AXAF Science Center

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Calibration Input Data Required for Grating Processing

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1 Analysis Reference Data *vs.* Calibration Interface Products

Standard data processing requires instrument calibration data at many stages of analysis. These products need to be provided in well defined, stable products, with inclusion of self-descriptive ancillary information. These analysis inputs are not necessarily identical to the outputs of the calibration effort. Hence, Analysis calibration inputs need to be defined and derived from calibration end-products.

D. Dewey has termed the analysis inputs as *Analysis Reference Data* (ARD) and the calibration end-products as *Calibration Interface Products* (CIP). (For a description of HETG calibration data, see `http://space.mit.edu/HETG/xrcf_cal/cal_prods.html`). The distinction is similar to the *Basic Calibration Files* (BCF) and *Calibration Product Files* (CPF) defined for other missions by the NASA-Goddard High Energy Astophysics Science Archive (HEASARC; quoted from `ftp://legacy.gsfc.nasa.gov/caldb/data/README`):

> Basic Calibration Files contain basic calibration information such as the effective area, energy resolution, point-spread function of the instrument. In many ways these datasets can be thought of as the "atomic" units of calibration.
>
> Calibration Product Files contain "higher" level calibration products (which can usually be generated using BCF datasets) suitable for specific data analysis tasks. Examples include exposure maps, response matrices etc.

This document tabulates the Analysis Reference Data currently defined for AXAF grating processing through Level 1.5 and exposure map calculation. (See for example, the Level 1.5 description in `http://space.mit.edu/ASC/analysis/L1.5_overview/L15.html`.)

After naming the two sets of data, the process connecting them must be defined. While this may never be totally automatic, there should be easy tests for new CIP and tools to compute new ARD if CIP are newer.

2 Grating Analysis Reference Data (GARD)

The following table collects reference data from specified grating data processing, from the Level 1.5 flight processing and from exposure map specifications. Along with the descriptions are suggested file formats. Some of these ARD are very close to a CIP, being mainly a difference in format; the grating efficiency is an example. Others will require some analysis; HRMA performance is typically specified as parameters for a ray-trace, rather than as a table or function.

Table 1: Grating-related Analysis Reference Data

Definition	Description	Suggested Format
$\mathrm{Hfw}(E, \theta; \%EE)$	HRMA PSF full-width versus energy and off-axis angle, for a specified fractional enclosed energy ($\%EE$).	function; parameter file
$R_{\mathrm{TG}}(n)$	Grating ring radius for shell n.	parameter file
X_{TG}	Grating Rowland spacing: the as-installed distance from the grating node to the on-axis focal point.	parameter file
TG_angles	Mean clocking angles of the facets as installed, relative to the AXAF y-axis.	parameter file
P_{TG}	Grating mean periods.	parameter file
Geometry	Various geometric parameters, such as detector geometry, HRMA node, HRMA to grating spacing — all incorporated into `pixlib` for coordinate transformations.	parameter file
$\mathrm{Dhw}_{\pm}(E; \mathrm{cid}, \%EE)$	Detector pulse-height (PI) distribution half-width (hw) as a function of energy, E, for a specified chip (cid), and for a specified fractional enclosed energy ($\%EE$). (A two-sided ($\pm$) parameterization is required since it is an asymmetric distribution.)	function; FITS bintable; parameter file
A_n	Mirror geometric area for shell n.	parameter file
$H_0(E, n)$	Mirror on-axis efficiency as a function of energy and shell.	FITS bintable
$V(\theta, E, n)$	Mirror vignetting as a function of off-axis angle, energy, and shell. This is defined by $V = H_0/H(\theta, E, n)$.	FITS bintable
$G_n(E, m)$	Grating efficiency for shell n as a function of energy and order. This is averaged over all facets on a given shell.	FITS bintable
$\overline{q}(E)$	Detector spatially averaged quantum efficiency as a function of energy.	FITS bintable
$U(E, x_d, y_d)$	Detector uniformity, as a function of energy an position.	FITS images
$Bad(x_d, y_d)$	Detector bad pixel locations	FITS table

NOTE: It is likely that simple parameters will come directly from the ASCDS archive into parameter files, and that the archive will hold the associated descriptive meta-data.