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Production, extraction and mass-separation of medical ^{43,44,47}Sc radionuclides at the CERN-MEDICIS facility

The CERN-MEDICIS facility at CERN specializes in extraction and mass-separation of wide range novel medical radionuclides, produced in reactions from 1.4 GeV and 1.7 GeV protons on thick targets at CERN Proton Synchroton Booster (PSB), as well as externally irradiated samples from nuclear reactors and cyclotrons. The extracted radionuclides are typically delivered in the form of singly charged atomic ions, but with development of more versatile ion sources, molecular species could be successfully extracted as well.
Molecules have been studied as a method to efficiently deliver beams of release-limited elements by forming and extracting volatile molecules of otherwise refractory species such as medical ^{43,44m,44g,47}Sc radionuclides which are very promising in "matched theranostic pair"radiopharmaceutical development for cancer treatment. The development of molecular beams is fostered by some desired radionuclide low volatility and vapour pressure, possible improvements to beam extraction, efficiency, radionuclidic and chemical purity. For instance, extracting radionuclides on a molecular sideband shifts the mass of interest, and can therefore be used as a technique to improve beam purity by changing the isobaric contamination.
In this study, natural titanium targets were irradiated at the MEDICIS target irradiation station with 1.4 GeV protons. The presence of contaminant isotopes such as ^{46}Sc in the final product for radiolabeling with radiopharmaceuticals is not acceptable, therefore produced Sc radionuclide separation step, according to their mass is mandatory. Nevertheless, ^{46}Sc could be used for extraction studies long after decay of medical Sc radionuclides.
Scandium fluoride molecular beams were studied with a Versatile Arc Discharge Ion Source (VADIS). ISOL and mass-separation is mandatory and effective to obtain high purity and yield ^{43,44m,44g,47}Sc, but chemical separation from collection foils and isobars must be done after extraction to prepare for radiolabeling.

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