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Experimental and numerical investigations of suprathermal electron dynamics in TCV using electron cyclotron emission

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1. Introduction

Suprathermal electrons play a key role in magnetic confinement fusion devices. They are characterized by a non-Maxwellian distribution function, which can be generated by various mechanisms, such as electron cyclotron heating (ECRH) and current drive (ECCD) or during sudden phenomena such as disruptions. Moreover, non thermal electrons can have a significant impact on the plasma dynamics, e.g., by affecting the plasma stability, transport, and heating efficiency. In this work, we construct a synthetic diagnostic for electron cyclotron emission (ECE) which takes into account the presence of suprathermal electrons through a fully numerical non-Maxwellian distribution function. It will be shown that this synthetic diagnostic can be used to constrain kinetic simulations with the help of vertical ECE measurements on the Tokamak á Configuration Variable (TCV) .

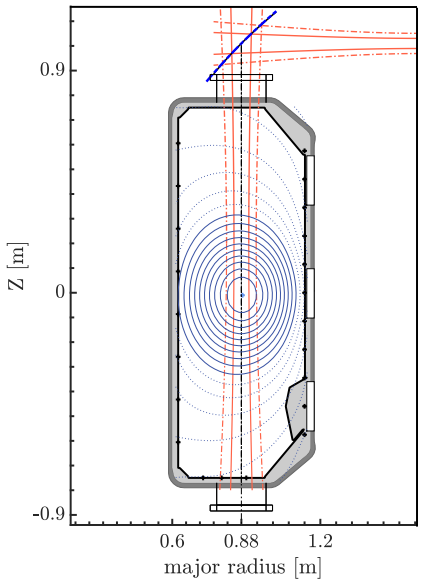

Figure 1: TCV vertical ECE poloidal cross section.

2. Modelling the Vertical ECE diagnostic

Among the many electron diagnostics present on TCV, the vertical ECE diagnostic is particularly well suited for measuring non thermal electrons [1]. Along its vertical line-of-sight (LOS), we can consider the tokamak magnetic field strength approximately constant, so that the electron cyclotron frequncy only depends on the energy of the emitting electrons

$$\mathscr{E} = m_{e0}c^2 \left(\frac{n f_{\mathrm{ece}}}{f_{\mathrm{meas}}} \right) \tag{1}$$

For example, if $B \sim 1.5\,\mathrm{T}$ and we consider electrons emitting at a frequency of $f \sim 109\,\mathrm{GHz}$, the corresponding energy will be of $\mathscr{E} \sim 80\,\mathrm{keV}$. In optically thin conditions, this allows us to es-