

Progress of global gyrokinetic simulations for future fusion devices



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ABSTRACT/MOTIVATION

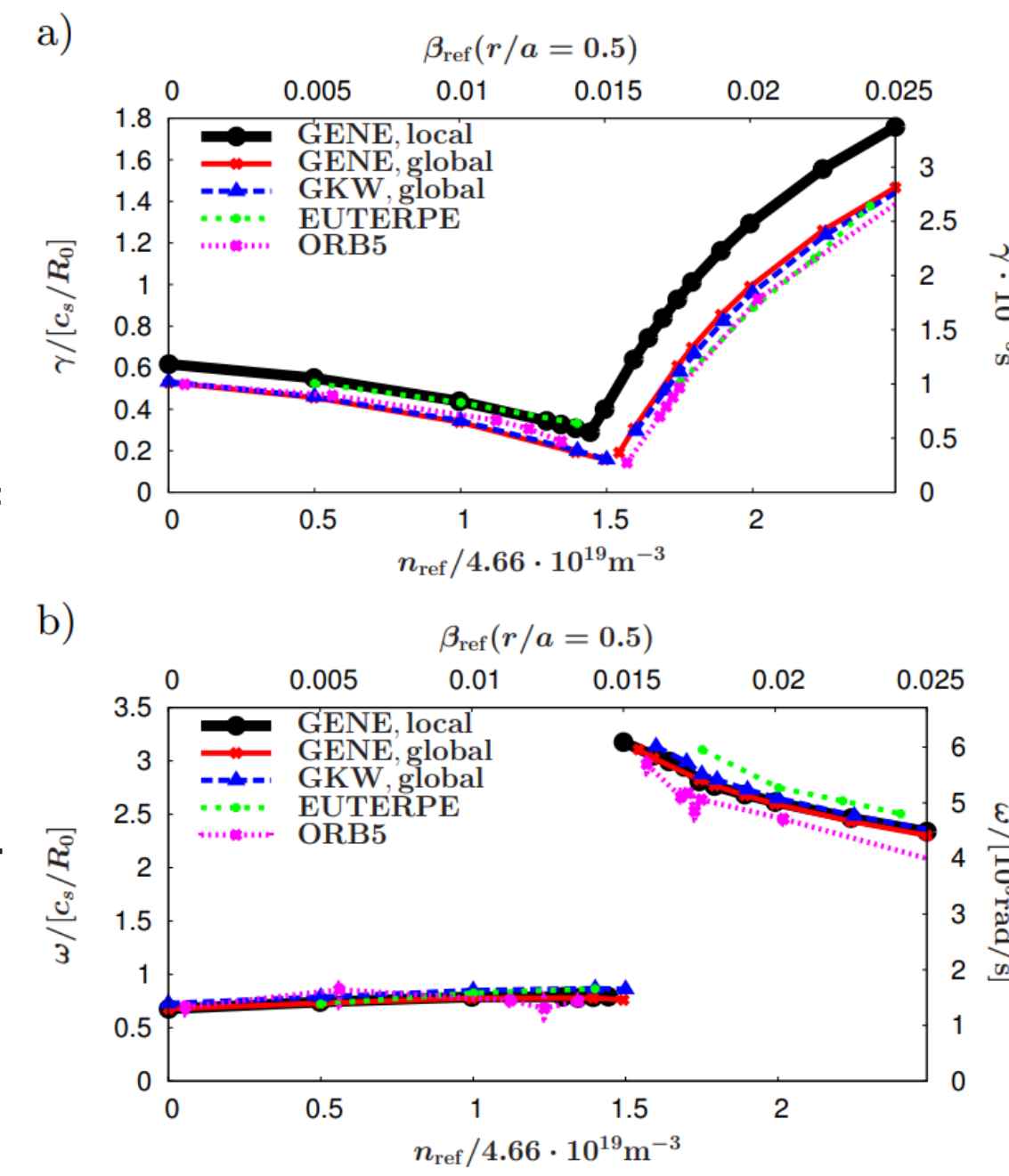
As we prepare for future fusion devices, such as the EUROfusion Volumetric Neutron Source (VNS) [see Ph. Lauber, this conf.] or for ITER, global gyrokinetic simulations (for both EPs and thermal plasma) are challenging. Here we show some progress for an ITER scenario and a VNS scenario of global electromagnetic gyrokinetic simulations of Alfvén eigenmodes (AEs) or thermal plasma-driven modes.

