

SXT X-RAY EFFECTIVE AREA

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This note describes the effective area of the SXT as a function of wavelength. The reader is also advised to refer to Calibration Notes 25 and 30. The SXT effective area was computed in July 1991 using the old (and incorrect) mirror effective area (see Calibration Note 30 for details) and used to compute the thermal response function (et_910709.genx) that was used for plasma temperature determinations until early 1993. Loren Acton did a separate calculation of SXT effective area and this is published in the Redbook (Tsuneta et al, 1991) as shown in Fig 2 of that paper. This note describes the updated SXT effective area calculation which was performed on 11 Feb 1993 and which is written in the data file \$DIR_SXT_SENSITIVE/sra930211_01.genx. This effective area data should be used in all future analyses of SXT data. Details about how to access this data file are given in Section 8. The thermal response function is described elsewhere (Calibration Note 32).

1. INTRODUCTION

The SXT effective area as a function of wavelength is the product of four quantities:

$$\text{Area}(\text{wave}) = \text{Mirror}(\text{wave}) \times \text{CCD QE}(\text{wave}) \times \text{E. filter}(\text{wave}) \times \text{A. Filter}(\text{wave})$$

where: Mirror(wave) = the wavelength dependent mirror effective area (cm²)
 CCD QE(wave) = the quantum efficiency of the CCD
 E. filter(wave) = the entrance filter transmission
 A. filter(wave) = the analysis filter transmission (there are 5 filters)

To compute the SXT effective area we have used the optical constants of Henke, Davis, Gullikson, and Perera (received by W. A. Brown in Dec 1990). Table 1 gives a list of the materials used in the SXT and their assumed densities.

TABLE 1: MATERIALS WHICH DETERMINE THE SXT EFFECTIVE AREA

	(atwt in g/mole)	(g/cm ³)
C	12.011	2.220
Al	26.982	2.699
Al2O3	20.392	3.965
Be	9.012	1.845
C	12.011	2.220
Lexan(C16H14O3)	7.706	1.200
Mg	24.312	1.741
Mn	54.938	7.430
Si	28.086	2.330
SiO2	20.028	2.200
Ti	47.900	4.450
TiO2	26.633	4.260

2. MEASUREMENTS

The measurements of the mirror effective area were made at the long-beam X-ray calibration facility at MSFC during June 1989. These are described in Calibration Note 30. The measurements of the CCD, entrance and analysis filters were made at LPARL in B255 in either the XUV monochromator/reflectometer or the high-energy X-ray monochromator. The measurements were made by Mons Morrison, James Lemen, and Hugh Hudson with help from Lawrence Shing, Bruce Jurcevich, Wesley Brookover. Loren Acton and Richard Catura provided helpful discussions and guidance.

3. MIRROR EFFECTIVE AREA

The SXT mirror effective area is described in detail in Calibration Note 30. The curve that is labeled "a" in Figure 3 of that report is used here to compute the SXT effective area as a function of wavelength.

4. CCD QUANTUM EFFICIENCY (QE)

The quantum efficiency (QE) of the flight CCD, FM44c, was measured in June 1991 by Mons Morrison and James Lemen. The measurements were made at 14 different wavelengths. The four shortest wavelengths were measured in the high-energy monochromator and the measurements at longer wavelengths were made in the XUV Monochromator/Reflectometer. These measurements were made prior to these monochromators being moved from B255 to B252. The observed data is shown in Table 2. The Cu L-alpha line (at 13.34 Ang) was measured in both systems.

Table 2: Flight Model CCD: Measured Quantum Efficiency

FM 44C (28-jun-91) (No dead-time; Old PC eff for High-E)

Wave (Ang)	QE(%)	d_QE	Line
4.15	77.68	0.65	Ag L
5.41	72.58	0.69	Mo L
8.34	55.17	0.44	Al K
13.34	53.62	1.84	Cu L
13.34	51.24	1.48	Cu L
17.59	28.85	0.78	Fe La
20.15	17.26	0.97	Fe Ll
21.64	11.80	0.58	Cr La
23.62	35.95	0.19	O K
24.25	35.39	0.76	V La
24.78	32.19	0.47	Cr Ll
27.42	24.32	0.37	Ti La
31.36	16.93	0.27	Ti Ll
44.70	4.34	0.06	C K
67.70	0.36	0.01	B K

Loren Acton fit the above data with a model that represented the CCD as shown in Fig. 8 of the Redbook (Tsuneta et al, 1991). The parameters that determine

the CCD QE are given in Table 3 including the fractional pixel areas which gave the best agreement with the data.

TABLE 3: Flight Model (FM 44C) CCD DESCRIPTION

	Material	Thick (Ang)
Substrate	Si	89490.6
Overcoat	SiO2	4871.7457
Poly Si gate	Si	7698.8805
Gate oxide	SiO2	632.7
Fractional gate area	=	0.4653573
Fractional open area	=	0.47556174
Fractional shoulder area	=	0.05908096

(These fractional areas sum to unity.)

Since the CCD consists of several layers, the QE for the SXT effective area should be computed assuming the CCD is a multi-layer. However, we have assumed that incident angle is 0 degrees. CCD QE computation are shown in Appendix B.

5. ENTRANCE FILTER TRANSMISSION

The SXT entrance filters consist of a double filter. Each gridless filter in the pair is made of Lexan coated with Ti and Al (Al is exposed to provide the correct thermal finish). The design includes no support grid or mesh since a grid would act as a diffraction grating in front of the mirror.

The double entrance filter is described in Table 4.

TABLE 4: Double Entrance Filter Description

Material	Thickness	Description
Lexan (C16H14O3)	3600 Ang	Support material
Ti	1400 Ang	Exclude He 304 Ang
Al	1800 Ang	Exclude visible, thermal control
Si	18 Ang	
Al2O3	130 Ang	

The SXT entrance filters were measured in the XUV Monochromator/Reflectometer by J. Lemen during May-June 1990. Loren Acton determined the best fit to these measurements as described in his handout entitled "Resp Parameters-rev 3" dated 15 March 1991 (MacIntosh Table). The entrance filter computation are shown in Appendix B.

6. ANALYSIS FILTER TRANSMISSIONS

There are five (5) X-ray (metal) filters in the SXT filter wheel. These were measured in the XUV Monochromator/Reflectometer and the High-energy monochromator by J. Lemen with help from H. Hudson. Loren Acton analyzed the data and determined the best fit parameters as described in his handout entitled "Resp Parameters-rev 3" dated 15 March 1991 (MacIntosh Table).

TABLE 5: X-ray Analysis (filter wheel) Filter Descriptions

Yodat Name:	Al.1	AlMg	Mg3
Nickname:	Thin Al	Dagwood	
	1265 Ang Al	2930 Ang Al	240 Ang Ti
	12.65 Ang Si	29.30 Ang Si	2.52 micron Mg
	27 Ang Al2O3	2070 Ang Mg	70 Ang TiO2
	83.6% mesh	562 Ang Mn	78% mesh
		190 Ang C	
		83% mesh	
Yodat Name:	Al12	Be	
Nickname:	Thick Al		
	11.594 micron Al	119 micron Be	
	0.116 micron Si		
	110 Ang Al2O3		
	83% mesh		

Since the filters consist of several layers, their transmissions should be computed assuming that each filter is a multi-layer. However, we have assumed that the incident angle is 0 degrees. The X-ray analysis filter computations are not given independently in this report, however, the products of each filter with the double entrance filter, mirror and CCD are shown in Appendix B.

The five X-ray analysis filters are located in the rear (gt_filtb) position in the filter wheel. In the front filter position (gt_filta) there is a neutral density mesh that is sometimes used in tandem with the X-ray analysis filters. This filter has been described in Calibration Note 5 (Hudson and Lemen). The neutral density mesh has a transmission of 8.3%.

7. RESULTS AND DISCUSSIONS

The SXT effective area through the five X-ray analysis filters and for the case of Noback (open/open) is shown in Fig 1. The Noback panel is shown on a log-log scale. In the other cases, the thin curve is the Noback curve and the thicker curve is for the filter as given by the title. This figure is to be compared with Fig. 2 of the Redbook (Tsuneta et al, 1991). Figure 2 (in this report) shows the percentage change ([new-old] / old) of this calculation (11-feb-93) compared to the July 1991 calculation. At 2 Ang the difference between the two calculations is revised obscuration factor (see

Calibration Note 30). At wavelengths greater than 2 Ang the differences are caused by the revised obscuration factor and the updated mirror calculation. Figure 3 shows the double entrance filter, CCD QE and mirror area, and Noback area in separate plot panels.

