Acronyms

	Sec.	
ACIS	1.1	AXAF CCD Imaging Spectrometer
ACIS-I		ACIS Imaging array
ACIS-S		ACIS Spectroscopic array
ACIS-2C	5.1.6	ACIS “2-chip” detector
ARD	9.1	Analysis Reference Data
ARM		Alignment Reference Mirror
ASC		AXAF Science Center
AXAF		Advanced X-Ray Astrophysics Facility
BESSY	3.2.4	Berlin Synchrotron Facility
BNDs	5.1.3	Beam Normalization Detectors
CCD		Charge Coupled Device
CEI	2.2	Contract End Item (specifications)
CIP	9.1	Calibration Interface Product
CMDB	5.3	Calibration Measurement Database
DCM	5.1.1	Double Crystal Spectrometer
EA	5.3.2	Effective Area
EE	6.2	Encircled Energy
FC	6.3	Focus Check
FCP	9.1	Fundamental Calibration Product
FITS		Flexible Image Transport System
FPC	5.1.5.3	Flow Proportional Counter
FWHM	1.3.3	Full Width at Half Maximum
HEG	1.2	High Energy Grating
HESS	1.2	HETG Element Support Structure
HETG	1.1	High Energy Transmission Grating
HETGS	1.3	High Energy Transmission Grating Spectrometer
HIREFS	5.1.1	High-Resolution Erect Field Spectrometer
HRMA	1.1	High Resolution Mirror Assembly
HRC	1.1	High Resolution Camera
HRC-I		HRC Imaging array
HRC-S		HRC Spectroscopic array
HSI	5.1.5.2	High Speed Imager
HXDS	5.1.5	HRMA X-Ray Detection System
LEG	1.1	Low Energy Grating
LETG	1.1	Low Energy Transmission Grating
LR	4.1	Laser Reflection setup at MIT
LRF	1.3.3	Line Response Function
MARX	2.3	Model of AXAF Response to X-rays
MC	7.8	Molecular Contamination

	Sec.	
MEG	1.2	Medium Energy Grating
MIT		Massachusetts Institute of Technology
MST		Mission Support Team at SAO
NSLS	3.2	National Synchrotron Light Source (Brookhaven)
PIGS	5.1.1	Penning Ionization Gas-discharge Source
PSF	1.3.3	Point Spread Function
PSPC	4.2	Position Sensitive Proportional Counter (in X-GEF)
rms		(square)root of the mean of the squares
rss		(square)root of sum of squares
SAO		Smithsonian Astrophysical Observatory
SF	6.3	Shutter Focus
SML	1.2	Space Microstructures Laboratory, at MIT
SPIE		Society of Photooptical Instrumentation Engineers
SSD	4.2	Solid State Detector, X-GEF
SSD	5.1.5.3	Solid State Detector, XRCF
TOGA	5	TMA Objective Grating Assembly
TMA	5	Technology Mirror Article
X-GEF	4.2	X-Ray Grating Evaluation Facility at MIT
XMM		X-Ray Multimirror Mission
XRCF	5	X-Ray Calibration Facility
XSPEC	7.8	X-Ray Spectral Fitting Package
XSS	5.1.1	X-Ray Source System

