ENERGETICS

CRT/DENERG - Test and modelling of HTS magnets for fusion applications

Funded By	Dipartimento DENERG FONDAZIONE CRT CASSA DI RISPARMIO DI TORINO [P.iva/CF:06655250014]
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Context of the research activity	Performance analysis of superconducting tapes, cables and coils through experimental and numerical studies.
Objectives	The activity aims at pushing forward the development of High-Temperature Superconducting (HTS) technology for compact fusion machines, through a complete analysis of high-field HTS coils, starting from the experimental characterization of state-of-the-art commercial HTS tapes, passing to the coils design and the assessment of its theoretical performances by numerical calculations. The experimental activities will be performed in the laboratories of Politecnico di Torino as well as in other institutions, among the national and international collaborations of the research groups involved in this project. Experimental characterizations will include high magnetic field/high electrical current transport, magnetic visualization, magnetic relaxation, thermo-calorimetry, critical current measurement under bend and tensile strain, microstructure visualization by electron and atomic force microscopy, X-ray crystallography. The multi-physics modelling of the HTS tapes will be instrumental for the prediction of the performance of the cable and of the requirements for the cooling system of the coils to be designed. Both commercial software and in-house codes will be used to achieve a thorough description of the electromagnetic, thermal and mechanical behavior of the HTS tape, in order to establish the requirements for assembling a high-performance HTS cable and for the subsequent coils design. The designed coils will have a target induction field larger than 10 T and operating temperature above 4.2 K (up to 20 K). Geometries and modes of operation will be adapted from the current state-of-the-art design of compact fusion reactors. Furthermore, strategies for predicting and preventing quenching and other instabilities will be studied and tested on a prototype HTS coil, which will also serve for the validation of the overall numerical approach.
Skills and	

competencies for the development of the activity	M.Sc. degree in Physcis or Energy and Nuclear Engineering, with know-how on superconductors.