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*

Nick Durham
Paul Plucinsky, Richard White, Catherine Grant
CXC Calibration Group

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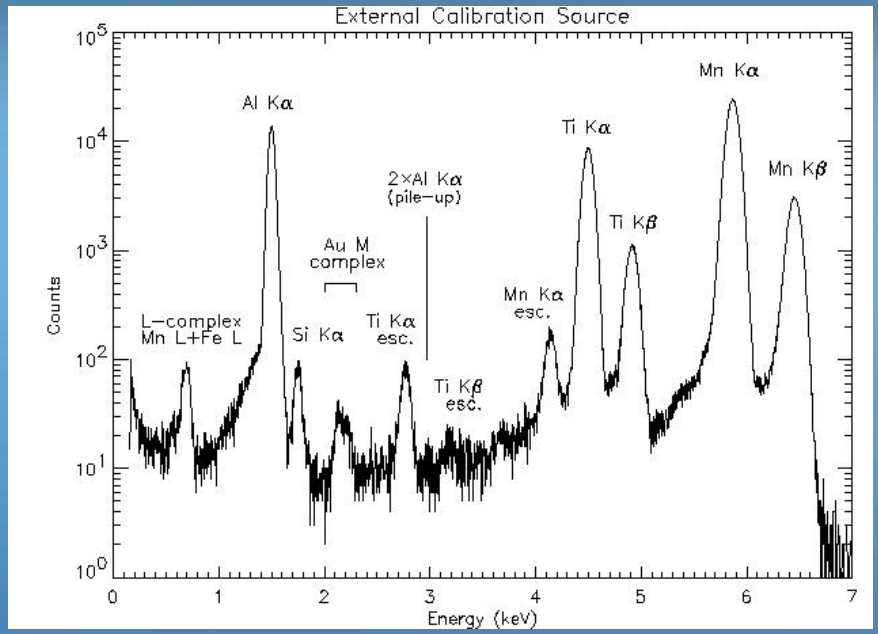
Chandra ECS

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:

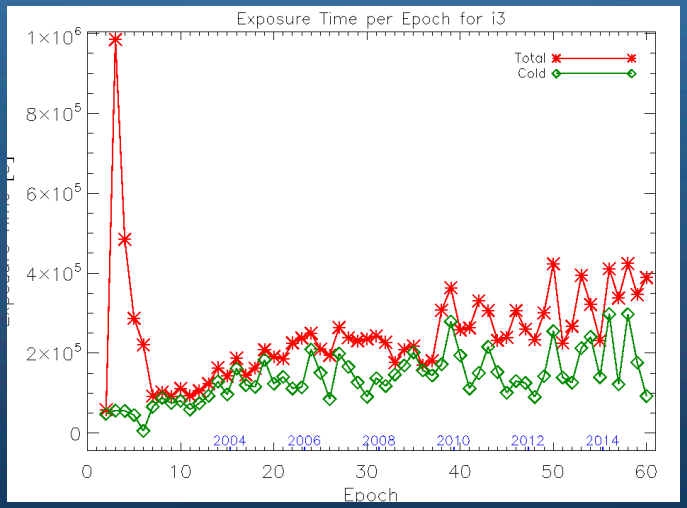
Al Ka	*1.49 keV*
Ti Ka+b	*4.51 & 4.93 keV*
Mn Ka+b	*5.90 & 6.49 keV*

and a number of weaker lines are also present.

