PAUL SCHERRER INSTITUT

PSI

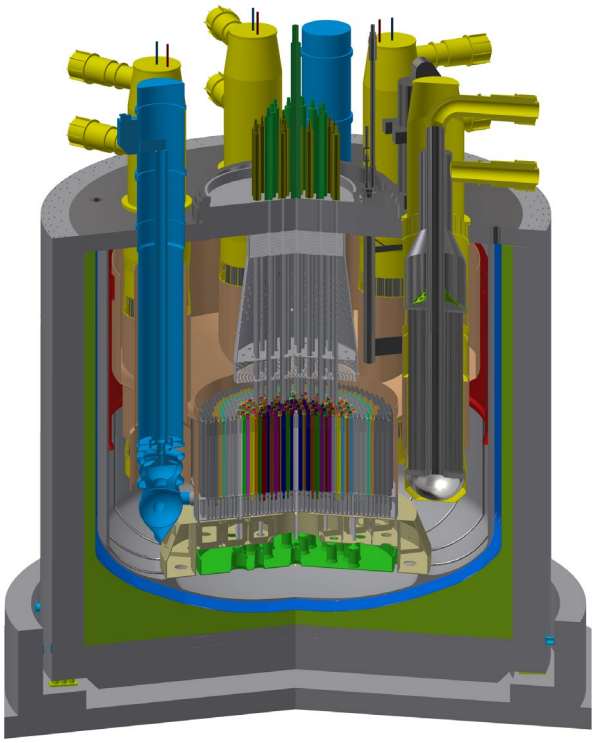
Konstantin Mikityuk and Jiri Krepel

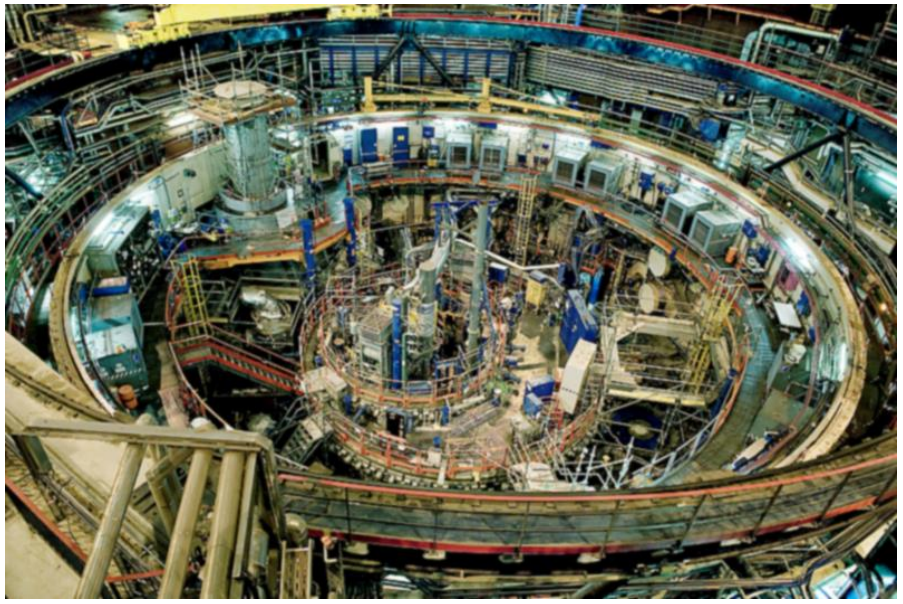
Advanced Nuclear Systems group at LSM: proposals for semester project / MS thesis

May 17, 2021

We focus on Sodium-cooled Fast Reactor

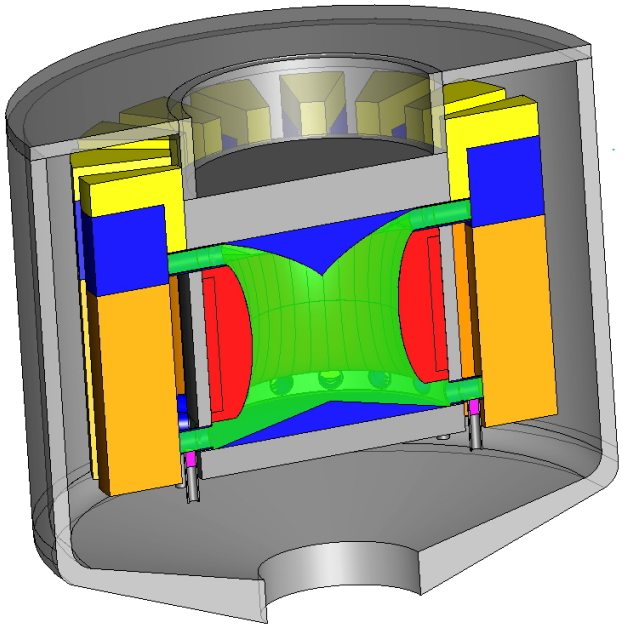
- Coordination and contribution to H2020 ESFR-SMART project
- Dynamic analysis of coupled neutronics and thermal hydraulics processes in case of sodium boiling. (*see common proposal with LRT*)
- Validation based on available reactor data: Superphenix, Phenix, EBR-II, CEFR, FFTF.



