Neutron flux characterisation inside inner irradiation Snail head of the KATANA facility

Domen Kotnik[1], domen.kotnik@ijs.si
J. Peric [1,2], S. Rupnik[3], L. Snoj[1,2]

[1] Reactor Physics Department, JSI, Slovenia
[2] Faculty of mathematics and Physics, Slovenia
[3] Reactor Infrastructure Centre, JSI, Slovenia

ISFNT16 INTERNATIONAL SYMPOSIUM ON FUSION NUCLEAR TECHNOLOGY

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
- Large discrepancies in **nuclear data libraries** (especially for $^{17}O(n,p)^{17}N$)

KATANA FACILITY

- Closed-water activation loop
- Successfully commissioned in Dec. 2023
- Execution of experiments to determine operational characteristics of KATANA
  - **Neutron flux characterisation**
  - **Miniature fission chamber: U235 & U238**
  - **Acquisition system: LIBERA MONACO 3**

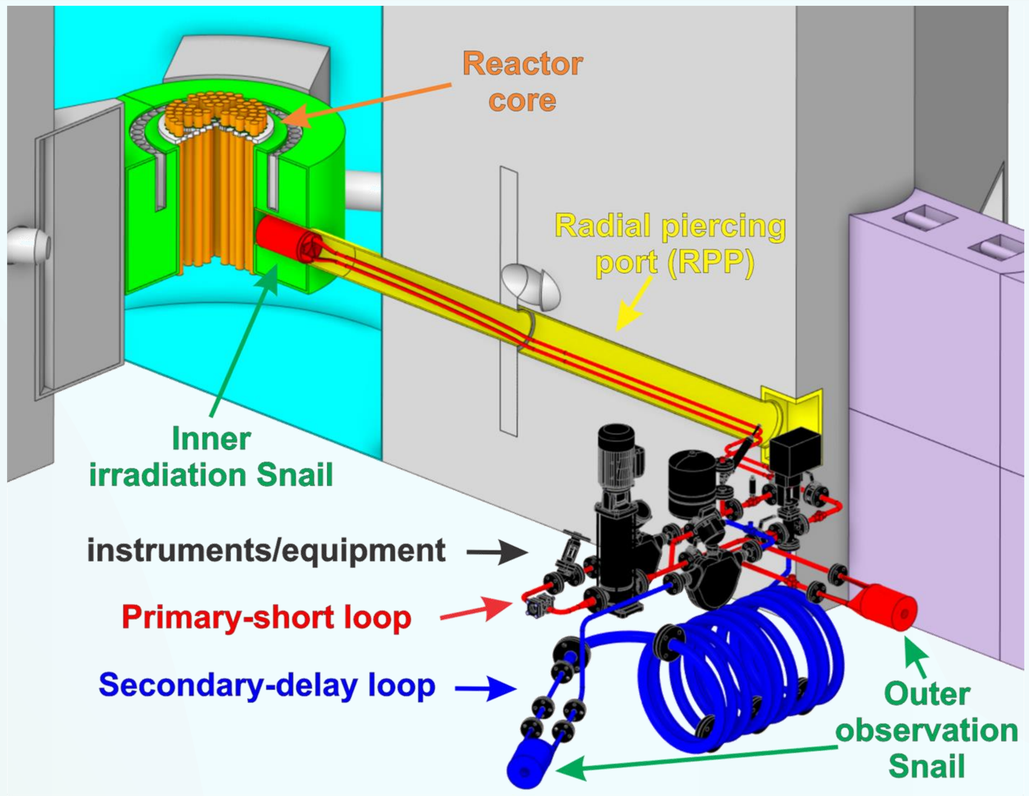
