

# HIGH CURRENT GAS TARGET ASSEMBLY FOR PRODUCTION OF $^{123}\text{I}$ .

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**Introduction:** The design and control of high current gas target systems well adapted for making effective use of modern cyclotrons beam performance is an essential technical challenge. The Target assembly and materials not only have to withstand beam currents well above  $100\mu\text{A}$  for maximizing the production capacity, it too needs to be controlled continuously over extended irradiation periods for a safe, reliable and economic routine production. Improved target body and target window issues, process control devices and requirements to beam transport into and through the target are exemplified by our isotope production system KIPROS (Karlsruhe Isotope Production System) for large scale  $^{123}\text{I}$  production. The method is based on the well known nuclear reaction of protons with highly enriched  $^{124}\text{Xe}$ .

**Target System:** The technical characteristics of our standard KIPROS target system are designed to operate at 100 to 200  $\mu\text{A}$  at 30 MeV delivering a bulk yield of 350 MBq/ $\mu\text{Ah}$  of  $^{123}\text{I}$  (at EOB+6h) as [ $^{123}\text{I}$ ]NaI at high isotopic and radiochemical purity. The production unit is fully automated and allows continuous in-process control of each operation: target preparation,  $^{124}\text{Xe}$  transfer, irradiation,  $^{124}\text{Xe}$  recovery,  $^{123}\text{I}$  recovery and target qualification for the next batch. All operations are monitored and archived, and are retraceable. In-process controls are displayed on the control screen.

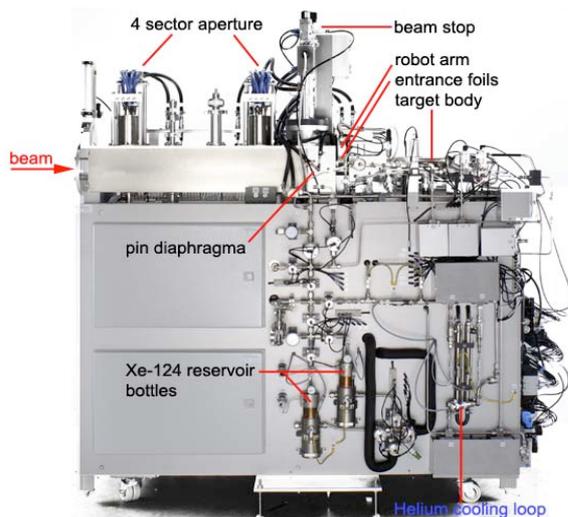


Fig 1: Outline of KIPROS for routine  $^{123}\text{I}$  production

The KIPROS system is being employed in routine operation at various facilities worldwide. The target assembly consists of:

- A diagnostic unit for beam adjustment and control during the irradiation process. One pair of four sector collimators and one ring collimator ensure a parallel or slightly convergent proton beam at the target entry. Currents on the collimators (each sector) and the target body are monitored separately, recorded, and may be followed online allowing a reliable and narrow beam control during the irradiation.
- An improved aluminum target body with a nickel plated inner surface ensuring consistently good-product purity. The target body is equipped with pressure and temperature sensors for online recording the proton beam situation in the target gas. Especially the gas pressure is highly sensitive to the accurate beam alignment.
- A remote target window exchange mechanism for replacement of the Helium cooled target window at minimum radiation exposure. The Helium cooling loop is controlled by a temperature and pressure monitoring system for the early tracing of a beginning foil insufficiency or leakage.
- A gas storage vessel for  $^{124}\text{Xe}$  located close to the target body with a short gas transfer line, minimizing  $^{124}\text{Xe}$  losses from batch to batch and allowing a close balancing of the Xe inventory as part of the in-process controls. The gas transfer part is separated from the “wet” radioactivity wash-out part.

**Development:** A further refinement of our KIPROS high current gas target system is still ongoing and will be described. It is directed to the improvement of the target body and the double foil window configuration, and the respective cooling efficiency for a safe, repeated and long period use at 200  $\mu\text{A}$ . Additionally its adaption to 24 MeV cyclotrons is envisaged which could deliver reasonable yields of  $^{123}\text{I}$  at high current operation. A test target set-up has been used to derive data about the temperature and pressure profile in the target and in the target window up to 250  $\mu\text{A}$ . Helium flow profiles and its heat removal efficiencies have been simulated and compared to the measured data. First results will be presented for discussion.