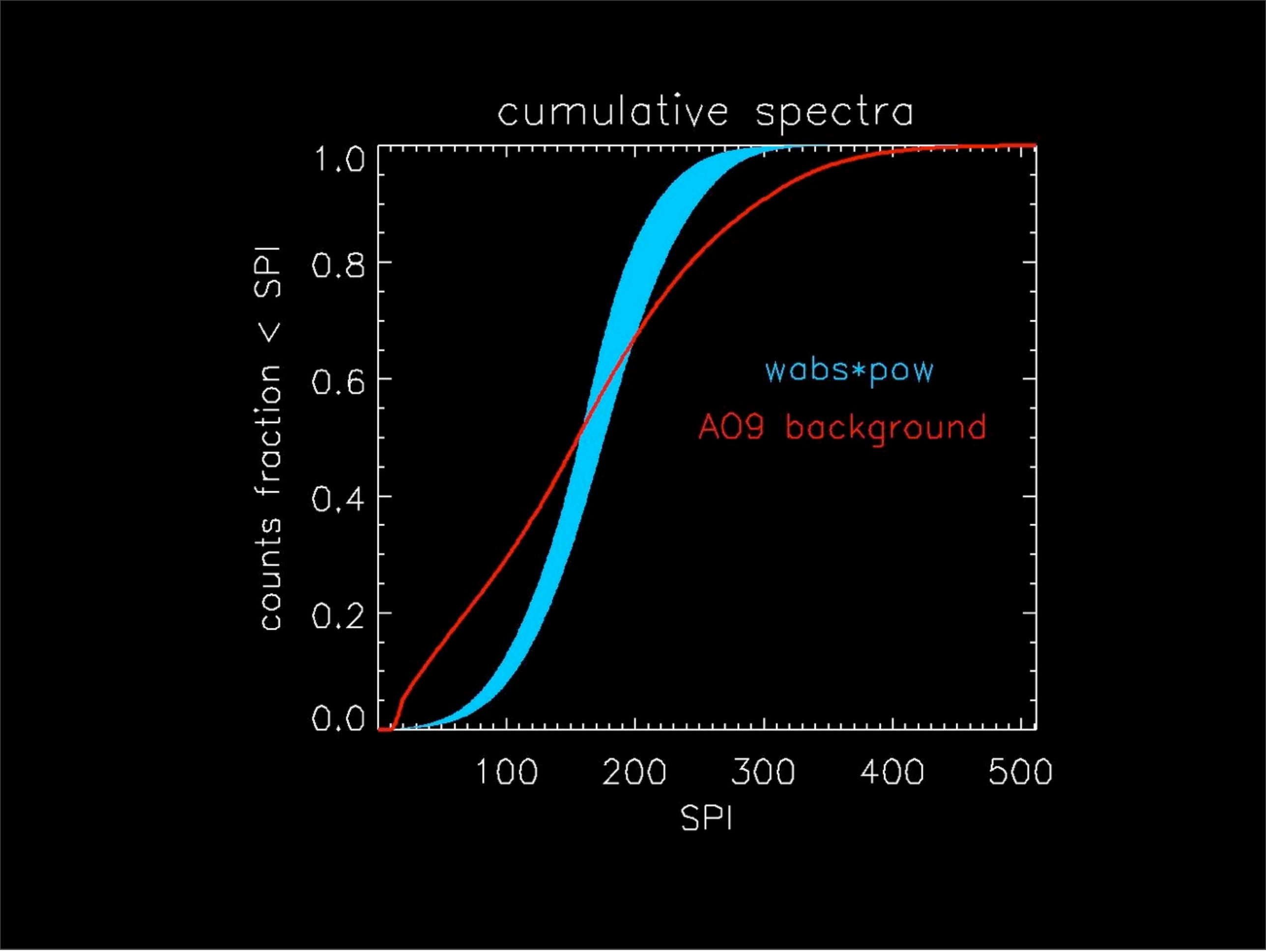

wabs*pow HRC-I spectra
α :: 1.0 1.4 2.0 2.6 3.0 3.4 4.0
@ N_H=1e-3
Intensity
1.0
0.8
0.6
0.4
0.2
0.0
50
100
150
200
250
300
PI

