MASTER

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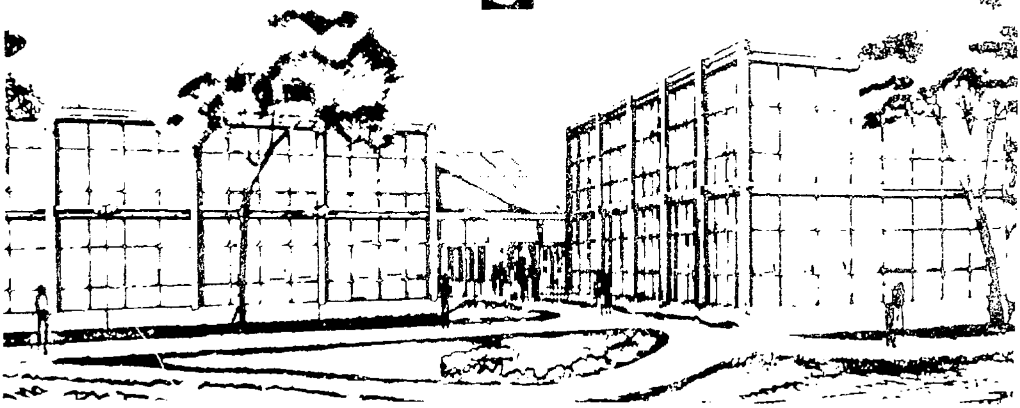
Lawrence Livermore Laboratory



[illegible] was designed [illegible] of the Argus and Shiva laser facilities. [illegible] filtered detectors; however, the [illegible] recent experiments [illegible] demonstration of this technique. Five [illegible] in the spectrometer for [illegible] intensity [illegible] Pb filtered detectors will be used for [illegible] spectral information for energies greater than 100 keV. Provisions [illegible] made to automate this diagnostic to produce the xray spectrum [illegible] after shot time.

*Work performed under the auspices of the U. S. Department of Energy by Lawrence Livermore Laboratory under Contract No. W-7405-Eng-48.

Figure 1 shows two x-ray spectra at different intensity levels, 3×10^{14} W/cm^2 and 3×10^{15} W/cm^2, using a 1 ns laser pulse. It is significant that at the higher laser intensity, the high energy tail is both hotter and more intense. The filter-fluorescer technique is appropriate for measuring the higher intensity spectrum.

Measuring the shallower slope of the x-ray spectrum presents a problem for using the K-edge filter technique.(Figure 2) It works fine for low temperatures and low intensities (see A) because the x-ray spectrum falls so rapidly that the fraction of the total signal from x-rays beyond the K-edge energy is small. For hotter spectra, however, this is not the case. There, further discrimination against the x-rays beyond the K-edge energy is necessary. This is accomplished in the filter-fluorescer technique (see B) by allowing the x-rays transmitted through the K-edge filter to fluoresce an elemental material (fluorescer) of a lower Z than the filter. The fluorescent xrays from the fluorescer pass through a post filter (generally the same Z at the fluorescer) to a detector. The effect of this combination (channel) reduces considerably the high energy "tail" of the channel response. An added advantage is that if the filter and fluorescer thickness are chosen appropriately, the channel response will be essentially flat between the K-edge energies of the fluorescer and filter (see B).