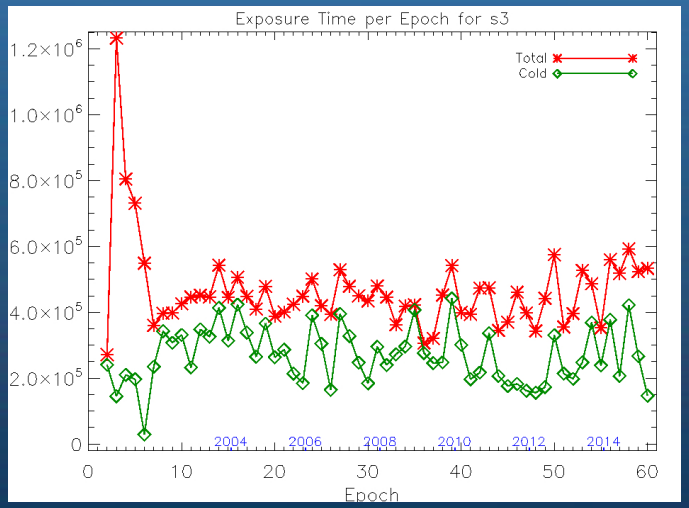


ECS exposure time from launch to February 2015

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



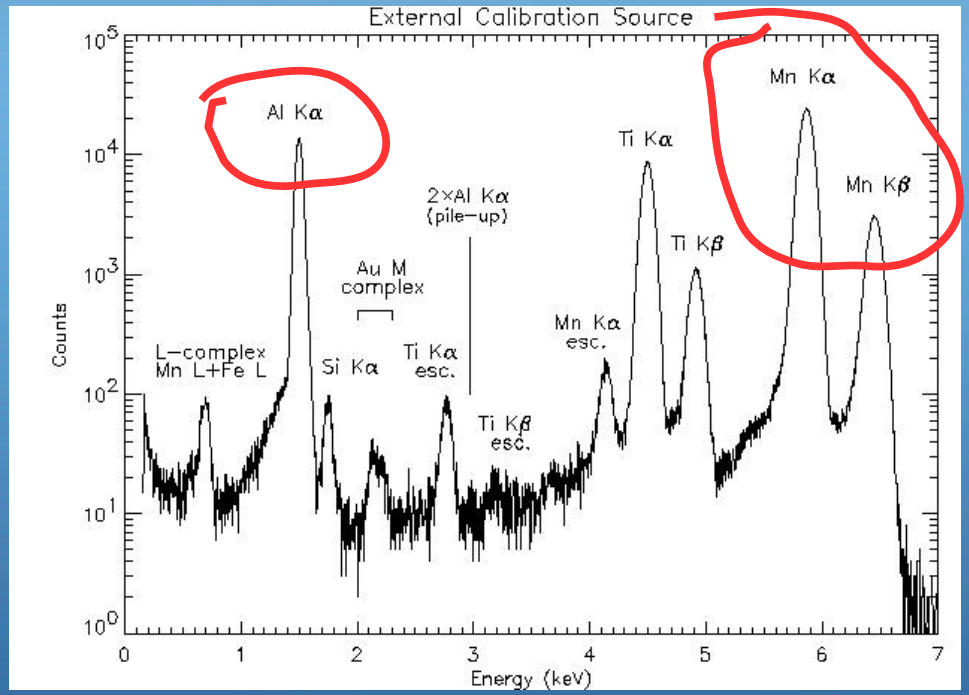
Energy resolution versus time and temperature

Analysis

- *Merge 1 year of ECS observations.*
- *Filter into 1C focal plane temp bins:*

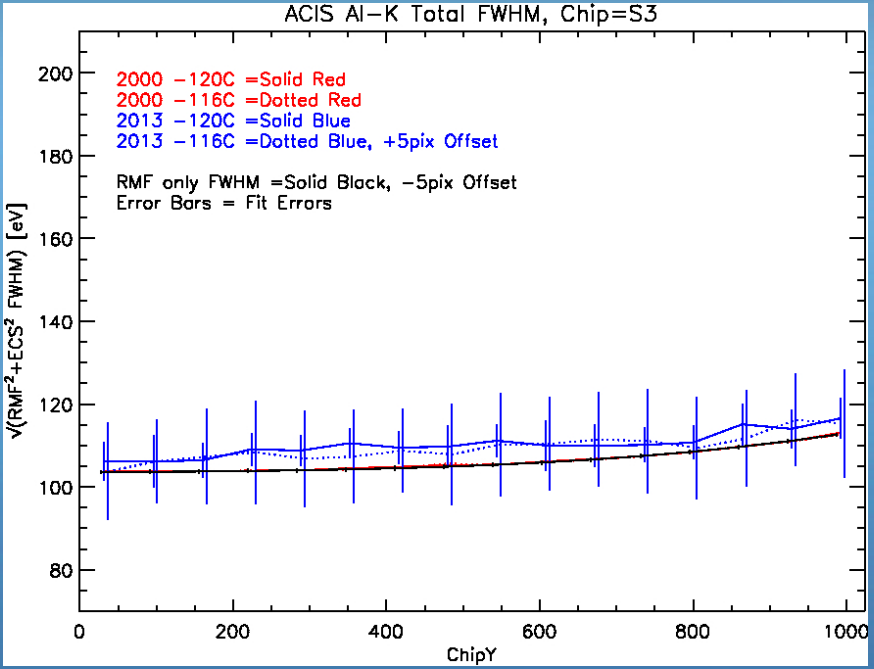
-120 : -119C	*~750 ksec*
-119 : -118C	*~85 ksec*
-118 : -117C	*~60 ksec*
-117 : -116C	*~66 ksec*
-116 : -115C	*~65 ksec*

