EVOLUTION OF EPIC-PN SPECTRAL RESOLUTION

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MONITORING OF CAL CLOSED (SINGLES)

Single-pixel events, full RAW-Y range

Apparent linear increase of the measured width of the Mn line over the mission
MONITORING OF CAL CLOSED (DOUBLES)

Double-pixel events, full RAW-Y range

Apparent linear increase of the measured width of the Mn line over the mission
EVIDENCE OF EXCESS LINE WIDTH FROM CAL CLOSED (SINGLES) – FOLDED THROUGH RMF

Full CCDs: 0.3 - 0.45 ADU/year increase
CCD4 around boresight: 0.74 ADU/year increase
i.e. ~10 ADU additional width now at boresight

Single-pixel events, folded through RMF
EVIDENCE FROM REAL DATA – CIRCINUS (2001)

Circinus 2001–08–06, 6.385 (sing), 6.405 (dub), narrow

FF mode observation from 2001-08

Best fit with current RMF

\[ E_S = 6.385 \text{ keV} \]
\[ E_D = 6.405 \text{ keV} \ (\pm 20 \text{ eV}) \]
EVIDENCE FROM REAL DATA – CIRCINUS (2013)

Circinus 2003-02-03, 6.405 (sing), 6.45 (dub), narrow

FF mode observation from 2013-02

Best fit with current RMF

$E_S = 6.405 \text{ keV} \ (\pm 20 \text{ eV})$

$E_D = 6.45 \text{ keV} \ (\pm 65 \text{ eV})$

$C = 4892 / 3187$
Single-pixel events

Double-pixel events

FF mode observation from 2013-02

Best fit with current RMF

$E_S = 6.41\ \text{keV}$

$E_D = 6.45\ \text{keV}$

$\sigma_S = 77\ \text{eV}$

$\sigma_D = 88\ \text{eV}$

$C = 3921 / 3185$
EVIDENCE FROM REAL DATA – NGC 5548 (2001)

SW mode observation from 2001-07

Best fit with current RMF

\( E_S = 6.30 \text{ keV} \)

\( E_D = 6.32 \text{ keV} \ (\pm 20 \text{ eV}) \)

Single-pixel events
Double-pixel events

\( z=0.0165; \ Fe=6.3 \text{ keV} \)
EVIDENCE FROM REAL DATA – NGC 5548 (2013)

SW mode observation from 2013-12-20

Fit with current RMF, nominal energy

\[ E_S = 6.3 \text{ keV} \]
\[ E_D = 6.32 \text{ keV} \]

Single-pixel events

Double-pixel events
EVIDENCE FROM REAL DATA – NGC 5548 (2013)

SW mode observation from 2013-12-20

Best fit with current RMF

$E_S = 6.345 \text{ keV} \ (\pm 45 \text{ eV})$

$E_D = 6.38 \text{ keV} \ (\pm 80 \text{ eV})$

Single-pixel events

Double-pixel events
NGC 5548 (2013) – WIDE GAUSSIAN

SW mode observation from 2013-12-20

Best fit with current RMF

$E_S = 6.345$ keV
$E_D = 6.38$ keV
$\sigma = 0$

$C = 3588/3197$

Wide gaussians, widths from Circinus-2013 best fit

$E_S = 6.35$ keV
$E_D = 6.39$ keV
$\sigma_S = 77$ eV
$\sigma_D = 88$ eV

$C = 3580/3197$
 ACTIONS:

- Increase of line centre energies with time – Long-term CTI
- Difference between singles and doubles line centres at T=0 – new CAL/epevents call
- Increase of single and double line widths with time –
  - Lack of quality, intermediate date data.
  - Trend looks to be linear from CAL closed results
  - Use Circinus to quantify the 2013 widths
  - Interpolate linearly between 2000 and 2013
  - Only want to change higher energy line widths as no obvious effects seen at Aluminium. We could use the quadratic energy-dependent width noise term (NoiseP(4)) to control the time-dependent change and minimise the impact on lower-energies. Perhaps interpolate this param over time within the CAL.

- Fine for the CCD-4 boresight but what about other CCDs and RAW-Y values?