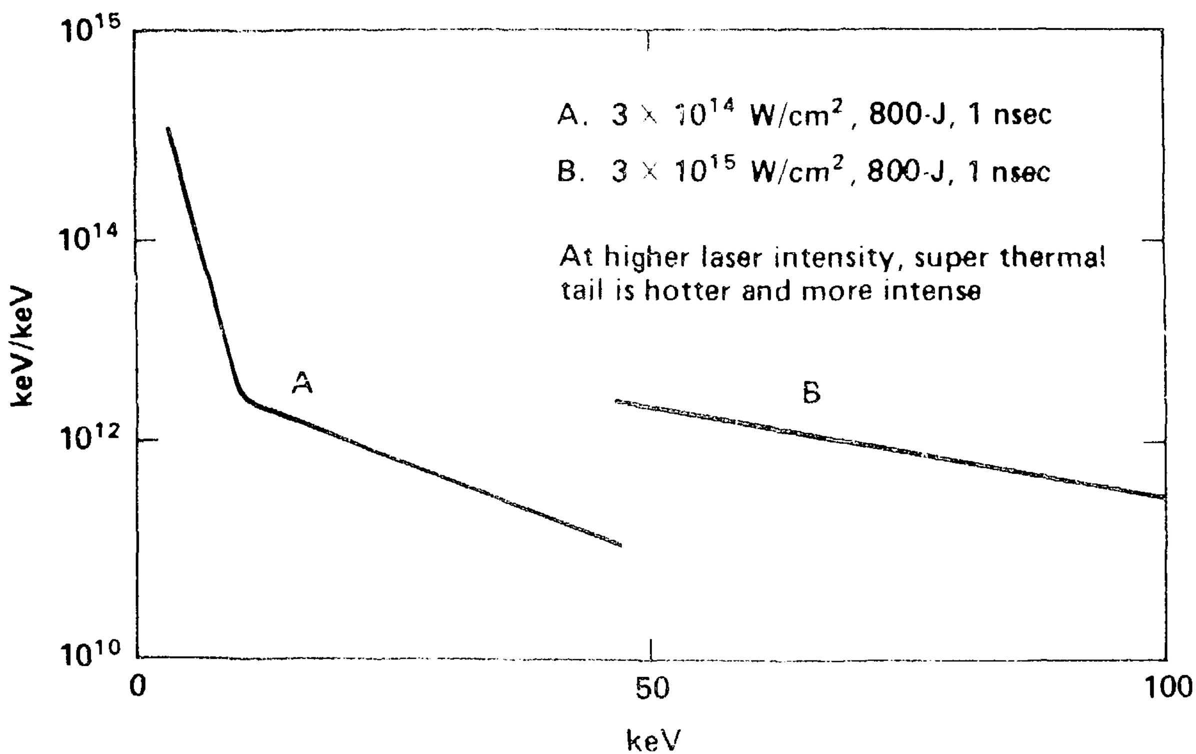
Figure 3 is a picture of the filter-fluorescer system. For clarity, only eight of the ten filter-fluorescer channels are shown. The x-rays from the target are collimated to prevent scattering from the walls of the vacuum pipe. Further upstream the beam is [illegible] to ten [illegible] beams into the filters. Also shown in this picture are two of the five detectors that look through both the filters and fluorescers to the target. They are labeled, "high energy x-ray detectors." Thick lead filters will be placed in front of these detectors for obtaining spectral information greater than 100 keV. Five other detectors are also installed in this vicinity. They have K edge filters for measuring the x-ray spectrum from 20 - 115 keV from weak, low temperature sources, where there is not enough x-ray intensity to use the filter-fluorescer technique.

Figure 4 shows a listing of the pertinent information for the 20 channels. Note that channels 11 - 15 essentially have three filters. However, filters (1) and (2) are the thin, low Z filters from channels 1 - 5 and have no effect on the channel response. It is convenient to leave these filters in place so that channels 1 - 5 and 11 - 15 can be operated simultaneously. Channels 16 - 20 are operated in the same way, looking through the filter and fluorescer of channels 6 - 10.

Displayed in Figure 5 are the calculated responses for the filter fluorescer channels. The channels are wider and farther apart in the high energy region where the x-ray spectrum varies less rapidly with energy.

This figure (6) represents how the instrumentation for this experiment is configured at Argus. The x-ray pulse from each [illegible] is integrated with a gated integrator. (LRS Model 2249). The gate width is adjusted to discriminate against the later arriving neutron signal. For Argus, this time separation is 50 ns while at Shiva it is [illegible] ns. The digitized data is stored on a floppy disk and then transferred to a PDP-11/34 or 11/70 where a plot of intensity vs. energy is generated.