8. ACCESSING THE DATA FILE

The SXT effective area data is contained in a file in the Yohkoh software tree called:

```
$DIR_SXT_SENSITIVE/sra930211_01.genx
```

(at the time this report was compiled, \$DIR_SXT_SENSITIVE=/ys/sxt/response). This is a genx file and can be easily read in IDL using the procedure restgen (stands for RESTore GENx file). For example,

```
IDL> restgen,file='$DIR_SXT_SENSITIVE/sra930211_01',text=text,str=area
```

area is a structure variable. Using the help,/str,area command you will find:

```
IDL> help,area,/str
```

```
** Structure MAKE_STR000002, 5 tags, length=11600:
```

WAVE	FLOAT	Array(290)
ENTRANCE	FLOAT	Array(290)
CCD	FLOAT	Array(290)
MIRROR	FLOAT	Array(290)
FILTER	FLOAT	Array(6, 290)

Thus, area.wave = wavelengths (Ang)
area.entrance = Double entrance filter transmission
area.ccd = CCD fractional QE
area.mirror = area of SXT mirror (cm²)
area.filter = Product of mirror, entrance filter and analysis filters

The area.filter data is shown in Fig. 1 of this report are in units of cm². The correspondence with filter is as follows:

```
area.filter(0,*) = Noback (open/open in filter wheel)
(1,*) = Al.1 (Thin Al)
(2,*) = AlMG (Dagwood)
(3,*) = Mg3
(4,*) = Al12 (Thick Al)
(5,*) = Be
```

APPENDIX A. WORK NOT DONE

There are several things that have not been done in this analysis, however, their omission is not expected make a large change to the results. Here I list a few things that come to mind in no particular order:

1. Proportional counter dead-time corrections for filter transmission and CCD QE measurements.
2. Effect of 4.3 deg incident angle on X-ray analysis filters and CCD.
3. Estimates statistical and systematic errors.
4. Mirror effective area needs to be checked with White Sands data which was taken shortly before launch in May 1992.

APPENDIX B. DATA IN TABULAR FORM

The following table gives the SXT effective area from 1.27 Ang to 98 Ang. The columns are as follows:

Label	Units	Description
Wave	Ang	Wavelength
Entrance	-	Fractional transmission of double entrance filter
Mirror	cm ²	Effective area of SXT mirror (includes obscuration)
CCD	-	CCD QE (fractional quantum efficiency)
Noback	cm ²	Eff area for SXT telescope with open/open selected
Al.1	cm ²	Eff area for SXT telescope with Al.1 filter selected
AlMg	cm ²	Eff area for SXT telescope with AlMg filter selected
Mg3	cm ²	Eff area for SXT telescope with Mg3 filter selected
Al12	cm ²	Eff area for SXT telescope with Al12 filter selected
Be	cm ²	Eff area for SXT telescope with Be filter selected

