HXS Field Tests at LLE

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November 20-21, 2000

Summary

X-ray spectra in the energy range above 12 keV were recorded by the Hard X-Ray Spectrometer (HXS) on Tuesday, November 21. The spectrometer had been installed in TIM2 the previous week as described in the HXS Off-Line Tests at LLE document. The targets dedicated to the HXS instrument on November 21 consisted of planar gold and silver foils and CH shell targets with a krypton fill. Additional gold spherical targets dedicated to the DMX instrument were irradiated on November 21. Good HXS x-ray spectral CCD images were recorded on all of the shots. The HXS instrument was connected to the LLE Ethernet and successfully operated in an autonomous manner for the entire day. The x-ray spectral CCD images from the eleven shots on November 21 are shown in Sections 3-5. These shots were coordinated by Christian Stroeckl.

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1. Autonomous Operation of HXS

The HXS instrument was operated from a computer in the LLE conference room as shown in Fig. 1. The Graphical User Interface (GUI) of the Ground Support Equipment (GSE) is shown in Fig. 2. The HXS instrument implemented the LLE OIP sequence of commands. Good spectra were recorded on all laser shots. The HXS instrument operated in an autonomous manner the entire day. The implementation by LLE personnel of automatic data file archiving was incomplete.

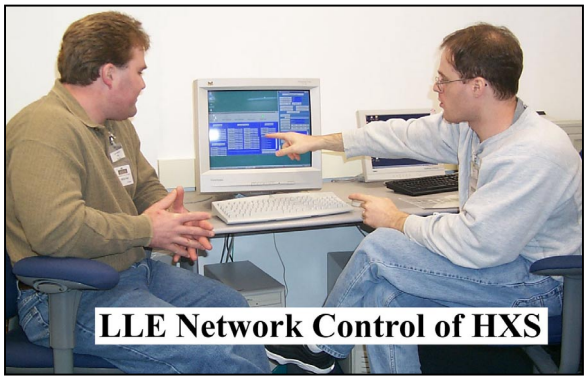


Fig. 1. The HXS GSE control computer in the LLE conference room.