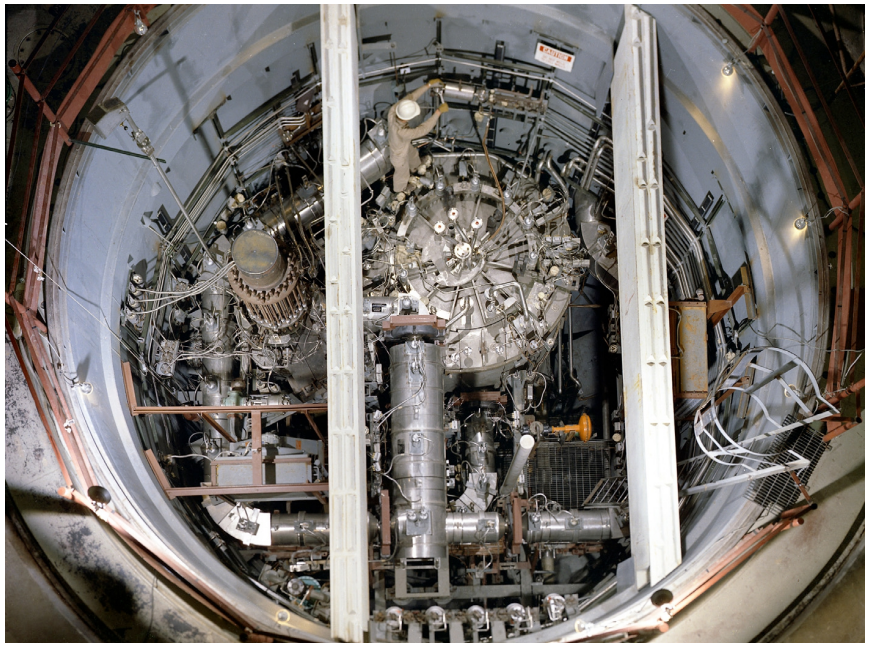


We focus on Molten Salt Reactor

- Nuclear Energy and Safety Division Project on Generation-IV MSR.
- Euratom H2020 project SAMOSAFER – Safety Assessment of the Molten Salt Fast Reactor.
- Validation based on available reactor data: Molten Salt Reactor Experiment (ORNL).



Molten Salt Fast Reactor Concept



Molten Salt Reactor Experiment

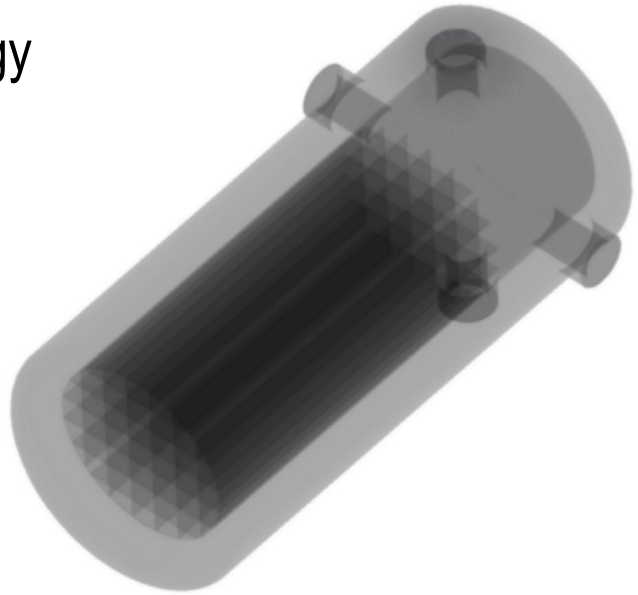
Topic 1: Contribution to development of Python-based ROOSTER code for fast reactor analysis

- Robust Object-Oriented Solver of Transport Equations in a Reactor
- Development started in 2021 and currently is done by a team of three students + code supervisor
- One possible topic for semester project / MS thesis: development of subsolver for adjoint flux and reactivity calculation
- Read more at https://kmikityuk.github.io/webrooster

```
Reactor
├─ Control
├─ Solid
│  ├─ Structure[]
│  └─ FuelRod[]
│     ├─ Fuel[]
│     │  └─ FuelGrain[]
│     ├─ InnerGas
│     └─ Clad[]
├─ Fluid
└─ Core
   ├─ Isotope[]
   └─ Mix[]
```

Topic 2: Fast solver for molten salt reactor design and fuel cycle optimization

- Based on previous students works…
- Develop diffusion-based burnup solver in Matlab for quick evaluation of fast MSR core performance in breed-and-burn cycle using simplified geometry.
- Verify the partial solvers by comparison to other codes result.
- Couple the solver with optimizing strategy *e.g.* genetic algorithm, and search for optimal core design.
- Optimization parameters could be: refiling fluid composition and rate, core and blanket radius.
- Optimization criteria could be: minimal salt volume or maximal fuel burn-up (resources utilization) or their weighted combination.



De Oliveira, R. G. and Hombourger, B., A., Fuel tap: a simplified breed and burn MSR, PHYSOR 2020, UK, 29.3-2.4, 2020

PAUL SCHERRER INSTITUT

Wir schaffen Wissen – heute für morgen

- **Thank you!**
- **Questions?**

- If interested contact konstantin.mikityuk@psi.ch