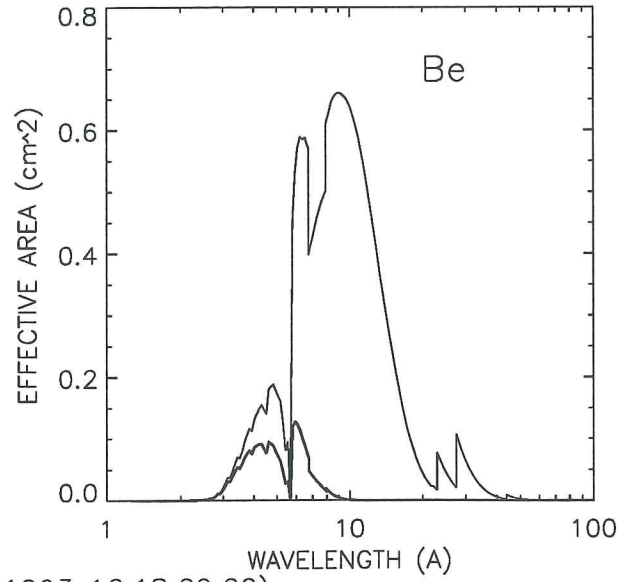
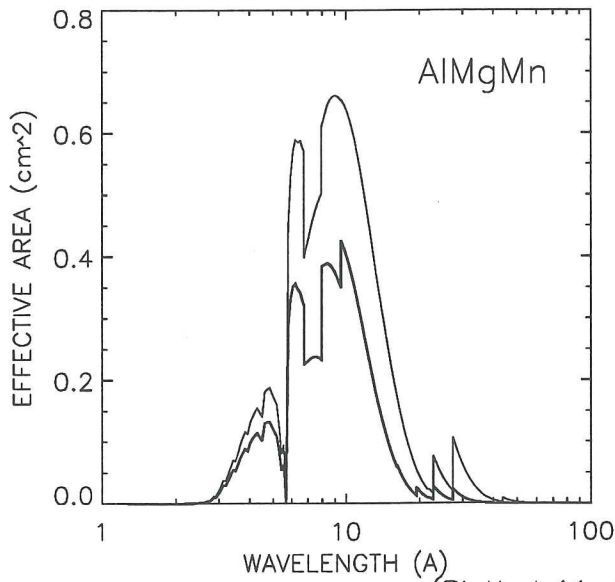
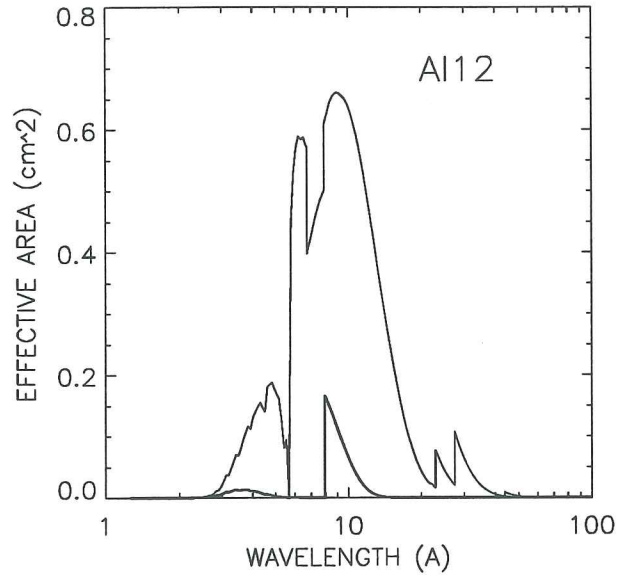
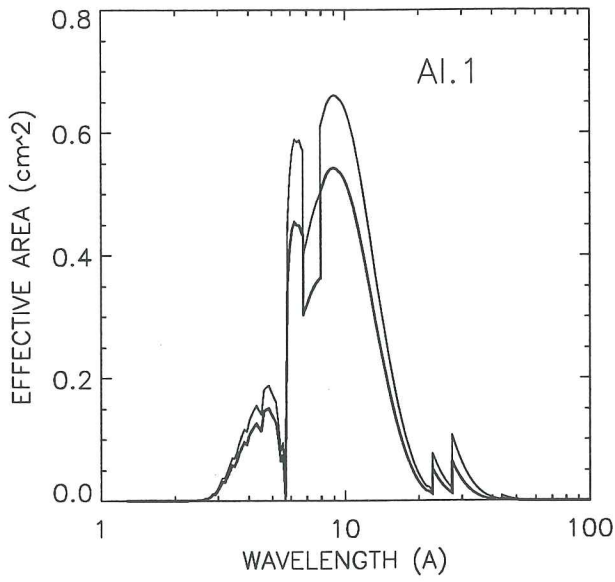
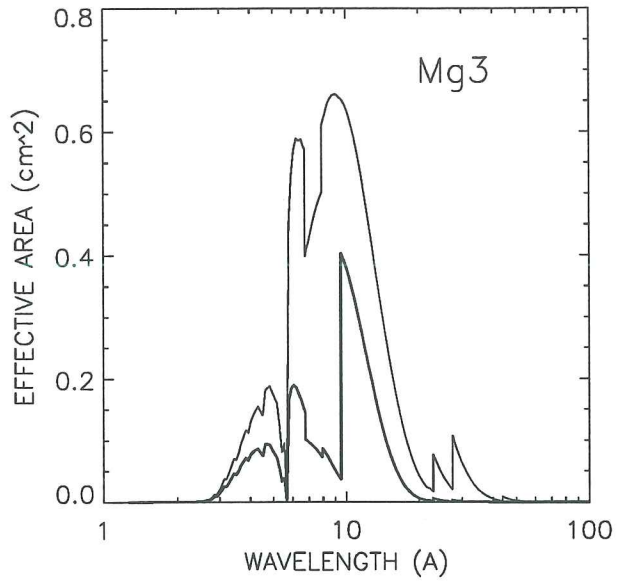
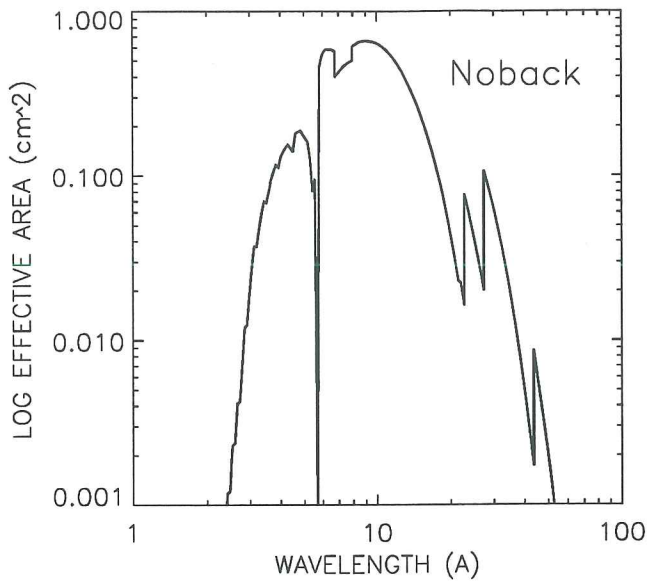
Wave	Entrance	Mirror (cm ²)	CCD	Noback (cm ²)	Al.1 (cm ²)	AlMg (cm ²)	Mg3 (cm ²)	All2 (cm ²)	Be (cm ²)
1.27	0.9911	1.291e-06	0.0686	8.77e-08	7.33e-08	7.21e-08	6.77e-08	6.70e-08	8.67e-08
1.30	0.9905	6.309e-06	0.0731	4.57e-07	3.81e-07	3.75e-07	3.52e-07	3.47e-07	4.51e-07
1.33	0.9899	7.508e-06	0.0780	5.80e-07	4.84e-07	4.76e-07	4.46e-07	4.37e-07	5.72e-07
1.36	0.9892	1.565e-05	0.0833	1.29e-06	1.08e-06	1.06e-06	9.93e-07	9.66e-07	1.27e-06
1.39	0.9885	3.710e-05	0.0888	3.26e-06	2.72e-06	2.67e-06	2.50e-06	2.42e-06	3.21e-06
1.42	0.9877	1.114e-05	0.0945	1.04e-06	8.68e-07	8.52e-07	7.99e-07	7.68e-07	1.02e-06
1.46	0.9869	1.774e-06	0.1008	1.76e-07	1.47e-07	1.44e-07	1.35e-07	1.29e-07	1.73e-07
1.49	0.9860	1.220e-05	0.1073	1.29e-06	1.08e-06	1.05e-06	9.89e-07	9.36e-07	1.27e-06
1.53	0.9851	2.271e-05	0.1143	2.56e-06	2.13e-06	2.09e-06	1.96e-06	1.84e-06	2.51e-06
1.56	0.9842	8.668e-06	0.1216	1.04e-06	8.66e-07	8.47e-07	7.93e-07	7.38e-07	1.01e-06
1.60	0.9831	2.879e-05	0.1294	3.66e-06	3.06e-06	2.99e-06	2.80e-06	2.58e-06	3.58e-06
1.63	0.9820	5.232e-05	0.1376	7.07e-06	5.90e-06	5.75e-06	5.39e-06	4.92e-06	6.89e-06
1.67	0.9809	3.911e-05	0.1463	5.61e-06	4.68e-06	4.56e-06	4.27e-06	3.86e-06	5.46e-06
1.71	0.9797	4.971e-05	0.1554	7.57e-06	6.31e-06	6.15e-06	5.75e-06	5.13e-06	7.35e-06
1.75	0.9784	7.364e-05	0.1650	1.19e-05	9.92e-06	9.64e-06	9.01e-06	7.95e-06	1.15e-05
1.79	0.9770	8.152e-05	0.1752	1.40e-05	1.16e-05	1.13e-05	1.06e-05	9.19e-06	1.35e-05
1.83	0.9755	1.319e-04	0.1858	2.39e-05	1.99e-05	1.93e-05	1.81e-05	1.55e-05	2.31e-05
1.88	0.9740	1.262e-04	0.1970	2.42e-05	2.02e-05	1.95e-05	1.82e-05	1.54e-05	2.33e-05
1.90	0.9733	1.275e-04	0.2022	2.51e-05	2.09e-05	2.02e-05	1.89e-05	1.59e-05	2.41e-05
1.90	0.9733	1.275e-04	0.2022	2.51e-05	2.09e-05	2.06e-05	1.89e-05	1.59e-05	2.41e-05
1.92	0.9724	1.292e-04	0.2088	2.62e-05	2.19e-05	2.15e-05	1.97e-05	1.64e-05	2.52e-05
1.96	0.9706	3.603e-04	0.2211	7.73e-05	6.44e-05	6.33e-05	5.80e-05	4.75e-05	7.39e-05
2.01	0.9688	3.378e-04	0.2340	7.66e-05	6.38e-05	6.27e-05	5.72e-05	4.60e-05	7.29e-05
2.06	0.9669	2.952e-04	0.2474	7.06e-05	5.88e-05	5.77e-05	5.26e-05	4.15e-05	6.70e-05
2.11	0.9648	5.664e-04	0.2614	1.43e-04	1.19e-04	1.17e-04	1.06e-04	8.20e-05	1.35e-04
2.15	0.9627	6.184e-04	0.2760	1.64e-04	1.37e-04	1.34e-04	1.22e-04	9.20e-05	1.55e-04
2.20	0.9604	1.090e-03	0.2912	3.05e-04	2.54e-04	2.48e-04	2.25e-04	1.66e-04	2.86e-04
2.26	0.9580	1.039e-03	0.3069	3.06e-04	2.54e-04	2.49e-04	2.25e-04	1.62e-04	2.85e-04
2.31	0.9555	1.963e-03	0.3232	6.06e-04	5.04e-04	4.93e-04	4.44e-04	3.11e-04	5.62e-04
2.36	0.9529	2.020e-03	0.3400	6.55e-04	5.44e-04	5.31e-04	4.77e-04	3.25e-04	6.04e-04
2.42	0.9501	3.453e-03	0.3573	1.17e-03	9.74e-04	9.50e-04	8.50e-04	5.62e-04	1.08e-03
2.47	0.9472	3.408e-03	0.3751	1.21e-03	1.01e-03	9.80e-04	8.74e-04	5.60e-04	1.10e-03
2.50	0.9460	4.405e-03	0.3824	1.59e-03	1.32e-03	1.29e-03	1.15e-03	7.25e-04	1.45e-03
2.50	0.9840	4.405e-03	0.3824	1.66e-03	1.38e-03	1.34e-03	1.20e-03	7.54e-04	1.51e-03
2.53	0.9833	5.926e-03	0.3934	2.29e-03	1.90e-03	1.85e-03	1.66e-03	1.02e-03	2.07e-03
2.59	0.9822	5.896e-03	0.4120	2.39e-03	1.98e-03	1.92e-03	1.72e-03	1.02e-03	2.14e-03
2.65	0.9810	9.837e-03	0.4310	4.16e-03	3.45e-03	3.35e-03	2.98e-03	1.69e-03	3.71e-03
2.71	0.9797	9.599e-03	0.4503	4.24e-03	3.51e-03	3.40e-03	3.02e-03	1.64e-03	3.74e-03
2.78	0.9784	1.518e-02	0.4699	6.98e-03	5.78e-03	5.59e-03	4.94e-03	2.57e-03	6.11e-03
2.84	0.9770	2.490e-02	0.4896	1.19e-02	9.86e-03	9.52e-03	8.37e-03	4.15e-03	1.03e-02
2.91	0.9754	2.499e-02	0.5093	1.24e-02	1.03e-02	9.90e-03	8.67e-03	4.08e-03	1.06e-02
2.97	0.9738	3.696e-02	0.5291	1.90e-02	1.57e-02	1.51e-02	1.32e-02	5.88e-03	1.62e-02
3.04	0.9721	5.135e-02	0.5488	2.74e-02	2.26e-02	2.17e-02	1.88e-02	7.91e-03	2.30e-02
3.11	0.9703	6.765e-02	0.5682	3.73e-02	3.08e-02	2.95e-02	2.54e-02	1.00e-02	3.09e-02
3.19	0.9683	6.533e-02	0.5873	3.72e-02	3.06e-02	2.93e-02	2.51e-02	9.27e-03	3.03e-02
3.26	0.9662	8.129e-02	0.6060	4.76e-02	3.92e-02	3.74e-02	3.18e-02	1.10e-02	3.81e-02