X-RAY SPECTRA – Au DISK TARGETS



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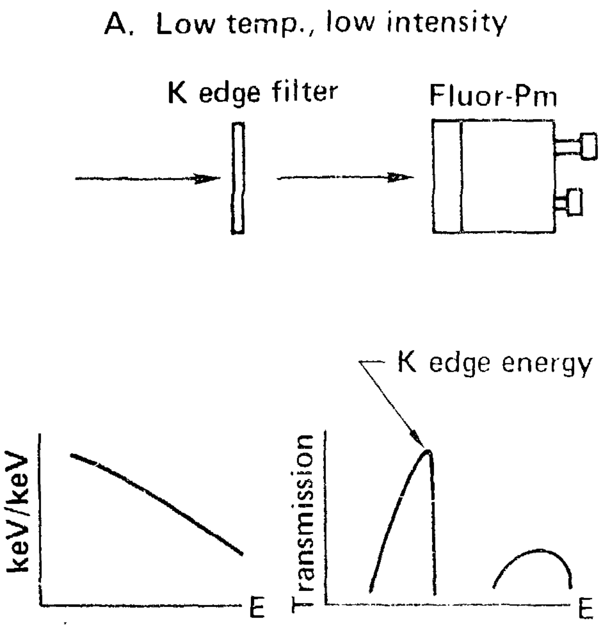
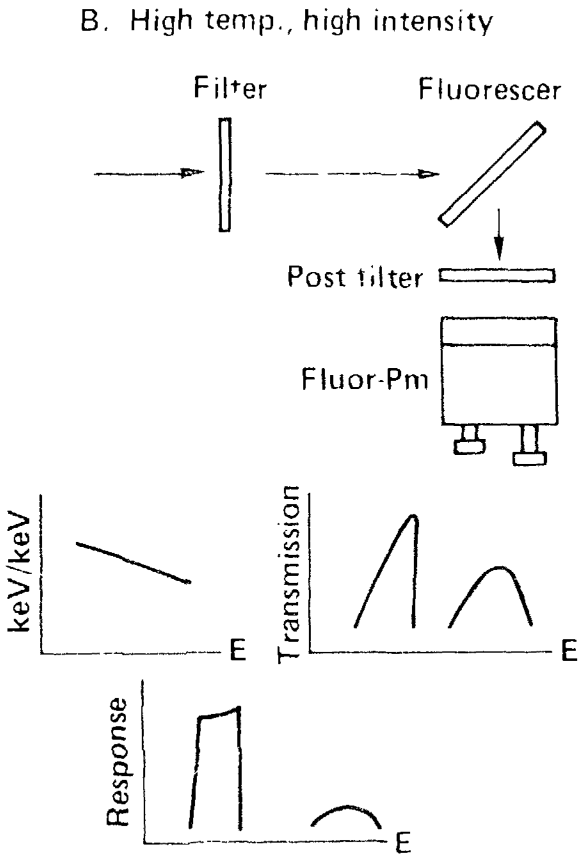
X-RAY MEASUREMENT TECHNIQUES





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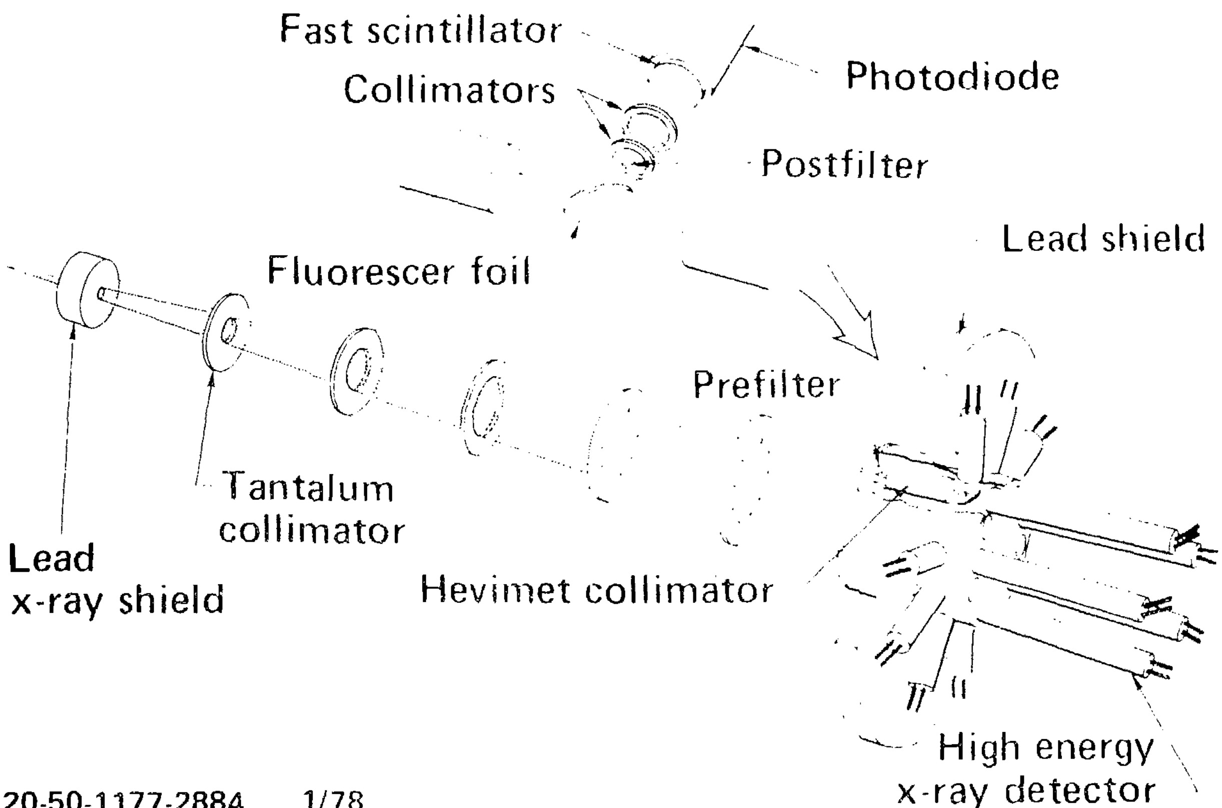
SHIVA NOVA X-RAY DIAGNOSTICS – FILTER FLUORESCER EXPERIMENT



