Overview of Chandra Calibration

Geometrical Factors

- Focal point along the optical axis has been stable to better than 50um. (1 part in 2
- No observable degradation in imaging.
- Absolute positions accurate to 0.6″
- Plate scale accurate to 0.5″ over 30′ field of view.
- Mirror distortions are less than 0.5″ over 30′ field of view.
- Combining all uncertainties yields astrometric measurements to 1″.

Imaging

- On-axis encircled energies are accurately modeled by the raytrace code to better th

for apertures smaller than the 95% encircled energy radius (5″)

Effective Area

- Analysis of XRCF data has reduced the systematic errors in the on-axis effective a

the mirrors to 3% excluding the Ir M-edge where the uncertainties are about 15%

- Mirror vignetting predicted by the raytrace code is consistent with in-flight data t
- HRC-I effective area has been significantly improved since launch, especially at low

gies. Present uncertainties are at the 7% level.

• An algorithm has been released to account for the degradation in ACIS QE at low en
The largest uncertainty at present is the 15% cross-calibration error between the FI a
chips below 1.0 keV. Some of this discrepancy is due to the different areas affected by cl
particle flares between the FI and BI chips. In each frame, charged particle blooms cove
of the area on a FI chip, compared to only 0.5% of the area on a BI chip.

• First order effective areas for all gratings plus detector combinations are accurate t

• Higher LETG orders (up to fifth) are accurate to 30%.

Imaging Spectroscopy

• A new paradigm has been developed to account for the effects of radiation damage
CCDs. New CTI-corrected products are available for ACIS-I and S2. The CTI-correcte
tables are accurate to 0.5% for observations taken in the spring of 2000. Due to increasin
the gain is decreasing at a rate of about 0.1% per year near the read-out and 0.5% per yea
the top of the chips. Gains are accurate to about 1% above 0.7keV in the non CTI-cor
gain tables for the BI chips. All of these caveats refer to data acquired at T = −120°,
accounts for 85% of all ACIS data up to the present time.

• There are some residual features in the wings of spectral lines that are not pr
modeled in the CTI-corrected FEFs, but there are no obvious residuals near line centro

Dispersed Spectroscopy

• LETG - There is a systematic error of 0.1A in computed wavelengths due to a software
There are also random errors of 0.025A on the central HRC-S plate and 0.1A on the
plates due to the spatial non-linearity of the HRC-S on small scales.

• HETG - There is a systematic error of 0.04A due to a software error. In addition, the
errors of 0.05A for the MEG and 0.02A for the HEG due to the uncertainties in the chip

• LETG and HETG - Modeled LSFs are consistent with in-flight observations with
statistics.