Mathematical Symbols

Symbol	Equation	Description
β	1.1	diffraction angle
m	1.1	diffraction order
λ	1.1	X-ray wavelength
p	1.1	grating period
HETGS response$(E,\dots)$	1.2	
E	1.2	X-ray energy
$SEA(E,m,\dots)$	1.2	system effective area
$PSF(E,m,\dots)$	1.2	2-d normalized point spread function
s	1.3	shell (1,3,4,6) of HRMA or grating
$A_s(E,\dots)$	1.3	HRMA effective area
$G_s(E,m)$	1.3	grating shell average efficiency
$QE(E,\dots)$	1.3	detector quantum efficiency
ν_s	1.4	average grating vignetting on shell s
N_s	1.4	number of facets in shell s
f	1.4	grating facet identifier
$g_f(E,m)$	1.4	grating facet average efficiency
$G_{\rm config}(E,m)$	1.5	grating effective efficiency for config
config	1.5	config = set of shells: HEG, MEG, HETG
$\rho(y,z)$	1.6	2-D PSF, normalized distribution
y,z	1.6	detector coordinates
$l(y'),\ l(E)$	1.7	1-D LRF, normalized distribution
y',z'	1.7	grating dispersion coordinates
$R(E,m)$	1.8	resolving power
$dE,\ dy'$	1.8	FWHM of $l(E),\ l(y')$
$\Delta X_{\rm Rowland}$	2.2	detector offset to Rowland circle
$X_{\rm RS}$	2.2	Rowland spacing
R_0	2.3	perpendicular distance of grating ring
σ_H	2.6	effective HRMA rms blur
dx	2.9	detector defocus
γ	2.12	grating rms roll variation
a	2.13	aspect blur rms diameter
F	2.13	HRMA focal length
$R_{\rm dither}$	2.14	dither rate
t_D	2.14	detector quantization time
σ_D	2.15	detector rms blur

(to be continued...)

Bibliography

[1] Bautz, M.W., Nousek, J., Garmire, G., and the ACIS instrument team, "Science Instrument Calibration Report for the AXAF CCD Imaging Spectrometer (ACIS)", available at `wwwastro.msfc.nasa.gov/xray/axafps.html`, 1997.

[2] S. Abdali, F.E. Christensen, H.W. Schnopper, T.H. Markert, D. Dewey, and C.S. Nelson, "High Resolution X-Ray Studies of an AXAF High Energy Transmission Grating", *Multilayer and Grazing Incidence X-Ray/EUV Optics II*, Proc. SPIE, Vol. 2011, pp. 2–11, July 1993.

[3] C.L. Allen, P.P. Plucinsky, B.R. McNamara, R.J. Edgar, N.S. Schulz, and and J.W. Woo, "Analysis of the AXAF HRMA+ACIS effective area measurments from the XRCF" *X-Ray Optics, Instruments, and Missions*, Proc. SPIE, Vol. **3444** (this volume), (1998).

[4] E.H. Anderson, A.M. Levine, and M.L. Schattenburg, "Transmission X-ray Diffraction Grating Alignment using a Photoelastic Modulator", *Applied Optics*, Vol. **27**, pp. 3522-3525 (1988).

[5] M.W. Bautz, F. Baganoff, T. Isobe, S.E. Jones, S.E. Kissel, B. LaMarr, H.L. Manning, M. Pivovaroff, G.Y. Prigozhin, J.A. Nousek, C.E. Grant, K. Nishikida, F. Scholze, R. Thornagel, and G. Ulm, "X-Ray CCD Calibration for the AXAF CCD Imaging Spectrometer", *X-Ray Optics, Instruments, and Missions*, Proc. SPIE, Vol. **3444**, (1998).

[6] Beuermann, K.P., Bräuniger, H., and Trümper, J., "Aberrations of a facet-type transmission grating for cosmic x-ray and XUV spectroscopy," *Applied Optics* Vol. **17**, No. 15, 2304 (1978).

[7] Bevington, P.R., and Robinson, D.K, *Data Reduction and Error Analysis for the Physical Sciences*, Second Edition, McGraw-Hill, 1992.

[8] R.L. Blake, J.C. Davis, D.E. Graessle, T.H. Burbine, and E.M. Gullikson, "Optical Constants and Scattering Factors from Reflectivity Measurements: 50 eV to 5 keV", *Journal of X-ray Science and Technology*, in press.

[9] M. Born and E. Wolf, *Principles of Optics, Sixth Ed.*, pp. 401-414., Pergamon, New York, 1980.