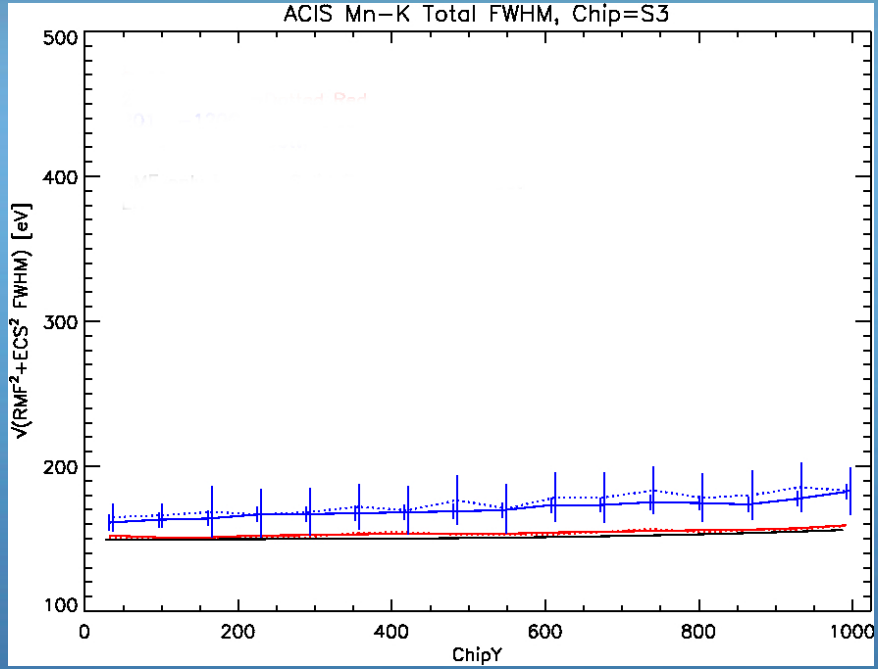
- *Filter into 64x64 pixel regions*
- *Create RMF response for each 64x64 region for each chip*



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

S3 total FWHM vs time & temperature, mean chipX





S3 Al-Kα 1.487keV

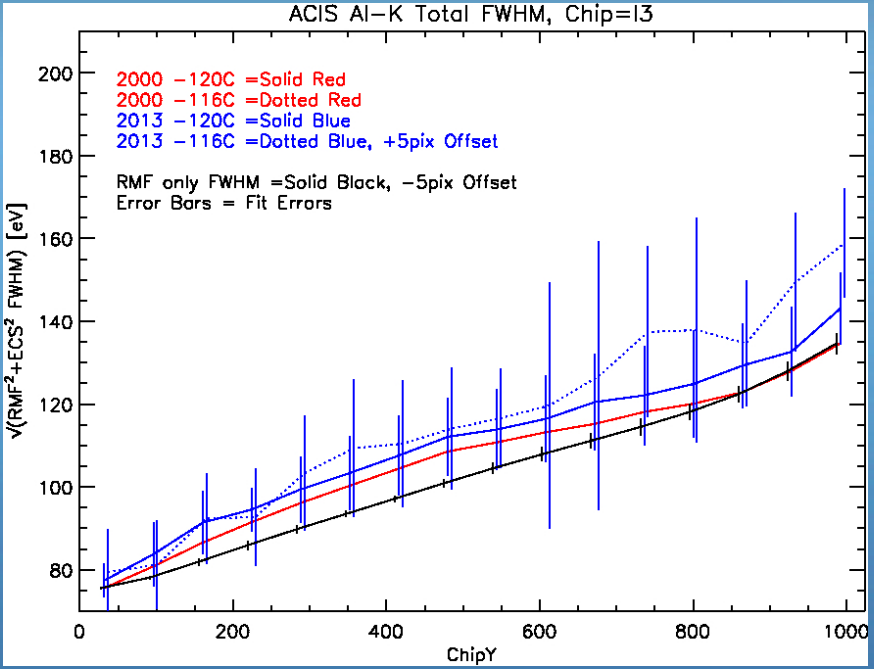
- *Time dependence = additional ~5eV (2000-2013)*
- *Temperature dependence = negligible (-120C to -116C for 2013)*