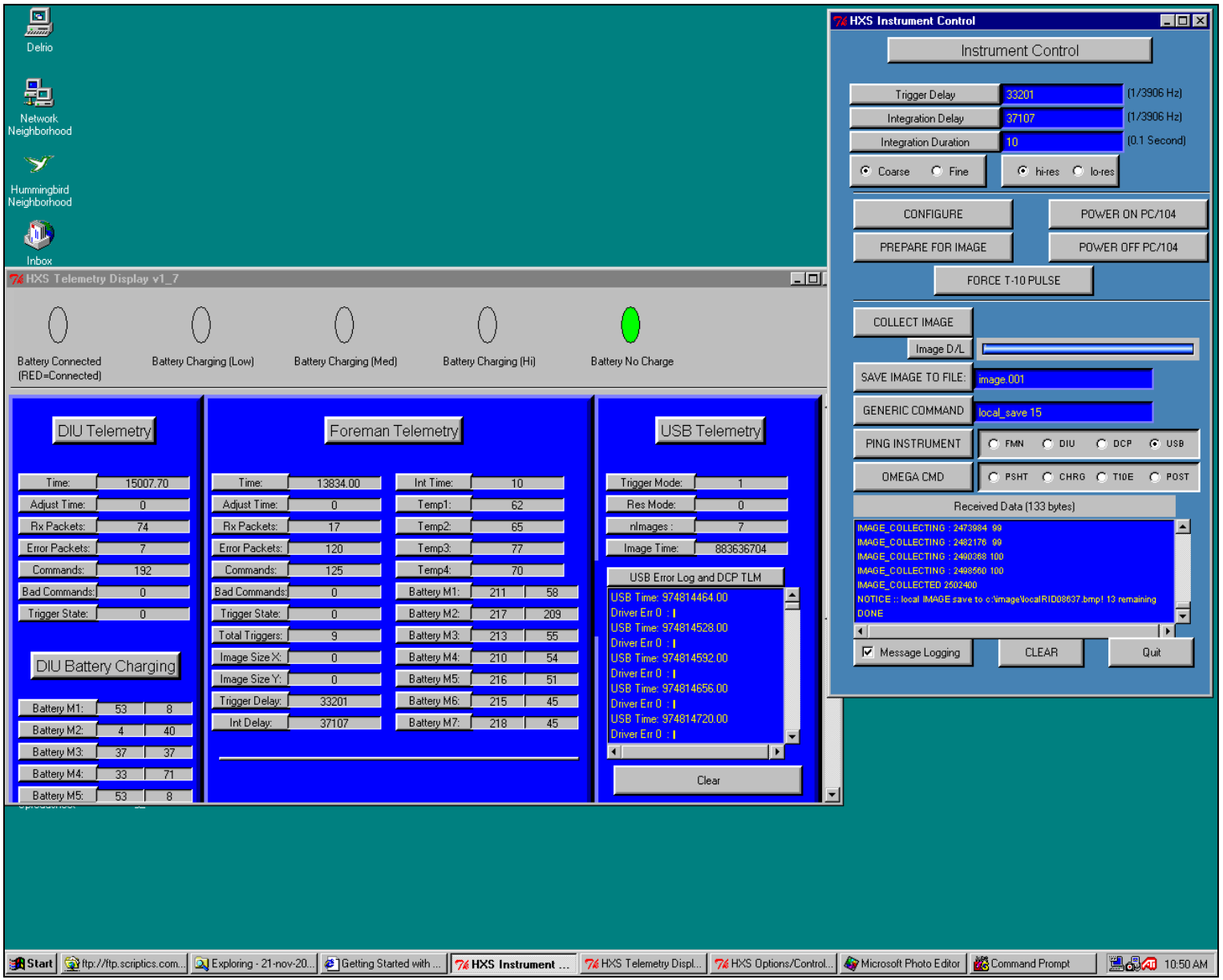


Fig. 2. The Graphical User Interface (GUI) of the Ground Support Equipment (GSE).

2. OMEGA Shots and Targets

The targets that were irradiated on November 21 are listed on the next page. The HXS filtration is also listed. An image of one of the HXS crossover slit filters, Type 2, is shown in Fig. 3. The transmittances of the various HXS filters are shown in Fig. 4. A spectral image that was recorded during the previous week using the Type 2 crossover slit filters is shown in Fig. 5, where the various filter regions are identified. This image is useful for the interpretation of the spectral images recorded on November 21 which are shown in Sections 3-5.

Shots 21657 and 21659 were on planar gold foils. Full beam smoothing was implemented on shot 21657, and some smoothing was removed for shot 21659. The yttrium K absorption edge at 17.037 keV is present in the yttrium filter region near the bottom of the images. Shot 21660 was on a planar silver foil with the same beam smoothing as the previous shot and with slightly higher energy. The silver Kα emission feature near 22.1 keV is present.

The pinhole images were attenuated by the 1 mm Ti pinhole filter and by the 5 mil Cu filter at the crossover slit. The pinhole images were not visible in these three CCD images. The 1 mm Ti pinhole filter was removed for the following shots, and the pinhole images were present on the CCD images.

Shots 21661-21666 were on the gold-coated spherical targets dedicated to the DMX instrument. Shot 21661 used a triangular pulse shape, and the dispersed spectral image was very weak. Shots 21662 and 21664 used a laser pulse with a sloping leading edge, and the dispersed spectra were brighter. In addition, a spectral line appears near the low energy end of the spectra in the open filter regions. Shots 21665 and 21666 used a laser pulse with a sharply increasing leading edge.

Shots 21667, 21668, and 21669 were on spherically-irradiated krypton filled CH targets. Shot 21667 had a nominal energy of approximately 23 kJ. Shot 21668 had higher energy, and shot 21669 had lower energy compared to shot 21667. The first three resonance line transitions of helium-like Kr^{+34} appear in the spectra at 13.11 keV, 15.43 keV, and 16.25 keV. In addition, lineouts of the spectra indicate that Li-like transitions appear on the low energy sides of the resonance lines in the lower energy shots. Relatively small pinhole images of the hot, dense krypton emission regions are present on the CCD images.

