Integration of HL-2A diagnostics

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The HL-2A tokamak with major radius of R = 1.65 m and minor radius of a = 0.4 m has a close, symmetric and double-null divertor. It can be operated in the parameters of plasma current I_P = 450 kA, toroidal field B_T = 2.8 T and discharge duration τ = 5.0 s with Double Null (DN) or Single Null (SN) divertor configuration. The main mission of the device is to explore new physics issues, to understand plasma control techniques, and to develop/test advanced diagnostics.

To meet the needs of the physics and control studies, about 30 kinds of diagnostics, most having good temporal and spatial resolutions, are arranged for plasma parameter measurements, such as the plasma configuration, profiles of electron/ion density and temperature, plasma radiations, effective charge, impurity spectral lines, and suprathermal electron emissions. These diagnostic systems include magnetics, microwave reflectometry, ECE radiometer, particle analyzer, visible/VUV spectrometers, Thomson scattering, FIR interferometer, X-ray detection, and so on. More detailed plasma image can be obtained by combination the detected data with advanced analysis, such as tomography.

In addition, the diagnostics for investigating the plasma turbulence and anomalous transport are described in this paper in detail. A novel design (3-D and 3-steps) of Langmuir probes with good toroidal and poloidal resolutions are used to study the 3-D structure of zonal flows at plasma edge. The microwave heterodyne reflectometry are employed to detect the density perturbation and plasma rotation at plasma perpheral. A tangential CO_2 collective Thomson scattering system is in developing for the correlation study of the turbulent perturbations.

Some new experiment results are presented in this paper as well.