X-RAY SPECTROMETER CHANNELS

Channel	Filter µm	Filter keV	Fluorescer µm	Fluorescer keV	Post Filter µm	Detector mm	
1	1.5 Zr	2.2	0.75 Al	1.6	–	0.25 NEIII	PM
2	2.0 Sm	3.9	13 Cl	2.8	–	0.25 NEIII	PM
3	13 Fe	7.1	5 Ti	5.0	2.5 Ti	2.5 NEIII	PM
4	20 Zn	9.7	5 Fe	7.1	2.5 Fe	2.5 NEIII	PM
5	50 Se	12.7	8 Zn	9.7	2.5 Zn	2.5 NEIII	PM
6	75 Mo	20.0	8 Y	17.0	5 Y	2.5 NEIII	PM
7	380 Dy	53.8	25 Sm	46.9	25 Sm	1.0 NaI	PM
8	250 W	69.5	50 Yb	61.3	50 Yb	1.0 NaI	PM
9	380 U	116	50 Pb	88.0	25 Au	3.0 NaI	PM
10	810 Pb	Bkgd	50 Pb		25 Au	3.0 NaI	PM

Channel	Filter (1)	Filter (2)	Filter (3) µm	Filter (3) keV	Detector mm	
11	Zr	Al	75 Mo	20.0	2.5 NEIII	PM
12	Sm	Cl	380 Dy	53.8	1.0 NaI	PM
13	Fe	Ti	210 W	69.5	1.0 NaI	PM
14	Zm	Fe	380 U	116	3.0 NaI	PM
15	Se	Zn	810 Pb	Bkgd	3.0 NaI	PM

Channel	Filters (g/cm^2 Pb)	Energy Range keV	Detector (mm CsI)
16	0.4	90 – 300	0.5
17	1.0	100 – 400	0.5
18	2.0	150 – 500	0.5
19	4.0	200 – 600	0.5
20	12.0	> 400	0.5

