



Contribution ID: 108

Type: **Invited Oral**

A new spallation-driven two-step target at ISAC-TRIUMF: Design, online irradiations and PIE

Friday, 10 November 2023 09:00 (30 minutes)

The ISAC-TRIUMF facility produces Radioactive Ion Beams (RIBs) by impinging a 500 MeV, 50 kW proton beam onto targets of several target materials, and ionizing the outgoing atomic species. A spallation-driven, two-step target has been developed and irradiated at the ISAC-TRIUMF facility, focusing on the production of neutron-rich fission fragments and limiting by design the production of their neutron-deficient isobaric contaminants.

This new target assembly has been designed, tested and commissioned to generate an intense neutron field by impinging the proton beam onto a tungsten spallation target, positioned downstream of an annular uranium carbide volume. The neutrons subsequently induce fission reactions in the actinide material, producing predominantly neutron-rich fission fragments while limiting the production of the neutron-deficient spallation reaction products. In addition to the different distribution of produced isotopes, the thermal decoupling between the tungsten spallation target and uranium carbide volume offers additional benefits that allow high-power irradiations in a more controlled thermal environment.

This contribution presents the optimization process that led to the final target design and focuses on the successful online results obtained at the ISAC-TRIUMF facility from three independent irradiation campaigns. The extensive online beam time dedicated to this target has allowed for precise characterization of its performance by exploring a wide parameter space, improving the purity of some elemental chains by up to a factor 50. Moreover, this prototype has already allowed the delivery of more exotic neutron-rich isotope beams of Rb, Cs, Ba, Zn, Ga and Sn, enabling successful completion of previously unfeasible experiments. Results of the Post Irradiation Examinations (PIE) performed on the three irradiated target units will also be presented, highlighting areas for future improvements.

Themes for the contribution

4 Target design, analysis, and validation of concepts:

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Session Classification: Topic4-3