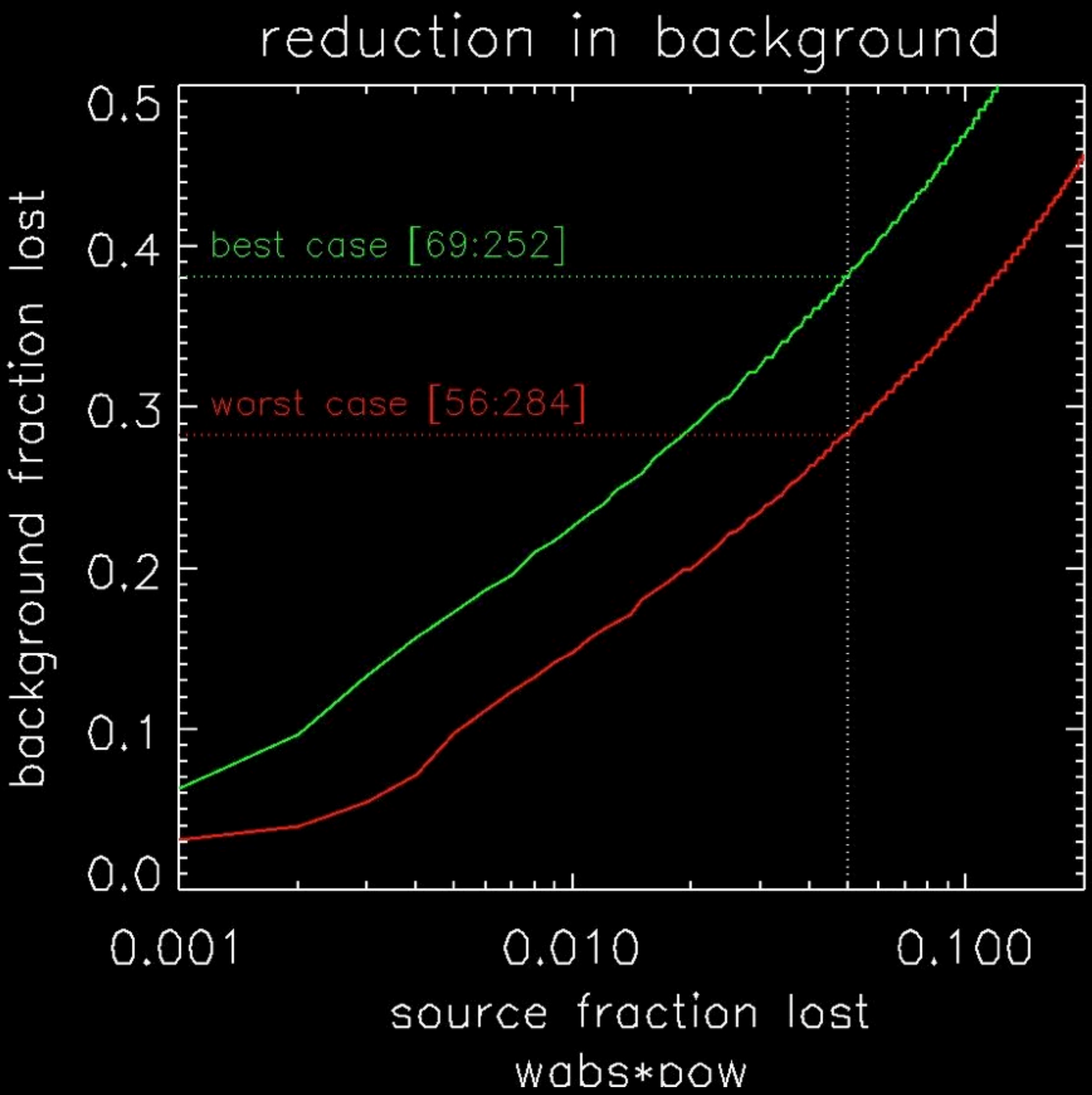
HRC-I background

- particle background has increased by ~2x
  - see Takashi's poster [C.17]
- spatial variations can be eliminated with gainmap
- temporal variations can be interpolated
- filter on SPI to improve source detection


HRC−I background spectra [A09]
aimpoint
<10'
>10'
background [ct/ks/arcmin²/SPI]
0.4
0.3
0.2
0.1
100
200
300
400
500
SPI