Wave	Entrance	Mirror (cm ²)	CCD	Noback (cm ²)	Al.1 (cm ²)	AlMg (cm ²)	Mg3 (cm ²)	Al12 (cm ²)	Be (cm ²)
3.34	0.9640	9.755e-02	0.6242	5.87e-02	4.83e-02	4.59e-02	3.88e-02	1.24e-02	4.64e-02
3.41	0.9617	1.136e-01	0.6417	7.01e-02	5.77e-02	5.47e-02	4.59e-02	1.35e-02	5.43e-02
3.49	0.9592	1.086e-01	0.6584	6.86e-02	5.64e-02	5.32e-02	4.43e-02	1.20e-02	5.21e-02
3.58	0.9566	1.234e-01	0.6742	7.94e-02	6.53e-02	6.15e-02	5.08e-02	1.26e-02	5.93e-02
3.66	0.9538	1.443e-01	0.6890	9.48e-02	7.77e-02	7.29e-02	5.97e-02	1.34e-02	6.91e-02
3.74	0.9508	1.584e-01	0.7027	1.06e-01	8.66e-02	8.10e-02	6.57e-02	1.34e-02	7.53e-02
3.83	0.9477	1.719e-01	0.7151	1.16e-01	9.52e-02	8.87e-02	7.12e-02	1.30e-02	8.08e-02
3.92	0.9443	1.642e-01	0.7263	1.13e-01	9.20e-02	8.52e-02	6.78e-02	1.10e-02	7.60e-02
4.01	0.9408	1.887e-01	0.7360	1.31e-01	1.07e-01	9.83e-02	7.73e-02	1.11e-02	8.56e-02
4.11	0.9371	2.011e-01	0.7442	1.40e-01	1.14e-01	1.05e-01	8.14e-02	1.03e-02	8.90e-02
4.20	0.9331	2.117e-01	0.7510	1.48e-01	1.21e-01	1.10e-01	8.45e-02	9.29e-03	9.10e-02
4.30	0.9289	2.205e-01	0.7562	1.55e-01	1.26e-01	1.14e-01	8.64e-02	8.21e-03	9.16e-02
4.40	0.9245	2.099e-01	0.7598	1.47e-01	1.19e-01	1.08e-01	8.04e-02	6.54e-03	8.38e-02
4.50	0.9198	2.002e-01	0.7617	1.40e-01	1.13e-01	1.02e-01	7.48e-02	5.16e-03	7.65e-02
4.61	0.9148	2.596e-01	0.7622	1.81e-01	1.46e-01	1.30e-01	9.41e-02	4.51e-03	9.18e-02
4.71	0.9096	2.670e-01	0.7610	1.85e-01	1.49e-01	1.32e-01	9.36e-02	4.51e-03	9.18e-02
4.82	0.9041	2.742e-01	0.7584	1.88e-01	1.51e-01	1.33e-01	9.25e-02	3.66e-03	8.87e-02
4.94	0.8983	2.628e-01	0.7543	1.78e-01	1.42e-01	1.24e-01	8.51e-02	2.74e-03	7.95e-02
5.05	0.8921	2.529e-01	0.7489	1.69e-01	1.35e-01	1.17e-01	7.82e-02	2.02e-03	7.10e-02
5.17	0.8857	2.444e-01	0.7421	1.61e-01	1.28e-01	1.10e-01	7.18e-02	1.47e-03	6.33e-02
5.29	0.8789	1.943e-01	0.7341	1.25e-01	9.94e-02	8.45e-02	5.41e-02	8.66e-04	4.61e-02
5.41	0.8717	1.275e-01	0.7251	8.06e-02	6.37e-02	5.36e-02	3.35e-02	4.14e-04	2.75e-02
5.54	0.8642	1.549e-01	0.7150	9.57e-02	7.53e-02	6.28e-02	3.82e-02	3.58e-04	3.02e-02
5.67	0.8563	1.280e-03	0.7040	7.72e-04	6.05e-04	4.99e-04	2.95e-04	2.07e-06	2.23e-04
5.80	0.8481	7.738e-01	0.6921	4.54e-01	3.55e-01	2.89e-01	1.66e-01	8.59e-04	1.20e-01
5.93	0.8394	9.293e-01	0.6795	5.30e-01	4.12e-01	3.32e-01	1.85e-01	6.92e-04	1.27e-01
6.07	0.8303	1.032e+00	0.6663	5.71e-01	4.42e-01	3.52e-01	1.89e-01	5.05e-04	1.23e-01
6.21	0.8210	1.099e+00	0.6528	5.89e-01	4.54e-01	3.56e-01	1.85e-01	3.48e-04	1.13e-01
6.36	0.8112	1.129e+00	0.6387	5.85e-01	4.49e-01	3.47e-01	1.74e-01	2.26e-04	9.97e-02
6.51	0.8009	1.176e+00	0.6240	5.88e-01	4.49e-01	3.42e-01	1.65e-01	1.45e-04	8.81e-02
6.66	0.7901	1.195e+00	0.6088	5.75e-01	4.37e-01	3.27e-01	1.52e-01	8.77e-05	7.51e-02
6.74	0.7840	1.214e+00	0.6004	5.71e-01	4.33e-01	3.21e-01	1.45e-01	6.65e-05	6.89e-02
6.81	0.7798	1.214e+00	0.4176	3.98e-01	3.02e-01	2.24e-01	1.01e-01	5.03e-05	4.80e-02
6.97	0.7681	1.241e+00	0.4255	4.08e-01	3.09e-01	2.28e-01	1.01e-01	4.08e-05	4.59e-02
7.13	0.7559	1.266e+00	0.4599	4.22e-01	3.17e-01	2.30e-01	9.70e-02	2.48e-05	4.05e-02
7.30	0.7434	1.291e+00	0.4764	4.40e-01	3.29e-01	2.34e-01	9.39e-02	1.49e-05	3.57e-02
7.47	0.7305	1.314e+00	0.4924	4.57e-01	3.39e-01	2.37e-01	9.04e-02	8.72e-06	3.09e-02
7.64	0.7171	1.333e+00	0.5081	4.73e-01	3.48e-01	2.38e-01	8.62e-02	4.96e-06	2.62e-02
7.82	0.7032	1.350e+00	0.5233	4.86e-01	3.56e-01	2.38e-01	8.14e-02	2.71e-06	2.19e-02
7.95	0.6928	1.360e+00	0.5338	4.97e-01	3.61e-01	2.36e-01	7.60e-02	1.42e-06	1.79e-02
8.00	0.8403	1.364e+00	0.5378	5.03e-01	3.63e-01	2.33e-01	7.19e-02	8.75e-07	1.52e-02
8.19	0.8309	1.376e+00	0.5516	6.12e-01	5.05e-01	3.84e-01	8.75e-02	1.67e-01	1.85e-02
8.38	0.8212	1.394e+00	0.5643	6.16e-01	5.08e-01	3.85e-01	8.58e-02	1.64e-01	1.74e-02
8.58	0.8112	1.400e+00	0.5758	6.31e-01	5.20e-01	3.87e-01	7.93e-02	1.55e-01	1.38e-02
8.78	0.8007	1.404e+00	0.5863	6.46e-01	5.32e-01	3.89e-01	7.30e-02	1.46e-01	1.07e-02
				6.54e-01	5.38e-01	3.87e-01	6.60e-02	1.36e-01	8.11e-03
				6.59e-01	5.42e-01	3.82e-01	5.90e-02	1.26e-01	5.98e-03