[10] A.C. Brinkman, J. J. van Rooijen, J.A.M. Bleeker, J.H. Dijkstra, J. Heise, P.A.J. de Korte, R. Mewe, and F. Paerels, "Low energy X-ray transmission grating spectrometer for AXAF", in *X-ray Instrumentation in Astronomy, Proc. SPIE*, vol. 597, pp. 232-240, 1985.

[11] A.C. Brinkman, *et al., Astro. Lett. and Communications*, Vol. 26, p. 73, 1987.

[12] A.C. Brinkman, C.J.Th. Gunsing, J.S. Kaastra, H. Bräuninger, G. Hartner, P. Predehl, J.J. Drake, J.Z. Juda, M. Juda, D. Dewey, K.A. Flanagan, and H.L. Marshall, "Preliminary Test Results on Spectral Resolution of the Low Energy Transmission Grating Spectrometer on board of AXAF", , *these proceedings*,(1997).

[13] Canizares, C.R., Schattenburg, M.L., and Smith, H.I., "The High Energy Transmission grating Spectrometer for AXAF", in *X-ray Instrumentation in Astronomy, Proc. SPIE*, Vol. **597**, 253–260 (1985).

[14] C.R. Canizares, *et al.*, *Astro. Lett. and Communications*, Vol. 26, p. 87, 1987.

[15] C.R. Canizares, "High Resolution X-Ray Spectroscopy of Thermal Plasmas" in Imaging X-Ray Astronomy, M. Elvis (ed.), Cambridge University Press, 1990.

[16] J.E. Davis, H.L. Marshall, M.L. Schattenburg, and D. Dewey, "Analysis and Modeling of Anomalous Scattering in the AXAF HETGS", *X-Ray Optics, Instruments, and Missions*, Proc. SPIE, Vol. **3444**, (1998).

[17] D.Dewey, D.N. Humpheries, G.Y. McLean and D.A. Moschella, "Laboratory Calibration of X-ray Transmission Diffraction Gratings", *EUX, X-Ray, and Gamma-Ray Instrumentation for Astronomy V*, Proc. SPIE, Vol. **2280**, 257–271 (1994).

[18] D. Dewey, H.L. Marshall, K.A. Flanagan, C. Baluta, C.R. Canizares, D.S. Davis, J.E. Davis, T.T. Fang, D.P. Huenemoerder, J.H. Kastner, N.S. Schulz, M.W. Wise, J.J. Drake, J.Z. Juda, M. Juda, A.C. Brinkman, T. Gunsing, J. Kaastra, G. Hartner and P. Predehl, "Towards the Callibration of the HETG Effective Area", *Grazing Incidence and Multilayer X-Ray Optical Systems*, Proc. SPIE, Vol. **3113**, 144–159 (1997).

[19] D. Dewey, J.J. Drake, R.J. Edgar, K. Michaud, and P. Ratzlaff, "AXAF Grating Efficiency Measurements with Calibrated, Non-imaging Detectors", *X-Ray Optics, Instruments, and Missions*, Proc. SPIE, Vol. **3444**, (1998).

[20] R.J. Edgar, E.Y. Tsiang, A. Tennant, S. Vitek, and D. Swartz, "Spectral Fitting in AXAF Calibration Detectors", *Grazing Incidence and Multilayer X-Ray Optical Systems, Proc. SPIE*, Vol. **3113**, (1997).

[21] I.N. Evans, E.M. Kellogg, W.C. McDermott, M.P. Ordway, J.M. Rosenberg, and B.J. Wargelin, "High Speed Imager AXAF Calibration Microchannel Plate Detector", *Grazing Incidence and Multilayer X-Ray Optical Systems, Proc. SPIE*, Vol. **3113**, (1997).

