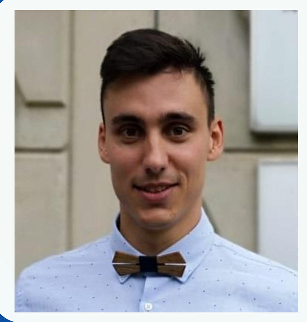
NENE

KATANA response to changing reactor power and flow rate



Domen Kotnik[1], domen.kotnik@ijs.si

J. Peric[1,2], L. Snoj[1,2], I. Lengar[1]

[1] Reactor Physics Department, JSI, Slovenia

[2] Faculty of mathematics and Physics, Slovenia

MOTIVATION

- Lack of **water activation** experiments in **fusion relevant conditions**
- Lack of experimental facilities featuring **high-energy** γ **sources**
- Lack of **experimentally validated** fluid activation codes/methodologies

KATANA FACILITY

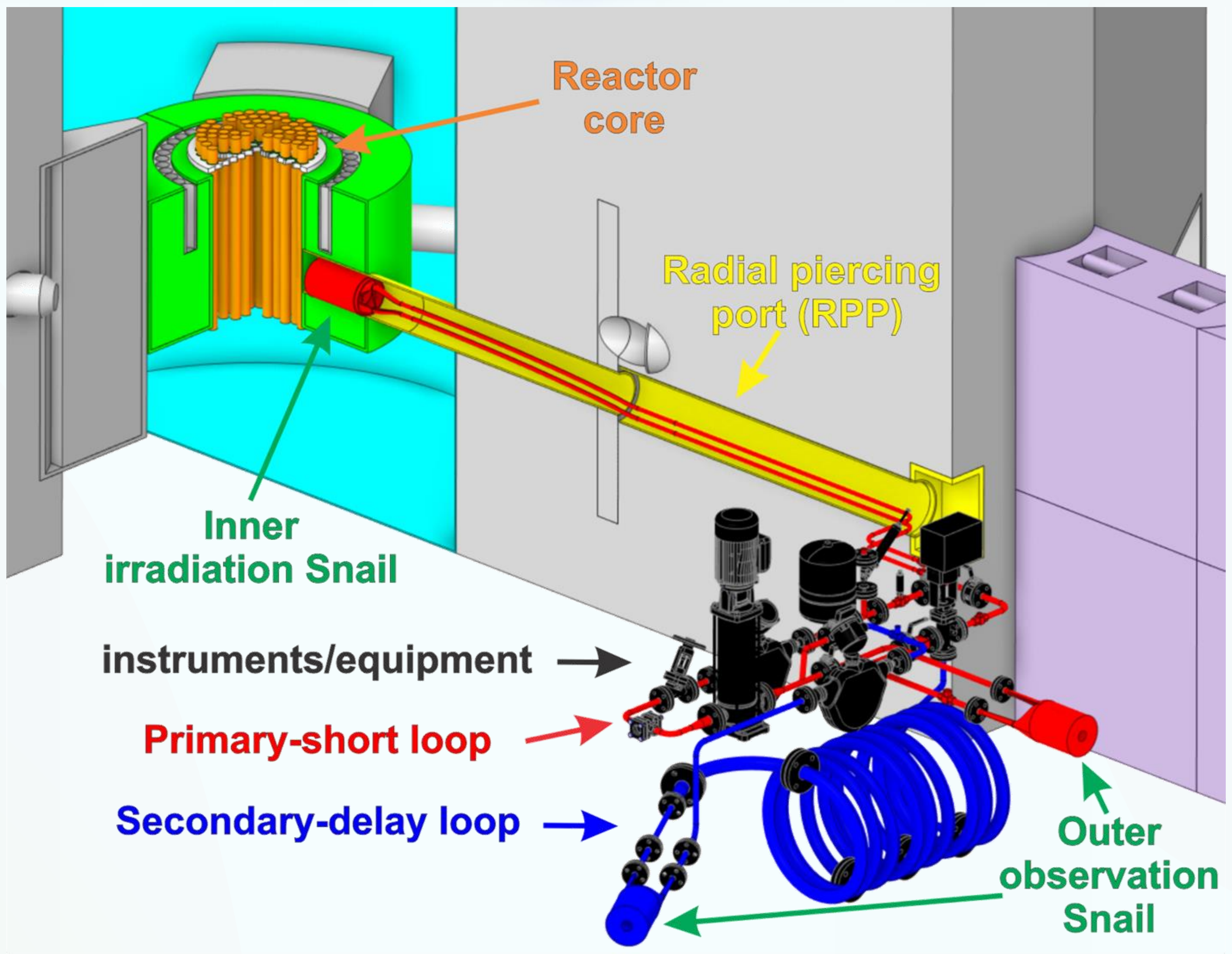
- Closed-water activation loop
- Successfully commissioned in Dec. 2023
- Execution of experiments to determine operational characteristics of KATANA
  - **response to changing reactor power**
  - **response to changing flow rate**