BACKGROUND: GLOBAL ELECTROMAGNETIC GYROKINETICS

- Local & electrostatic turbulence well studied
- Local **or** electrostatic turbulence also studied
- Global & electromagnetic EP (AE) physics well studied
- “Electromagnetic stabilization” and “EP stabilization” of turbulence increasingly discussed
- Competing effects, experimentally hard to decorrelate from MHD physics

Aim here is to use global electromagnetic gyrokinetics for ...

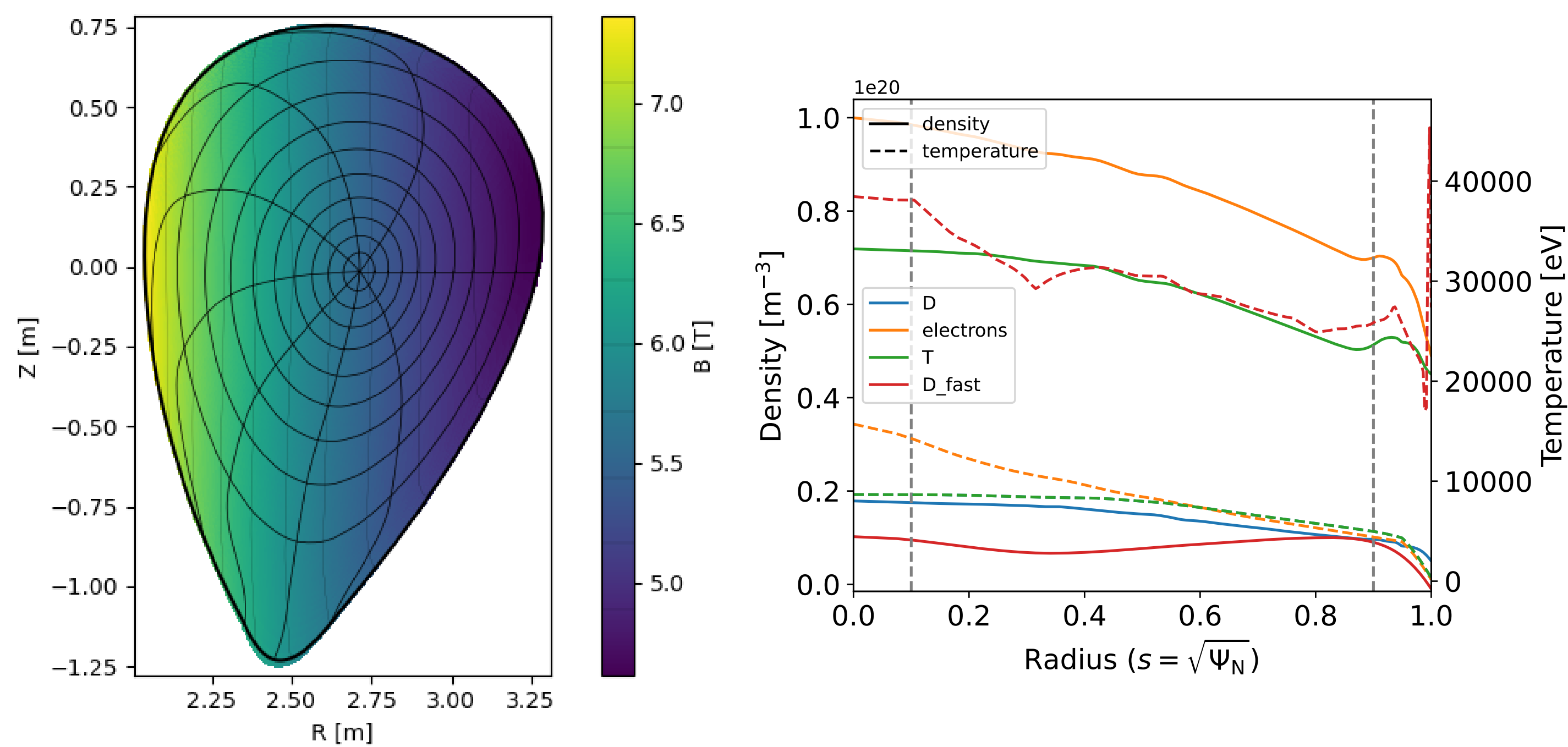
Description of code, motivation.



