Operational Experience of a High-Intensity Accelerator-based Fast Neutron Source Based on a Liquid-Lithium Target

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Motivation

- With SARAF phase I: creating unique high intensity fast neutron flux for advance research on:
  1. Nuclear Medicine (cancer therapy)
  2. Nuclear astrophysics (nucleosynthesis)
  3. Generation IV reactor and ADS design (cross section measurements)

- In SARAF phase II:
  1. Radioactive beams
  2. Fusion reactor material testing
  3. Unique radiopharmaceuticals production

Summary

- A fully operating liquid lithium target system has been built at Soreq
- The target has gone successful operational and heat load tests with SARAF phase I proton beam
- Neutron flux is $2 \times 10^{10}$ n/s @ 30 keV
- An upgrade for fast neutrons source of $10^{12}$ n/s is in progress

Irradiation result

- Peak power densities: 2.8 kW/cm², ~0.5 MW/cm³

Target system

- Proton energy: ~2 MeV
- Proton current: <3.5 mA
- $T = 220°C$
- $T_{\text{max}} = 350°C$
- Jet: 18 mm x 1.5 mm
- Lithium velocity: 2–7 m/s
- Wall assisted lithium jet

Target diagnostics

- Video Camera
- In-target thermocouples
- IR Camera

Beam diagnostics

- Multi layer fire prevention and suppression system

Fire safety

- Full power beam dump
- Wire scanners
- Target visualization

Jet chamber