[22] Feynman, R.P., and Hibbs, A.R., *Quantum Mechanics and Path Integrals*, McGraw-Hill, New York, 1965

[23] K.F. Fischbach, A.M. Levine, M.L. Schattenburg, D. Dewey, R.L. Renshaw, J. Dalcanton, R. Newman, and W. Fissell, "Performance of High Spatial Frequency X-Ray Transmission Gratings", *X-Ray Instrumentation in Astronomy II*, Proc. SPIE, Vol. 982, pp. 273–282, July 1988.

[24] K.A. Flanagan, D. Dewey, L. Bordzol, "Calibration and Characterization of HETG grating elements at the MIT X-ray Grating Evaluation Facility", *SPIE Proceedings* **2518**, 438–456 (1995).

[25] K.A. Flanagan, T.T. Fang, C. Baluta, J.E. Davis, D. Dewey, T.H. Markert, D.E. Graessle, J. Drake, J.E. Fitch, J.Z. Juda, J. Woo, S. Kraft, P. Bulicke, R. Fliegauf, F. Scholze, and G. Ulm, "Modeling the Diffraction Efficiencies of the AXAF High Energy Transmission Gratings: II", *EUX, X-Ray, and Gamma-Ray Instrumentation for Astronomy VII*, Proc. SPIE, Vol. **2808**, 650–676 (1996).

[26] K.A. Flanagan, N.S. Schulz, S.S. Murray, G.D. Hartner, and P. Predehl, "HETG High-order Diffraction Efficiency" *X-Ray Optics, Instruments, and Missions*, Proc. SPIE, Vol. **3444**, (1998).

[27] G.W. Fraser, X-ray detectors in astronomy, Cambridge University Press, Cambridge, 1989.

[28] G.P. Garmire, *et al.*, "The AXAF CCD Imaging Spectrometer", in *X-ray Instrumentation in Astronomy, Proc. SPIE*, vol. 597, pp. 261-266, 1985.

[29] G. Garmire, G. Chartas, L. Townsley, A.B. Garmire, and M. Bautz, "The AXAF CCD Imaging Spectrometer Sensitivity to Stellar Optical Frequency Contamination", 1998.

[30] P. Gorenstein and M. Zombeck, *High Resolution X-ray Spectroscopy of Cosmic Plasmas*, Cambridge University Press, Cambridge, 1990.

[31] D. Graessle, A.M. Clark, J.J. Fitch, B. Harris, D.A. Schwartz, R.L. Blake, "Reflectance calibrations of AXAF Witness Mirrors Using Synchrtron Radiation, 2-12 keV", *SPIE Proceedings* **2805**, 18 (1996)

[32] Graessle, D.E., Burek, A.J., Fitch, J.J., Harris, B., Schwartz, D.A., and Blake, R.L., "Optical constants from synchrotron reflectance measurements of AXAF witness mirrors - 2 to 12 keV, " in Grazing Incidence and Multilayer X-ray Optical Systems, Proc. SPIE, vol 3113, pp 52-64, 1997.

[33] Graessle, D.E., Blake, R.L., Burek, A.J., Dyson, S.E., Fitch, J.J., Schwartz, D.A., and Soufli, R., "Modeling of synchrotron reflectance calibrations of AXAF iridium-coated witness mirrors over 2-12 keV, " in X-ray Optics, Instruments, and Missions, Proc. SPIE, vol 3444, 1997.

[34] HRC Calibration web page: `hea-www.harvard.edu/HRC/calib/calib.html` (1998).

[35] B.L. Henke, E.M. Gullikson, and J.C. Davis, "X-ray Interactions: Photoabsorption, Scattering, Transmission, and Reflection at E = 50–30,000 eV, A = 1–92", *Atomic Data and Nuclear Data Tables*, Vol. 54, No. 2, July 1993.

[36] Kameritsch, P., "Calibration of Transmission Diffraction Gratings for the AXAF X-ray Satellite", thesis at the Ludwig Maximilians University, Munich, 1995.

[37] M. Keller, K. Shumate, Software Specification and Design : a Disciplined Approach for Real-Time Systems, John Wiley & Sons, Inc., New York, 1992.

