AKE 1: Nuclear Fusion

Zeit: Montag 9:00–10:30 Raum: HSZ-03

Hauptvortrag AKE 1.1 Mo 9:00 HSZ-03

The European Fusion Roadmap — •Francesco Romanelli for the A1-Collaboration — European Fusion Development Agreement

This talk describes the main technical challenges on the path to fusion energy. For all of the challenges candidate solutions have been developed and the goal of the programme is now to demonstrate that they will also work at the scale of a reactor.

The European Fusion Roadmap has been developed within a goal-oriented approach articulated in eight different Missions. For each Mission the critical aspects for reactor application, the risks and risk mitigation strategies, the level of readiness now and after ITER and the gaps in the programme have been examined.

ITER is the key facility in the roadmap and its success represents the most important overarching objectives of the EU programme.

A demonstration fusion power plant (DEMO), producing net electricity for the grid at the level of a few hundreds MW is foreseen to start operation in the early 2040s. Following ITER, it will be the single step to a commercial fusion power plant.

Industry must be able to take full responsibility for the commercial fusion power plant after successful DEMO operation. For this reason, DEMO cannot be defined and designed by research laboratories alone, but requires the full involvement of industry in all technological and systems aspects of the design.

The talk will also address the needs in the area of education and training and basic research.

Hauptvortrag AKE 1.2 Mo 9:45 HSZ-03

The optimized stellarator as a candidate for a fusion power plant — •Thomas Klinger — Max-Planck-Institut für Plasmaphysik, Greifswald

The stellarator is a promising concept for the magnetic confinement of Deuterium-Tritium plasmas for energy production by means of nuclear fusion. However, the magnetic field geometry of the stellarator needs to be carefully optimized to overcome intrinsic performance limitations. The superconducting stellarator device Wendelstein 7-X, currently under construction in Greifswald, Germany, is the key device for the verification of stellarator optimization principles. To establish the optimized stellarator as a serious candidate for a fusion power plant, reactor-relevant plasma parameters must be achieved in fully integrated steady-state plasma discharge scenarios. It is the goal of the project Wendelstein 7-X to demonstrate this for the first time. After more than 10 years of construction, the completion of the device is now ahead. In the first part of the present paper, we briefly introduce into the principles of nuclear fusion and magnetic confinement. In the second part we discuss lessons learned during the device assembly and first experiences with the remaining major work packages. In the third part of the paper, we report on the planning for the first operation phase (5-10s discharge duration at 8MW heating power), the completion and hardening of the device for full power steady-state operation, and the second operation phase (up to 30min discharge duration at 10MW heating power). Finally, a preview of a possible design concept for a stellarator-based fusion power plant is presented.