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X-Ray Spectra From The Cornell Electron-Beam Ion Source (CEBIS I)

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DISCLAIMER

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Abstract

Radiation emitted from the Cornell electron beam ion source (CEBIS I) has been surveyed with a Si(Li) x-ray detector. These spectra can be used to estimate backgrounds from electron bremsstrahlung and to evaluate the feasibility of atomic physics experiments using the CEBIS I source in this configuration.

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Spectroscopic studies of radiation emitted from EBIS sources are potentially of great importance. Such observations can provide for atomic physics studies in situ and for diagnostic studies of interactions of the electron beam with the drift tube structure or other source components.

Ideally, it would be desireable to choose a variety of observation geometries to systematically study spatial variations in radiation profiles. Transverse observations are generally not possible due to solenoidal magnetic structures. Looking through the cathode has been used successfully by Briand et al.[1], but the simplest and easiest approach is to look upstream toward the cathode. The obvious drawback is that large backgrounds are to be anticipated from cathode glow and electron bremsstrahlung. Examination of the bremsstrahlung spectrum can also be a useful method for gaining knowledge of the energy distribution of electrons in the interior of the EBIS.

A preliminary investigation of the feasibility of this technique using a Si(Li) detector was carried out on the CEBIS I source. Fig. 1 shows the experimental arrangement. After collimation and careful adjustment of the observation angle, low energy x-rays were recorded as a function of electron beam energy.

Fig. 2 shows the raw data obtained at electron energies of 1.0, 1.5, 2.0, and 2.5 keV. The end points of the spectral distributions increase proportionally with electron beam energy as expected for

bremsstrahlung radiation spectra. Some superimposed broad peaks are evident, however, especially at the higher energies. These structures are tentatively attributed to characteristic x rays from metal surfaces such as Al K x rays. These preliminary results are encouraging, but it appears that specific accommodations for spectroscopic observations of radiation from EBIS sources are advisable to reduce backgrounds and allow for more definitive studies.

Acknowledgements

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References

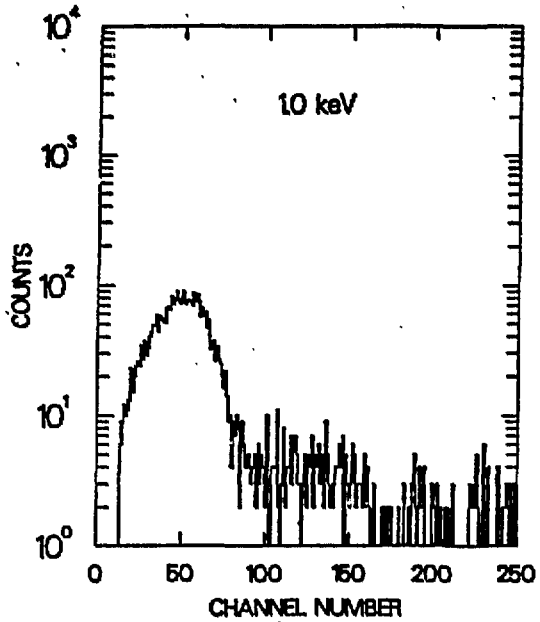
1. J. P. Briand, P. Charles, J. Arianer, H. Laurent, C. Goldstein, J. Dubau, M Loulerque, and F. Bely-Dubau. Electronic and Atomic Collisions, Eds. J. Eichler, I. V. Hertel, and N. Stolterfoht. (Elsevier Science Publishers B.V. 1984), p. 827.

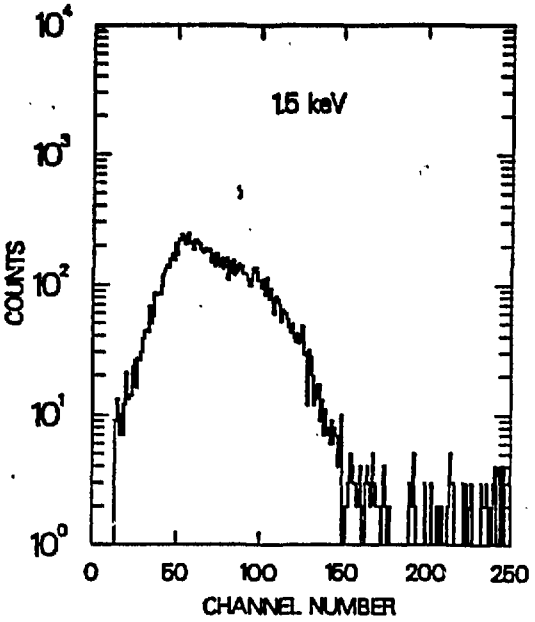
Figure Captions

Figure 1. Photograph of experimental arrangement used for the study of low energy x-ray emission from CEBIS I.

Figure 2. X-ray spectra from CEBIS I as a function of electron beam energy.

Fig. 1


1.0 keV
COUNTS
CHANNEL NUMBER


1.5 keV
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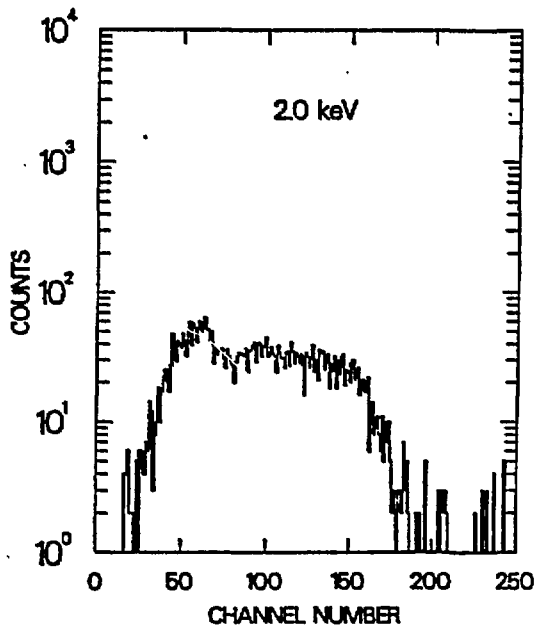
2.0 keV
COUNTS
CHANNEL NUMBER

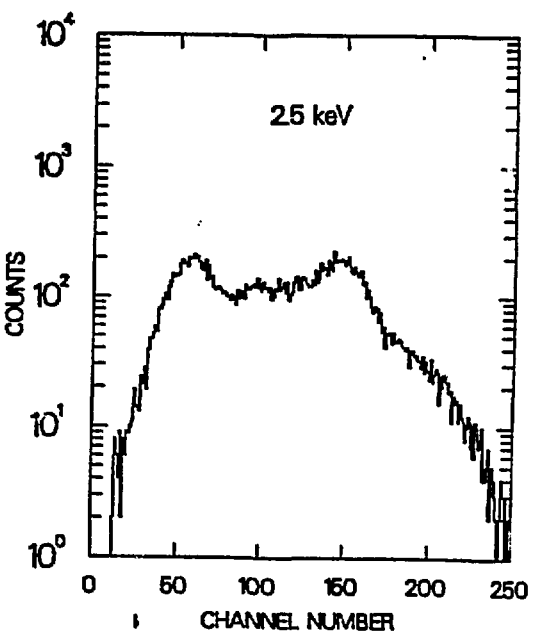
2.5 keV
COUNTS
CHANNEL NUMBER

Fig. 2