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The impact of anisotropy on ITER scenarios and ELMs

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We report on preliminary analysis of the impact of anisotropy on ITER pre-fusion power operation 5MA, B=1.8T ICRH scenarios, where a RF calculation gives the fast ion distribution function. To model ITER scenarios remapping tools are developed that iterate the anisotropy-modified current profile to produce the same q profile with matched thermal energy. We find characteristic detachment of flux surfaces from pressure surfaces (e.g. see Fig. 1), and an outboard (inboard) shift of peak pressure $T_{\parallel} > T_{\perp}$ ($T_{\parallel} < T_{\perp}$). Differences in the poloidal current profile are evident, albeit not as pronounced as for the spherical tokamak. We find that the incompressional continuum is largely unchanged in the presence of anisotropy, and the mode structure of gap modes is largely unchanged. The compressional branch however exhibits significant differences in the continuum (see for instance Fig. 2). We report on the implication of these modifications, and scan over a wider set of ITER scenarios.

We also report on the impact of anisotropy on ballooning mode, one of the instabilities believed to be responsible for ELMS. The investigation was conducted using the newly-developed codes HELENA+ATF and MISHKA-A, which adds anisotropic physics to equilibria and stability analysis. We have examined the impact of anisotropy on the stability of an *n=30* ballooning mode, confirming results conform to previous calculations in the isotropic limit. Growth rates of ballooning modes in equilibria with different levels of anisotropy were then calculated using the stability code MISHKA-A. The key finding was that the level of anisotropy had a significant impact on ballooning mode growth rates. For $T_{\perp} > T_{\parallel}$, typical of ICRH heating, the growth rate increases, while for $T_{\perp} < T_{\parallel}$, typical of neutral beam heating, the growth rate decreases.

References

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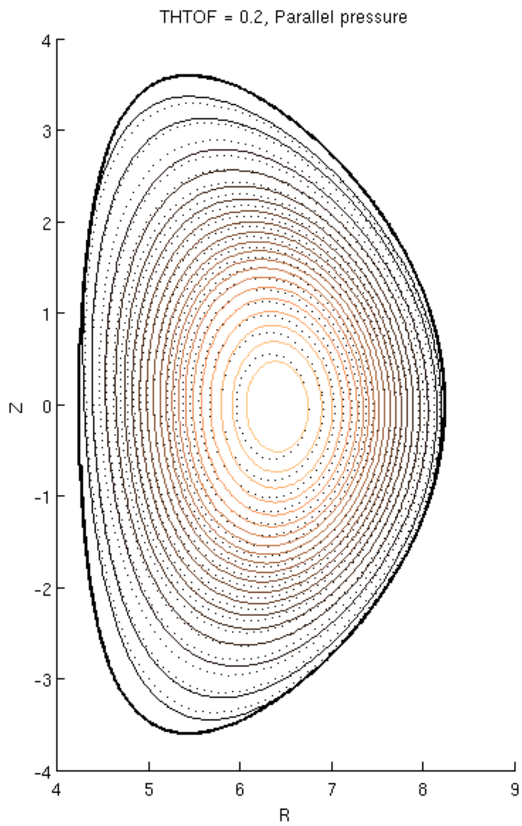

Figure 1: Cross-section of ITER plasma for a pre-fusion operation 5MA, B=1.8T scenario. The level of anisotropy has been artificially modified to $T_{\parallel}/T_{\perp} = 0.8$, to show separation of flux surfaces (dashed) from $p_{\parallel}$ contours (solid).

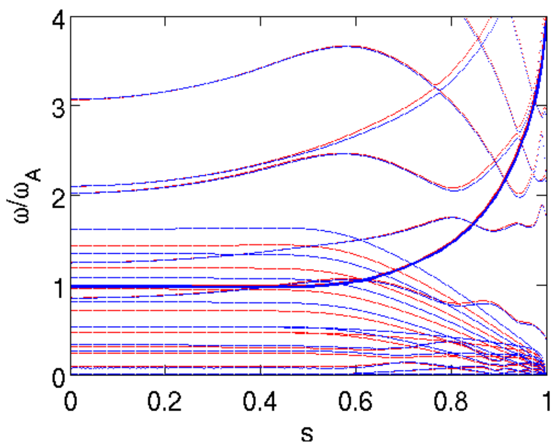

Figure 2: Alfvenic compressional continuum (CGL closure), for $T_{\parallel}/T_{\perp} = 0.8$ (red) and $T_{\parallel}/T_{\perp} = 1.2$ (blue).