



17TH MEDITERRANEAN MICROWAVE SYMPOSIUM (MMS2017)

NOVEMBER 28-30, 2017 – MARSEILLE, FRANCE

Major High Power Microwaves for Magnetic Nuclear Fusion Experiments and for the ITER Project

Julien Hillairet,

CEA, IRFM, F-13108 Saint Paul-lez-Durance, France.

The goal of controlled nuclear fusion research is to demonstrate the scientific and the technological feasibility of electricity-producing power plants, whose electromechanical generators would be driven by heat engines powered by nuclear fusion power. Fusion is the nuclear reaction occurring in the stars and could provide a way to supply the increasing energy demand. However, getting net energy gain from fusion requires generating and sustaining very hot plasmas of light elements such as hydrogen and its isotopes, with temperature exceeding 100 million of degrees. Magnetic nuclear fusion experiments -- such as the international experimental project ITER which is currently under construction at Cadarache (France) -- use Tesla range magnetic fields to confine such plasma into a vacuum chamber. In order to increase the plasma temperature and to achieve long pulse operations, such devices require additional heating and plasma current drive systems. Radio-Frequency (RF) antennas, delivering megawatts level of RF power into the plasma, transferring their energy to the charged particles, are presently used in major magnetic fusion installations in the world and also foreseen in ITER. The magnetised plasma is an inhomogeneous, anisotropic and lossy medium in which many wave modes can co-exist depending on their frequency and their polarization. RF plasma heating schemes generally aim at either ion or electron wave-particle resonances, depending on the frequency range of the waves which are transmitted in the plasma, typically 30-70 MHz for ions and 100-170 GHz for electrons. The GHz range of frequencies is also used for accelerating electrons and drive current inside the plasma with the aim to maintain the plasma discharge for long periods. This presentation reviews the different types of RF sources and main launching structures used in magnetic fusion experiments and specifically the ones foreseen for ITER.

Sponsors :