A NOTE ON SOME EMITTANCE MEASUREMENTS*

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1. Introduction

In recent work at Brookhaven National Laboratory[1], a duoplasmatron source produced a proton beam of low emittance and free from the effects of aberrations. When this source was fitted to the conventional pre-injector of the Brookhaven AGS, and the beam emittance measured again at 750 kV, the value had increased by a factor of about 18.

The present note describes some preliminary results of an experiment in which an ion beam, from a duoplasmatron with geometry identical to the Brookhaven source, is accelerated to an energy of several hundred kV across a single gap.

2. Apparatus and Results

The duoplasmatron is mounted in the high voltage bushing of a single gap accelerator[1]. The cathode of the gap is moveable so that the gap length can be varied. The gap was first set to 4 mm so that the geometry of the extraction gap of the Brookhaven source was reproduced. The emittance was measured by the slotted plate and copy paper method, the general arrangement of the apparatus being shown schematically in Fig. 1.

Fig. 2 shows an emittance diagram for a 35 mA beam at 40 kV. The emittance (E = area of diagram x $\beta\gamma/\pi$) is 6.7×10^{-3} cm-mrad and the brightness ($2I/\pi^2E^2$) is 1.6×10^{11} mA/cm^{2}rad^2. These values are about the same as those measured at BNL.

When the gap was increased to 30 mm and the extraction voltage raised to 280 kV, the emittance (8.7×10^{-3} cm-mrad) was about the same (Fig. 3). The beam current was 18 mA, so the brightness was reduced to 5.2×10^{10} mA/cm^{2}rad^2.

The highest voltage used to date has been 350 kV with a 30 mm gap. Efforts are now being made to raise the beam energy to 500 kV, using pulse voltages from a 1MV Marx impulse generator.

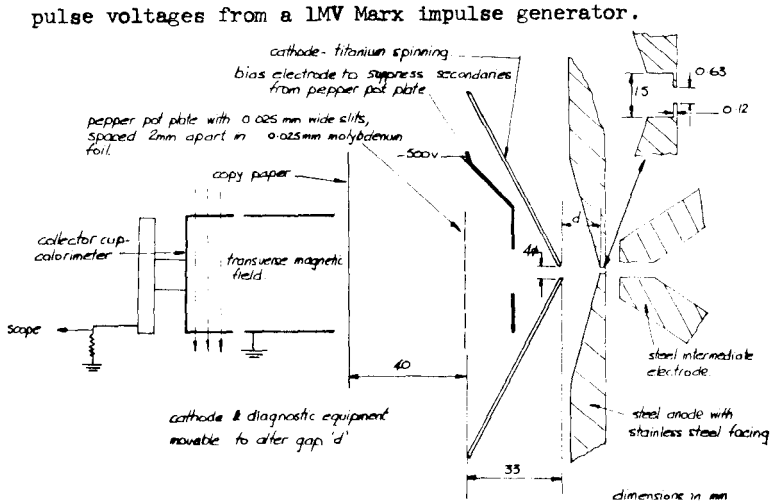

Fig. 1. Diagram of experimental arrangement.

3. Conclusion

The beam from a duoplasmatron source can be accelerated across a single gap to several hundred kV without a large increase in emittance and without suffering from the effects of aberrations.

4. Acknowledgements

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5. References

(1) BNL Accelerator Dept. Internal Rep. HW-2, and HW-3 by H. Wroe, Feb. 66.

(2) Nuclear Inst. and Methods 36 (1965), 345-346 by H. Wroe.

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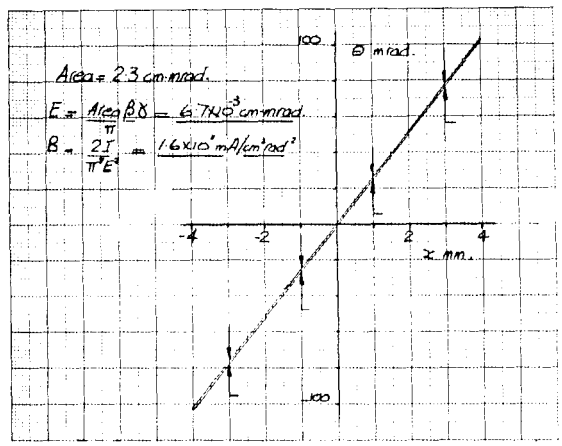

Fig. 2. Emittance diagram for 35 mA 40 kV beam, 4 mm extraction gap.

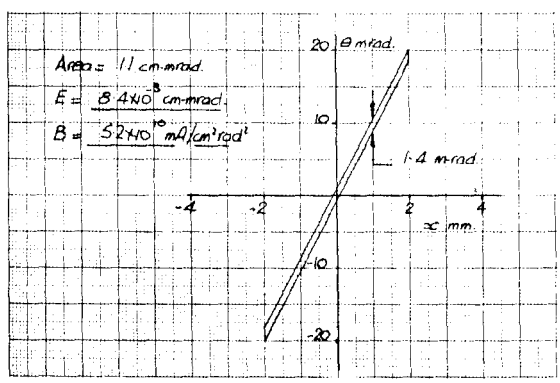

Fig. 3. Emittance diagram for 18 mA 280 kV beam, 30 mm extraction gap.