Prosta mesta za mlade raziskovalce

PhD topics and positions available

https://f2.ijs.si/

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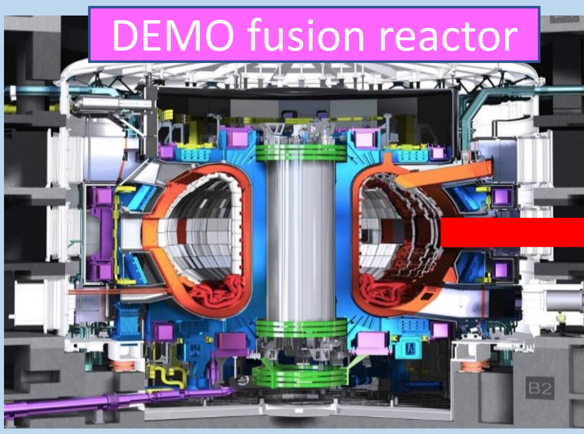
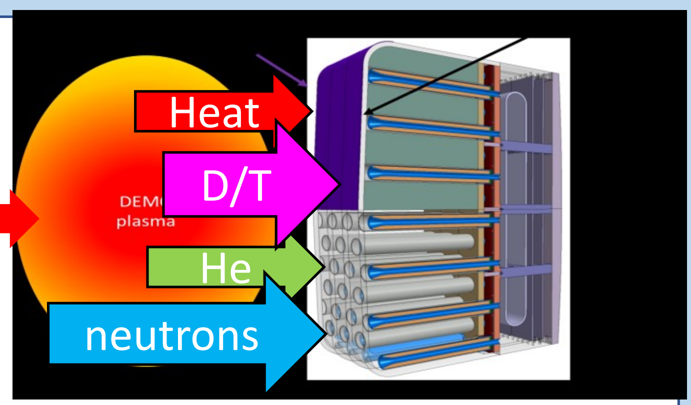
Raziskave v fuziji – Interakcija goriva z materiali

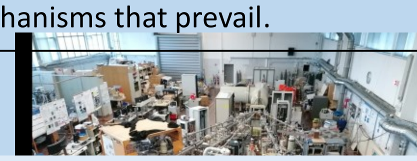
Iščemo motivirane študente za doktorsko delo v Laboratoriju za fuzijske raziskave https://f2.ijs.si/en/fusion, Odsek za fiziko nizkih in srednji energij (F2) na Institutu Jožef Stefan. Delo bi bilo povezano z raziskavami termonuklearne fuzije. Fuzija velja za nov brezogljičen vir energije za prihodnje generacije https://www.iter.org/ . V našem laboratoriju potekajo raziskave, kjer želimo vsaj delno simulirati pogoje, ki se bodo dogajali na stenah, ki obkrožajo 100 milijonov stopinj vročo fuzijsko plazmo: istočasno obstreljevanje z 14 MeV nevtroni, kopičenje helija ter implantacija vodikovih izotopov. Glavni cilj je prevideti zadrževanje in transport goriva (devterija in tritija) v stenah prihodnjih fuzijskih reaktorjev ter razumevanje procesov, ki pri tem prevladujejo.

Fusion research - Interaction of fuel with materials

We are looking for young and motivated students who are interested in a PhD work in our Laboratory for fusion research https://f2.ijs.si/en/fusion, Department for low and medium energy physics (F2) at Jožef Stefan Institute, Slovenia. Fusion is seen as a carbon-free energy source for the future generations https://www.iter.org/ . In our research we want to partially simulate the conditions that will occur on the walls, surrounding the 100 million degrees hot fusion plasma: simultaneous 14 MeV neutron irradiation, helium accumulation and hydrogen isotope (HI) implantation. Our main goal is to foster microscopic understanding to be able to predict fuel (deuterium and tritium) retention and transport in the walls of a future fusion reactor and to understand the mechanisms that prevail.







The studies would take place at two experimental stations located at the 2 MV tandem accelerator in a dynamic and relaxed environment.

https://f2.ijs.si/en/mic

Related references:

Markelj S. et al., Phys. Scr. 97 (2022) 024006

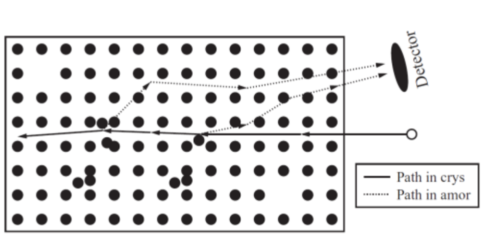
Pečovnik M. et al. Nucl. Fusion 60 (2020) 036024.

