The Berkeley Gas-Filled Separator

V. Ninov, S.A.Abbott, K.E. Gregorich, C.A. Mcgrath

Magnetic separators have been used for the separation of compound nucleus products making use of the momentum imparted to the compound nucleus in the nuclear reaction. However, in heavy ion reactions, the low-energy recoils show broad distributions of velocity and ionic charge. The resulting magnetic rigidities are spread over a wide range, leading to a broad spatial distribution of the recoils at the focal plane of a separator.

An alternative method applied in the Berkeley Gas-filled Separator (BGS) uses a magnetic deflection system filled with gas at low pressure. In the gas the recoils undergo atomic collisions, capturing or losing electrons. They take on a well-defined average charge state, which is nearly proportional to the velocity, resulting in a high efficiency, small image size, and large energy/momentum/velocity acceptance.

The BGS is being constructed at the 88-Inch Cyclotron. The magnetic configuration of the BGS will allow a large angular acceptance, four times larger than other compound nucleus separators, and good suppression of scattered projectiles. A schematic of the magnetic and vacuum systems is presented in Fig. 1. Initial testing is scheduled for March 1998, with the first Physics experiments planned for summer of 1998.

The ionoptical properties of BGS allow a program of nuclear physics studies utilizing a broad range of nuclear reactions. The experimental program will include heavy element studies with lead-, bismuth- or actinide targets as well studies with proton drip-line nuclei, binary transfer reactions and even inverse kinematics fission.

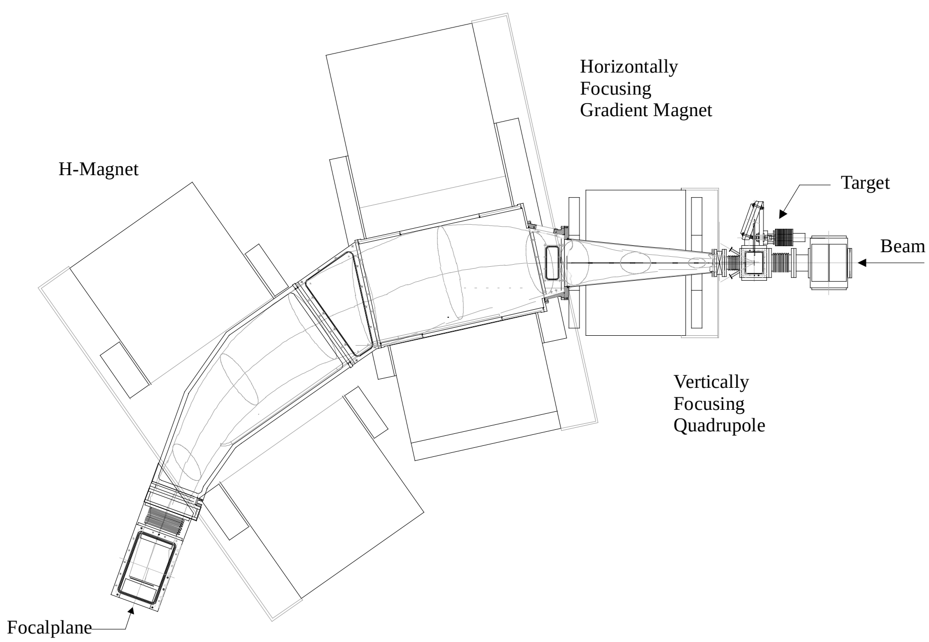

Fig. 1. Schematic of the BGS. The Cyclotron beam will enter the target chamber from the right. The first magnet is a vertically focusing quadrupole. The center magnet is a dipole magnet modified to produce a strong horizontally focusing field gradient. The magnet at the lower left is a flat field dipole magnet. The detector chamber is at the far lower left. The outline of the vacuum chambers, and the recoil envelope are also shown.