

## Recent Updates to *Chandra* Calibration

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There were six releases of the *Chandra* calibration database (CALDB) during 2014. These releases included the regularly scheduled updates to the detector gains (quarterly for ACIS and yearly for the HRC), a revised ACIS contamination model (which only affects the analysis of ACIS data acquired since April 2013), and revisions to the HRC-S effective area which improve the cross-calibration between LETG/HRC-S and LETG/ACIS-S gratings data.

The calibration team continues to monitor the build-up of molecular contamination onto the ACIS filters through yearly imaging observations of Abell 1795 and E0102-72 and gratings observations of Mkn 421, PKS 2155-304, and RXJ 1856-3754. Over the past few years, the condensation rate and spatial distribution of the contaminant on the ACIS filters has changed significantly which has required adjustments to the ACIS contamination model. The ACIS contamination model is used in CIAO to compute the appropriate ACIS effective area for a given observation. In addition to changes in the condensation rate and spatial distribution of the contaminant, the molecular composition of the contaminant has also changed as measured by the optical depths at the C, O and F K-edges in gratings observations. These changes are probably due to the changing thermal environment of the *Chandra* X-ray Observatory. An update to the ACIS contamination model was released in July 2014 to account for the recent changes in the behavior of the contaminant.

Every year, the calibration team carries out a set of interleaved Mkn 421 observations with all gratings/detector combinations for internal cross-calibration purposes. A systematic analysis of the past few years of these observations showed that an adjustment to the HRC-S QE was required to improve cross-calibration between ACIS-S and the HRC-S and an updated HRC-S QE was released in December 2014.

In addition to a time-independent correction to the HRC-S QE, a new set of time-dependent HRC-S QE maps (one for each year) was also released in December 2014 to account for the steady degradation in the HRC-S QE. Using the recently released HRC-S QE and QE maps reduces systematic residuals be-

tween LETG/HRC-S and LETG/ACIS-S data to less than 5%.

A memo was also posted on the CXC calibration web pages ([http://cxc.harvard.edu/cal/Acis/Cal\\_prods/ccmode/ccmode\\_final\\_doc02.pdf](http://cxc.harvard.edu/cal/Acis/Cal_prods/ccmode/ccmode_final_doc02.pdf)) regarding the data analysis of HETG/ACIS-S gratings data taken in continuous clocking mode.

The *Chandra* calibration team continues to support the efforts of the International Astronomical Consortium for High Energy Calibration (IACHEC). These meetings bring together calibration scientists from all present and many future X-ray and  $\gamma$ -ray missions. Collaborations established at these meetings have led to a number of cross-calibration papers published in the *Journal of Astronomy & Astrophysics*. The next IACHEC meeting is scheduled for April 20–23, 2015 in Beijing, China.