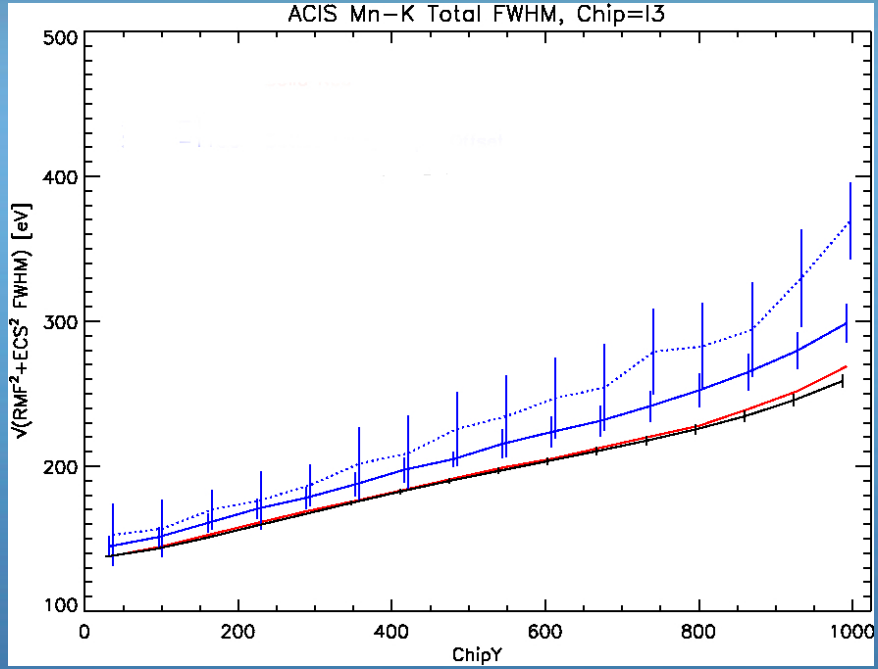
S3 Mn-Kα 5.898keV

- *Time dependence = additional <20eV (2000-2013)*
- *Temperature dependence = additional <10eV (-120C to -116C for 2013)*

- *Very little ChipY dependence*

I3 total FWHM vs time & temperature, mean chipX





I3 Al-Kα 1.487keV

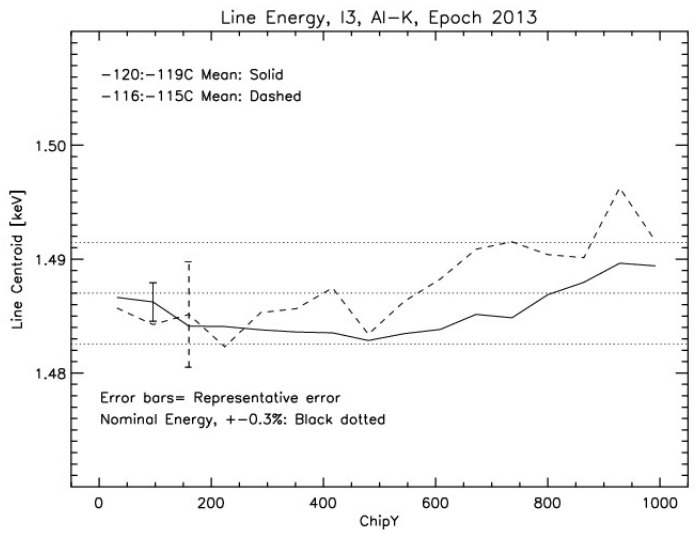
- *Time dependence = additional <10eV (2000-2013)*
- *Temperature dependence =*
- *additional <20eV (-120C to -116C for 2013)*