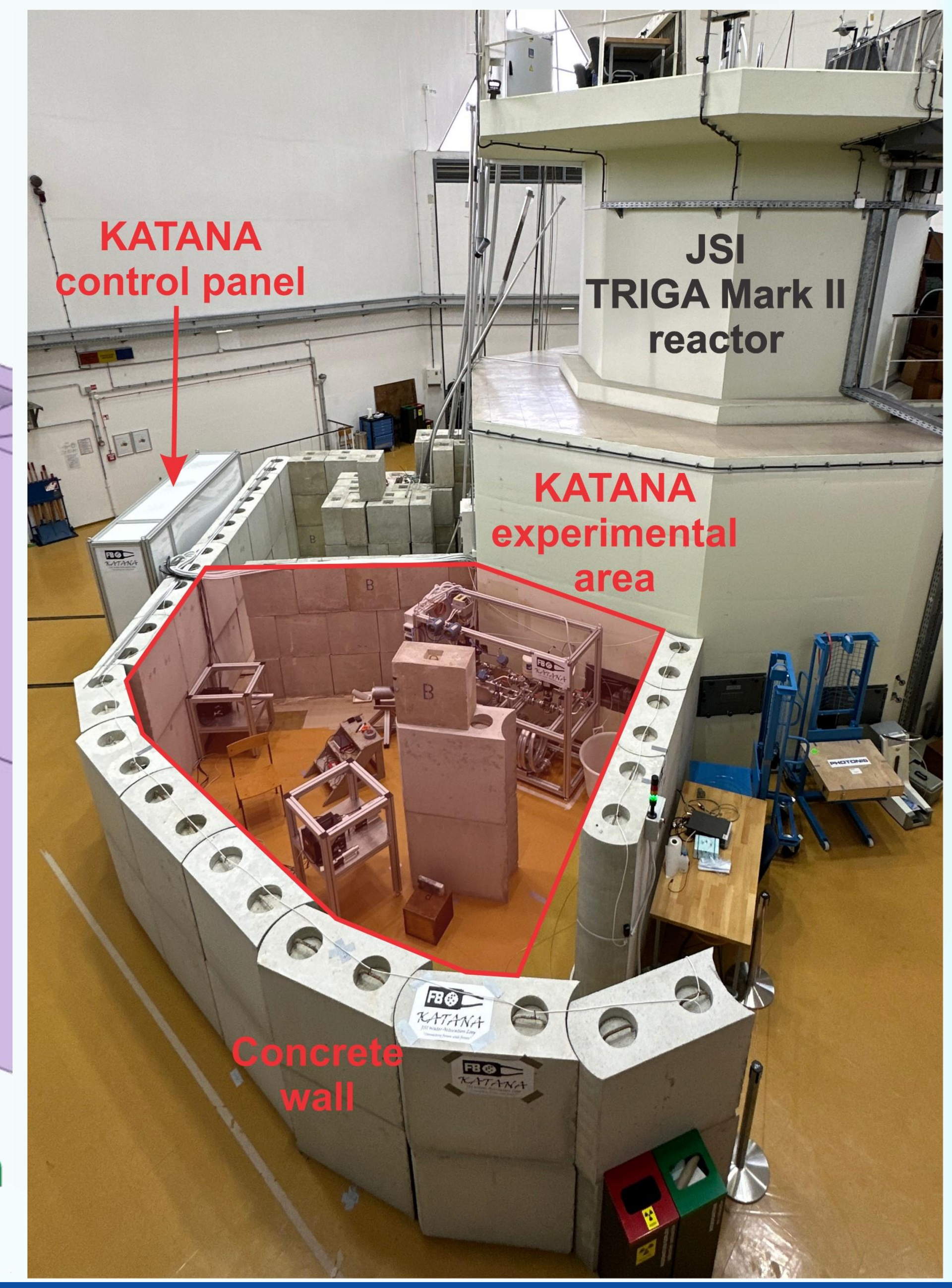
CONCLUSIONS

- **Obtained operational characteristics of KATANA**
- Determination of the saturation point: **0.4 L/s**
  - minimise uncertainties caused by flow fluctuations
- Experimental campaigns: **2024, 2025, 2026+** EUROfusion
- Improvements: - **Absolute calibration** of γ and n detectors
  - Experimental resolution/reduction of systematic uncertainties
  - Additional shielding: lead blocks, collimators, etc.

