

ION SOURCE DEVELOPMENT FOR THE V.E.C.

The Variable Energy Cyclotron is to accelerate a wide range of ions from protons to very heavy particles, up to energies of 10 MeV per nucleon, and in the case of protons up to 50 MeV. To attain these energies, highly charged ions - such as C^{5+} , N^{5+} , O^{6+} , Ne^{7+} , Cl^{13+} and Al^{15+} - are required. The purpose of the work being carried out, is to develop sources to give usable quantities of these ions.

In the test rig (Fig.1) the ion current from the source is analysed into its various charge and mass components, and the ion currents measured. The source is located between the 20" diameter poles of an electromagnet which can produce fields up to 17 kgauss in the 6" gap. Ions are pulled out of a narrow slit in the side of the source by a potential of about 30 kV applied to an electrode close to the slit. The ions are accelerated from the source by the electric field and are bent into curved orbits by the magnetic field. Ions of different mass and charge have different radii of curvature and are thus separated from one another. A moveable cup collects the beams after deflection through 180°.

The source is of the Penning Ionization Gauge type. (Fig.2) The anode is tubular and two cathode discs are spaced a short distance from the ends of the anode tube. Electrons from a cathode are accelerated through the anode tube and are reflected by the opposite cathode. The electrons thus oscillate between the cathodes, and in doing so, create many ion pairs by collision with the low pressure gas within the source. The anode is a water cooled copper block and the cathodes are made from tantalum. Up to 2 kW of electrical power is dissipated in the source and the cathodes can be made to glow white hot. Large ion currents can be drawn from the source, depending on the size of the exit slit in the anode. The area of the slit is limited by the gas flow from the source. (An oil diffusion pump of 5000 litres/sec capacity is used on the test rig.) From a slit .2 inch long and .09 inch wide, 10 to 20 mA of ions can be obtained.

The source in the demonstration is operating with hydrogen gas and the discharge seen through the ion exit slit, appears a blood red colour. The hydrogen ion current from the source is composed of up to 99% atomic ions. A thin molybdenum foil intercepts the ion beam after acceleration through 30 kV and deflection in the magnetic field. There is sufficient energy in the beam to make the foil become visibly hot.

THE MAGNETIC FIELD
IS PERPENDICULAR
TO THE PAPER

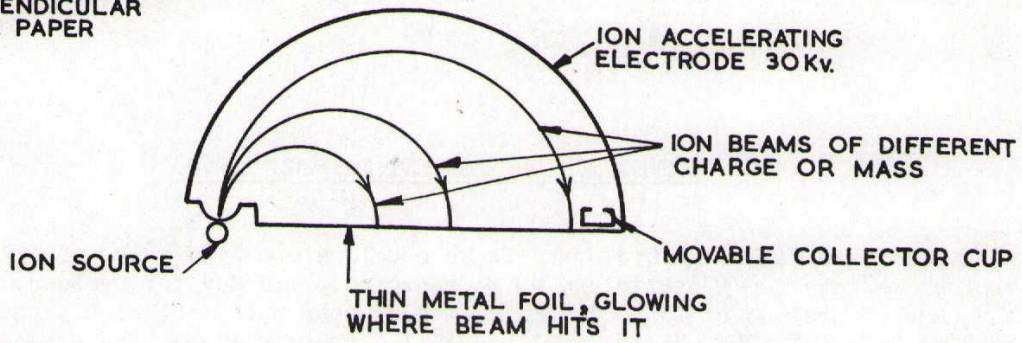


FIGURE 1 SEPARATION OF IONS OF DIFFERENT CHARGE AND MASS IN THE TEST RIG

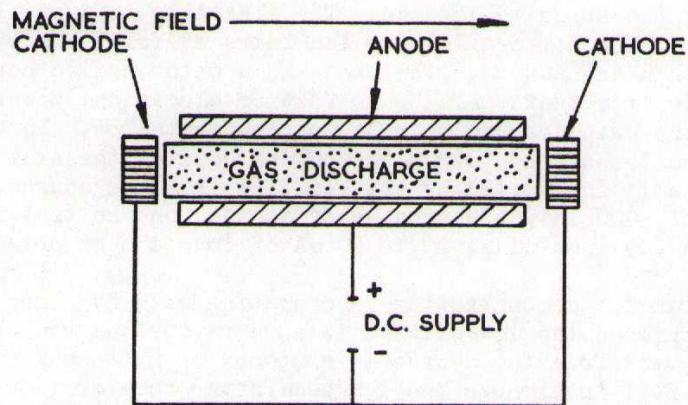


FIGURE 2 DIAGRAM OF PENNING IONIZATION GAUGE ELECTRODE GEOMETRY USED IN THE ION SOURCE