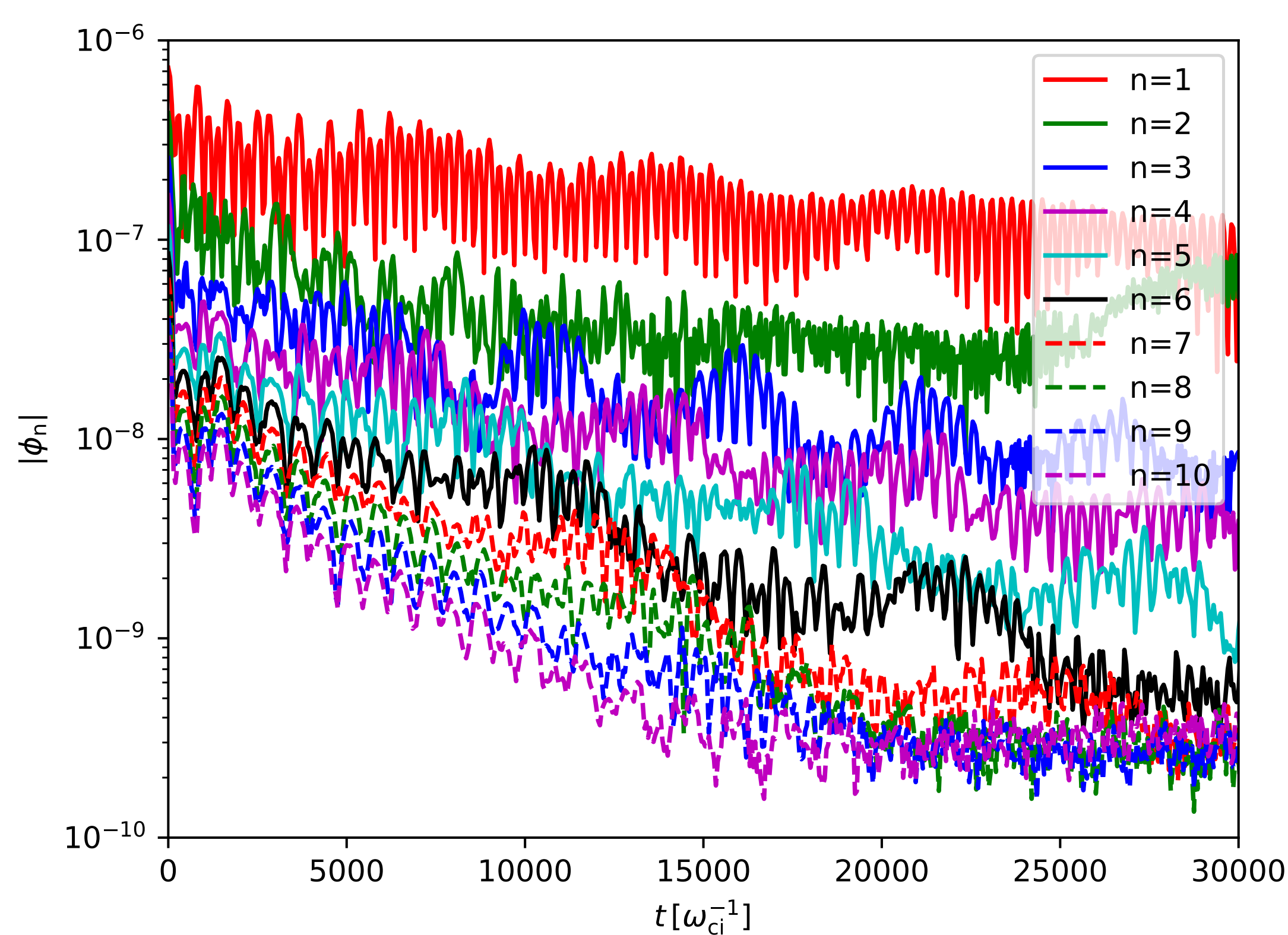
Goerler et al., Phys. Plasmas (2016)

VNS SCENARIO

Preliminary VNS scenario (not the latest update) with limited beam penetration, IMAS #9706,r4 [E. Bray]. Start by taking NBI ions as equivalent Maxwellian, still to be improved.



Proof of principle linear global GK simulations across annulus ($s = [0.1, 0.9]$) show decaying modes.

