Non-linear benchmark

- Following the results of the linear benchmark for the AUG-NLED case, between HYMAGYC, MEGA and ORB5 (see G. Vlad et al., Nuclear Fusion, 61:116026, 2021) we analyze the nonlinear saturation of the n=-1 toroidal mode
- We compare the results of nonlinear simulations for the off-axis EP density profile case, for which all the three codes show a similar results during the linear phase: same dominant mode, i.e., very similar radial eigenfunction, real frequencies in very good agreement, growth-rate within a factor two:

[Linear phase results from: G. Vlad et al., Nuclear Fusion, 61:116026, 2021]

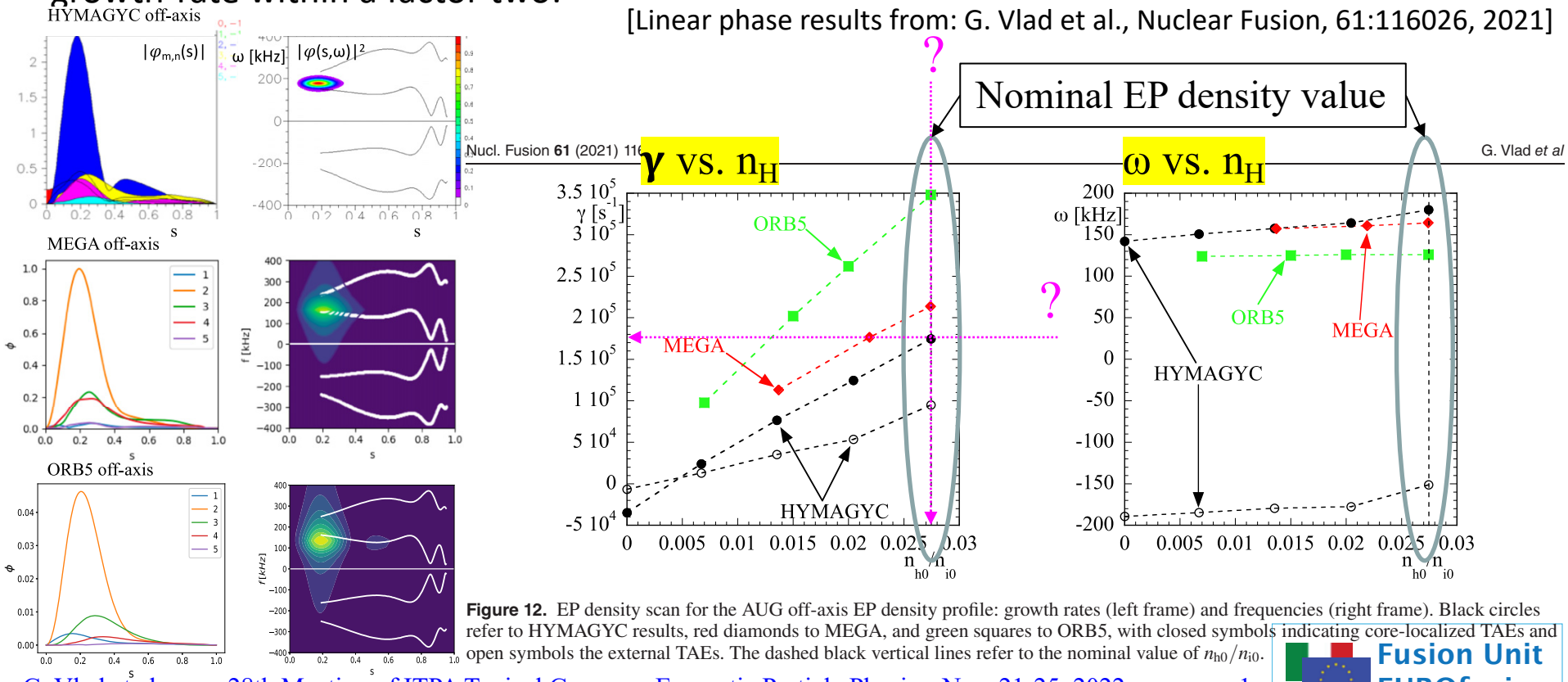
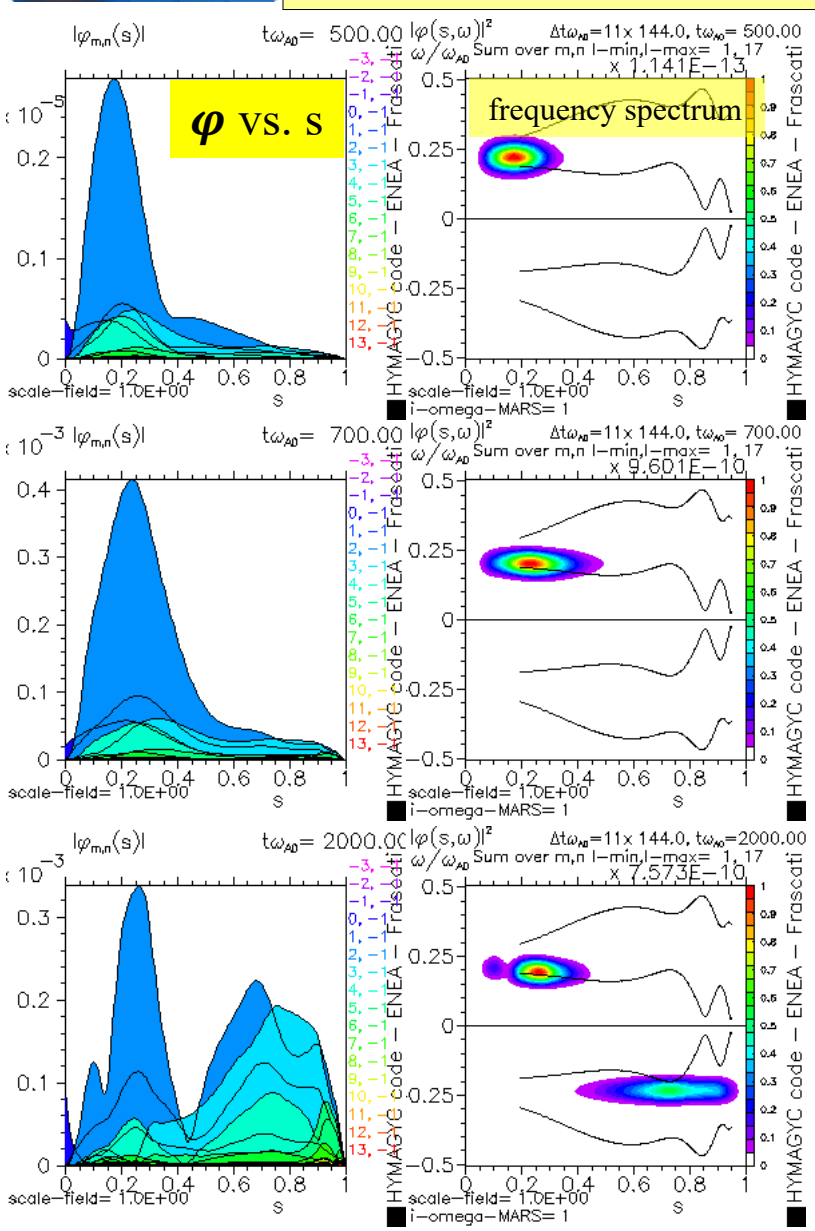


