Magnetic diagnostics

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Abstract. Magnetic diagnostics are essential for the operation and understanding of a magnetic fusion device. Magnetic data are used in real time to measure and control the current, shape and position of the discharge, the thermal energy of the plasma, the confining magnetic field, and the currents in the magnet coils. Equilibrium reconstructions based on magnetic data yield the magnetic geometry of the plasma, providing a framework for interpretation of all other diagnostic measurements. Magnetic measurements also provide input for the analysis and feedback control of magnetohydrodynamic (MHD) instabilities. This review focuses on the inductive loops and Hall effect probes that are used in nearly all present devices. We describe the

principles of magnetic diagnostics, and discuss issues related to their practical implementation. The interpretation of magnetic measurements for equilibrium reconstruction and for identification of MHD instabilities are summarized. Magnetic diagnostics based on inductive measurements are well understood in both implementation and interpretation, and are expected to meet the needs of ITER. However, the challenges presented by future steady-state burning plasma experiments may require the development of other techniques. The prospects for addressing these challenges are reviewed, in particular the status of possible approaches to long-pulse magnetic measurements.