[38] E. Kellogg, "Kα Line-to-continuum ratio for electron impact x-ray sources", internal memo to AXAF Calibration Task Team, October 5, 1992.

[39] E.M. Kellogg *et al.*, "Absolute calibration of the AXAF telescope effective area", *Grazing Incidence and Multilayer X-Ray Optical Systems, Proc. SPIE*, Vol. **3113**, (1997).

[40] A. Kenter, J.H. Chappell, R.P. Kraft, G.R. Meehan, S.S. Murray, M.V. Zombeck, *SPIE Proceedings* **2808**, 626 (1996).

[41] A.T. Kenter, J.H. Chappell, K. Kobayashi, R.P. Kraft, G.R. Meehan, S.S. Murray, M.V. Zombeck, G.W. Fraser, J.F. Pearson, J.F. Lees, A.N. Brunton, S.E. Pearce, M. Barbera, A. Collura, S. Serio, *SPIE Proceedings* **3114**, 26 (1997).

[42] J.J. Kolodziejczak, R.A. Austin, R.F. Elsner, M.K. Joy, M. Sulkanen, E.M. Kellogg, and B.J. Wargelin, "X-Ray Source System at the MSFC X-Ray Calibration Facility", *X-Ray and Extreme Ultraviolet Optics*, Proc. SPIE, Vol. **2515**, 420–435 (1995).

[43] Kolodziejczak, J.J., et al., "Uses of continuum radiation in the AXAF calibration, ", in Grazing Incidence and Multilayer X-ray Optical Systems, Proc. SPIE, vol 3113, pp 65-76, 1997.

[44] C.J. Borkowski and M. Kopp, "Design and properties of position-sensitive proportional counters using resistance-capacitance position encoding", Rev. Sci. Instrum., Vol. 46, No. 8, August 1975.

[45] T.H. Markert, "Dispersive Spectroscopy on AXAF", in *High-Resolution X-ray Spectroscopy of Cosmic Plasmas, IAU Colloquium No. 115*, P. Gorenstein and M. Zombeck, eds., pp. 339-344, Cambridge University Press, Cambridge, 1990.

[46] T.H. Markert, C.R. Canizares, D. Dewey, M. McGuirk, C. Pak, and M.L. Schattenburg, "The High Energy Transmission Grating Spectrometer for AXAF", *EUX, X-Ray, and Gamma-Ray Instrumentation for Astronomy V*, Proc. SPIE, Vol. **2280**, 168–180 (1994).

[47] T.H. Markert, D. Dewey, J.E. Davis, K.A. Flanagan, D.E. Graessle, J.M. Bauer, C.S. Nelson, "Modeling the Diffraction Efficiencies of the AXAF High Energy Transmission Gratings", *SPIE Proceedings* **2518**, 424–437 (1995).

[48] H.L. Marshall, D. Dewey, K.A. Flanagan, C. Baluta, C.R. Canizares, D.S. Davis, J.E. Davis, T.T. Fang, D.P. Huenemoerder, J.H. Kastner, H.L. Marshall, N.S. Schulz, M.W. Wise, J.J. Drake, J.Z. Juda, M. Juda, A.C. Brinkman, C.J.Th. Gunsing, and J.S. Kaastra, G. Hartner and P. Predehl, "Towards the Calibration of the HETGS Line Response Function", *Grazing Incidence and Multilayer X-Ray Optical Systems*, Proc. SPIE, Vol. **3113**, 160–171 (1997).

[49] H.L. Marshall, D. Dewey, N.S. Schulz, and K.A. Flanagan, "Spectral Features in the AXAF HETGS Effective Area using High-signal Continuum Tests", *X-Ray Optics, Instruments, and Missions*, Proc. SPIE, Vol. **3444**, (1998).