Figure 12. EP density scan for the AUG off-axis EP density profile: growth rates (left frame) and frequencies (right frame). Black circles refer to HYMAGYC results, red diamonds to MEGA, and green squares to ORB5, with closed symbols indicating core-localized TAEs and open symbols the external TAEs. The dashed black vertical lines refer to the nominal value of n_{h0}/n_{i0}.

Non-linear benchmark – HYMAGYC

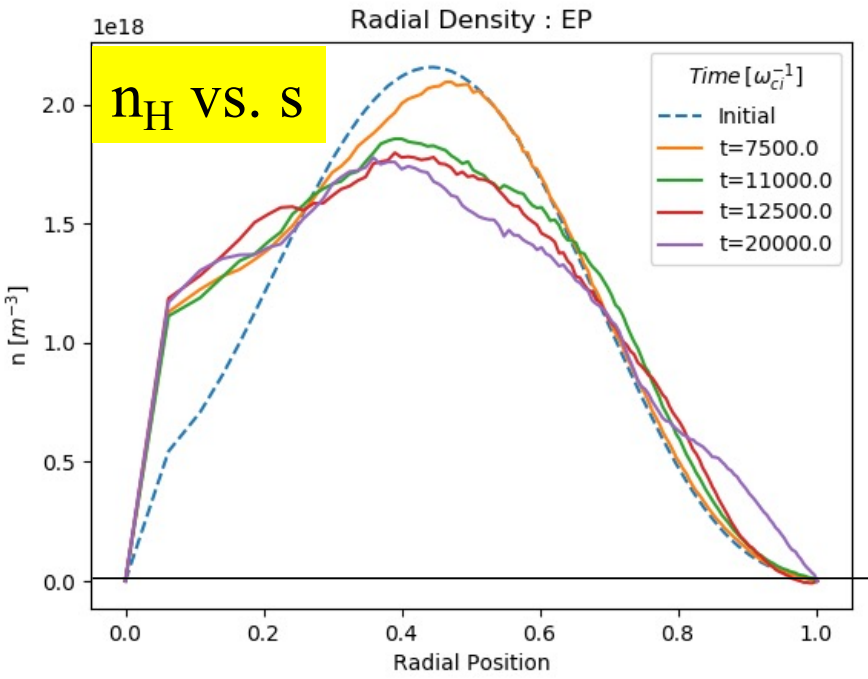


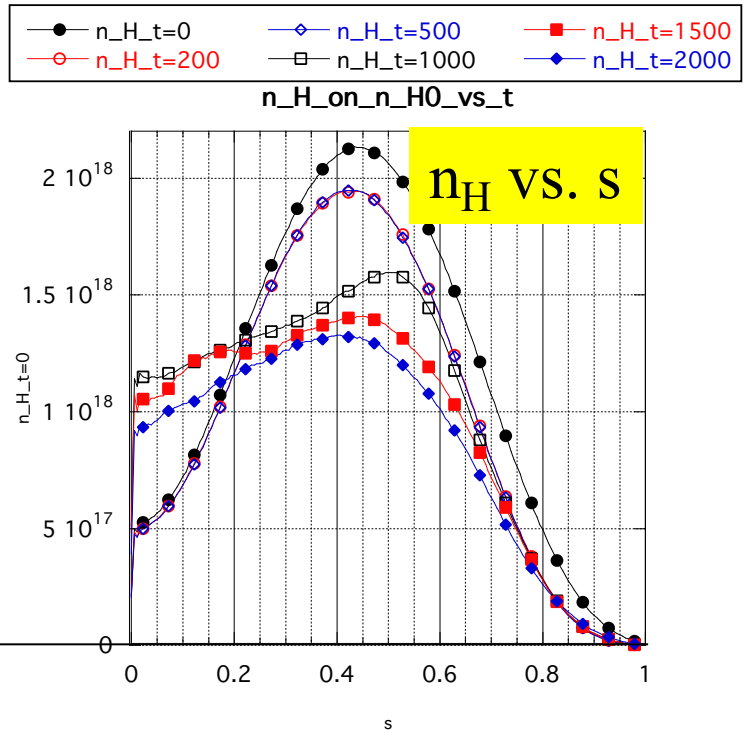
- HYMAGYC, similarly to MEGA and ORB5, shows, during the linear phase, the most unstable mode located close to the magnetic axis, with positive real frequency.
- During nonlinear saturation, a second, subdominant mode appears close to the edge, rotating in opposite direction.
- Saturation leads to "fill" the energetic particle density profile in the innermost region of the radial profile.
- Results shown are from a simulation including FLR effects; FOW simulations show similar results but more noisy...