No.	OMEGA Shot	RID	Target	Laser Conditions	HXS PH Filter	HXS Slit Filter
1	21657	8624	2 mmx25µm Au foil	1ns, 24 beams TCC	1 mm Ti	Type 1
2	21659	8637	2 mmx25µm Au foil	1ns, 24 beams TCC	1 mm Ti	Type 1
3	21660	8638	2 mmx25µm Ag foil	1ns, 24 beams TCC	1 mm Ti	Type 1
4	21661	8563	1 mm Au sphere	CEA-102, 60 beams TCC	None	Type 2
5	21662	8564	1 mm Au sphere	CEA-202, 60 beams TCC	None	Type 2
6	21664	8565	1 mm Au sphere	CEA-202, 60 beams TCC	None	Type 2
7	21665	8566	1 mm Au sphere	CEA-302, 60 beams TCC	None	Type 2
8	21666	8567	1 mm Au sphere	CEA-302, 60 beams TCC	None	Type 2
9	21667	8625	D(3)H(7) Kr1%CH[10]	1ns, 60 beams TCC	None	Type 1
10	21668	8640	D(3)H(7) Kr1%CH[10]	1ns, 60 beams TCC	None	Type 1
11	21669		D(3)H(7) Kr1%CH[10]	1ns, 60 beams TCC	None	Type 1

HXS Slit Filters

Type	Top	Middle	Bottom
1	1 mil Cd 2 mil Cd	5 mil Cu	4 mil Y 8 mil Y 12 mil Y
2	1 mil Cd 2 mil Cd	Open	4 mil Y