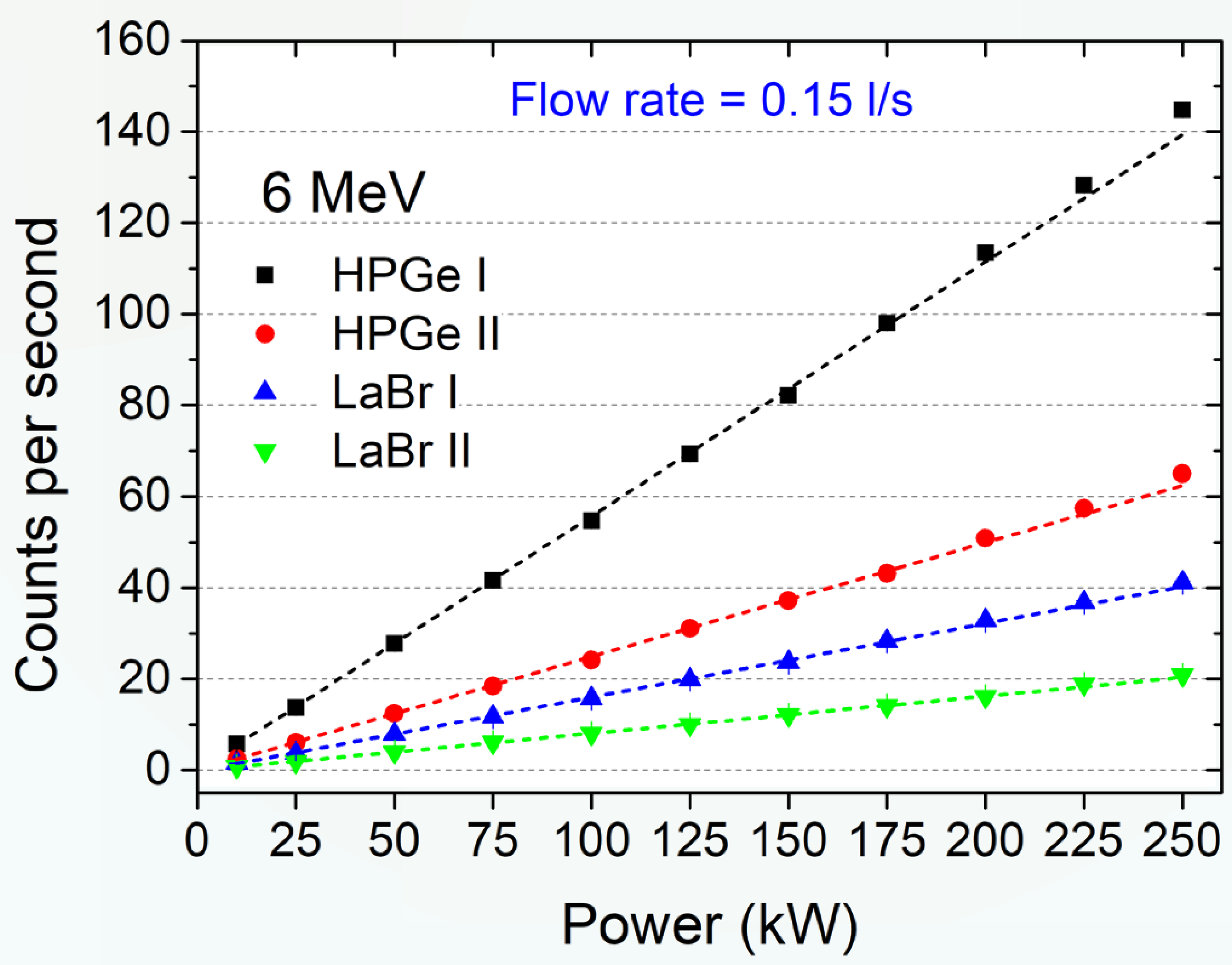
KATANA: closed water activation loop

- **Well-defined and stable high** energy irradiation source:
  - Gamma: 6 MeV – 7 MeV
  - Neutron: ~1 MeV
- **Water activation based experiments** (^{16}N, ^{17}N, ^{19}O)
- Experimental validation of **fluid activation codes**
  - **FLUNED, RSTM, ActiFlow & GammaFlow**
- **Calibration** of γ detectors and dosimeters