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Figure 1

FILTER-FLUORESCER CHANNEL RESPONSES

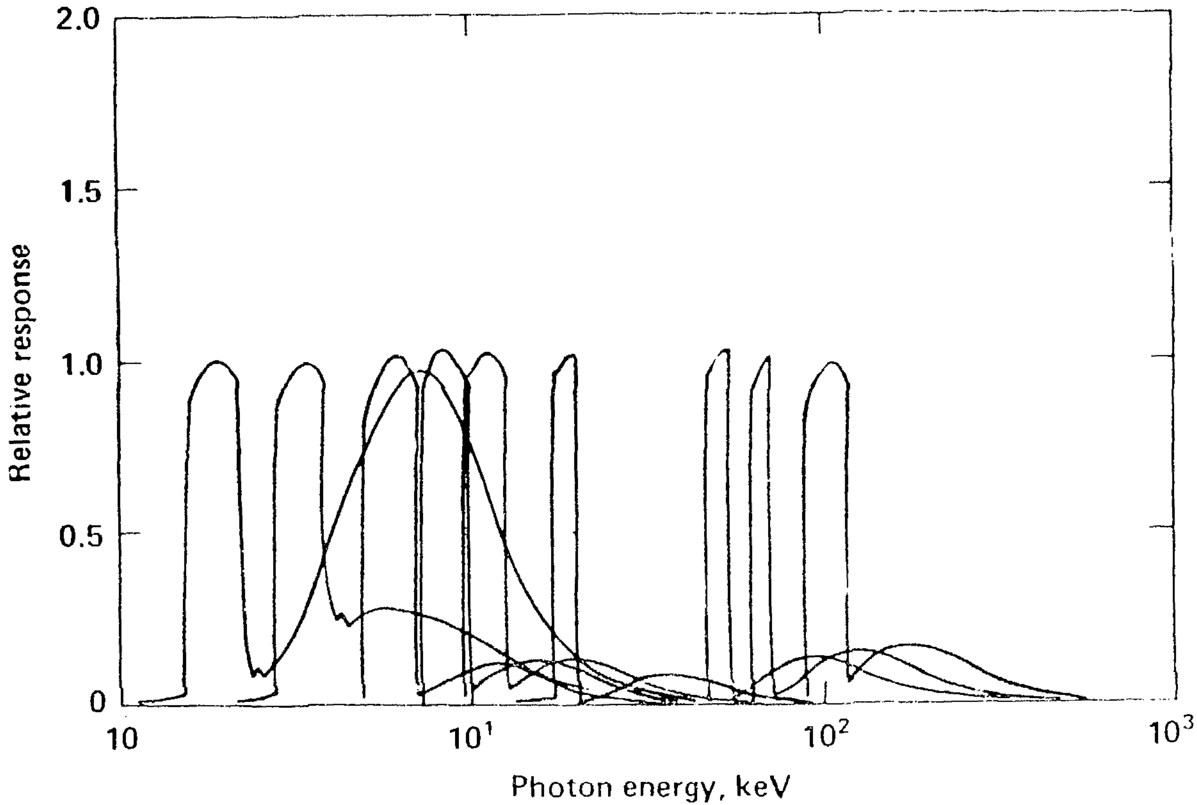

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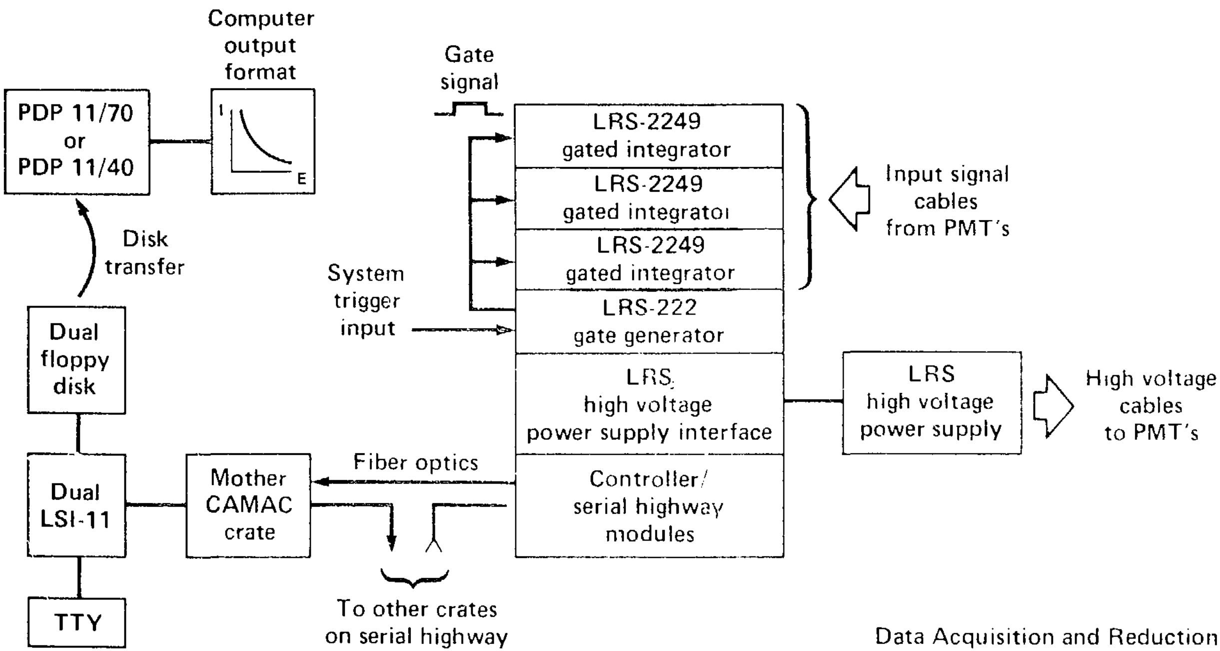
Figure 5



Data Acquisition and Reduction

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