18-F Production For PET and An Investigation of the 18-F(p,alpha)15-0 Reaction With a Radioactive Beam

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Improved methods for the production of 18-F have been developed. The isotope, a beta+ emitter with a 110 min half-life, serves a vital role in positron emission tomography (PET), and more recently has become important in the emerging field of a radioactive beam development for nuclear reaction studies. Aside from increasing some PET radiopharmaceutical yields by factors of 2-20, the present work made possible a factor of 10[3]-10[4] improvement in 18-F ion beam intensity over previously published methods.

18-F production targetry was developed for an 11.4 MeV, 6-8 mm FWHM, 50 uA proton beam from the UW Cyclotron. Nucleophilic aqueous [18F]fluoride is produced via the 18-O(p,n)18-F reaction on an enriched [18-O]water target. The target yield is (80 plus or minus 15)% of the theoretical maximum for beam currents up to 40 uA, with the highest yield to date of 70 GBq. Gas targets for the production of electrophilic [18-F]F2 were developed with a saturation bombardment yield of 3.10 plus or minus 0.40 GBq/uA for beam currents up to 45 mA, and a maximum yield to date of 45.5 GBq. The 18-F in either form has important applications in the labeling of PET radiopharmaceuticals, and the applicability of each to radioactive beam technology has been investigated.

An 18-F ion beam was generated by a dual-accelerator method incorporating off-line chemical separation. 18-F was produced on the UW radioisotope production cyclotron, then delivered to Argonne National Laboratory (ANL) for beam formation on the tandem accelerator on ATLAS. An average 18-F-beam intensity of 1 pA was achieved from a cesium vapor, sputter negative ion source (SNICS) with a peak intensity of 4.5 ppA. This was sufficient to allow direct measurements of the 18-F(p,alpha)15-O reaction cross section at energies of astrophysical interest.

Cyclotron targetry studies, radioactive beam production techniques and results from the 18-F(p,alpha)15-O experiment are presented.