^{76}Kr Beams at the 88″ Cyclotron

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We have successfully produced and accelerated a radioactive ion beam (RIB) of ^{76}Kr using the 88-Inch "Recyclotron".

The Recyclotron project uses the 88-Inch Cyclotron to first produce and later accelerate the RIB of interest. Early tests have concentrated on the production of ^{76}Kr, with its 14 hour half-life, in the ^{74}Se(alpha, 2n)^{76}Kr reaction. This beam will be used for a g-factor measurement in order to continue the systematic study [1] by the Rutgers University group of the even Kr isotopes as one approaches N=Z. These studies provide a sensitive probe of the nuclear wavefunction and competition between single-particle and collective motion.

The target consists of a thin (8 mil) layer of separated ^{74}Se. The target is covered by a 5 mil Al cover foil and backed by a water-cooled block. This choice of thickness covers the energy peak of the (α,2n) reaction while minimizing the other reaction channels which will contribute unwanted radioactivity. The production runs typically last several hours and produce 10^{12} atoms of ^{76}Kr/microamp-hour (typical beam intensities are 5 particle microamps).

After the production run, the target is left for several hours to allow the short-lived ^{77}Kr product to decay away, then transfer of the Kr to the BEARS trap commences. The target is remotely heated up to the melting point of selenium (274K) and He is flowed through in order to drive the Kr upstairs to the BEARS LN trap adjacent to the AECR. The Kr is trapped out in a charcoal trap in the LN and the He pumped out. Great care must be taken to assure that there are no leaks in the transfer system which will allow nitrogen to contaminate the Kr trap, as this can easily load down the AECR and suppress the Kr ionization. The efficiency and integrity of the system is tested before each run with a calibrated Kr leak.

The first successful ionization and acceleration of the ^{76}Kr through the Cyclotron was demonstrated in February. In less than 30 minutes of running, 10^{10} ions of ^{76}Kr were collected at the exit of the accelerator. This corresponds to approximately 10^7 ions/second through the Cyclotron. Rough efficiencies were measured as:

- Transfer from target to trap – 10%
- Transfer out of trap – 60%
- Ionization and extraction from AECR – 2-3%
- Transmission through cyclotron – 10%

for a total efficiency of 10^{-4}.

Footnotes and References

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[1] T.J. Mertzimekis, et al, PRC 64, 024314 (2001)
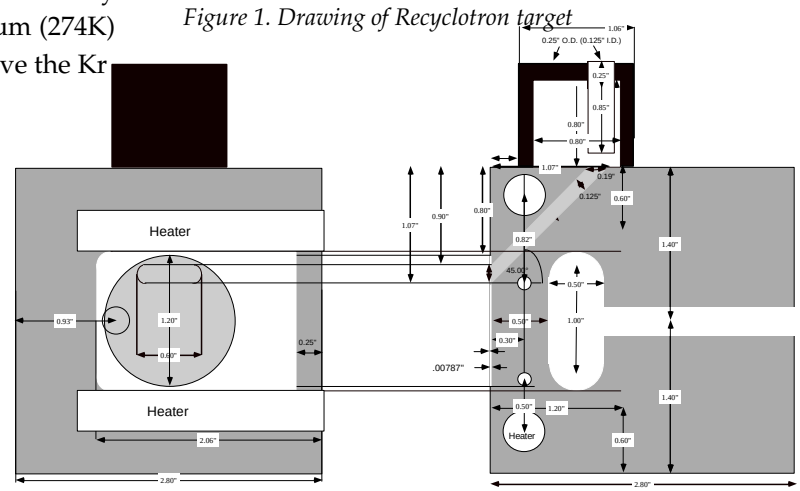
Figure 1. Drawing of Recyclotron target