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This is copy 3 of 4 series B
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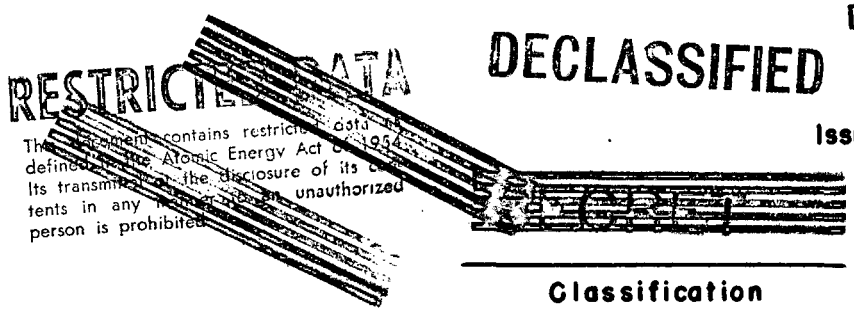

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RL-220

THE OCCLUDED GAS ION SOURCE

by

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Applications and advantages of the occluded gas ion source are described. The absence of continuous neutral gas flow into the reacting volume is emphasized. A proposed scheme for injection into the mirror machine is discussed. Experiments are described dealing with extraction in nonuniform magnetic fields and with programmed extractor voltages.

The production of a low-temperature plasma using deuterated titanium has found several applications[1,2] in the Sherwood program at Livermore. Concurrently, a pulsed ion source producing deuterons in the kilovolt range has been developed for Sherwood and other uses. Full details are available elsewhere.[3] Advantages of the occluded gas ion source for injecting into a pulsed mirror machine are:

a. High-intensity--i.e., space-charge-limited--ion beams.
b. High ratio of atomic to molecular ions.
c. The absence of auxiliary ion-source magnets.
d. The absence of continuous neutral gas flow into the reacting volume.

The importance of the last item has been pointed out by Carothers.[4] In the face of this, the use of other types of ion sources will involve prohibitive neutral densities unless an efficient means can be found to pulse the external gas supply.

The injection scheme now favored[5] is to place the ion source on axis and slightly inside the smaller mirror. Extraction will be accomplished radially from several slots that run parallel to the axis. The extracted beam is inclined slightly forward of the normal to the magnetic field lines. This angle may range from a backward limit fixed by the requirement that in one revolution the ion advance sufficiently along the axis to clear the source structure, to a forward limit determined by the

conditions that the extractor not arc over and that the trapping time not be appreciably decreased. For maximum trapping time the optimum angle is slightly forward. In order to partially simulate the situation a cone-shaped source was constructed which extracted successfully at 5° to a uniform dc magnetic field of 1300 gauss.

Some advantage may be gained from injecting with a programmed extractor voltage.[5] For a linearly rising magnetic field the desired extractor voltage would rise as the square of the time. So that the extracted current also is not a function of time, an accel-decel system[6] can be used. A circuit has been developed to provide voltage of the desired time dependence for either the accel or the accel-decel system.

Future work will aim at providing space-charge neutralization for the extracted beam and constructing a source to be used in the Felix machine.

REFERENCES

[1] Coensgen, F., et al., Progress Report on Toy Top, This Volume.

[2] Bostick, W. H., Measurements on the Performance of a Rail Source, This Volume.

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[4] Carothers, J. E., Implications of Charge Transfer Phenomena in Thermonuclear Devices, University of California Radiation Laboratory Report No. UCRL-4133 (Confidential).

[5] Hiskes, J. R., Arc Research - Note on Table Top Injection: High Energy Injection Inside the Mirrors, University of California Radiation Laboratory Report No. UCRL-4558 (Secret).

[6] Bing, G. F., et al., Effect of a Decelerating Grid on Current From An Ion Source (Sherwood), UCRL-4461 (Confidential).

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