- **Shielding experiments** using ITER-relevant materials
- **Integral cross-section** measurements
- Dose rates and γ spectrum measurement
- iter relevant conditions





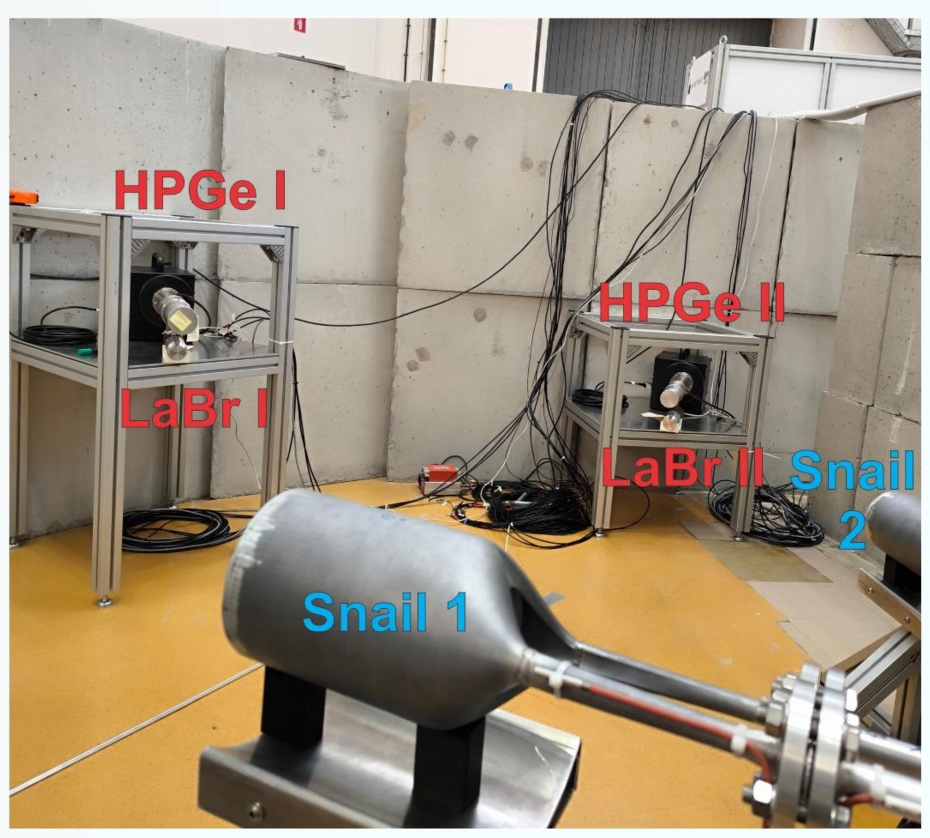
response to REACTOR POWER



- Constant flow rate: 0.15 L/s
- Linear correlation
- HPGe higher efficiency than LaBr
- Branching ratio of ^{16}N decay deviate 20 % to 30 % from well known value 13.4 (0.67/0.05)

