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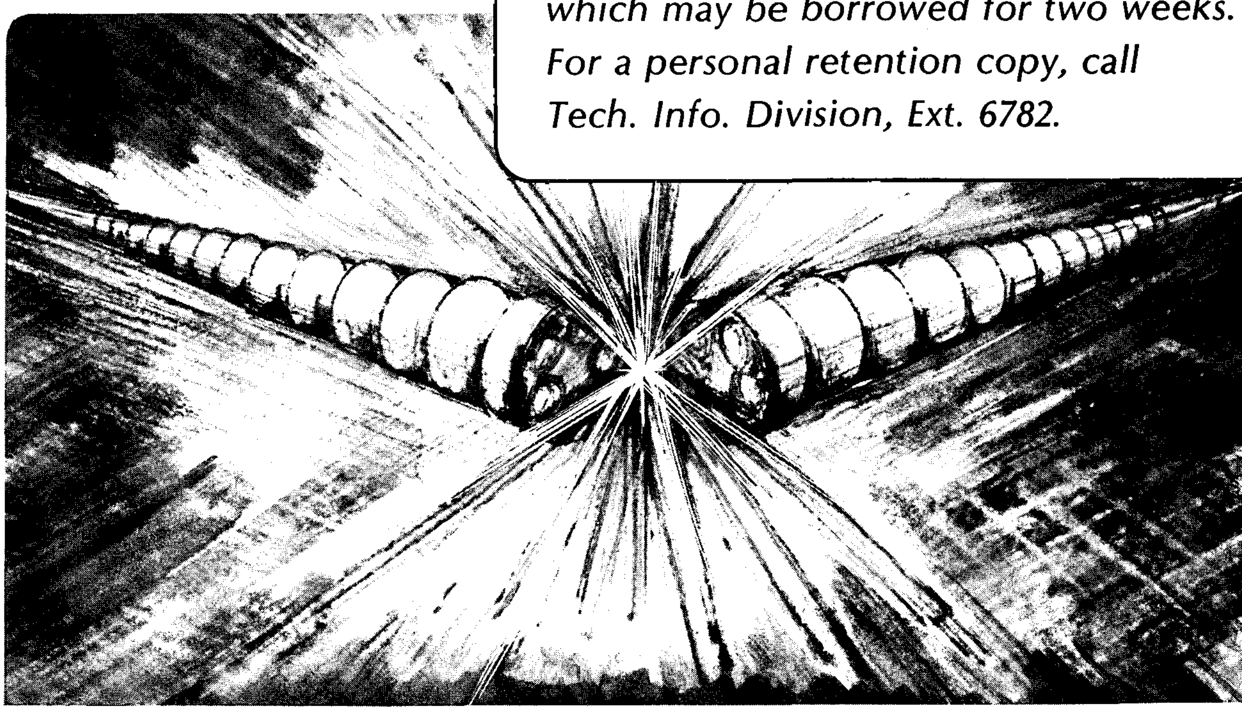

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H^- Production from Partially Cesiated Surfaces in the Presence of a Hydrogen Plasma*

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High H^- yields from surfaces immersed in cesiated hydrogen plasmas have been attributed to the likely low work function of the partially cesiated surface and studies have, since, related the two.[1,2]

A large source employing a magnetic "bucket" geometry with a large curved converter surface focused on a single slit extractor is presently being studied at LBL.[3] In order to understand the relationships among the Cs coverage, the high energy (back-scattered) and low energy (desorbed) H^- beams and the angular and energy distributions of the beams, we have constructed a small version of the LBL source in which the work function of the converter, which is immersed in the plasma ($n < 10^{11}/cm^3$), can be measured by photo emission while the other parameters are varied. In addition, the converter can be rotated and the H^- beam collimated and analyzed to give a complete energy and angular spectrum.

By means of a chopped variable wave-length light source and a phase-sensitive amplifier, the work function is measured by the photo-electron emission current from the target. (Fig. 1) The H^- ions from the negatively biased target are accelerated

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in the plasma sheath, collimated at the chamber exit and analyzed in a magnetic analyzer. A slitted Faraday cup is located at the focus of the analyzer. The energy resolution is about 2%. In place of the target shown, a rotatable target can be inserted for angular measurements. The plasma density can be inferred from the saturated ion current on the target or from a separate probe nearby which also can be used to measure the electron temperature.

