MF-I18 AAPPS-DPP2018

2nd Asia-Pacific Conference on Plasma Physics, 12-17,11.2018, Kanazawa, Japan

Overview of the Divertor Tokamak Test Facility Project

Piero Martin (1), Raffaele Albanese (2), Flavio Crisanti (3), Aldo Pizzuto (3) and the DTT Team
[1] Università degli Studi di Padova and Consorzio RFX, Padova
[2] Università degli Studi di Napoli Federico II and Consorzio CREATE, Napoli
[3] ENEA FSN, C.R.E. Frascati
e-mail (speaker): martin@igi.cnr.it

The Divertor Tokamak Test Facility (DTT) is a new tokamak whose construction has recently been approved by the Italian government. DTT will be a high field superconducting toroidal device (6 T) carrying plasma current up to 5.5 MA in pulses with length up to 100s, with an up-down symmetrical D-shape defined by major radius R=2.10 m, minor radius a=0.65 m and average triangularity 0.3.
The main role of DTT is to contribute to the development of a reliable solution for the power and particle exhaust in a reactor, a challenge commonly recognised as one of the major issues in the road map towards the realisation of a nuclear fusion power plant.
Following the project approval, since June 2017 the design review of DTT has started.
This paper will present the device by summarizing its main physics goals and the present status of the design.
After an extensive activity, which involved Italian labs and scientists from other European labs, the DTT preliminary design report was released in June 2015. In the first semester of 2017 the Italian government identified the funding strategy of the experiment and authorized its start. In October 2017 EUROfusion noted that the DTT proposal may provide important elements for finding solutions to the plasma exhaust problem delivering information in operational ranges or configurations that are not accessible for the present devices or JT-60SA and approved its involvement in the DTT facility at a date around 2022-23.
To fulfill its goals, DTT will perform experiments aiming at: (a) demonstrating the possibility to operate with a heat exhaust system capable of withstanding DEMO relevant thermal loads and in integrated scenarios, i.e. maintaining adequate core performance and edge and bulk parameters as close as possible to ITER and DEMO; (b) exploring innovative solutions like advanced divertor configurations and use of liquid metals that can be integrated in a DEMO device, taking into account the constraints on plasma bulk performances, poloidal field coil system, materials, space for the blanket and neutron shielding.
DTT main physics and technology goals and requirements are the following:
(a) Matching 4 DEMO relevant parameters: the electron temperature T_e the normalized collisionality ν^*, the ratio between the SOL thickness and the neutral mean free path Δ_d/λ_0 and the plasma pressure normalized to the magnetic one β;
(b) Relaxation of the normalized Larmor radius: $\varrho^*_{reactor}=\varrho^*_{scaled}R^\gamma$, where R is the major radius and γ is a controlled scaling parameter, which has been chosen as g = 0.75.
(c) Availability of integrated scenarios, so that the power exhaust options will be studies in core/edge plasma conditions relevant to DEMO.
(e)Matching the P_{SEP}/R values with ITER and DEMO. This means that the machine has to be designed with $P_{SEP}/R \geq 15$ MW/m;
(f) Providing flexibility for divertor choices, which calls for a design that guarantees the possibility to allocate in the vessel and to test several divertor options.
(g)Possibility to test liquid metals and to close the loop, i.e. to collect liquid metal on the first wall. The surface temperature of the first wall should be between 200-300 °C to guarantee the flow of the liquid metal on it.
In addition to the aforementioned requirements, the DTT device design has evolved since its 2015 version in order to provide a complete up-down symmetry, to allow the study of double null (DN) divertor configurations and to improve its portfolio of auxiliary heating systems so that the maximum power coupled to the plasma is 45 MW, distributed among ECRH, ICRH and NBI.

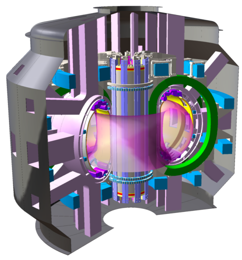

Figure: the DTT tokamak