# Updates to *Chandra* Calibration in 2012

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Nine updates to the *Chandra* calibration database (CALDB) were released during 2012. The CALDB releases contained the standard quarterly calibration updates of the ACIS-S and ACIS-I gain tables and the yearly calibration updates of the HRC-I gain table. The increase in the operating high voltage of the HRC-S in April, 2012 necessitated the release of two gain tables for the HRC-S (one for the old high voltage setting and one for the new high voltage setting).

During the past year, a revised ACIS contamination model and a set of time-dependent ACIS QE maps were released. Both of these calibration products affect the effective area of ACIS. An analysis of ACIS external calibration source (ECS) data acquired during the *Chandra* mission shows that the QE has declined since launch by about 5% on the BI chips and by 3% on the FI chips. To correct for this effect, a set of time-dependent ACIS QE maps (one for every two years) was released. CIAO tools automatically select the appropriate QE map for any observation. The ECS data, along with monitoring observations of Abell 1795, also show that the condensation rate of the molecular contaminant onto the ACIS filters increased slightly over the past few years. In addition, the spatial pattern of the contamination on the ACIS filters changed during this time. Accordingly, a new ACIS contamination model was released in May, 2012. The new contamination model mainly affects data taken since 2009. The correction to the ACIS effective area with the latest contamination model can be up to 10% at 0.5 keV for observations taken in early 2012.

While the QE of the HRC-I has been very steady, the QE of the HRC-S along the dispersion direction of LETG spectra has declined by about 5% during the *Chandra* mission. To restore the declining HRC-S QE, the operating high voltage of the HRC-S was increased in April, 2012. LETG/HRC-S calibration observations of a soft source (the white dwarf HZ43) and a hard source (the blazar Mkn421) were then taken with the new high voltage setting to re-calibrate the detector. These observations showed that the HRC-S QE with the new high voltage setting is very similar to the launch QE. Using the the HZ43 and Mkn421 observations, the CXC calibration team released new versions of the HRC-S QE and gain in 2012. The CIAO software will automatically use the appropriate calibration products when analyzing HRC-S data.

The aim-point on the focal plane detectors has drifted slightly during the course of the mission (see the POG for a more in-depth discussion). Due to this drift, the zeroth order of LETG/HRC-S spectra shifted onto a new HRC-S tap (the region between adjacent pre-amps) during parts of the dither pattern. The degapping procedure of the data acquired in this new tap region produced some distortion in the zeroth order image. Since the wavelength scale in dispersed spectra is computed relative to the centroid of the zeroth order image, the distortion in the zeroth order image can produce a systematic shift in the wavelength scale. The lack of good de-gap coefficients near the new HRC-S aim-point was simply due to a lack of existing data in this region. To remedy this problem, the calibration team carried-out a LETG/HRC-S observation of HZ43 with the zeroth order image centered on the new tap, from which new de-gap coefficients were derived. Updated HRC de-gap coefficient tables were then released to the public in June, 2012 to correct the distortion in the zeroth order image.

The *Chandra* calibration team continues to support the efforts of the International Astronomical Consortium for High Energy Calibration (IACHEC). Several CXC calibration scientists attended the 7th annual IACHEC meeting in Napa, California in March, 2012. These meetings bring together calibration scientists from all present and many future X-ray and γ-ray missions. Collaborations established at these meetings have led to a number of cross-calibration papers published in the Journal of Astronomy & Astrophysics.