[50] AXAF Science Center, `asc.harvard.edu`, "MARX 2.0 User Guide, Rev 1.0", ASC TD. 404, October 1997.

[51] W.C. McDermott, E.M. Kellogg, B.J. Wargelin, I.N. Evans, S.A. Vitek, E. Tsiang, D.A. Schwartz, R.J. Edgar, S. Kraft, F. Scholze, R. Thornagel, G. Ulm, M.C. Weisskopf, S.L. O'Dell, A.F. Tennant, J. Kolodziejczak, and G. Zirnstein, "AXAF HXDS germanium solid state detectors", *Grazing Incidence and Multilayer X-Ray Optical Systems*, Proc. SPIE, Vol. **3113**, 535–543 (1997).

[52] S.S. Murray and J.H. Chappell, "The Advanced X-ray Astrophysics Facility High Resolution Camera", in *X-ray Instrumentation in Astronomy, Proc. SPIE*, vol. 597, pp. 274-281, 1985.

[53] S.S. Murray, *et al.*, *Astro. Lett. and Communications*, Vol. 26, p. 113, 1987.

[54] S.S. Murray, J.H. Chappell, A.T. Kenter, K. Kobayashi, R.P. Kraft, G.R. Meehan, M.V. Zombeck, G.W. Fraser, J.F. Pearson, J.E. Lees, A.N. Brunton, S.E. Pearce, M. Barbera, A. Collura, S. Serio, *SPIE Proceedings* **3114**, 11 (1997).

[55] C.S. Nelson, *Synchrotron Studies of an X-ray Transmission Grating*, Bachelor's Thesis, MIT (1994)

[56] C.S. Nelson, T.H. Markert, Y.S. Song, M.L. Schattenburg, K.A. Flanagan, R.L. Blake, J. Bauer, E.M. Gullikson, "Efficiency Measurements and Modelling of AXAF High Energy Transmission Gratings", *EUX, X-Ray, and Gamma-Ray Instrumentation for Astronomy V*, Proc. SPIE, Vol. **2280**, 191–203 (1994).

[57] J.A. Nousek, G.P. Garmire, G.R. Ricker, S.A. Collins, and G.R. Reigler, *Astro. Lett. and Communications*, Vol. 26, p. 35, 1987.

[58] The AXAF Observatory Guide, Rev. 1.0, AXAF Science Center.

[59] The AXAF Proposers' Guide, Rev. 1.0, AXAF Science Center.

[60] F.B.S. Paerels, J.V. Bixler, J.W. den Herder, C.J. Hailey, S.M. Kahn, and C.W. Mauche, "Modeling and Analysis of X-ray Emission Line Images Acquired with a Prototype Model of the XMM Reflection Grating Spectrometer", *X-Ray and Ultraviolet Spectroscopy and Polarimetry*, Proc. SPIE, Vol. **2283**, 107–118 (1994).

[61] C. Pak and M. McGuirk, "Computer Aided Design for the High Energy Transmission Grating (HETG) Spectrometer", paper 94-4566 presented at the *AIAA Space Programs and Technologies Conference*, Huntsville, AL (1994).

[62] G.J. Patnaude, D. Pease, H. Donnelly, M. Juda, C. Jones, S.S. Murray, M.V. Zombeck, R.P. Kraft, A.T. Kenter, G.R. Meehan, D.A. Swartz, R.F. Elsner, "Effective Area of the AXAF High-Resolution Camera (HRC)", *X-Ray Optics, Instruments, and Missions*, Proc. SPIE, Vol. **3444**, (1998).

[63] P. Predehl, H. Bräuninger, A.C. Brinkman, D. Dewey, J.J. Drake, K.A. Flanagan, C.J.Th. Gunsing, G. Hartner, J.Z. Juda, M. Juda, J. Kaastra, H.L. Marshall, and D. Swartz, "X-Ray Calibration of the AXAF Low Energy Transmission Grating Spectrometer: Effective Area",*Grazing Incidence and Multilayer X-Ray Optical Systems, Proc. SPIE*, Vol. **3113**,(1997).