AR Lac background
0.4
0.3
0.2
0.1
0.0
[ct/s/arcmin²/SPI]
100
200
300
400
500
SPI
oct99
dec99
ao2
ao3
ao4
ao5
ao6
ao7
sep07
ao9


cumulative spectra
counts fraction < SPI
1.0
0.8
0.6
0.4
0.2
0.0
wabs*pow
A09 background
100
200
300
400
500
SPI

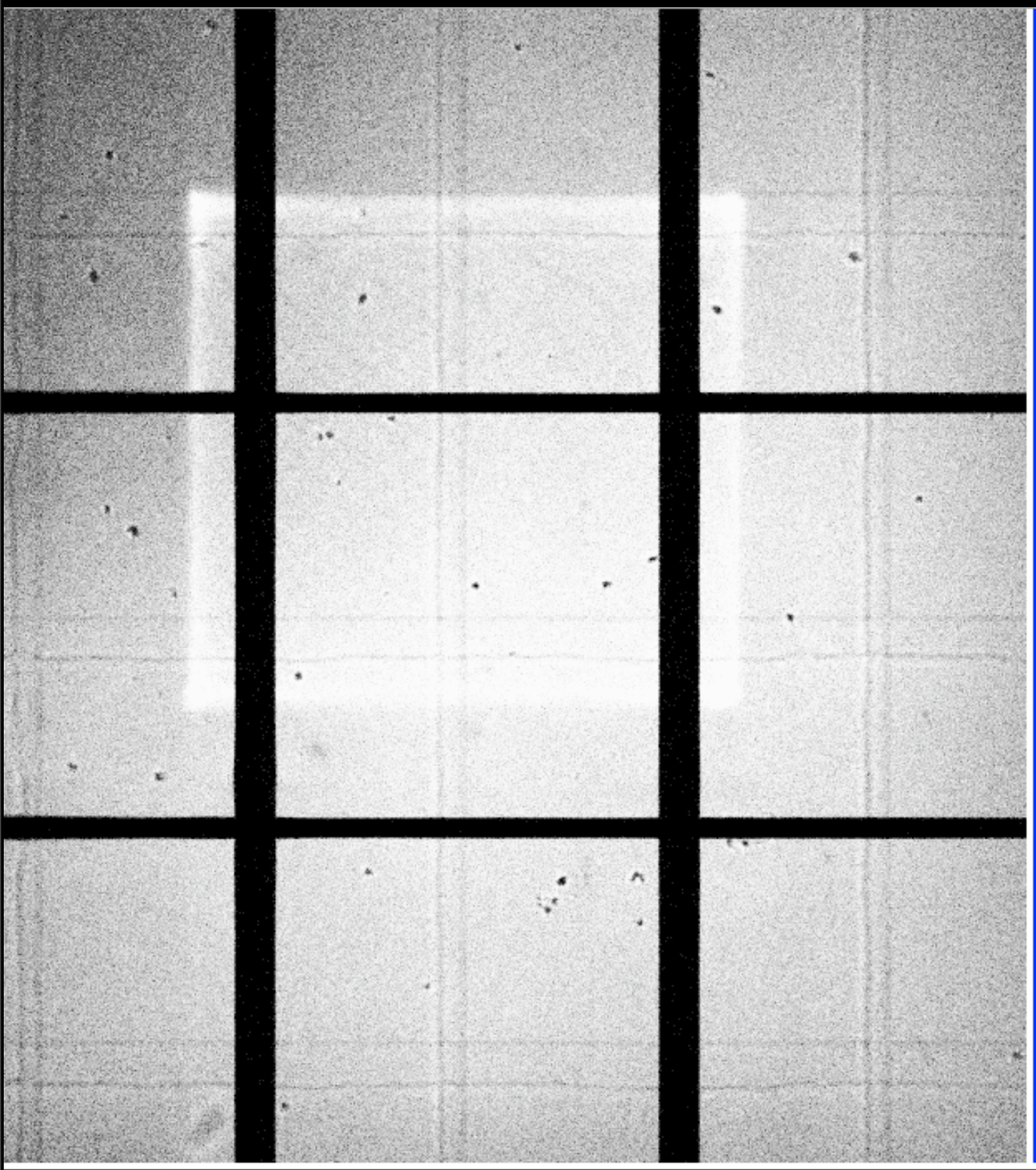

reduction in background
0.5
0.4
0.3
0.2
0.1
0.0
background fraction lost
best case [69:252]
worst case [56:284]
0.001
0.010
0.100
source fraction lost
wabs*pow