Wave	Entrance	Mirror (cm ²)	CCD	Noback (cm ²)	Al.1 (cm ²)	AlMg (cm ²)	Mg3 (cm ²)	Al12 (cm ²)	Be (cm ²)
8.98	0.7897	1.406e+00	0.5955	6.61e-01	5.43e-01	3.75e-01	5.21e-02	1.15e-01	4.30e-03
9.19	0.7782	1.405e+00	0.6035	6.60e-01	5.41e-01	3.66e-01	4.55e-02	1.04e-01	3.00e-03
9.40	0.7662	1.402e+00	0.6100	6.55e-01	5.37e-01	3.55e-01	3.92e-02	9.25e-02	2.03e-03
9.51	0.7599	1.404e+00	0.6128	6.54e-01	5.35e-01	3.50e-01	3.63e-02	8.71e-02	1.66e-03
9.51	0.7599	1.404e+00	0.6128	6.54e-01	5.35e-01	4.26e-01	4.04e-01	8.71e-02	1.66e-03
9.62	0.7536	1.406e+00	0.6151	6.52e-01	5.33e-01	4.22e-01	4.00e-01	8.20e-02	1.34e-03
9.85	0.7404	1.407e+00	0.6186	6.45e-01	5.26e-01	4.11e-01	3.89e-01	7.19e-02	8.56e-04
10.08	0.7269	1.407e+00	0.6205	6.35e-01	5.18e-01	3.98e-01	3.77e-01	6.21e-02	5.27e-04
10.31	0.7128	1.405e+00	0.6208	6.22e-01	5.06e-01	3.84e-01	3.63e-01	5.29e-02	3.12e-04
10.55	0.6982	1.402e+00	0.6194	6.06e-01	4.93e-01	3.68e-01	3.47e-01	4.44e-02	1.78e-04
10.80	0.6830	1.402e+00	0.6163	5.90e-01	4.79e-01	3.51e-01	3.32e-01	3.69e-02	9.71e-05
11.05	0.6672	1.395e+00	0.6115	5.69e-01	4.61e-01	3.32e-01	3.13e-01	3.00e-02	5.04e-05
11.31	0.6509	1.392e+00	0.6050	5.48e-01	4.43e-01	3.13e-01	2.95e-01	2.41e-02	2.51e-05
11.57	0.6339	1.388e+00	0.5968	5.25e-01	4.23e-01	2.93e-01	2.76e-01	1.90e-02	1.18e-05
11.84	0.6165	1.383e+00	0.5870	5.00e-01	4.02e-01	2.73e-01	2.56e-01	1.48e-02	5.26e-06
12.12	0.5987	1.379e+00	0.5758	4.75e-01	3.81e-01	2.53e-01	2.37e-01	1.13e-02	2.22e-06
12.40	0.5805	1.375e+00	0.5638	4.50e-01	3.60e-01	2.33e-01	2.18e-01	8.56e-03	8.78e-07
12.69	0.5617	1.374e+00	0.5504	4.25e-01	3.39e-01	2.14e-01	2.01e-01	6.32e-03	3.24e-07
12.98	0.5424	1.368e+00	0.5353	3.97e-01	3.16e-01	1.95e-01	1.82e-01	4.54e-03	1.11e-07
13.28	0.5227	1.362e+00	0.5190	3.70e-01	2.93e-01	1.76e-01	1.63e-01	3.20e-03	3.52e-08
13.59	0.5029	1.365e+00	0.5022	3.45e-01	2.72e-01	1.59e-01	1.47e-01	2.21e-03	1.05e-08
13.91	0.4829	1.368e+00	0.4849	3.20e-01	2.52e-01	1.43e-01	1.31e-01	1.50e-03	2.93e-09
14.23	0.4625	1.374e+00	0.4669	2.97e-01	2.33e-01	1.27e-01	1.16e-01	9.92e-04	7.47e-10
14.57	0.4419	1.376e+00	0.4480	2.72e-01	2.13e-01	1.13e-01	1.02e-01	6.36e-04	1.72e-10
14.91	0.4210	1.380e+00	0.4283	2.49e-01	1.93e-01	9.87e-02	8.91e-02	3.97e-04	3.52e-11
15.25	0.4000	1.381e+00	0.4080	2.25e-01	1.74e-01	8.55e-02	7.67e-02	2.40e-04	6.41e-12
15.61	0.3789	1.384e+00	0.3873	2.03e-01	1.56e-01	7.35e-02	6.55e-02	1.40e-04	1.04e-12
15.97	0.3578	1.387e+00	0.3664	1.82e-01	1.39e-01	6.27e-02	5.54e-02	7.95e-05	1.48e-13
16.12	0.3495	1.388e+00	0.3582	1.74e-01	1.33e-01	5.88e-02	5.17e-02	6.28e-05	6.53e-14
16.12	0.3495	1.388e+00	0.3582	1.74e-01	1.33e-01	6.30e-02	5.17e-02	6.28e-05	6.53e-14
16.34	0.3370	1.390e+00	0.3459	1.62e-01	1.23e-01	5.70e-02	4.64e-02	4.37e-05	1.86e-14
16.72	0.3163	1.391e+00	0.3254	1.43e-01	1.08e-01	4.79e-02	3.85e-02	2.31e-05	2.02e-15
17.11	0.2958	1.396e+00	0.3052	1.26e-01	9.48e-02	3.99e-02	3.16e-02	1.18e-05	1.89e-16
17.51	0.2756	1.400e+00	0.2851	1.10e-01	8.21e-02	3.30e-02	2.57e-02	5.75e-06	1.49e-17
17.92	0.2576	1.402e+00	0.2664	9.62e-02	7.14e-02	2.73e-02	2.08e-02	2.83e-06	1.23e-18
18.34	0.2399	1.401e+00	0.2479	8.33e-02	6.14e-02	2.23e-02	1.66e-02	1.33e-06	8.51e-20
18.77	0.2209	1.400e+00	0.2289	7.08e-02	5.17e-02	1.78e-02	1.29e-02	5.48e-07	3.65e-21
19.08	0.2076	1.400e+00	0.2156	6.27e-02	4.55e-02	1.50e-02	1.07e-02	2.78e-07	3.24e-22
19.08	0.2076	1.400e+00	0.2156	6.27e-02	4.55e-02	1.50e-02	1.07e-02	2.78e-07	3.24e-22
19.20	0.2023	1.400e+00	0.2104	5.96e-02	4.31e-02	1.40e-02	9.93e-03	2.11e-07	1.19e-22
19.41	0.1940	1.400e+00	0.2021	5.49e-02	3.96e-02	1.25e-02	8.75e-03	1.34e-07	2.33e-23
19.41	0.1940	1.400e+00	0.2021	5.49e-02	3.96e-02	2.60e-02	8.75e-03	1.34e-07	2.33e-23
19.65	0.1848	1.401e+00	0.1930	5.00e-02	3.58e-02	2.33e-02	7.55e-03	7.89e-08	3.48e-24
20.11	0.1683	1.403e+00	0.1766	4.17e-02	2.96e-02	1.87e-02	5.68e-03	2.85e-08	8.75e-26
20.58	0.1525	1.407e+00	0.1610	3.45e-02	2.43e-02	1.49e-02	4.22e-03	9.74e-09	1.77e-27
21.06	0.1375	1.410e+00	0.1461	2.83e-02	1.97e-02	1.18e-02	3.08e-03	3.11e-09	2.74e-29
21.55	0.1233	1.412e+00	0.1319	2.30e-02	1.58e-02	9.15e-03	2.21e-03	9.31e-10	3.17e-31

