"FAILSAFE" GAS TARGET FOR PRODUCTION OF I-123 FROM Xe-124

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The production of I-123 from Xe-124 has made very high purity I-123 available to facilities with medium energy cyclotrons (30 MeV) (1,2,3). A cryogenic target for the production of I-123 has proven very successful (4,5), but it was felt that a more traditional gas target design would also be useful for those facilities where the cryogenic target could not be easily adapted to the existing beam lines. One of the critical concerns in using a gas target for the production of I-123 from Xe-124 is the chance that the isotopically enriched gas will be lost in the case of a foil rupture. In order to reduce this risk, a gas target with a liquid nitrogen cooled buffer volume was designed and built.

Preliminary experiments were carried out using the test target shown in Figure 1. This target consisted of a cylindrical target body equipped with a pressure sealed plunger. The plunger had a sharp point on the end facing the foil. This target body was attached to a buffer volume as shown in the diagram. The inlet and outlet lines from this buffer volume were immersed in liquid nitrogen. The foil between the buffer volume and the xenon gas was a .0025 cm Havar foil and the foil between the cyclotron vacuum isolation foil and the buffer volume was a .005 cm Havar foil. The target was pressurized to pressures typical of production conditions (500 kPa) and then the plunger tapped into the front foil to rupture it. The gas trapped in the loops leading out of the buffer volume was recondensed into the target and the pressure measured again. This gave a percentage recovery of the xenon gas. These experiments were repeated at several different pressures up to twice the pressure expected to be present in the xenon target under typical irradiation conditions. In all cases, more than 99% of the xenon gas was recovered.

The target designed for production was similar to that used for testing except that the target volume was conical in shape to compensate for multiple scattering in the two foils. The conical gas target is attached to a buffer volume with a helium cooling which enters and leaves the buffer volume through a liquid nitrogen cooled "U" trap or spiral trap into a closed loop helium recirculation system. A diagram is shown in Figure 2. The gas is contained in the target volume at high pressure (> 10 atmospheres) and the buffer volume allows expansion of the gas thereby lowering the pressure in the total volume to slightly above atmospheric. The gas can then be trapped in the liquid nitrogen cooled inlet and outlet lines.

This target arrangement allows very efficient recovery of the isotopically enriched xenon gas at a very low cost in comparison to designs involving fast acting valves on the beam line. This system can be easily constructed and fit onto existing beam lines without extensive modification.

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References

1. Firouzbakht, M.L., Teng, R.R., Schlyer, D.J. and Wolf, A.P. Production of High Purity Iodine-123 from Xenon-124 at Energies from 15 to 34 MeV. Radiochimica Acta 41 (1987) 1-4.

2. Kurenkov, N.V., Malinin, A.A., Sebyakin, N.I., and Venikov, N.I., Excitation Functions of Proton-Induced Nuclear Reactions on 124Xe: Production of 123I. J. Radioanal. Nucl. Chem. Letters 135 39-50 (1989).

3. Tarkanyi, F., Kovack, Z., Qaim, S.M., and Stocklin, G. Differential Production Yields of 123I in Proton and Deuteron Induced Reactions on Natural Xenon. Radiochim. Acta 47 (1989) 25-27.

4. R. E. Shefer, R. E. Klinkowstein, B. J. Hughey, M. J. Welch Production of PET Radionuclides with a High Current Electrostatic Accelerator. J. Nucl. Med. 32 (1991) 1096.

5. M. L. Firouzbakht, D. J. Schlyer, and A. P. Wolf A Solid Xenon Ice Target for the Production of I-123 J Labelled Cmpds and Radiopharm. 32 (1993) 243-244.

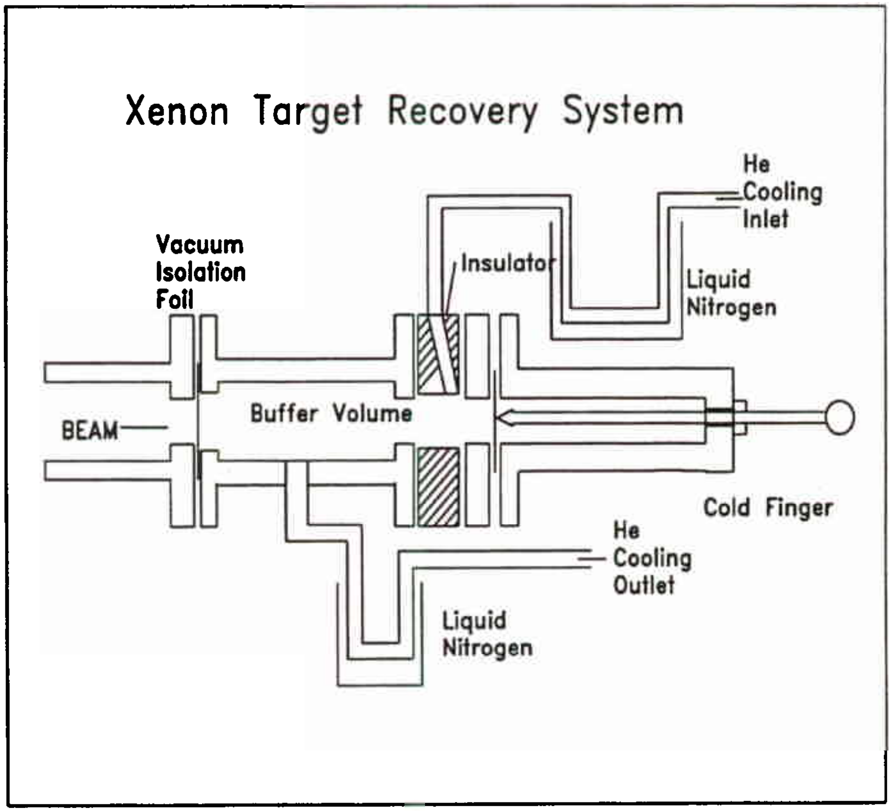

Figure 1. Test target to approximate foil rupture under pressure. Rear plunger was equipped with knife point which was tapped into the target foil.

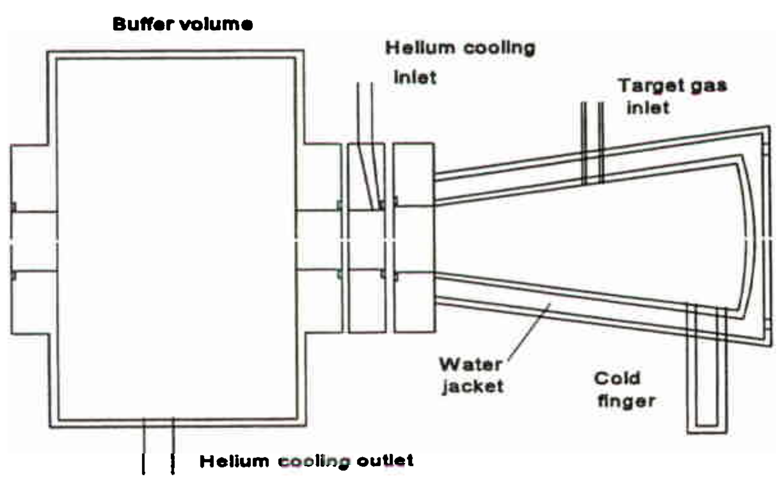

Figure 2. Final target design of "failsafe" xenon target.