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## Optimisation of the long lived $^{121}\text{Te}$ contaminant in production of $^{123}\text{I}$ through the $^{124}\text{Xe}(p,x)$ route

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At present the preferred route for  $^{123}\text{I}$  ( $T_{1/2} = 13.2$  h) production is bombardment of highly enriched  $^{124}\text{Xe}$  with 35 MeV protons and taking advantage of the cascade decay  $^{123}\text{Cs} \rightarrow ^{123}\text{Xe} \rightarrow ^{123}\text{I}$ . After irradiation the gas targets are allowed to cool for 7 h ensuring optimal in-growth of  $^{123}\text{I}$  from its precursors. A separation of I from all other elements is performed resulting in a nca, pure solution.

An unavoidable contaminant is  $^{121}\text{I}$  ( $T_{1/2} = 2.12$  h) produced by  $^{124}\text{Xe}(p,\alpha)$  reaction with a cross section maximum around 20 MeV.

This rather short lived radioiodine will disappear quickly from the  $^{123}\text{I}$  solution, but its long lived decay product  $^{121g}\text{Te}$  (16.8 d) accumulates and impairs the late use (several half lives of  $^{123}\text{I}$  after calibration date) of the solution. This situation could be improved by lowering the  $^{121}\text{I}$  production through limitation of the target thickness and imposing a higher exit energy.

As the only values for the  $^{124}\text{Xe}(p,\alpha)$  reaction were reported by Tarkanyi et al. [1] at higher energy, reliable data on the excitation function need to be measured for the first time.

Highly enriched  $^{124}\text{Xe}$  was bombarded with protons between 13 and 37 MeV with the double aim of determining cross sections for  $^{121}\text{I}$  production and resolving discrepancies existing in the previously published values for production of  $^{123}\text{Cs}$  and  $^{123}\text{Xe}$  [2].

Here only results for  $^{121}\text{I}$  are presented and compared with results from different theoretical codes.

In the experimental (and production) conditions formation of  $^{121}\text{Cs}$  and  $^{121}\text{Xe}$  are impossible or extremely low (practical threshold of 1 mb at 38 MeV [1]).

Direct formation of  $^{121g}\text{Te}$  (16.8d) or  $^{121m}\text{Te}$  (154d) through the  $(p,3pn)$  reaction are not of importance because of the needed chemical separation at EOB+ 7 h.

The cross sections for  $^{121}\text{I}$  production show a practical threshold at 9.5 MeV rising to a maximum of 13 mb at 21 MeV, not in agreement with theoretical results.

From a fit to our excitation curve, production yields for short irradiations on thick targets are calculated. The  $^{121}\text{I}$  activity present at the optimal cooling time is then calculated for different energy degradation in the target and for different irradiation times (up to 13 h, 1 half life of  $^{123}\text{I}$ , saturation of  $^{121}\text{I}$ ).

By comparing to the cumulative produced  $^{123}\text{I}$  in the same irradiation conditions, the evolution of the relative activity of both  $^{121}\text{I}$  (decreasing in time) and  $^{121}\text{Te}$  (increasing in time) is calculated. By defining maximal admissible contaminations levels for late use of the  $^{123}\text{I}$  solution, limits on target thickness are defined.

[1] F. Tarkanyi et al. , Applied Radiation and Isotopes, 42, 1991, p221

[2] IAEA TECDOC 1211, Vienna 2001.

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