Measurements from the Chandra ECS

- Energy Resolution Versus Time and Temperature
- Line Centroid Accuracy Versus Time and Temperature
- Time Dependent QEU
- Contamination Spatial Variations Application
Chandra ECS

External Calibration Source

The ACIS external calibration source (ECS) consists of a 55Fe source and a target made of aluminum and titanium. The source emits strong lines at:

- Al Ka 1.49 keV
- Ti Ka+b 4.51 & 4.93 keV
- Mn Ka+b 5.90 & 6.49 keV

and a number of weaker lines are also present.

ECS exposure time from launch to February 2015

I3 8.1 Msec at -120C
14.8 Msec at all FP_TEMP

S3 15.9 Msec at -120C
27.5 Msec at all FP_TEMP
Energy resolution versus time and temperature

Analysis

- Merge 1 year of ECS observations.

- Filter into 1C focal plane temp bins:
  - -120 : -119C ~750 ksec
  - -119 : -118C ~85 ksec
  - -118 : -117C ~60 ksec
  - -117 : -116C ~66 ksec
  - -116 : -115C ~65 ksec

- Filter into 64x64 pixel regions

- Create RMF response for each 64x64 region for each chip

- XSpec gaussian+powlaw fit separately to Al Kα, Mn Kα and Kβ emission lines.

Nick Durham, CfA

IACHEC, Beijing, April 2015
S3 Al-\(\alpha\) 1.487keV

- **Time dependence** = additional \(~5\text{eV (2000-2013)}\)
- **Temperature dependence** = negligible (-120C to -116C for 2013)

S3 Mn-\(\alpha\) 5.898keV

- **Time dependence** = additional <20eV (2000-2013)
- **Temperature dependence** = additional <10eV (-120C to -116C for 2013)
- **Very little ChipY dependence**
I3 Al-Kα 1.487keV

- Time dependence = additional <10eV (2000-2013)

- Temperature dependence = additional <20eV (-120C to -116C for 2013)

I3 Mn-Kα 5.898keV

- Time dependence = additional <40eV (2000-2013)

- Temperature dependence = additional <70eV (-120C to -116C for 2013)

- I3 RMF has room for refinement
S3 & I3 line energy centroid accuracy vs time & temperature, mean chipX

Nick Durham, CfA

IACHEC, Beijing, April 2015
**Time dependent QEU**

Small spatial QE variations caused by CTI

**Theory**


- Apply TGain corrections to ECS cold (-120C) observations
- Merge 2 years of ECS observations
- Extract ACIS flight grades that migrate into bad grades because of CTI, to enhance the CTI effect.
- Derive QEU(x,y,e)

- ~3.5%/10years decline, S3 aimpoint with CTI correction
- ~4%/10years decline, S3 aimpoint without CTI correction
- ~1.5% decline for I3 over 10 years

- 2012-2013 QEU update coming soon
Coming Soon...

- Use contamination-sensitive Mn L-complex
- Bin data in time and space to obtain robust statistics
- 2013 Al, Ti, Mn count rates ~ 4% of 2000