1.2 Overview of Detector Calibration Measurements

As has been indicated in the introduction to this report, the calibration of the ACIS instrument has been performed at several levels. Figure 1.4 provides summary of the various calibration stages.

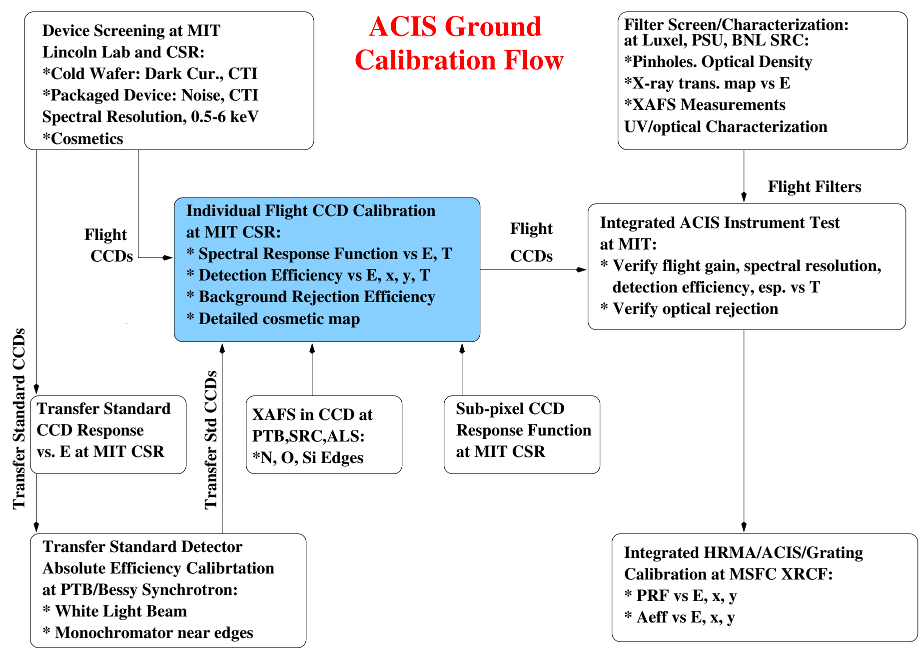

Figure 1.4: ACIS ground calibration flow.

In nearly every stage of this process, data were obtained that constrain the response of the CCDs themselves. Moreover, a number of ancillary measurements, not shown in figure 1.4, were made to address particular calibration issues. These include measurement of X-ray Absorption Fine Structure near the relevant edges in the detector response, measurement of structure within a single CCD pixel, and measurement of pileup effects for a variety of source spectral and spatial distributions. At this writing, not all of these data have been analyzed.

Here we summarize the objectives and some salient characteristics of each type of measurement that bears directly on CCD performance calibration. It is intended that this summary serve as a guide to the analysis presented in the remainder of this chapter, as well as an indication of what additional data remain to be analyzed.

Specifically, spectral response function measurements are discussed in section 1.3, and pileup effects and sub-pixel structure are considered in sections 1.4 and 1.5, respectively. Absolute quantum efficiency measurements are described in section 1.6, while comparison of the flight detectors to absolutely calibrated standards is discussed in section 1.7.

It should be noted that the confidence we may ultimately place in the ACIS calibration will depend critically on the extent to which the elements of this large, overlapping measurement set can be compared, one to another. The power of this intercomparison is illustrated, for example, in section 1.7.3, which compares relative detection efficiency measurements made at MIT subassembly calibration with those made using the integrated instrument at XRCF. It is clear at present, that much work remains to be done if we are to achieve a calibration that is as accurate as this vast data set allows.

ACIS Detector Response Function Measurements are summarized by objective in Table 1.3.

Measurement Objective	Site	Spectral Content†	Spatial Distrib.	Energies (keV)	Flight Devices?	Analysis Status	Remarks
Spectral Response	MIT	Mon.	Diffuse	0.2-1.5(cont)	yes	TBD	HIREFS,IFM
		QM.	Diffuse	0.5 - 9.9 (15 energies)	yes	Done	
	PTB/ BESSY	Mono.	Diffuse	0.2-1.5	no	Done	SX-700 grating mon.
		Mono.	Diffuse	1.5-6	no	Done	KMC 2-crys. mono.
	XRCF(I)	Mon.,QM.	Diffuse	0.3 - 8.1 (7 energies)	yes	In prog.	1.3
Detection Efficiency (Primary Std.)	PTB/ BESSY	Continuum	Diffuse	0.2 -4	no	Done	sec. 1.6.1
		Undisp. S. R.		0.2-12	no	Done	WLS; 1.6.1
		Mono.	Diffuse	0.2-1.5	no	Done	SX-700; FI and BI
Detection Efficiency (Secondary. Std.)	MIT	QM	Diffuse	0.2-8.0 (8 energies)	yes	Done	2×10^6 phot/energy sec 1.7.2
	XRCF(F,G)	QM,Mon.	HRMA	0.3 - 10	no	In Prog.	ACIS 2C
	XRCF(H)	QM,Mon.	HRMA	0.3 - 8	yes	In Prog.	Flight Instr.
	XRCF(I)	QM,Mon.	Diffuse	0.3 - 8.0	yes	In Prog.	Flight Instr. sec. 1.7.3
XAFS	ALS,UW/SRC PTB/BESSY	Mon.	Diffuse	N-K,O-K,Si-L,K	no	Done	Thin Films sec. 1.6.4
Sub-pixel	MIT	QM	Mesh(4μm)	0.5 -2	no	In Prog.	sec. 1.5
Structure/ Spatial Lin.	XRCF(F)	QM,Mon.	HRMA	0.3 - 8	no	In Prog.	ACIS 2C
	XRCF(H)	QM,Mon.	HRMA	0.3 - 8	yes	In Prog.	Flight Instr.
Pileup/	MIT	QM	Diffuse	0.2-8.0	no	In Prog.	sec. 1.4
Count Rate	PTB/BY	Cont. S.R.	Diffuse	0.2 -4	no	In Prog.	sec. 1.4
Linearity	XRCF(F,G)	QM,Mon.	HRMA	0.3 - 10	no	In Prog.	ACIS 2C
	XRCF(H)	QM,Mon.	HRMA	0.3 - 8	yes	In Prog.	Flight Instr.

†:
Mon.: monochromatic; $\frac{E}{\Delta E} > 100$;.
QM: quasi-monochromatic (electron-impact or photon-fluor.;
S.R: Synchrotron Radiation

Table 1.3: ACIS CCD Response Function Measurement Summary