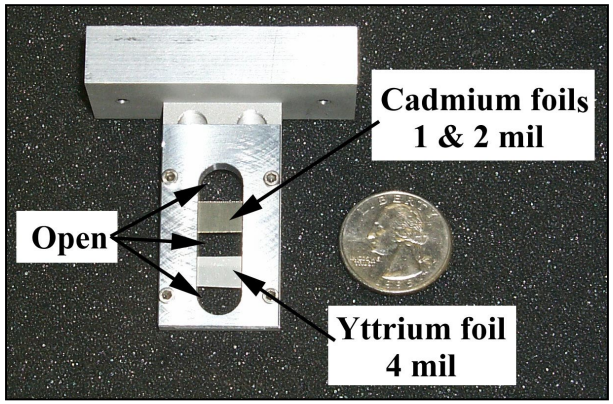


Fig. 3. Type 2 HXS Slit Filter

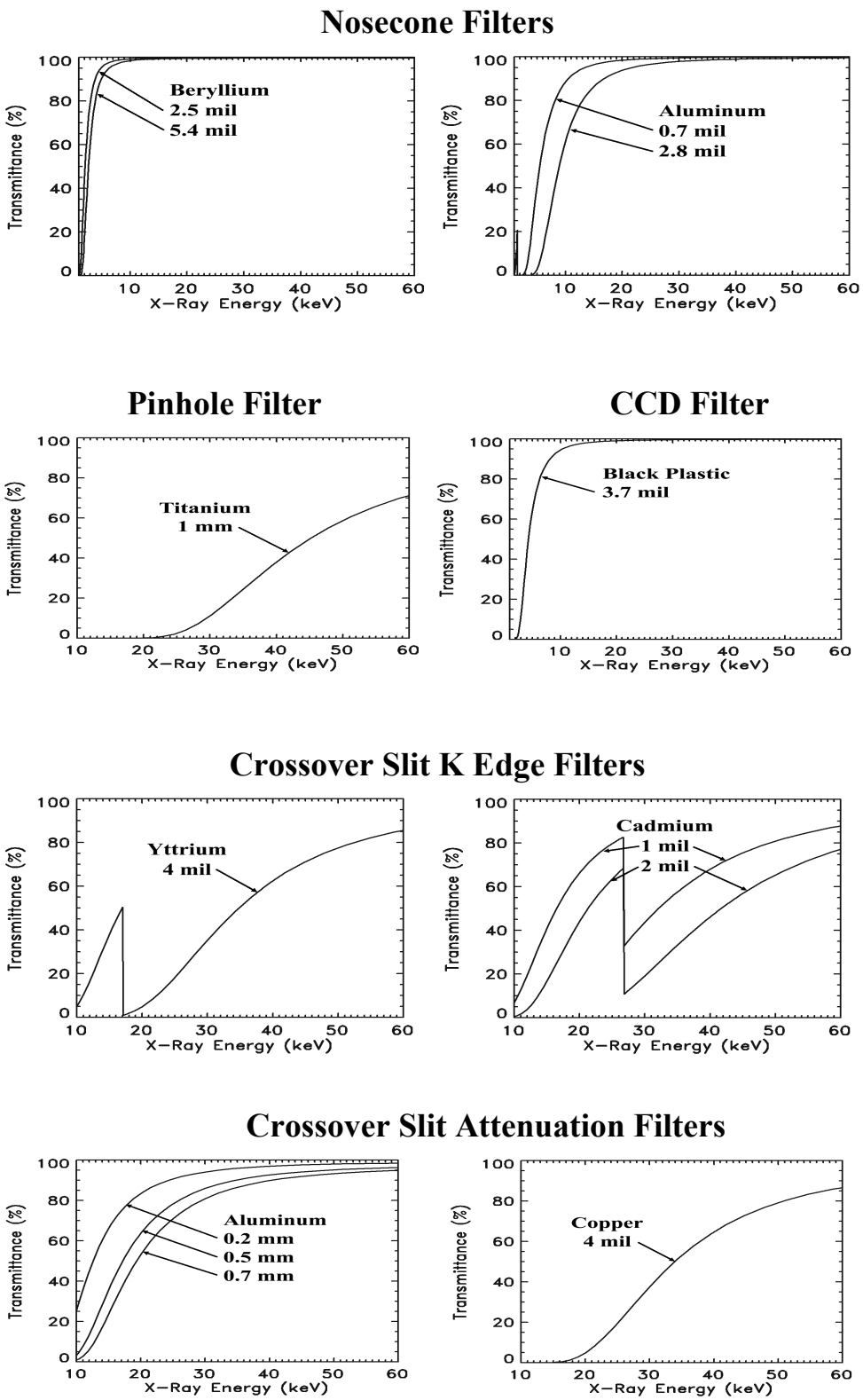


Fig. 4. Transmittances of HXS Filters.

