Production of and research on medical radioisotopes at the Heavy Ion Laboratory, University of Warsaw

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Irradiations & measurements

There are two cyclotrons at the Heavy Ion Laboratory used for the production of radioactive isotopes:

- **U-200P**
  - 2 - 10 AMeV
  - ¹⁰⁷He → ⁷²As
  - max. 1 µA internal beam

- **PETtrace**
  - 16 MeV
  - p - d
  - 0.5 - 4 µA external beam

Targets used at U-200P are prepared as pellets bonded in thin aluminium foil (Sc and Se/As production) or by direct melting into backing (At production). PETtrace targets are material pressed using a hydraulic press. Each target consists of the target enrichment. Yields of long-lived Tc isotopes, impossible to eliminate by chemistry, were calculated with EMPIRE evaporation code.

**Proton energy [MeV]**

- **TTY [MBq/µAh]**
  - ⁹⁹mTc: 150
  - ⁴⁴Sc: 0.02% EOB

**6 h irradiation, 40 µA**

- **Horizontal Impurities**
  - ⁹⁹mTc: 0.02% EOB

**A EOB**

- **Scandium-44m and scandium-44g with **⁴⁴Sc = three photon PET

The production of ⁴³Sc was investigated via the ⁴⁴Ca(α,p) using ⁴⁴Ca metal targets (96.9% ⁴⁴Ca in ⁴⁴Ca). The observed impurities level in the ⁴⁴Sc target was <0.05% of ⁴⁴Sc. The production route is extremely attractive. The enriched ⁴⁴CaCO₃ (99.99% ⁴⁴Ca) yields impurities lower than 10⁻⁶% for over 15 h after the EOB. Additionally, irradiating the ⁴⁴Ca metal with the α-beam of 25 µA (from commercially available cyclotron), a 14 GBq of ⁴⁴Sc at EOB could be produced after a 4 h irradiation.

**Summary**

The cyclotrons operating at the Heavy Ion Laboratory of the University of Warsaw have been extensively employed in recent years for the production of medical radioisotopes: ⁹⁹mTc, ⁷²Se/⁷²As, ²¹¹At, ⁴³Sc and ⁴⁴Sc. The intensity of a beam is sufficient for the production of research quantities of the studied radioisotopes, but yet a more intense beam would be needed for their production for clinical applications. An upgrade of the U-200P cyclotron is in preparatory phase.