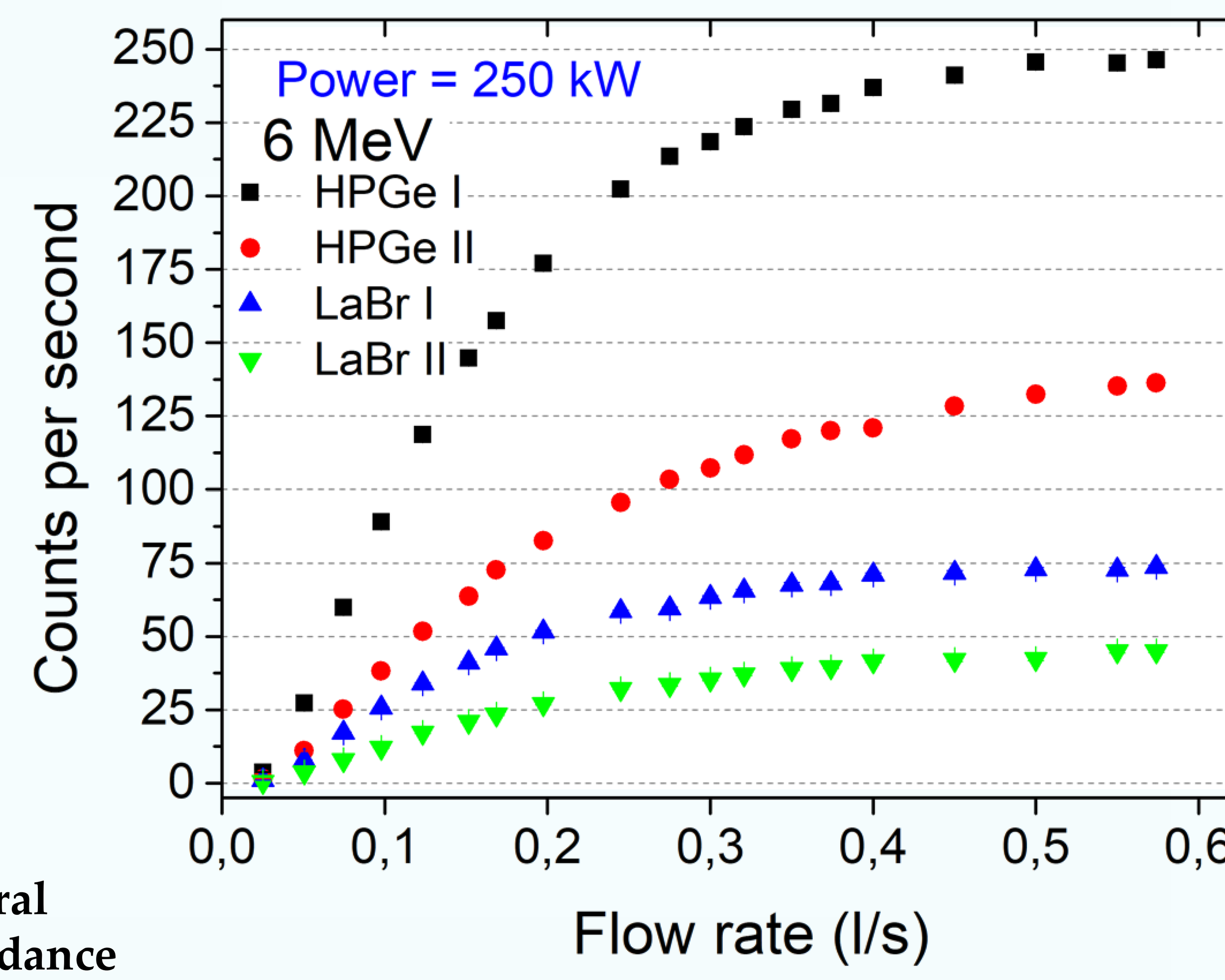
KATANA experimental set-up:

- 4 gamma detectors (2x HPGe, 2x LaBr)
- γ spectrometry of ^{16}N at **6 MeV** and 7 MeV



Reaction	$t_{1/2}$ [s]	Major decay products	Threshold energy	Natural abundance
$^{16}O(n,p)^{16}N$	7.13 s	γ: 6.13 MeV (67 %) γ: 7.12 MeV (5 %)	~10.5 MeV	99.76 %
$^{17}O(n,p)^{17}N$	4.17 s	n: 0.38 MeV (35 %) γ: 0.87 MeV (3 %) n: 1.17 MeV (53 %)	~9 MeV	0.04 %
$^{18}O(n,\gamma)^{19}O$	26.9 s	γ: 0.20 MeV (96 %) γ: 1.36 MeV (50 %)	< 1 eV	0.2 %

response to FLOW RATE



- Constant reactor power: 250 kW
- Non-linear correlation
- Saturation point near 0.4 L/s
  - consistent with the model predictions