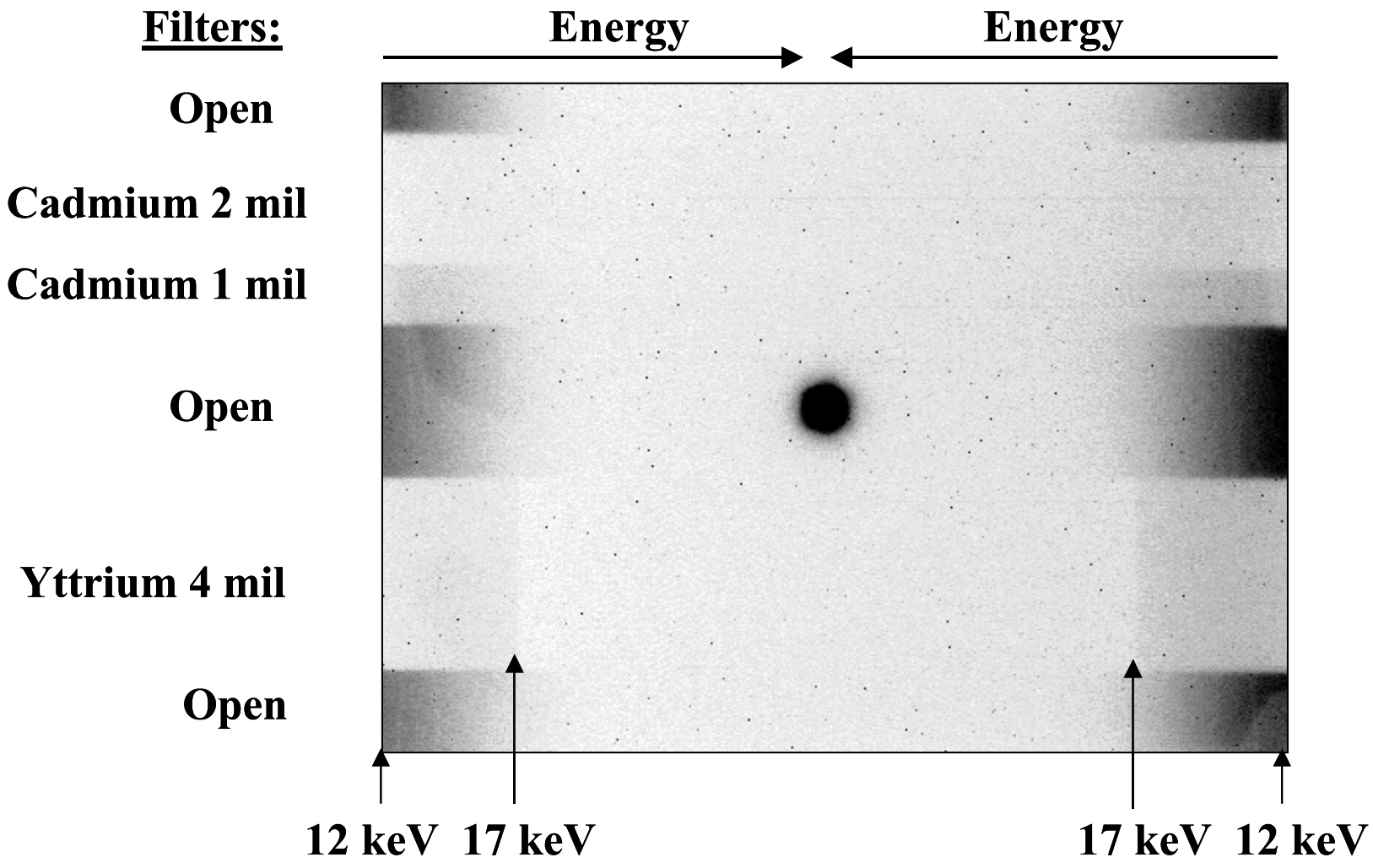
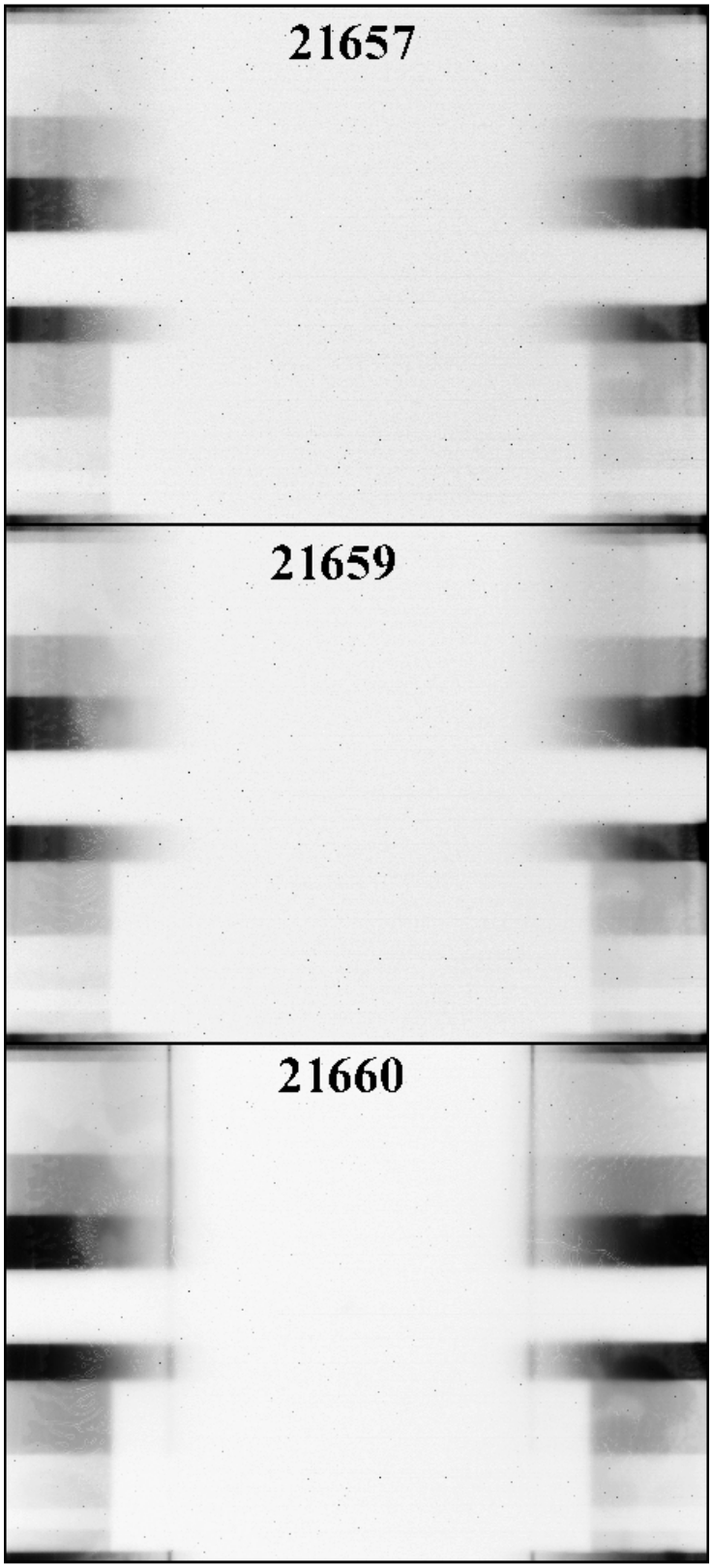
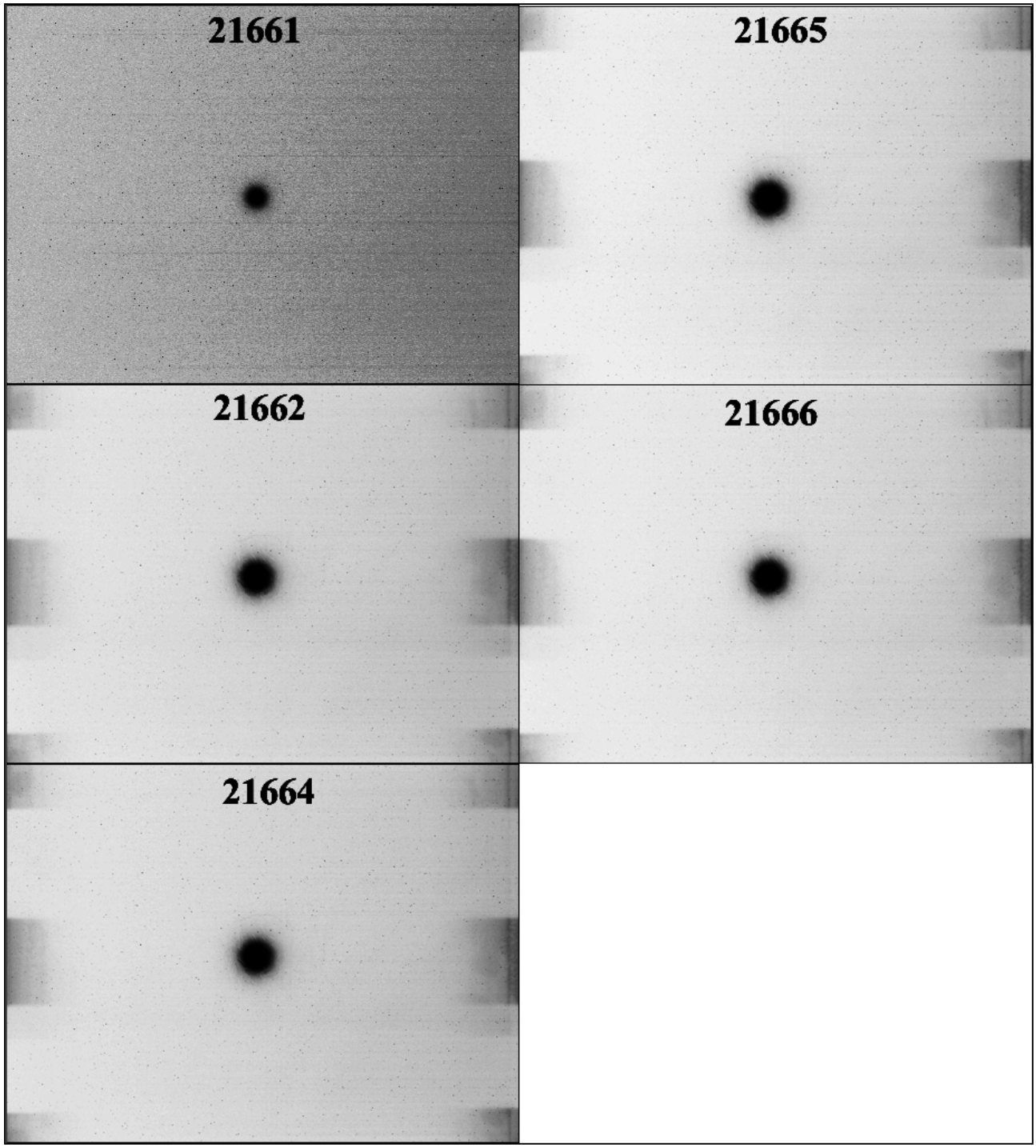