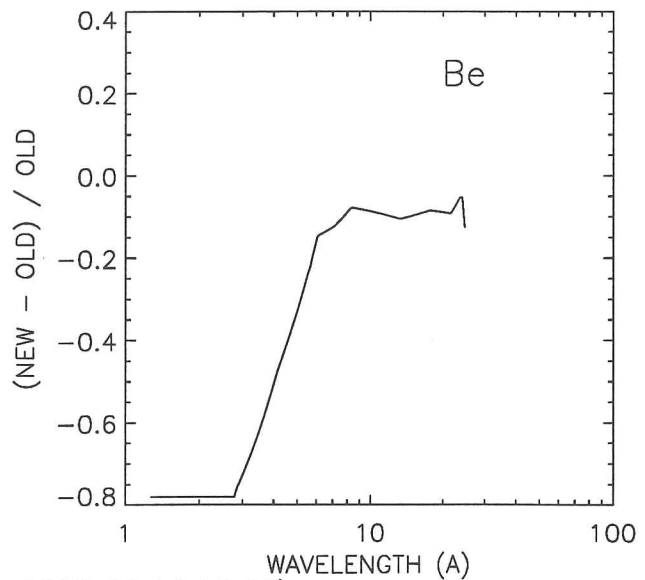
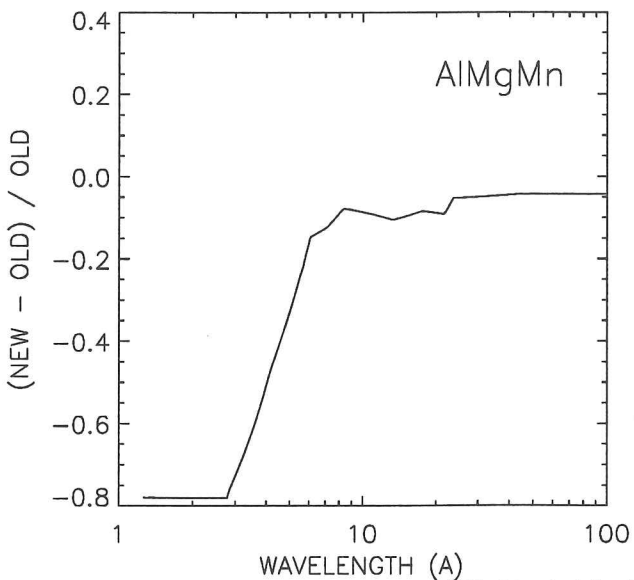
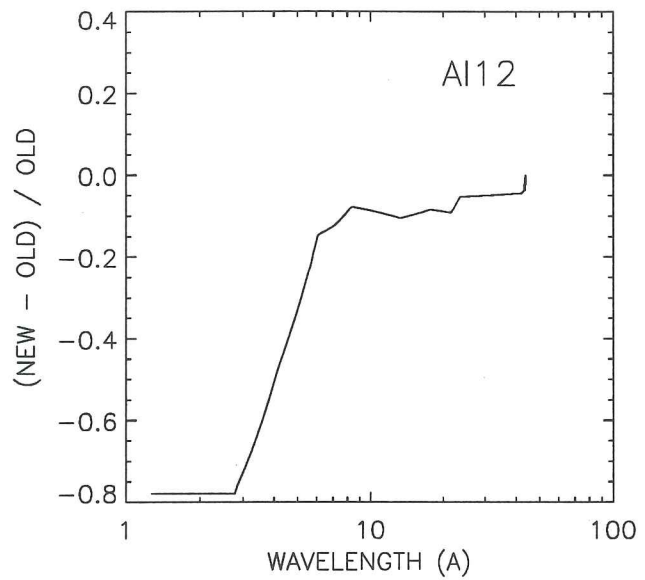
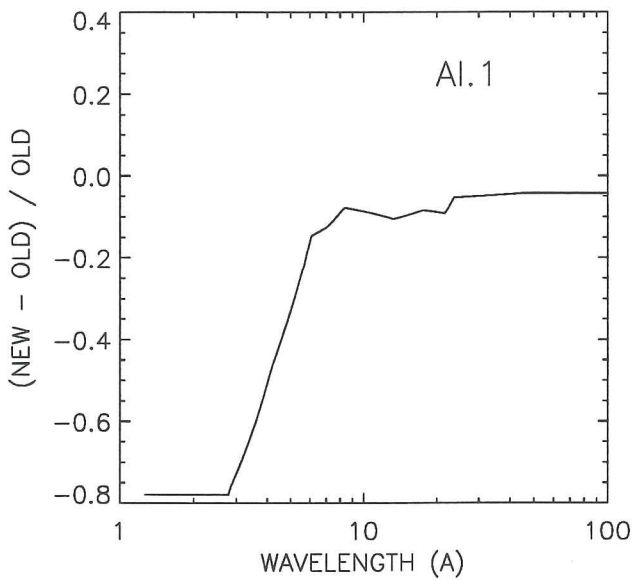
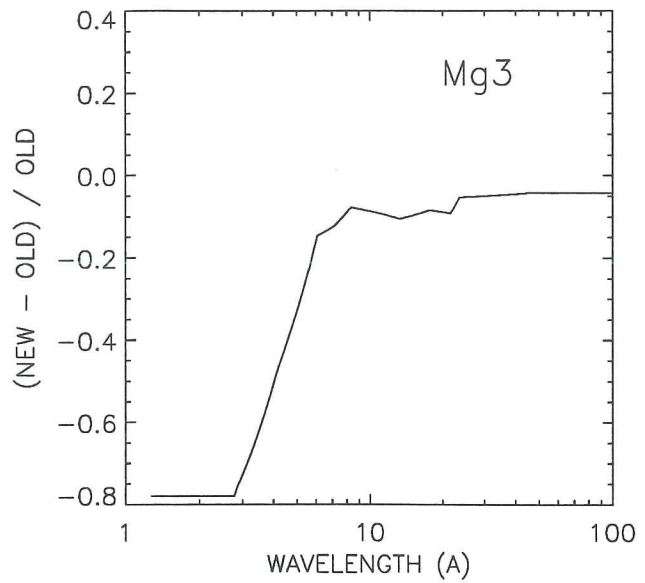
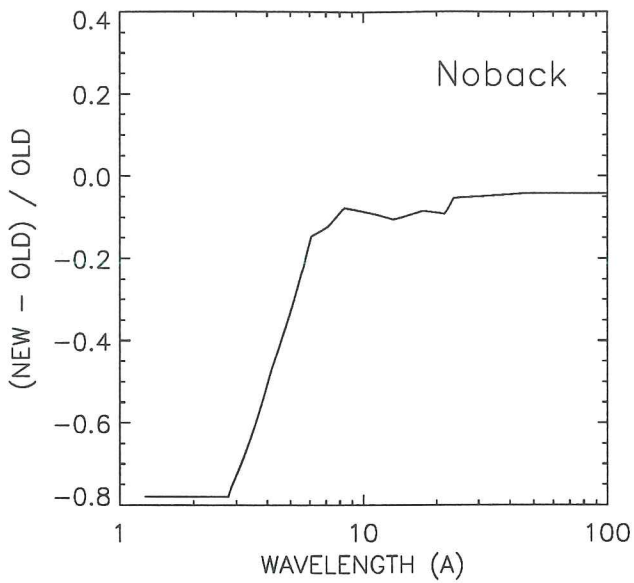
Wave	Entrance	Mirror (cm ²)	CCD	Noback (cm ²)	Al.1 (cm ²)	AlMg (cm ²)	Mg3 (cm ²)	All2 (cm ²)	Be (cm ²)
22.05	0.1323	1.428e+00	0.1184	2.24e-02	1.52e-02	8.53e-03	1.96e-03	3.17e-10	3.20e-33
22.10	0.1307	1.430e+00	0.1169	2.19e-02	1.48e-02	8.29e-03	1.89e-03	2.75e-10	1.86e-33
22.10	0.1307	1.430e+00	0.1169	2.19e-02	1.48e-02	8.29e-03	1.89e-03	2.75e-10	1.86e-33
22.56	0.1185	1.447e+00	0.1056	1.81e-02	1.21e-02	6.59e-03	1.38e-03	8.58e-11	2.09e-35
22.83	0.1117	1.457e+00	0.0994	1.62e-02	1.08e-02	5.75e-03	1.15e-03	4.31e-11	1.48e-36
22.83	0.1384	1.457e+00	0.3828	7.72e-02	5.20e-02	2.74e-02	5.62e-03	2.14e-10	7.06e-36
23.09	0.1315	1.467e+00	0.3743	7.22e-02	4.83e-02	2.50e-02	4.89e-03	1.14e-10	5.44e-37
23.62	0.1178	1.488e+00	0.3568	6.25e-02	4.13e-02	2.06e-02	3.64e-03	2.94e-11	2.18e-39
24.17	0.1049	1.489e+00	0.3403	5.32e-02	3.46e-02	1.66e-02	2.64e-03	6.86e-12	5.80e-42
24.74	0.0928	1.492e+00	0.3246	4.50e-02	2.88e-02	1.32e-02	1.88e-03	1.48e-12	9.81e-45
25.31	0.0816	1.496e+00	0.3092	3.78e-02	2.38e-02	1.05e-02	1.32e-03	3.01e-13	0.00e+00
25.90	0.0713	1.502e+00	0.2939	3.15e-02	1.95e-02	8.18e-03	9.10e-04	5.67e-14	0.00e+00
26.51	0.0620	1.505e+00	0.2790	2.60e-02	1.59e-02	6.31e-03	6.15e-04	9.68e-15	0.00e+00
26.88	0.0567	1.508e+00	0.2700	2.31e-02	1.39e-02	5.36e-03	4.80e-04	3.13e-15	0.00e+00
26.88	0.0567	1.508e+00	0.2700	2.31e-02	1.39e-02	5.36e-03	4.80e-04	3.13e-15	0.00e+00
27.12	0.0535	1.510e+00	0.2644	2.13e-02	1.28e-02	4.82e-03	4.08e-04	1.50e-15	0.00e+00
27.32	0.0510	1.512e+00	0.2599	2.00e-02	1.19e-02	4.41e-03	3.57e-04	8.15e-16	0.00e+00
27.32	0.2737	1.512e+00	0.2599	1.08e-01	6.40e-02	2.37e-02	2.68e-03	4.38e-15	0.00e+00
27.76	0.2603	1.517e+00	0.2501	9.87e-02	5.79e-02	2.06e-02	2.13e-03	1.18e-15	0.00e+00
28.40	0.2413	1.522e+00	0.2362	8.67e-02	4.98e-02	1.67e-02	1.50e-03	1.63e-16	0.00e+00
29.06	0.2230	1.529e+00	0.2226	7.59e-02	4.27e-02	1.35e-02	1.04e-03	2.25e-17	0.00e+00
29.74	0.2054	1.535e+00	0.2093	6.60e-02	3.64e-02	1.08e-02	7.07e-04	2.89e-18	0.00e+00
30.43	0.1883	1.541e+00	0.1965	5.70e-02	3.07e-02	8.51e-03	4.71e-04	3.32e-19	0.00e+00
31.14	0.1718	1.547e+00	0.1840	4.89e-02	2.58e-02	6.65e-03	3.07e-04	3.41e-20	0.00e+00
31.87	0.1561	1.552e+00	0.1719	4.17e-02	2.14e-02	5.13e-03	1.96e-04	3.09e-21	0.00e+00
32.61	0.1407	1.558e+00	0.1602	3.51e-02	1.76e-02	3.89e-03	1.22e-04	2.46e-22	0.00e+00
33.37	0.1265	1.563e+00	0.1488	2.94e-02	1.43e-02	2.92e-03	7.37e-05	1.71e-23	0.00e+00
34.15	0.1132	1.570e+00	0.1378	2.45e-02	1.16e-02	2.17e-03	4.36e-05	1.03e-24	0.00e+00
34.94	0.1004	1.577e+00	0.1272	2.01e-02	9.21e-03	1.57e-03	2.51e-05	4.48e-26	0.00e+00
35.76	0.0887	1.583e+00	0.1170	1.64e-02	7.24e-03	1.12e-03	1.40e-05	1.42e-27	0.00e+00
36.59	0.0778	1.590e+00	0.1072	1.33e-02	5.63e-03	7.84e-04	7.62e-06	3.64e-29	0.00e+00
37.44	0.0677	1.597e+00	0.0978	1.06e-02	4.31e-03	5.37e-04	4.02e-06	7.52e-31	0.00e+00
38.31	0.0585	1.602e+00	0.0889	8.33e-03	3.25e-03	3.61e-04	2.04e-06	1.23e-32	0.00e+00
39.21	0.0502	1.608e+00	0.0804	6.49e-03	2.42e-03	2.37e-04	1.01e-06	1.58e-34	0.00e+00
40.12	0.0426	1.614e+00	0.0724	4.98e-03	1.77e-03	1.53e-04	4.78e-07	1.57e-36	0.00e+00
41.05	0.0359	1.620e+00	0.0648	3.78e-03	1.28e-03	9.58e-05	2.19e-07	1.18e-38	0.00e+00
42.01	0.0300	1.628e+00	0.0577	2.82e-03	9.02e-04	5.86e-05	9.65e-08	6.60e-41	0.00e+00
42.99	0.0248	1.635e+00	0.0515	2.09e-03	6.31e-04	3.53e-05	4.12e-08	2.76e-43	0.00e+00
43.62	0.0219	1.639e+00	0.0479	1.72e-03	4.99e-04	2.52e-05	2.35e-08	7.01e-45	0.00e+00
43.62	0.1116	1.639e+00	0.0479	8.75e-03	2.54e-03	1.59e-04	1.20e-07	3.64e-44	0.00e+00
43.99	0.1068	1.642e+00	0.0459	8.04e-03	2.28e-03	1.35e-04	8.90e-08	4.20e-45	0.00e+00
45.01	0.0941	1.652e+00	0.0406	6.31e-03	1.68e-03	8.50e-05	3.82e-08	0.00e+00	0.00e+00
46.06	0.0823	1.662e+00	0.0357	4.89e-03	1.22e-03	5.22e-05	1.58e-08	0.00e+00	0.00e+00
47.14	0.0728	1.673e+00	0.0312	3.80e-03	8.90e-04	3.27e-05	6.38e-09	0.00e+00	0.00e+00
48.23	0.0645	1.684e+00	0.0271	2.94e-03	6.50e-04	2.04e-05	2.49e-09	0.00e+00	0.00e+00
49.36	0.0569	1.694e+00	0.0234	2.26e-03	4.68e-04	1.24e-05	9.38e-10	0.00e+00	0.00e+00
50.51	0.0499	1.705e+00	0.0200	1.71e-03	3.32e-04	7.43e-06	3.38e-10	0.00e+00	0.00e+00