Figure 2 shows intensity vs energy and angle for H^- from the converter surface near the work function minimum. On the 0° line most of the ions occur near the 100% bias point, in this case 100 V. The higher energy part of the spectrum represents backscattered H^- from H^+, H_2^+ and H_3^+ ions which have been accelerated across the plasma sheath, while the lowest energy portion must come from desorbtion of hydrogen from the surface. Although the low work function must play an important role in this enhanced yield, it is likely that the Cs^+ ions in the discharge also enhance the desorbtion of H^-. A careful look at similar spectra also suggests the possibility of substantial yield from backscattered atoms of about 5-10 eV.[4]

The picture changes considerably if we look at the H^- yield at various angles from the target. When we consider the energy spectrum vs angle as the target is rotated away from the beamline, we see that most of the beam is in the higher energy (backscattered) component. An integration over all solid angles, which assumes symmetry about the surface normal, shows most of the H^- yield to be from backscattered 1/3 energy nuclei (i.e., H_3^+).

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1. P. J. Schneider, LBL-10616, Ph.D. Thesis, University of California, Berkeley (1980).
2. M. Wada, LBL-15800, Ph.D. Thesis, University of California, Berkeley, (1983).
3. K. N. Leung and K. W. Ehlers, Rev. Sci. Inst. 53, 803 (1982).
4. J. R. Hiskes and P. J. Schneider, "Proceeding of the Second International Symposium on the Production and Neutralization of Negative Ion Beams," Brookhaven National Laboratory, BNL-51341, p. 15, (1980).

Figure Captions

1. Schematic of apparatus. Filaments, pumping and collimation are not shown. Only a circular surface at the end of the target is exposed to the plasma.
2. Relative H^- intensity vs energy and rotation of target surface with respect to collimation. Work function near minimum.