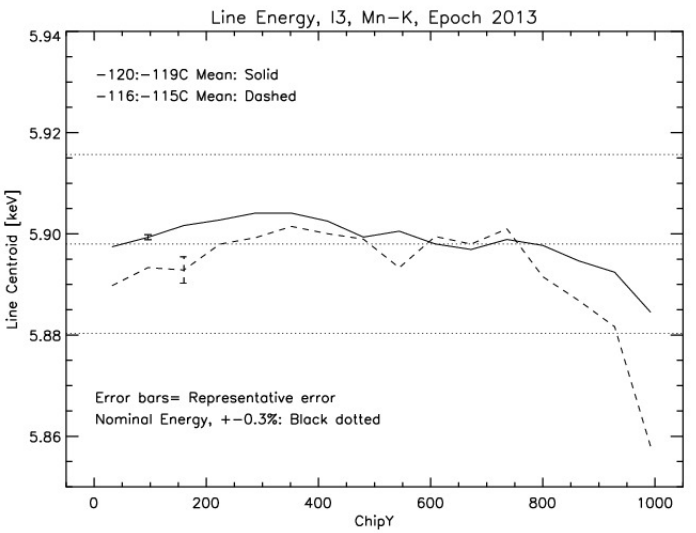
I3 Mn-Kα 5.898keV

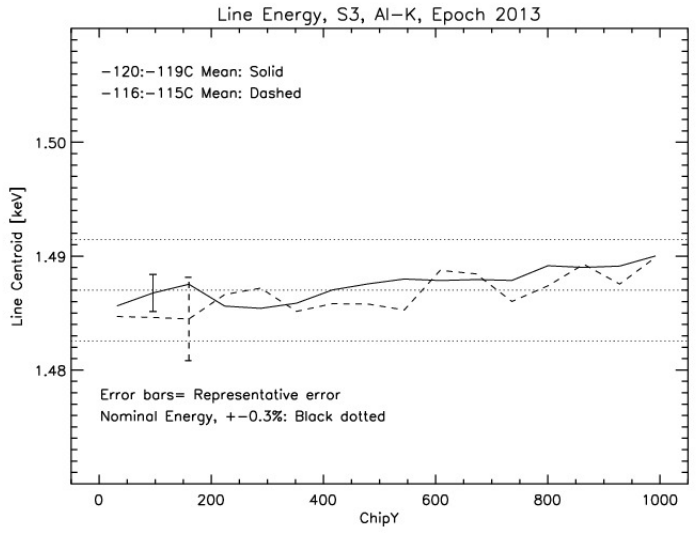
- *Time dependence = additional <40eV (2000-2013)*
- *Temperature dependence = additional <70eV (-120C to -116C for 2013)*