CONCLUSIONS

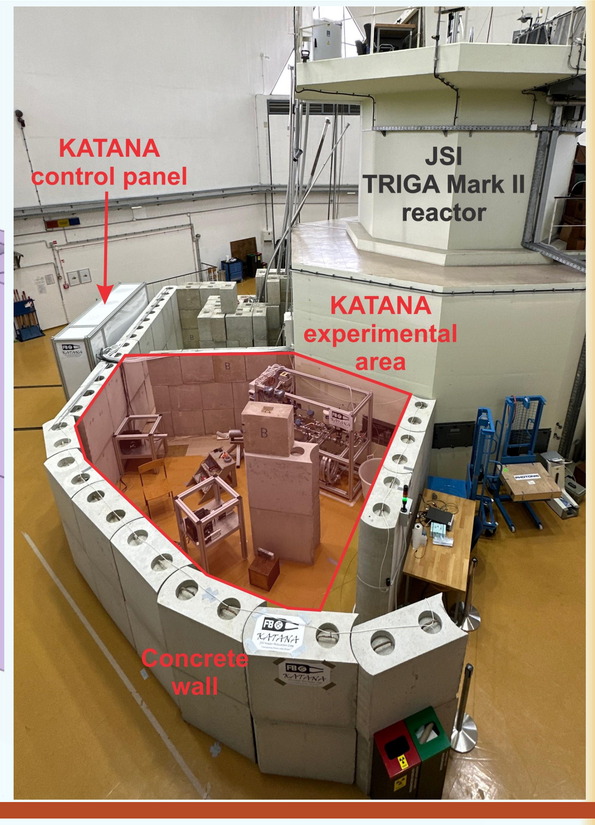
- Determine operational characteristics of FC U235 & FC U238
  - linear trend in response to reactor power (count & current mode)
  - Good agreement for thermal neutrons: RR U235 & FC U235
  - Large discrepancies for fast neutrons: RR U238 & FC U238
    - Similar beahivour of FC U238 and U235 ? !!!

IMPROVEMENTS:
new (better defined) FC U238 + additional activation foils

KATANA: closed water activation loop

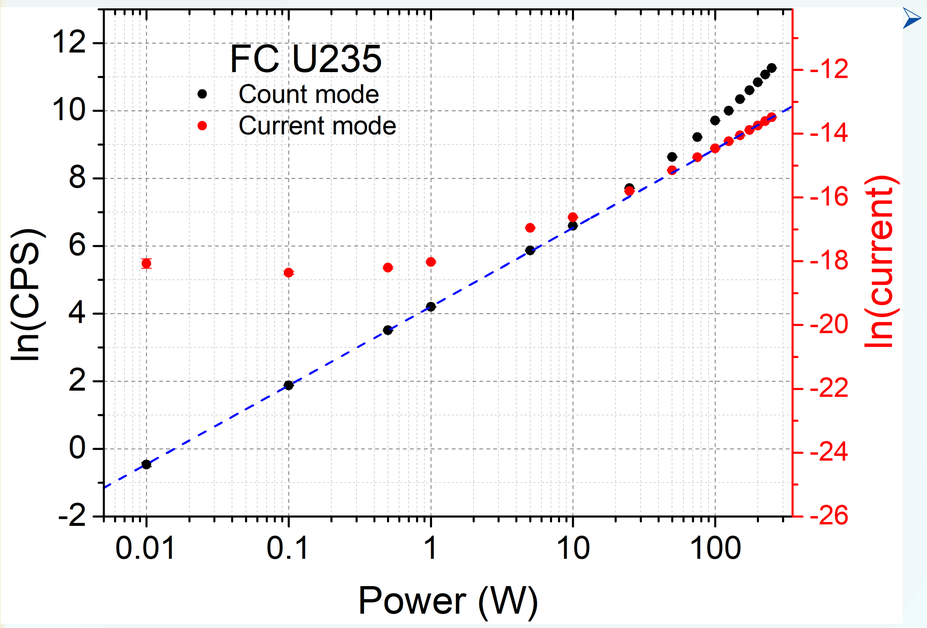
- **Well-defined and stable high** energy irradiation source:
  - Gamma: 6 MeV – 7 MeV
  - Neutron: ~1 MeV
- **Water activation based experiments** (^{16}N, ^{17}N, ^{19}O)
  - High threshold reactions: above 9 MeV
- Experimental validation of **fluid activation codes**
  - **FLUNED, RSTM, ActiFlow & 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