Wave	Entrance	Mirror (cm ²)	CCD	Noback (cm ²)	AL.1 (cm ²)	AlMg (cm ²)	Mg3 (cm ²)	Al12 (cm ²)	Be (cm ²)
51.68	0.0436	1.716e+00	0.0170	1.27e-03	2.32e-04	4.34e-06	1.17e-10	0.00e+00	0.00e+00
52.89	0.0377	1.729e+00	0.0143	9.31e-04	1.58e-04	2.49e-06	3.86e-11	0.00e+00	0.00e+00
54.12	0.0324	1.743e+00	0.0118	6.68e-04	1.05e-04	1.38e-06	1.21e-11	0.00e+00	0.00e+00
55.38	0.0275	1.757e+00	0.0097	4.70e-04	6.85e-05	7.41e-07	3.62e-12	0.00e+00	0.00e+00
56.67	0.0228	1.773e+00	0.0079	3.20e-04	4.25e-05	3.71e-07	1.01e-12	0.00e+00	0.00e+00
57.99	0.0187	1.790e+00	0.0064	2.13e-04	2.57e-05	1.79e-07	2.71e-13	0.00e+00	0.00e+00
59.34	0.0153	1.808e+00	0.0050	1.39e-04	1.51e-05	8.32e-08	6.86e-14	0.00e+00	0.00e+00
60.72	0.0123	1.828e+00	0.0040	8.90e-05	8.64e-06	3.72e-08	1.65e-14	0.00e+00	0.00e+00
62.14	0.0098	1.849e+00	0.0031	5.57e-05	4.81e-06	1.61e-08	3.77e-15	0.00e+00	0.00e+00
63.59	0.0078	1.868e+00	0.0023	3.42e-05	2.62e-06	6.70e-09	8.21e-16	0.00e+00	0.00e+00
65.06	0.0062	1.892e+00	0.0018	2.05e-05	1.38e-06	2.69e-09	1.70e-16	0.00e+00	0.00e+00
66.58	0.0048	1.921e+00	0.0013	1.19e-05	7.03e-07	1.03e-09	3.32e-17	0.00e+00	0.00e+00
68.13	0.0037	1.952e+00	0.0009	6.84e-06	3.51e-07	3.79e-10	6.20e-18	0.00e+00	0.00e+00
69.72	0.0029	1.987e+00	0.0007	4.29e-06	1.94e-07	1.57e-10	1.23e-18	0.00e+00	0.00e+00
71.34	0.0024	2.026e+00	0.0006	2.94e-06	1.22e-07	7.84e-11	2.59e-19	0.00e+00	0.00e+00
73.01	0.0020	2.065e+00	0.0005	2.09e-06	8.00e-08	4.07e-11	5.52e-20	0.00e+00	0.00e+00
74.70	0.0017	2.105e+00	0.0005	1.63e-06	5.73e-08	2.30e-11	1.25e-20	0.00e+00	0.00e+00
76.45	0.0014	2.140e+00	0.0004	1.31e-06	4.22e-08	1.33e-11	2.86e-21	0.00e+00	0.00e+00
78.23	0.0011	2.169e+00	0.0004	1.03e-06	3.04e-08	7.47e-12	6.24e-22	0.00e+00	0.00e+00
80.05	0.0009	2.195e+00	0.0004	8.02e-07	2.16e-08	4.11e-12	1.32e-22	0.00e+00	0.00e+00
81.91	0.0008	2.214e+00	0.0003	5.83e-07	1.43e-08	2.11e-12	2.54e-23	0.00e+00	0.00e+00
82.82	0.0007	2.223e+00	0.0003	4.71e-07	1.11e-08	1.46e-12	1.08e-23	0.00e+00	0.00e+00
83.82	0.0006	2.232e+00	0.0003	3.71e-07	8.42e-09	1.46e-12	1.08e-23	0.00e+00	0.00e+00
85.78	0.0005	2.243e+00	0.0002	2.31e-07	4.85e-09	4.44e-13	6.65e-25	0.00e+00	0.00e+00
87.77	0.0004	2.251e+00	0.0001	1.40e-07	2.71e-09	1.96e-13	1.01e-25	0.00e+00	0.00e+00
89.81	0.0004	2.258e+00	0.0001	9.28e-08	1.67e-09	9.49e-14	1.66e-26	0.00e+00	0.00e+00
91.91	0.0003	2.263e+00	0.0001	6.62e-08	1.10e-09	4.91e-14	2.88e-27	0.00e+00	0.00e+00
94.05	0.0002	2.269e+00	0.0001	5.14e-08	7.86e-10	2.76e-14	5.41e-28	0.00e+00	0.00e+00
96.24	0.0002	2.274e+00	0.0001	4.45e-08	6.27e-10	1.73e-14	1.12e-28	0.00e+00	0.00e+00
98.48	0.0002	2.278e+00	0.0001	3.80e-08	4.93e-10	1.07e-14	2.28e-29	0.00e+00	0.00e+00

