FZJ

Fusion researchers at Forschungszentrum Jülich address two key aspects of fusion research:

- Materials for extreme loads – New materials and composites are developed, characterised and tested by exposing them to the harsh conditions of plasma-facing components
- Plasma-material interactions – Understanding the physics of the boundary plasma towards the wall and its interaction with the materials allows the definition of the operational window for ITER and future fusion reactors

Jülich researchers use linear plasma machines on site along with fusion experiments, including Wendelstein 7-X, JET, ASDEX Upgrade, and EAST. In conjunction with theory and model developments, ITER operation scenarios are predicted and the gained knowledge enables extrapolation for DEMO.

RESEARCH INTO THE SYNERGISTIC EFFECTS OF PARTICLE FLUX, HEAT LOAD AND NEUTRON DAMAGE ON MATERIALS

Linear plasma devices are used in order to mimic conditions at the boundary region in current and next generation fusion experiments. PSI-2, located at Jülich, enables well-defined experiments which apply high particle fluxes and heat loads to material surfaces. To obtain the information in situ with regard to both the plasma conditions and the state of materials in a fusion environment, new techniques, including laser-based diagnostics and spectroscopy, are developed.

The unique infrastructure at Jülich enables, for the first time, investigations into the effects of neutron damage to wall materials during interaction with plasmas. A second linear machine, JULE-PSI, will start operation at the High-temperature Materials Laboratory (HML). Here, wall materials that have been damaged by neutron irradiation can be safely handled and investigated, whilst also examining the highest heat loads applied by electron beams.

TECHNOLOGY AND PHYSICS FOR ITER AND WENDELSTEIN 7-X

Researchers at Jülich are involved in the technological developments of Wendelstein 7-X and ITER. They contribute towards the design and construction of diagnostics intended to obtain information on material and plasma conditions during the experiment. Jülich has developed and manufactured the superconducting bus system as well as several diagnostics systems for Wendelstein 7-X. Plasma edge and plasma-material interaction physics are the key domains of Jülich researchers at Wendelstein 7-X.

SIMULATION TOOLS FOR FUSION REACTORS

Jülich boasts a strong theory group and access to high-performance supercomputers. Numerical tools developed at Jülich describe the plasma-wall interaction processes of tokamaks, stellarators and linear machines. The codes developed and used by Jülich bridge the dimensions from atomic scale to reactor size and combine aspects of plasma physics, transport phenomena, surface and solid state physics. They are applied in order to interpret current fusion experiments and to design future fusion reactors.

GERMANY . MATERIALS RESEARCH . PLASMA-WALL INTERACTIONS . PLASMA EDGE . PSI-2 . JULE-PSI. SUPERCONDUCTING BUS SYSTEM . THEORY . SUPERCOMPUTERS . DEMO .

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