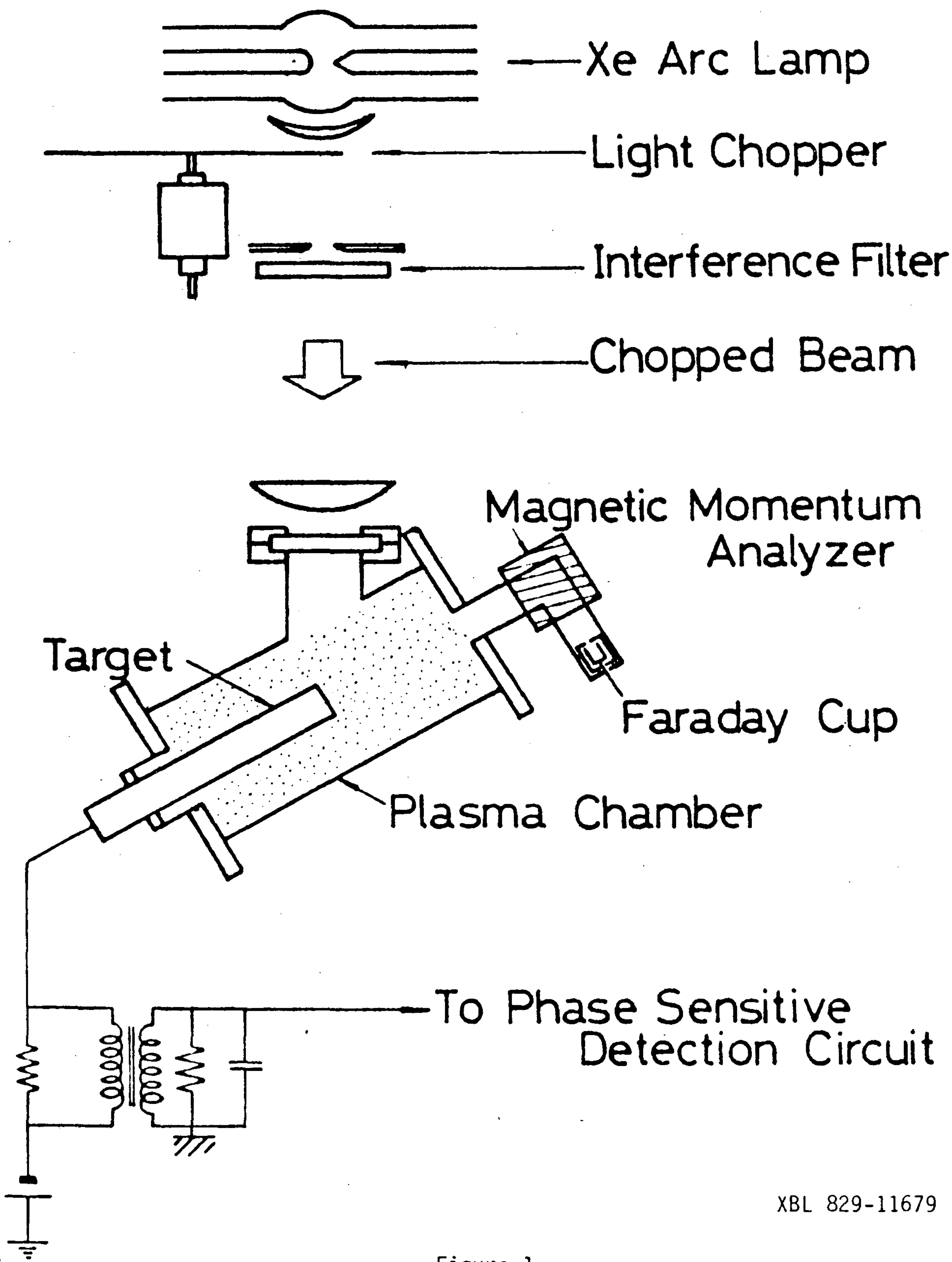

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Figure 1

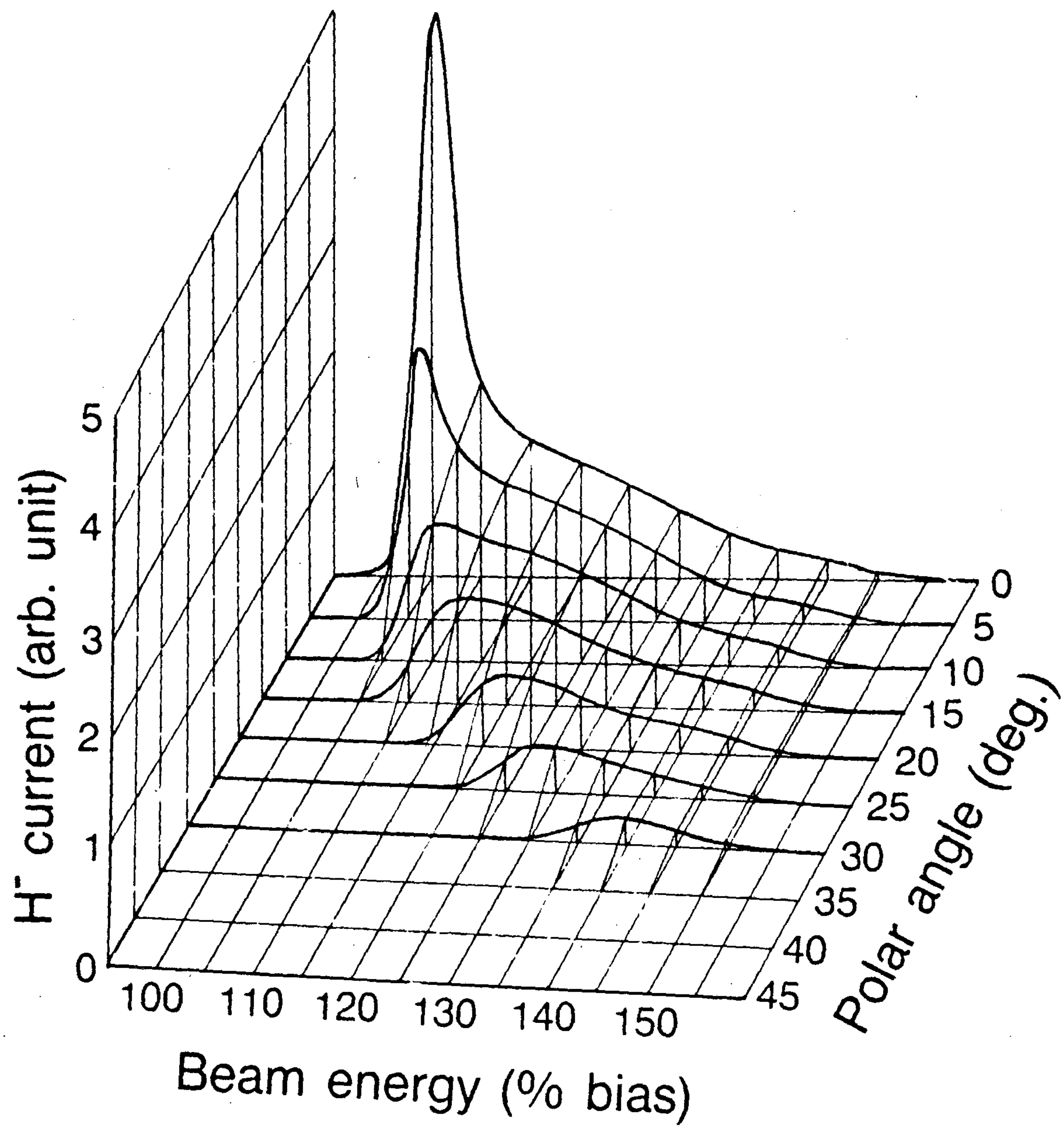

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Figure 2

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