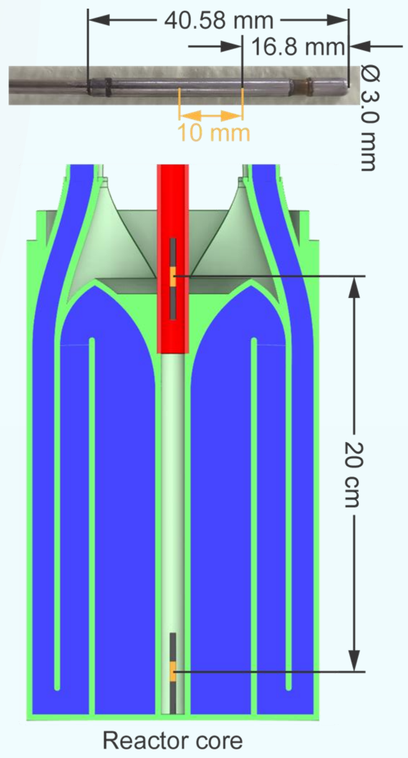
- Reactor power: 10 W – 250 kW
- FC fully inserted (Distance: 2.2 cm)
- Count mode & Current mode



- Linear operational mode:
  - **FC U235:** Count mode: < 10 kW; Current mode: > 50 kW
  - **FC U238**: Count mode: entire region; Current mode: > 100 kW

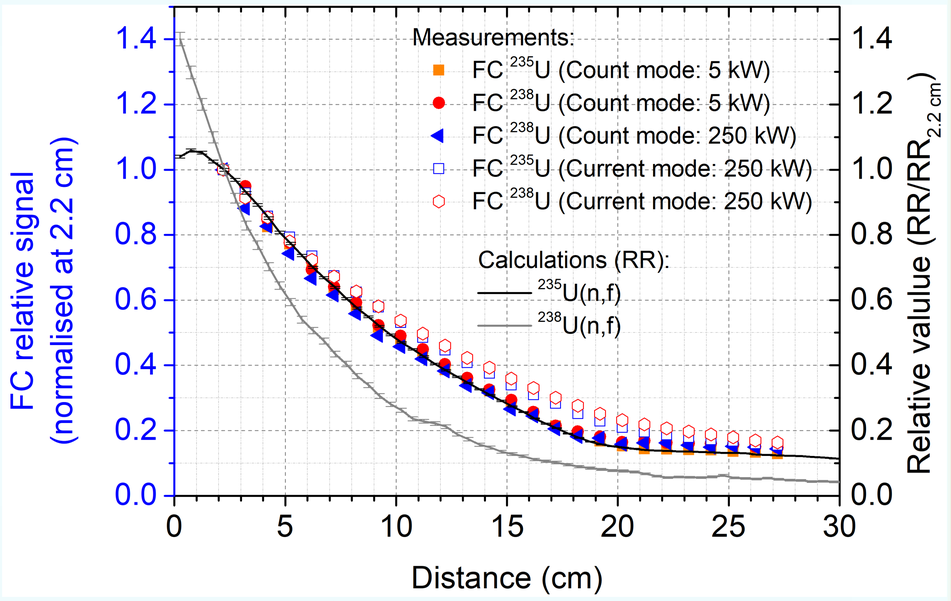
KATANA experimental set-up:

- 2 miniature fission chambers:
  - FC U235 (sensitive to thermal neutrons)
  - FC U238 (sensitive to fast neutrons)
- Inserted along inner irradiation Snail head



response to DISTANCE

- Distance: 2.2 cm – 27.2 cm (total 25 cm)
- Constant reactor power: 5 kW & 250 kW
- Count mode & Current mode



- Non-linear correlation
- Experiments VS Calculations:
  - Good agreement for thermal neutrons: RR U235
  - Large discrepancies for fast neutrons: RR U238
- Why FC U238 behaves as FC U235 ? Material composition ?