ICRH SYSTEM FOR THE IGNITOR EXPERIMENT

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Ignitor is a burning plasma experiment designed to reach ignition by ohmic heating only. However, both to provide a wider margin of success and to explore a variety of plasma regimes, a flexible auxiliary ICRH system (f = 70 – 120 MHz) is included in the machine design.

Only 5 – 6 MW of ICRH at f = 115 MHz are needed to boost the plasma temperature during the crucial phase of the initial current and toroidal field rise, and thus accelerate the attainment of ignition conditions. Simulations with a full wave code, carried out for D-T plasmas in the time interval $2<t<4$ sec when the magnetic field and the plasma current are ramping from 9 to 13 T and from 8 to 11 MA respectively, show strong direct ion heating (around 80%) at the first harmonic of Deuterium (at $r/a \approx 0.5$ for B = 9 T), and at the first harmonic of Tritium (at higher magnetic field with a more central location of the resonant layer). The remaining power is absorbed by the electrons via Landau damping. Other heating scenarios are under consideration, as appropriate for a variety of physics experiments, at lower frequencies and/or higher amounts of power coupled to the plasma.

In order to comply with a wide range of operational scenarios, a modular configuration of the ICRH system has been adopted, with a generated unit power per module of 3.6 MW at 120 MHz and 8 MW at 70 MHz. Each module is based on 4 RF generators, each one consisting of a 3 stages amplifying chain (100 KW) and a cavity coupled, high power tetrode, final stage. The ICRH antennas consist of 4 current straps, grouped in 2 poloidal pairs, and a Faraday shield. The transfer and matching of the power among the generators and the antennas is based on 9 1/16"coaxial rigid lines. Stub tuners and line stretchers are used for matching; coaxial 3dB hybrid junctions are used for the generators power splitting and reflected power insulation. A proper PLL phase control in the generators low level stage (S.S.) allows an independent control of the current strap phases and full poloidal and toroidal wave phasing. A 30 Ω vacuum transmission line, including the vacuum feedthrough transition, transfers the power inside the load assembly. Two modules, based on 8 generators and 4 antennas, occupying 4 ports, will be installed initially, with the possibility of adding two more antennas.