Contribution ID: 1 Type: not specified

## Treating Radioactive Waste: Measurement of 93Zr + d Reactions at 30 MeV/u

Wednesday, 8 March 2023 15:05 (5 minutes)

Treating nuclear waste, in particular long-lived fission products (LLFPs), remains a worldwide problem for the future long-term sustainability of nuclear energy. A promising solution uses nuclear transmutation reactions to convert LLFPs into stable and short-lived nuclear matter for simpler, safer storage. Transmutation studies typically use neutron-induced fission, however, the LLFP  $^{93}$ Zr (half-life ~  $10^6$  years) poses the challenge that stable Zr isotopes in the waste, namely  $^{91}$ Zr and  $^{92}$ Zr, may be transformed into  $^{93}$ Zr by neutron capture. Consequently, transmuting  $^{93}$ Zr by neutron capture is not practical. An alternative transmutation process uses deuteron-induced pre-equilibrium reactions on  $^{93}$ Zr, but there's a lack of cross-section data at energies below 50 MeV/u. To address this knowledge gap, the  $^{93}$ Zr+d pre-equilibrium cross-sections were measured at ~ 30 MeV/u as part of the ImPACT program using the BigRIPS-OEDO beamline at the RIBF in RIKEN, Japan. A radioactive  $^{93}$ Zr beam was produced and separated by BigRIPS. Using OEDO the beam was decelerated and focused onto the cryogenically cooled deuterium gas target. Reaction products were momentum-analyzed by part of the SHARAQ spectrometer and then identified using the Bp-dE-range method. This poster presents the experimental procedure and preliminary results.

## Experimental study on nuclear physics

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Session Classification: Poster Session