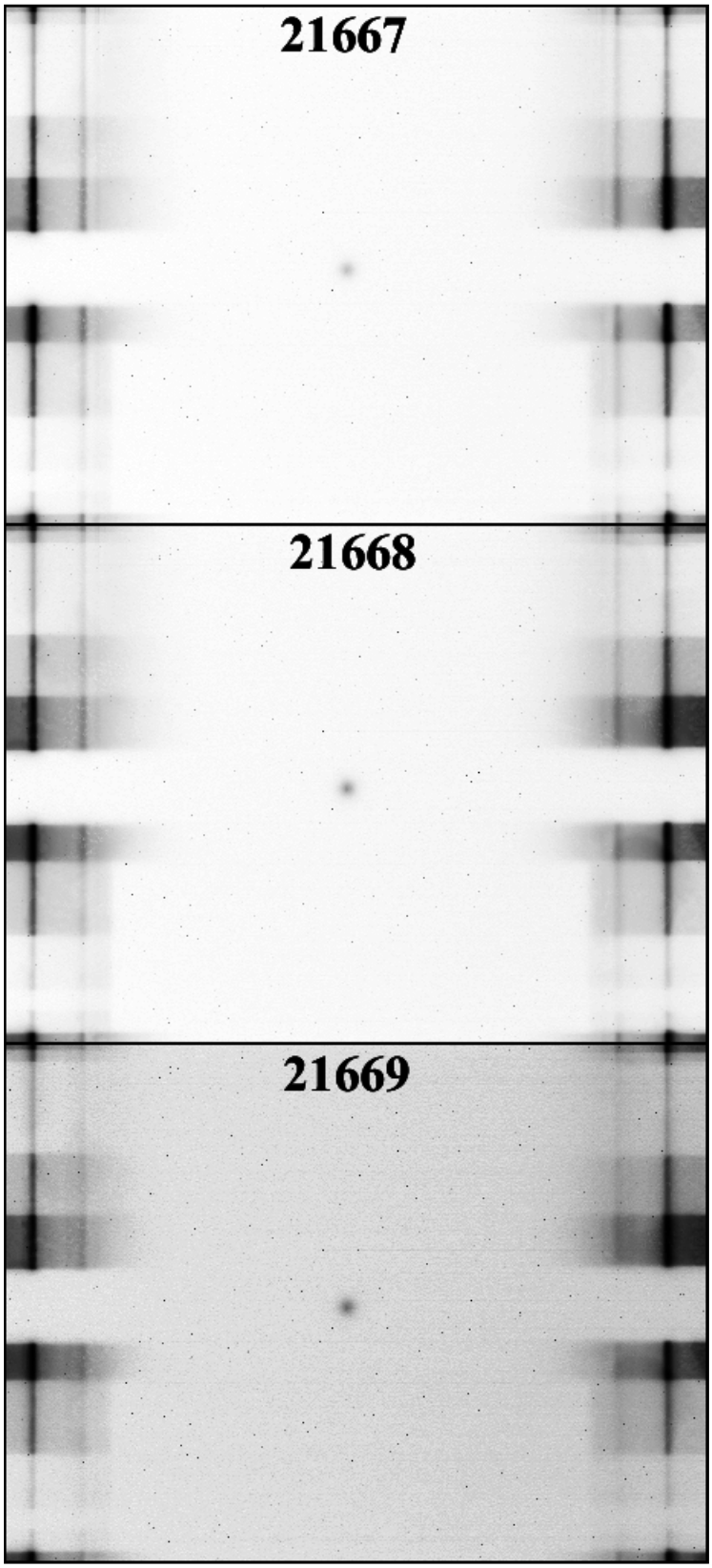


Fig. 5. The x-ray spectral CCD image from shot #9 on Tuesday, November 14.

3. Gold and Silver Foil Spectra



4. DMX Gold Sphere Spectra



5. Krypton Filled CH Shell Spectra