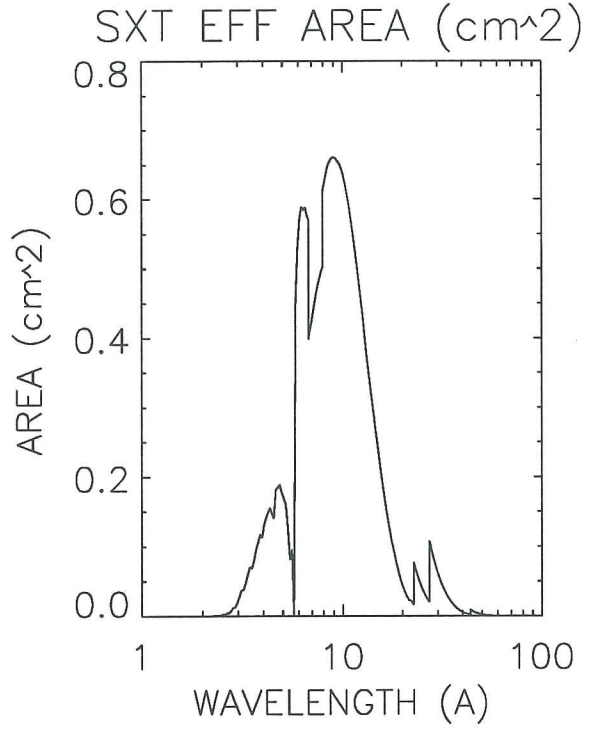
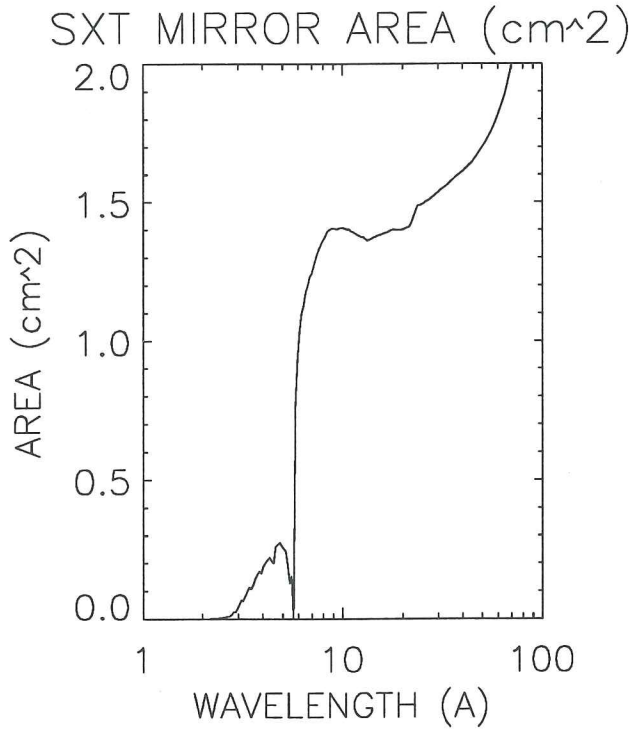
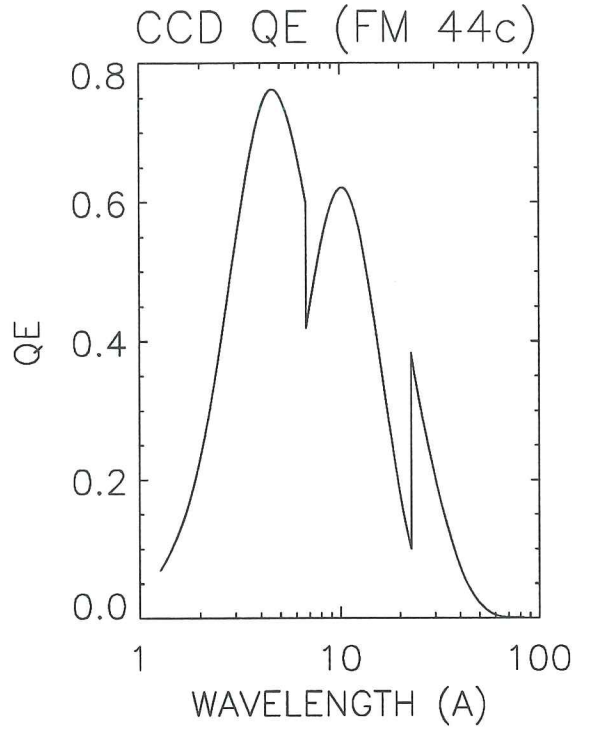
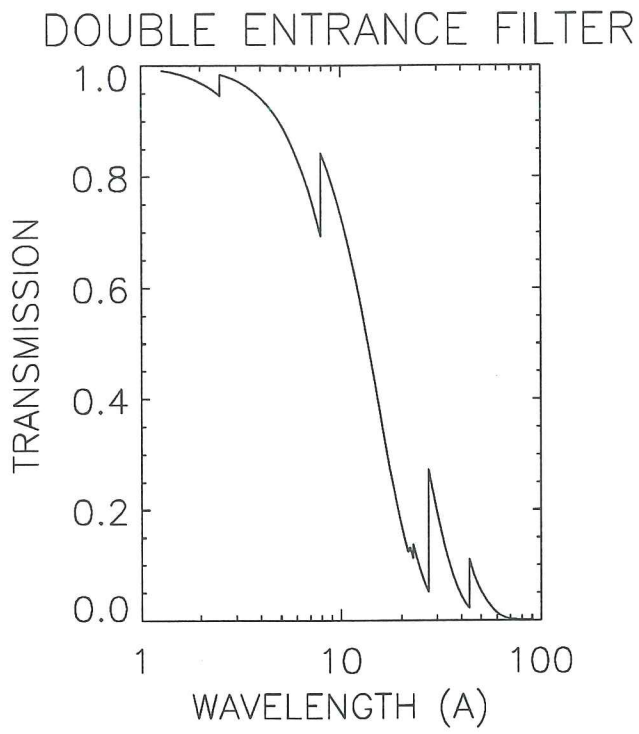


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Fig 2



(Plotted 11-Feb-1993 16:18:11.00)



(Plotted 11-Feb-1993 16:18:13.00)