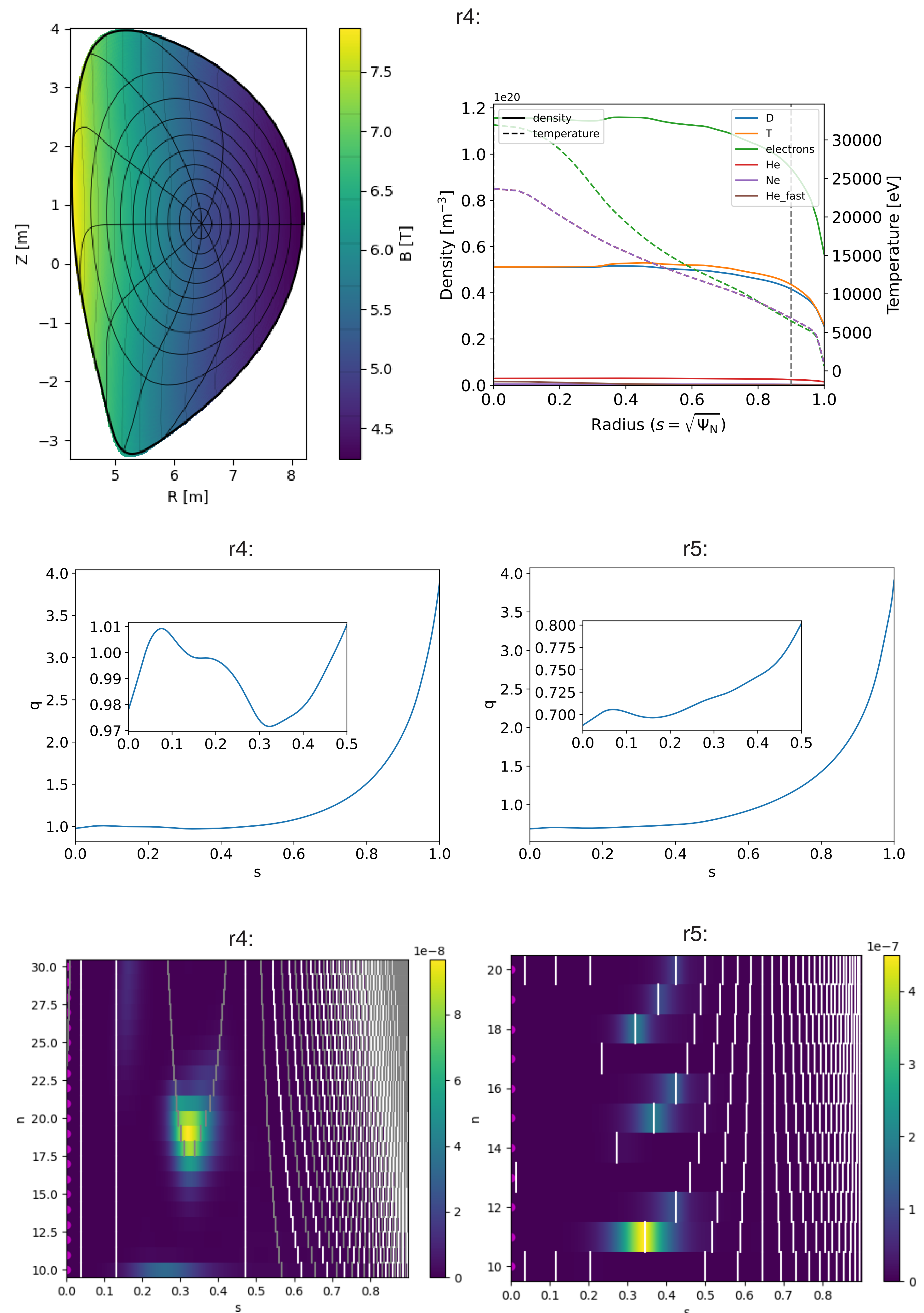


Outlook: consider latest scenario version (more beam penetration, more drive expected), model RABBIT/ASCOT NBI distribution functions, extend checks of thermal-plasma instabilities.

ITER BASELINE BENCHMARK CASE

Further to our previous works on ~2015 ITER 15MA and ITER Pre-fusion 7.5MA case, we look at 15MA case in ITPEA-TC/ITPEA-EP benchmark activity.

Two cases under consideration taken from 2 points (pre/post q-relaxation) of a time-dependent simulation IMAS #53299,r3&4, updated as #53299,r5&6.



r4: TAEs observed driven by EPs at (double) TAE half-rational surface in core.

r5: Low-frequency thermal-plasma driven electromagnetic modes (AITG [Zonca 98, Hayward-Schneider 2022]) driven unstable on rational surfaces.

Outlook: Update r4 analysis to r6 (similar relaxed q-profile)

SUMMARY

To be filled