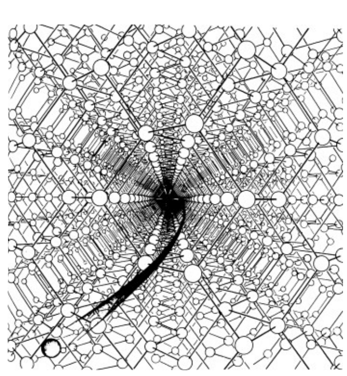
Markelj S. et al. Nucl. Fusion 59 (2019) 086050.

Markelj S. et al. Nucl. Fusion 60, (2020) 106029.

Detection of defects and hydrogen trapped in the crystal lattice using ion analysis methods in channeling mode

The PhD thesis would mainly include experimental work on a beam line intended to study hydrogen retention. The PhD candidate would study the defects in the crystal lattice of the material caused by high-energy particle bombardment and consequently impact of these defects on the retention of hydrogen isotopes in the materials. As part of the doctoral topic, the candidate would develop analytical techniques in channeling mode (C-RBS and C-NRA) in the existing experimental setup that will allow the detection of defects in the crystal lattice and the amount of hydrogen trapped in the defects. This newly developed techniques will allow us to upgrade our current knowledge in the interaction of HI with defects with the goal of better extrapolation for future fusion reactors. The proposed project will also bring a new analysis method for material development for laboratories working on hydrogen technology (hydrogen storage) and for characterization of materials for laboratories studying hydrogen embrittlement. The PhD work will be part of the European EUROfusion project DeHydroC led by S. Markelj and will be performed in collaboration with colleagues from Germany, France and Finland. *Related references: Zhou et al. J. Nuclear Materials 565, (2022) 153689 ; Zhang et al. Phys. Rev. E 94, (2016) 043319; Picraux, S. T. & Vook, F. L., Phys. Rev. Letters 33, (1974) 1216)*





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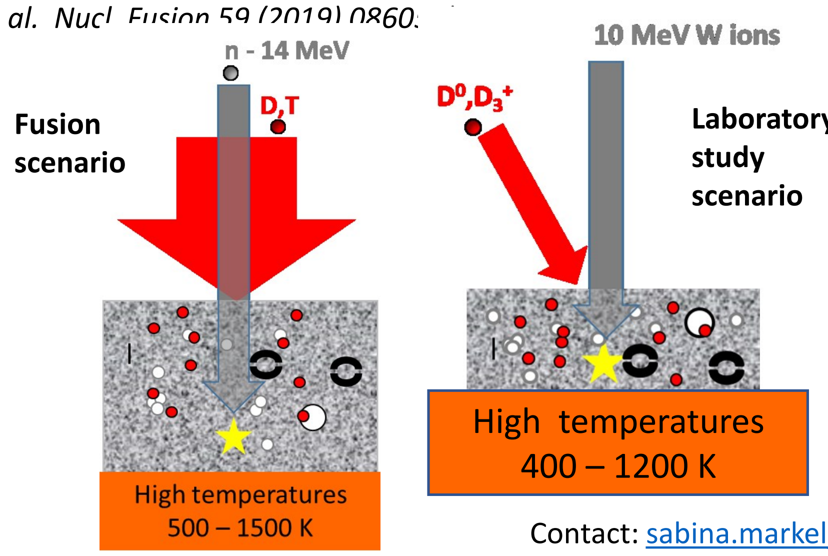
Retention of hydrogen isotopes in materials bombarded with high energy ion beams

The PhD thesis would first include experimental work on a new ultra high vacuum beam line intended for homogeneous irradiation of materials to create defects in the crystal lattice and then study hydrogen interaction with such a material. As part of the doctoral work, the candidate would finish setting up the new beam line and make it operational. The next step would be to study the evolution of defects in the crystal lattice of the material (fusion steel) caused by high-energy particle bombardment at different exposure conditions such as different irradiation dose, effect of temperature, presence of hydrogen during defect creation or influence of helium. Finally, deuterium retention and transport in such material will be studied with advanced ion beam methods. The PhD work would also include modelling of physical processes that will help to understand the experimental results. Work will be performed in collaboration with colleagues from Germany, France, England and Finland. *(Related references: Markelj S. et al., Phys. Scr. 97 (2022) 024006; Markelj S. et al. Nucl Fusion 59 (2019) 0860*



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