Overview of physics and technology of magnetic fusion in Italy

Paola Batistoni[1], Piero Martin[2]

[1] ENEA, Nuclear Department, Via E. Fermi 45, 00044 Frascati (Roma) Italy
[2] Dipartimento di Fisica e Astronomia, Università di Padova, Consorzio RFX and DTT S.c.a r.l.

Developing fusion energy entails the combination of many different disciplines including plasma physics, materials physics and engineering, computer science. In this talk, an overview will be given of the physics and technology in view of magnetic fusion reactors, including the recent achievements, the current challenges and the main developments. The contributions that the new Divertor Tokamak Test facility (DTT) will offer for the development of fusion energy will be highlighted.

Starting from a historical perspective, we will discuss the main open issues in the magnetic confinement fusion physics development and report about the current effort in the international community to address them.

Key parts of the fusion technology program include the development of *i)* suitable materials for the different components/functions, resilient to fusion neutron damage and tolerant to gas production in order to meet lifetime performance requirements, and meeting the lifetime activation requirements in order to avoid geological disposal facilities; *ii)* a component/system to produce tritium and ensure tritium self-sufficiency while allowing the extraction of fusion power under conditions suitable for maintaining an efficient thermodynamic cycle to produce electricity; iii) a component/system to exhaust the power deposited in the plasma by alpha particles and delivered by external heating without damaging the in-vessel components and without adversely affecting the quality of the burning plasma; iv) superconducting magnets with reduced electrical and cryogenic consumption for the economics of fusion to be viable.

The integration of all fields is essential for understanding the plasma behaviour, for modelling the complex interactions needed to achieve a sustained fusion reaction,and designing and controlling a safe and sustainable fusion reactor.