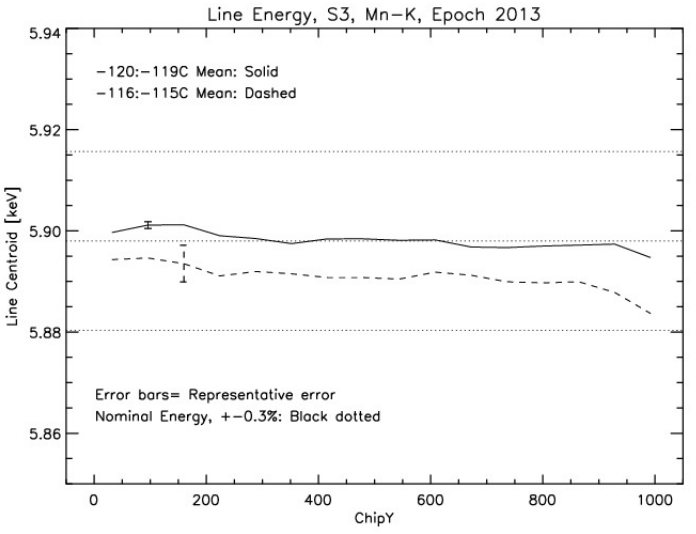
- *I3 RMF has room for refinement*

S3 & I3 line energy centroid accuracy vs time & temperature, mean chipX









Time dependent QEU

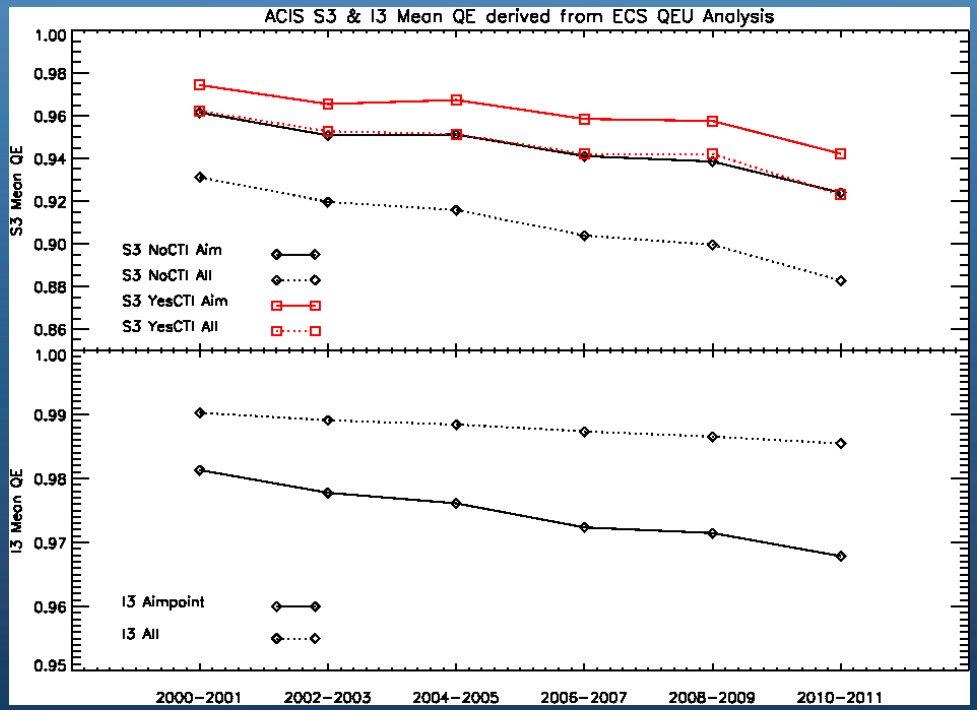
Small spatial QE variations caused by CTI

Theory
See: http://hea-www.cfa.harvard.edu/~alexey/acis/memos/qeu.pdf

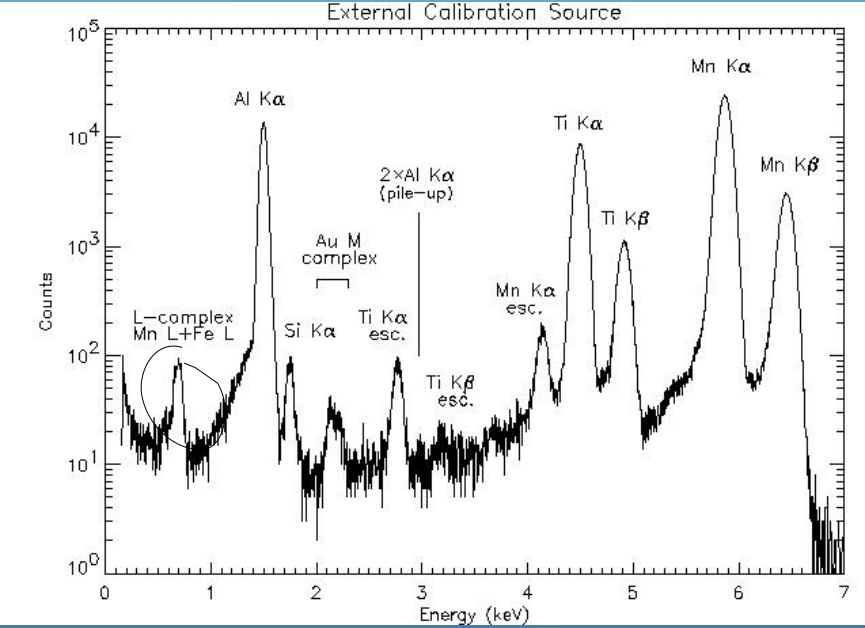
- *Apply TGain corrections to ECS cold (-120C) observations*
- *Merge 2 years of ECS observations*
- *Extract ACIS flight grades that migrate into bad grades because of CTI, to enhance the CTI effect.*
- *Derive QEU(x,y,e)*