[64] M. Weisskopf, R.F. Elsner, S.L. 0'Dell and the AXAF Project Science team, "Calibration of the Advanced X-ray Astrophysics Facility: Project Science analyses" available at at `wwwastro.msfc.nasa.gov/xray/axafps.html` (1997)

[65] SAOimage: The Next Generation, SAOtng home page: `hea-www.harvard.edu/RD/` (1998).

[66] M.L. Schattenburg, *et al.*, Optical Engineering,vol. 30, p. 1590, 1991.

[67] M.L. Schattenburg, R.J. Aucoin, R.C. Fleming, I. Plotnik, J. Porter, and H.I. Smith, "Fabrication of High Energy X-ray Transmission Gratings for AXAF", *EUX, X-Ray, and Gamma-Ray Instrumentation for Astronomy V*, Proc. SPIE, Vol. **2280**, 181–190 (1994).

[68] H.W. Schnopper, *et al.*, "Diffraction Grating Transmission Efficiencies for XUV and Soft X-rays", *Appl. Optics*, Vol. 16, p. 1088, 1977.

[69] F. Scholze, M. Krumrey, P. Müller, and D. Fuchs, "(PTB monochromator purity)", *Rev. Sci. Instrum.* **65**, 3229 (1994)

[70] Daniel J. Schroeder, *Astronomical Optics*, Chapter 14, Academic Press, San Diego, 1987.

[71] N.S. Schulz, D. Dewey, H.L. Marshall, "Absolute Effective Areas of HETG", *X-Ray Optics, Instruments, and Missions*, Proc. SPIE, Vol. **3444**, (1998).

[72] M.D. Stage and D. Dewey, "Verifying the HETG Spectrometer Rowland Design", *X-Ray Optics, Instruments, and Missions*, Proc. SPIE, Vol. **3444**, (1998).

[73] Stratonovich, R.L., *Topics in the Theory of Random Noise*, Volume 1, Gordon and Breach, 1963

[74] D.A. Swartz, R.F. Elsner, J.J. Kolodziejczak, S.L. O'Dell, A.F. Tennant, M.E. Sulkanen, M.C. Weisskopf, and R.J. Edgar, "Use of Monochromators for the Calibration of AXAF", *X-Ray Optics, Instruments, and Missions*, Proc. SPIE, Vol. **3444**, (1998).

[75] E.Y. Tsiang, R.E. Edgar, S. Vitek, and A. Tennant, "JMKMOD, a Software Suite within XSPEC for the Ground Calibration of AXAF", *Grazing Incidence and Multilayer X-Ray Optical Systems*, Proc. SPIE, Vol. **3113**, 132–141 (1997). `hea-www.harvard.edu/MST/simul/xrcf/XSPEC/jmkmod.html`

[76] G. Ulm, B. Wende, "(PTB Synchrotron)", *Rev. Sci. Instrum.* **66**, 2244-2247 (1995).

[77] B.J. Wargelin, E.M. Kellogg, W.C. McDermott, I.N. Evans, and S.A. Vitek, "AXAF Calibration: The HXDS Flow Proportional Counters", *Grazing Incidence and Multilayer X-Ray Optical Systems, Proc. SPIE*, Vol. **3113**, (1997).

[78] Warren, B.E., *X-Ray Diffraction*, Dover Publications, 1990

[79] M.C.Weisskopf and S.L. O'Dell, "Calibration of the AXAF observatory: overview", *Grazing Incidence and Multilayer X-Ray Optical Systems*, Proc. SPIE, Vol. **3113**, 2–17 (1997).

[80] K.A. Arnaud, *et al.*, "XSPEC, An X-Ray Spectral Fitting Package", part of the XANADU software from NASA Goddard Space Flight Center, `legacy.gsfc.nasa.gov/`