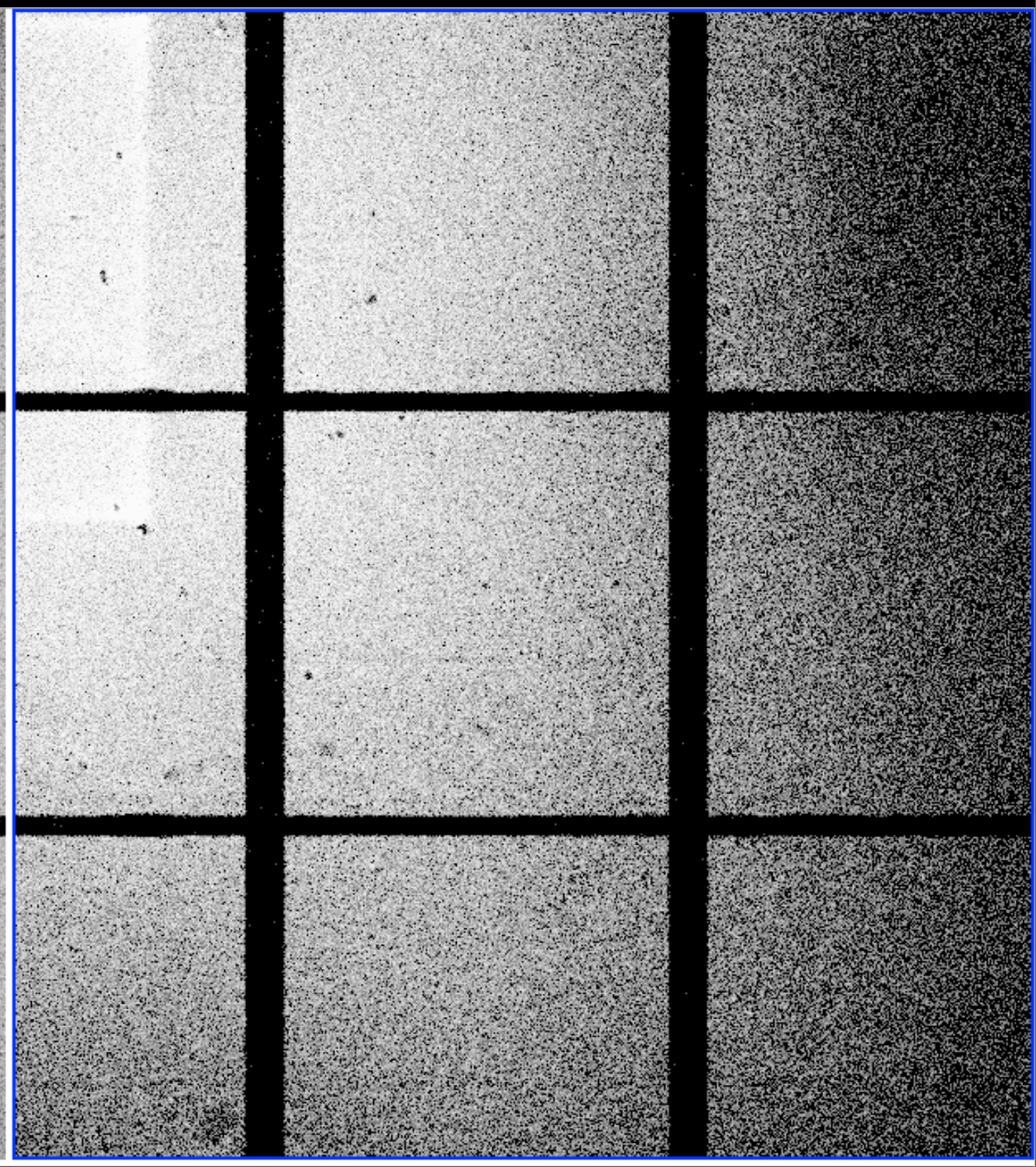
HRC-S bad pixel map

- Crab data at the HRC-S aimpoint

ObsID 758 : 2000-01-31

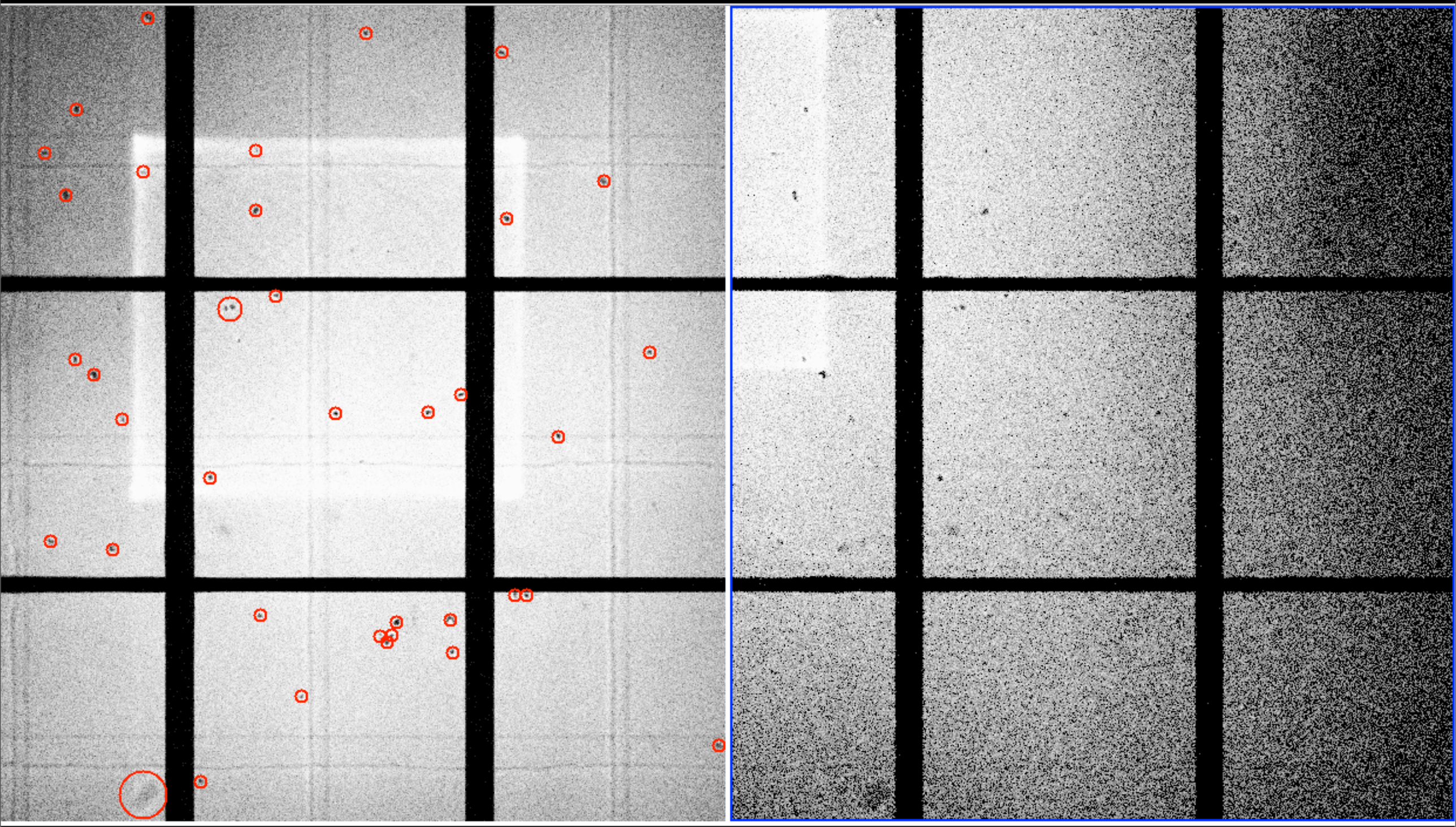
ObsID 9765 : 2008-01-22





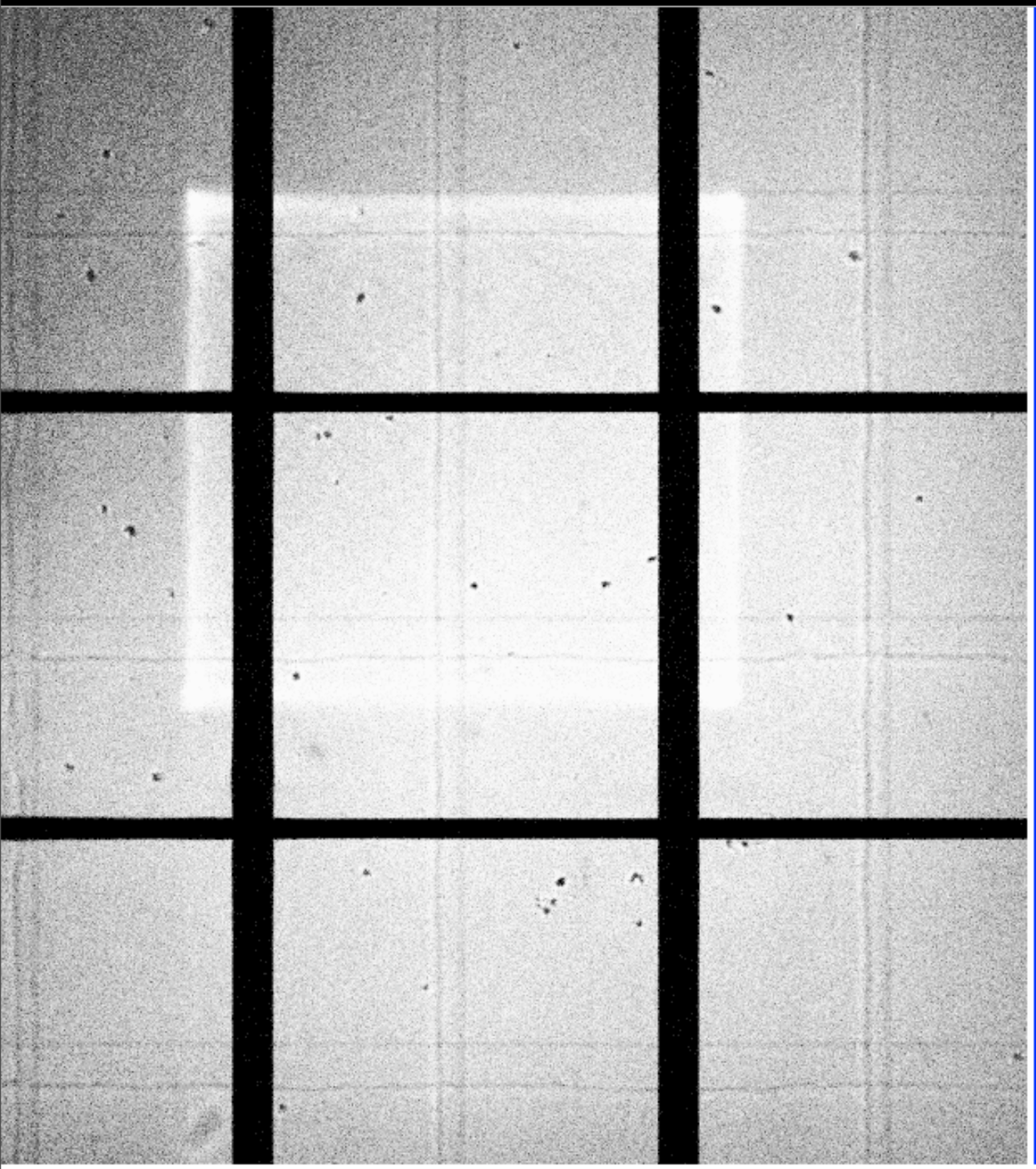
