Contribution ID: **63** Type: **Poster**

Modeling and Operation of an Electromagnetic Isotope Separation System for Ytterbium-176 Production

Tuesday, 9 September 2025 16:30 (1h 30m)

As radiopharmaceutical therapy gains prominence in the targeted treatment of certain cancers, global demand for radionuclides—particularly the beta-emitting lutetium-177—is rapidly increasing. Lutetium-177 is widely used in treating advanced neuroendocrine tumors and prostate cancer, and it is also well-suited for theranostic applications. Traditionally, production of lutetium-177 has relied primarily on direct neutron irradiation of the long-lived radioisotope lutetium-176, and to a lesser extent on neutron irradiation of the stable isotope ytterbium-176. For the latter route, several enrichment techniques have been developed, with laser-based isotope selectivity emerging as a novel approach. Nevertheless, the most established method for enriching ytterbium-176 remains electromagnetic isotope separation (EMIS), in which ions are extracted from a suitable source and directed through a bending electromagnet. This paper provides a high-level overview of Kinectrics' efforts in commissioning a first-generation EMIS system for the commercial production of highly enriched, chemically pure ytterbium-176. Particular attention is given to the advantages and limitations encountered when using the IBSimu particle tracking code to model ion beam extraction and transmission.

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Session Classification: Poster Session

Track Classification: Applications of ion sources