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Effects of the finite beam size of the ECE diagnostic in Tore Supra tokamak

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Tore Supra is a French tokamak with a circular cross section of 2.4m of major radius and 0.7m of minor radius. The ECE diagnostic of Tore Supra [J.-L.Ségui, Rev. Sci. Instrum. 76 (2005) 123501] has 32 channels which signals can be recorded in two acquisition rates: the slow mode, at 1kHz, which register the ECE measurements during the whole discharge and the fast acquisition mode, recently upgraded to 1MHz, which can recover up to 7s of measurements in selected time intervals (the duration of a plasma discharge in Tore Supra ranges from tens of seconds up to few minutes). The ECE antenna is placed on the external equatorial plane of the vacuum vessel and in the most usual plasma conditions (it is, central magnetic field of 3.8T and plasma current of 1MA) the ECE is able to cover a radial interval that corresponds to more than half of the plasma column.

This work reports a study of the ECE measurements of core MHD modes. It is observed that the measured signal of modes with poloidal mode numbers equal or bigger than 2 are strongly affected by the finite size of the ECE beam. Indeed, the profiles of the ECE oscillations have radial structures that are much more complex than the real electronic temperature oscillations. It will be presented a simple model of the ECE measurements that can reproduce the observed complex radial structures. Moreover, it will be shown how the poloidal mode numbers can be determined from the ECE measurements thanks to these effects. On the other hand, due to this effect the phase shift between ECE measurements in two radial positions are not exactly equal to the phase of the electronic temperature at those positions. It will be shown than this difference implies in several restrictions for advanced uses of the ECE measurements, for example, when using ECE to perform tomographic reconstructions or to evaluate MHD displacements or when computing the phase shifts with measurements from other diagnostics.

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