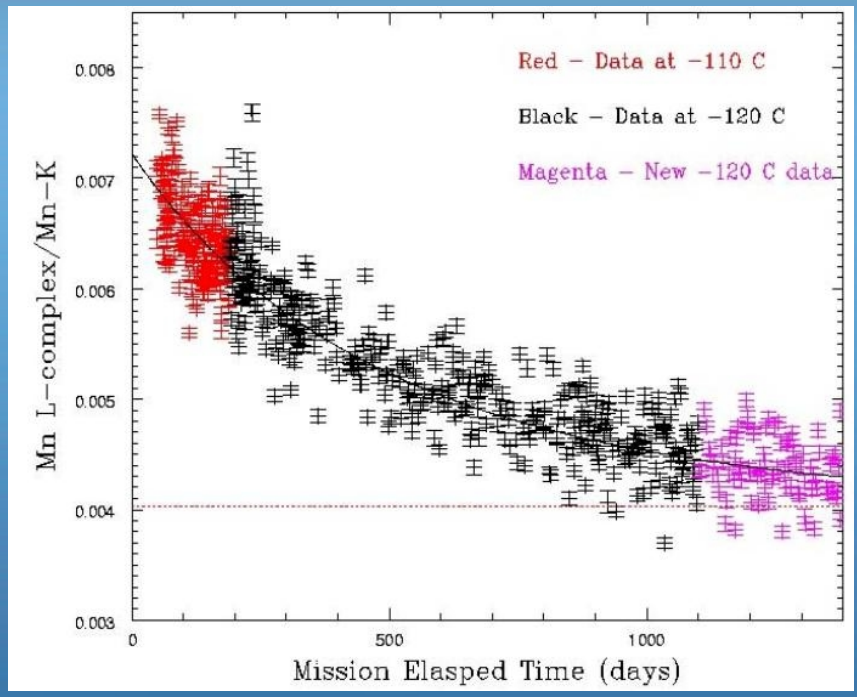
- *~3.5%/10years decline, S3 aimpoint with CTI correction*
- *~4%/10years decline, S3 aimpoint without CTI correction*
- *~1.5% decline for I3 over 10 years*

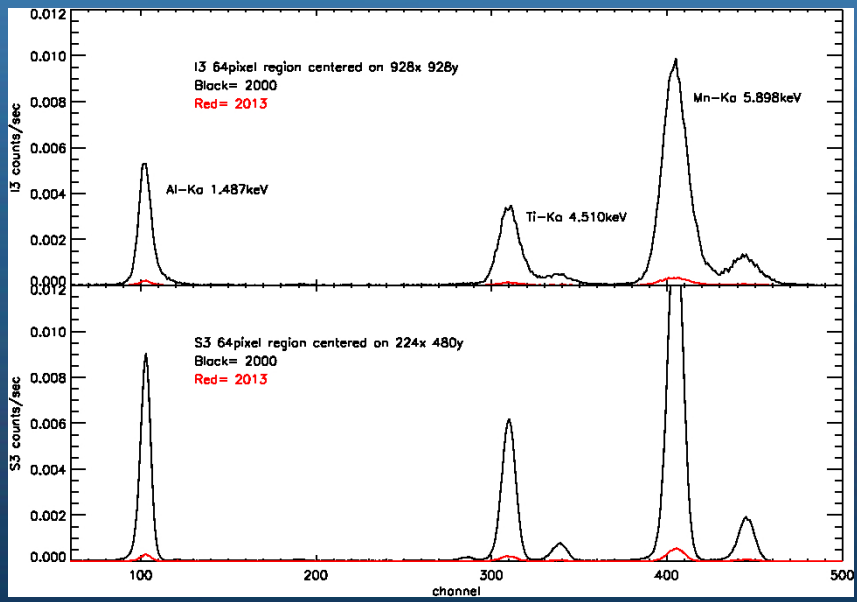
- *2012-2013 QEU update coming soon*



Spatial extent of contamination







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*