Tipo di tesi: Laurea Magistrale

Tipologia: numerica e sperimentale

Titolo della tesi:
Design and specification for the construction of the cryogenic, electrical, and cooling penetrations for the DTT vacuum vessel
Progetto e specifica per la costruzione delle penetrazioni criogeniche, elettriche e di raffreddamento per la camera a vuoto di DTT

Proponente: dr. ing. Mauro Dalla Palma

Capogruppo RFX: dr. ing. Andrea Rizzolo

Relatore Accademico: prof. ing. Piergiorgio Sonato

Argomento della tesi:
DTT is one of the largest superconducting tokamak under construction with the mission to get scientific and technological proofs of power exhaust in prospect of the first nuclear fusion power plant [1, 2]. The 5.5MA maximum plasma current, 6T toroidal magnetic field at the plasma center, and 2.19m plasma radius make DTT a flexible and compact facility for testing D-shaped plasmas with different configurations of heat load spreading.
The mechanical systems of DTT are designed and integrated analysing interfaces consistently with machine operating states including plasma operation, disruptions, baking, seismic event, testing, and maintenance.
Multi-purpose ports are designed for the DTT vacuum vessel to house in each port a combination of more than one of the following three types of systems:

- diagnostics probing the plasma;
- auxiliary plasma heating systems (ECRH, ICRH, neutral beam injection with shielding plates in the port duct);
- services (divertor and first wall cooling tubes, vacuum pumping including cryolines, in-vessel coil feeders, cables for sensors embedded into the in-vessel components).

In particular, the use of multi-purpose ports introduces the need to integrate one port bellows (compensating relative displacements between the vacuum vessel and the cryostat) and more service bellows (compensating relative displacements between the services and the cryostat) in the same port.
The allocation of services, diagnostics, and auxiliary plasma heating systems is defined, but the design of supports and displacement compensation systems has to be developed. Interfaces between the vessel ports and in-port systems have been analysed in order to address the structural integrity verification and the heat transfer analysis in particular during baking and plasma operation.
The design parameters resulting from this analysis and verification activity will be used to prepare suitable technical specifications for the procurement of the vacuum vessel and the cryostat of DTT.
The proposed activity could include CAD design, numerical calculations, finite element analyses, verification of the simulation results, design of welded joints, preparation of the technical specification for the procurement, interactions and follow-up with possible suppliers.

References
[1] R. Ambrosino, “DTT - divertor tokamak test facility: A testbed for DEMO,” Fusion Engineering and Design, vol. 167, p. 112330, 2021
[2] R. Martone, R. Albanese, F. Crisanti, A. Pizzuto, P. Martin Eds.. “DTT Divertor Tokamak Test facility Interim Design Report, ENEA (ISBN 978-88-8286-378-4), April 2019 ("Green Book")”

Data proposta: 21/03/2022

Stato: to be assigned

Studente: -