ObsID 758 : 2000-01-31

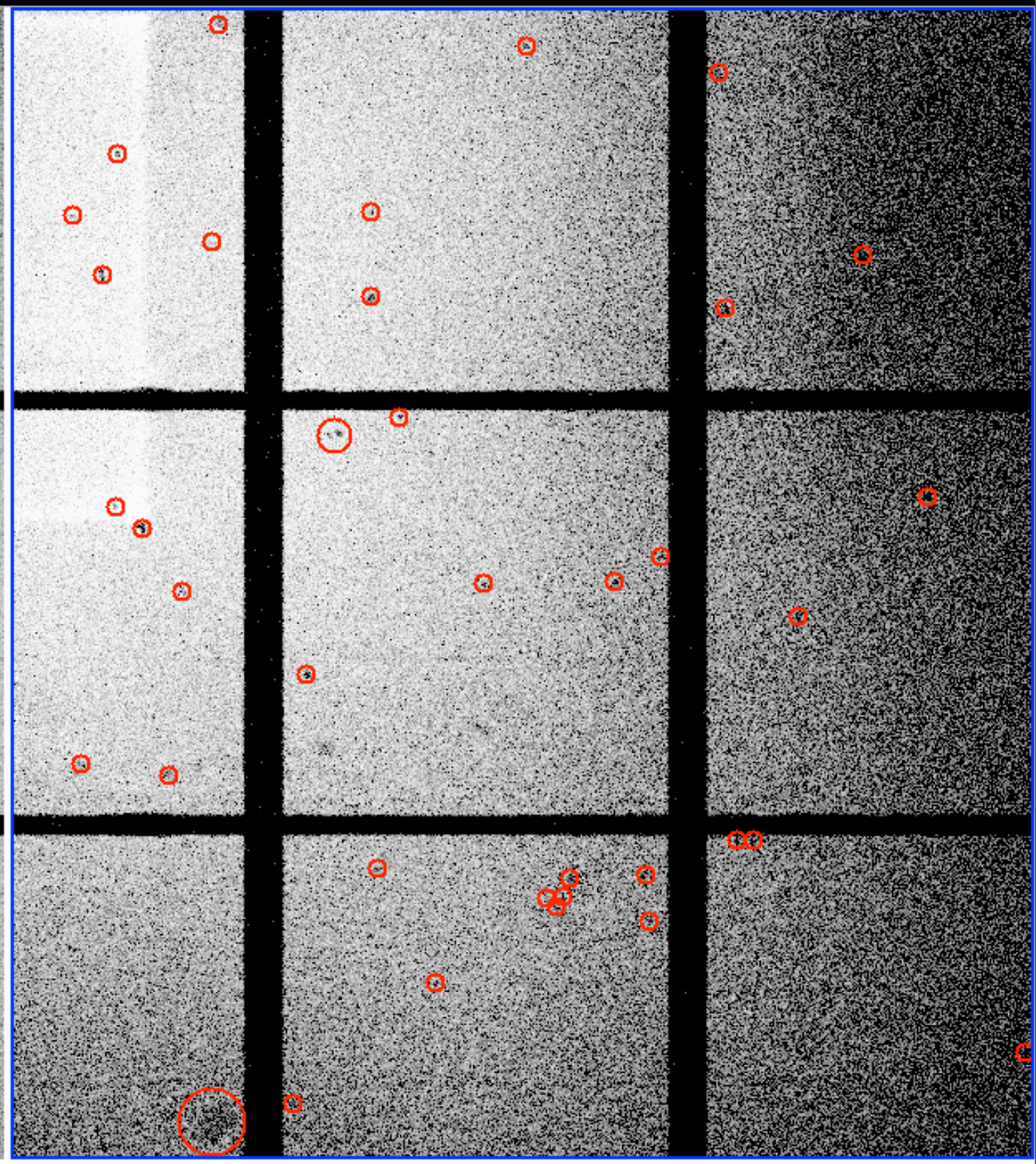
ObsID 9765 : 2008-01-22



ObsID 758 : 2000-01-31

ObsID 9765 : 2008-01-22





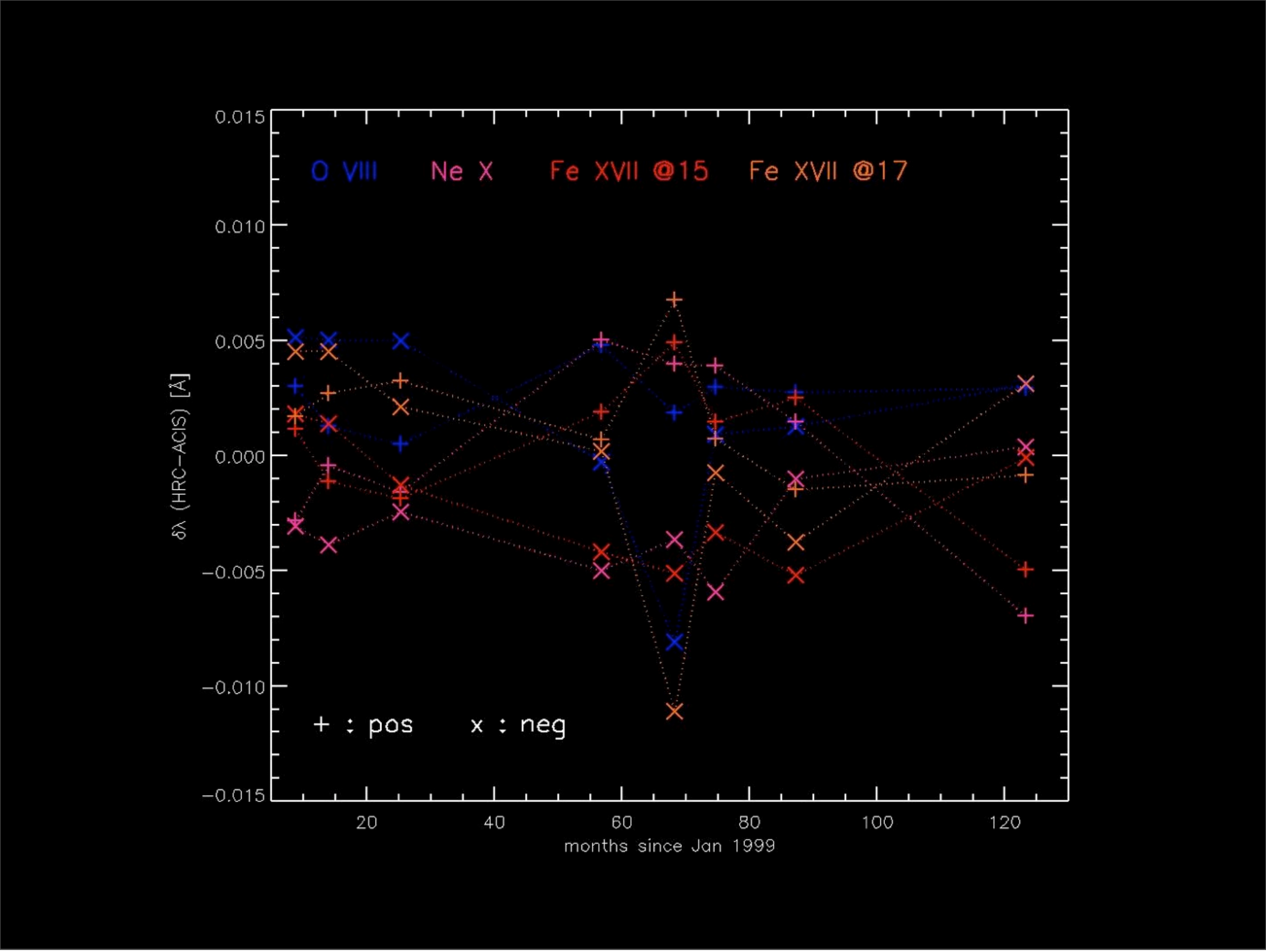
HRC-S bad pixel map

- many bad areas, but no new ones

one more thing..

HRC-S/LETG non-linearities

- dispersion relation expected to be correct to rms 0.006 Å on an absolute scale
- based on Capella: binary with ±60 km/s deviations (~0.003 Å at 15 Å)
- verify with near simultaneous ACIS-S/HETG wavelengths


O VIII
Ne X
Fe XVII @15
Fe XVII @17
0.015
0.010
0.005
0.000
−0.005
−0.010
−0.015
δλ (HRC−ACIS) [Å]
+ : pos
x : neg
20
40
60
80
100
120
months since Jan 1999

HRC-S/LETG non-linearities

line	offset from MEG [Å]
O VIII	0.002±**0.0034**
Ne X	-0.0014±**0.0039**
Fe XVII (15)	-0.0007±**0.0033**
Fe XVII (17)	0.0008±**0.0043**

HRC-S/LETG non-linearities

- residual non-linearities less than 0.004Å
- no evidence for time dependence in degap
  (yet)