Energetic particle density profile

ORB5

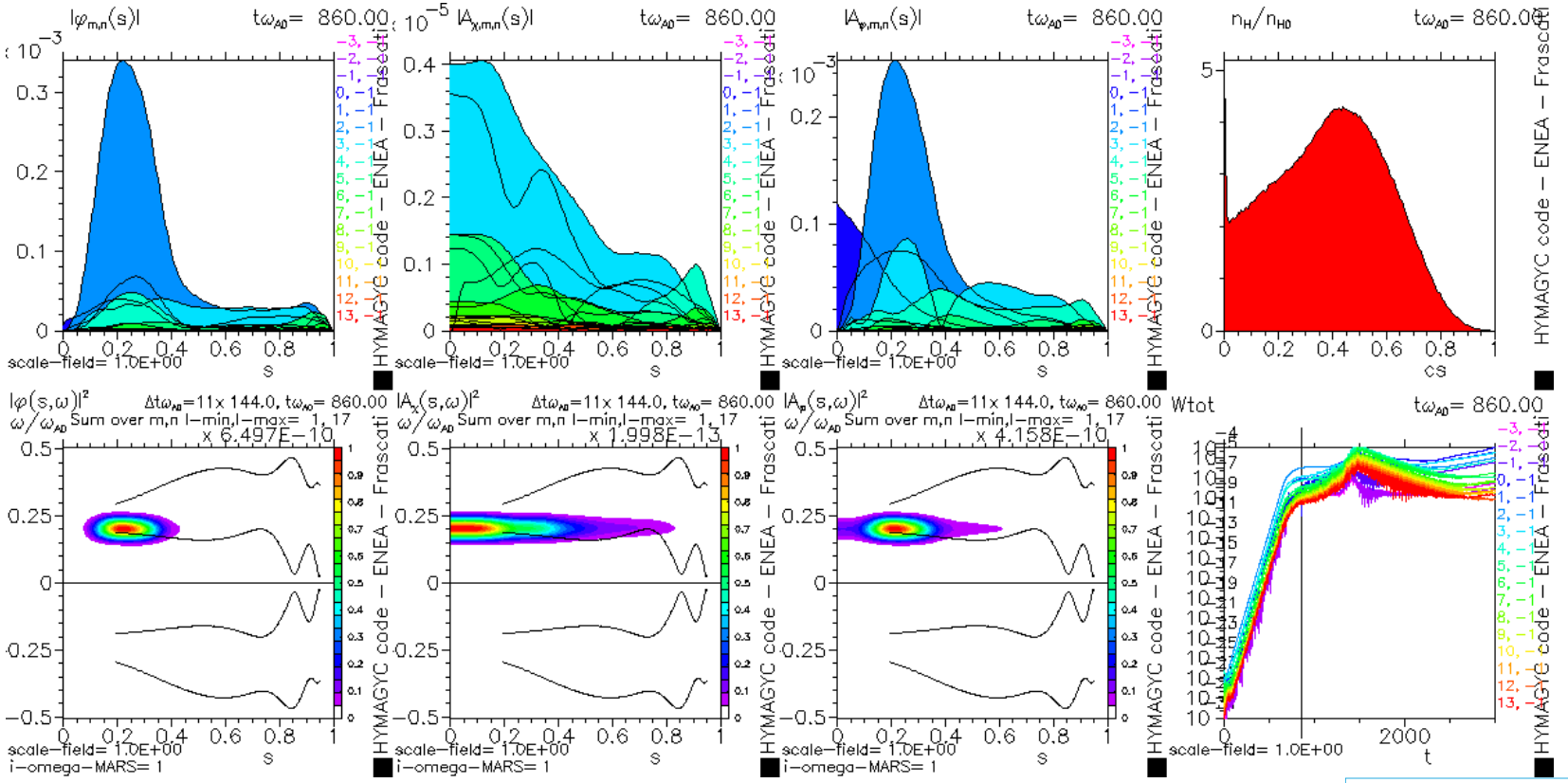
HYMAGYC





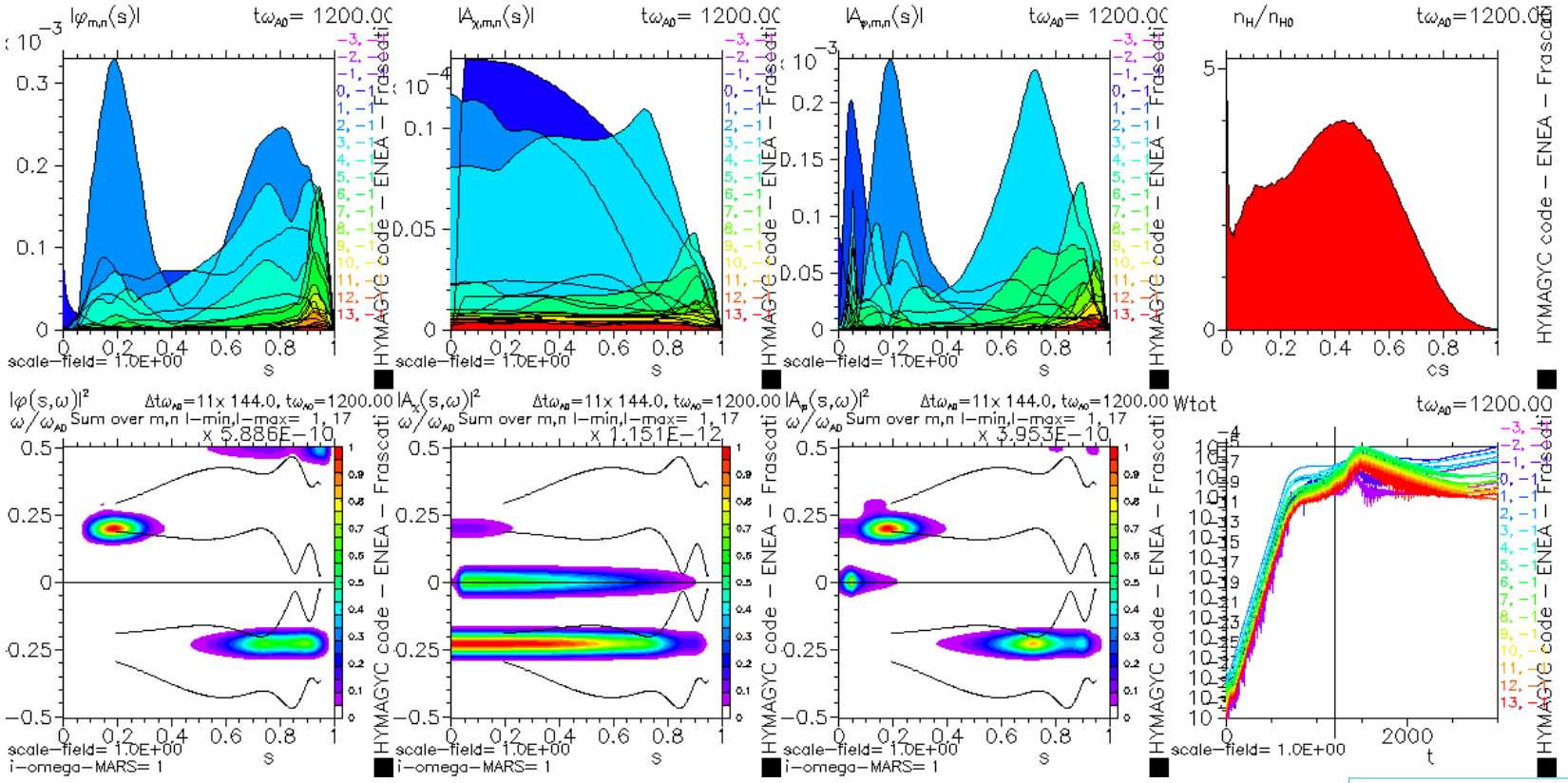
Comments

- FOW simulation shows, after saturation, some numerical instability (an_caso_AUG-nonmonotonic-BM-2020-T_H0.093_scaled_n_H_long_output_interfaccia_corretto_300x300.gif, t=860, OK):



Comments

- FOW simulation often shows after saturation some numerical instability (an_caso_AUG-nonmonotonic-BM-2020-T_H0.093_scaled_n_H_long_output_interfaccia_corretto_300x300.gif, t=1200, numerical instability is growing...)
- Some "tailoring" of the EP coupling term could help... to be further invetigated



Comments

- Scan on Energetic Particles density done
- Hamiltonian mapping analysis is under way (mainly VF and SB); any similar analyses from ORB5, MEGA?
- XTOR (H. Lütjens) has asked to join the benchmark
- Baruch Rofman from SPC (PostDoc of L. Villard, Lausanne, ORB5) has offered to contribute with ORB5 simulation.