HYMAGYC-nonlinear-benchmark-new-material-for-IAEA23-2023.07.05

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and contribution from:

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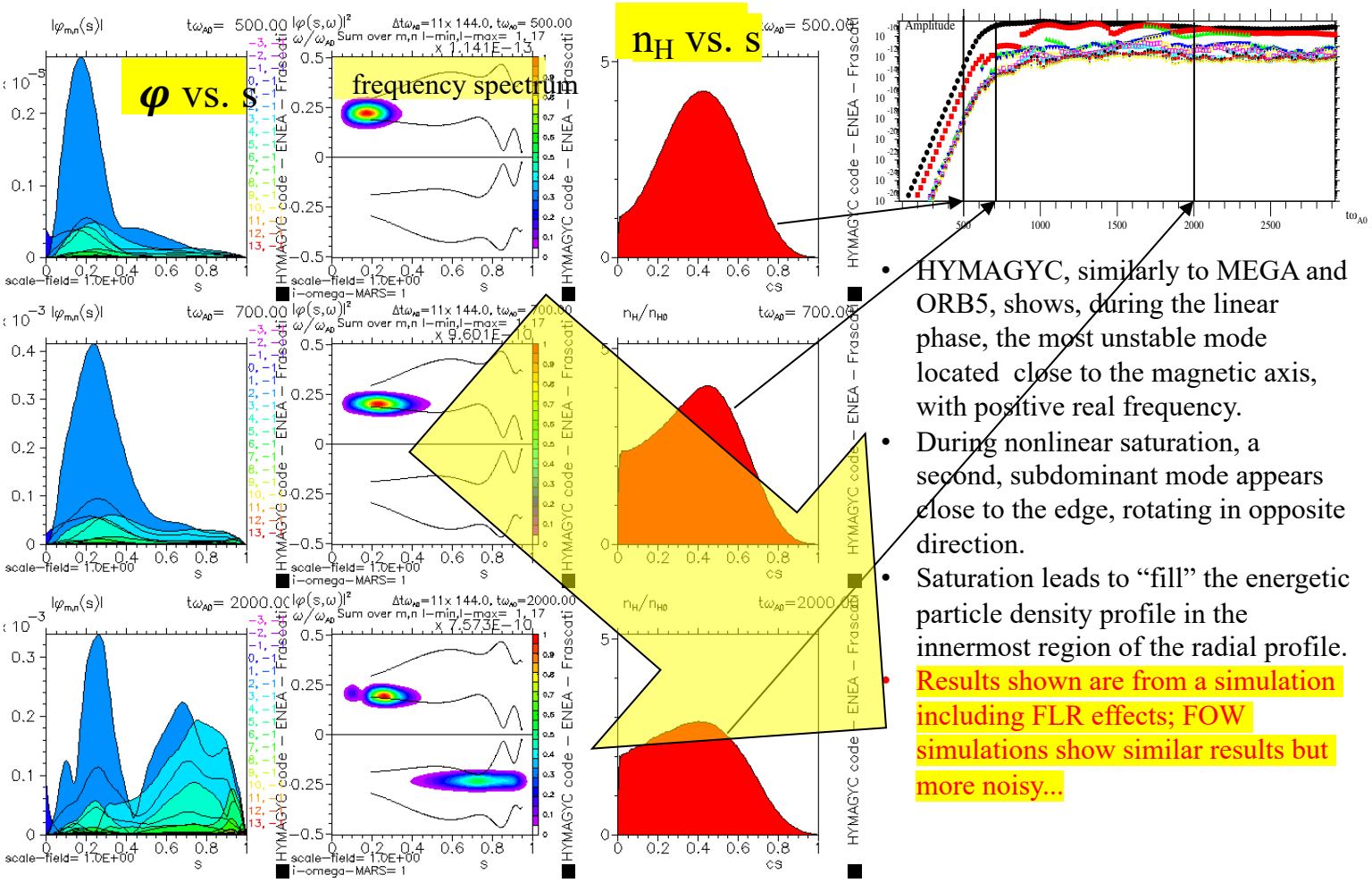
Old material:

https://www.afs.enea.it/vlad/Miscellaneous/Benchmark_AUG_testcase_MEGA_ORB5_HYMAGYC_2019/

Non-linear benchmark – HYMAGYC

Status for HYMAGYC simulation at 2022.12.21:



- 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...

Improved pressure tensor evaluation

Energetic Particle pressure tensor Π_{ij} in HYMAGYC is computed on the usual curvilinear flux grid (s, χ), with s \propto $sqrt(\psi)$ and χ the generalized poloidal angle (here obtained by equal arc length condition imposed in the Jacobian...).

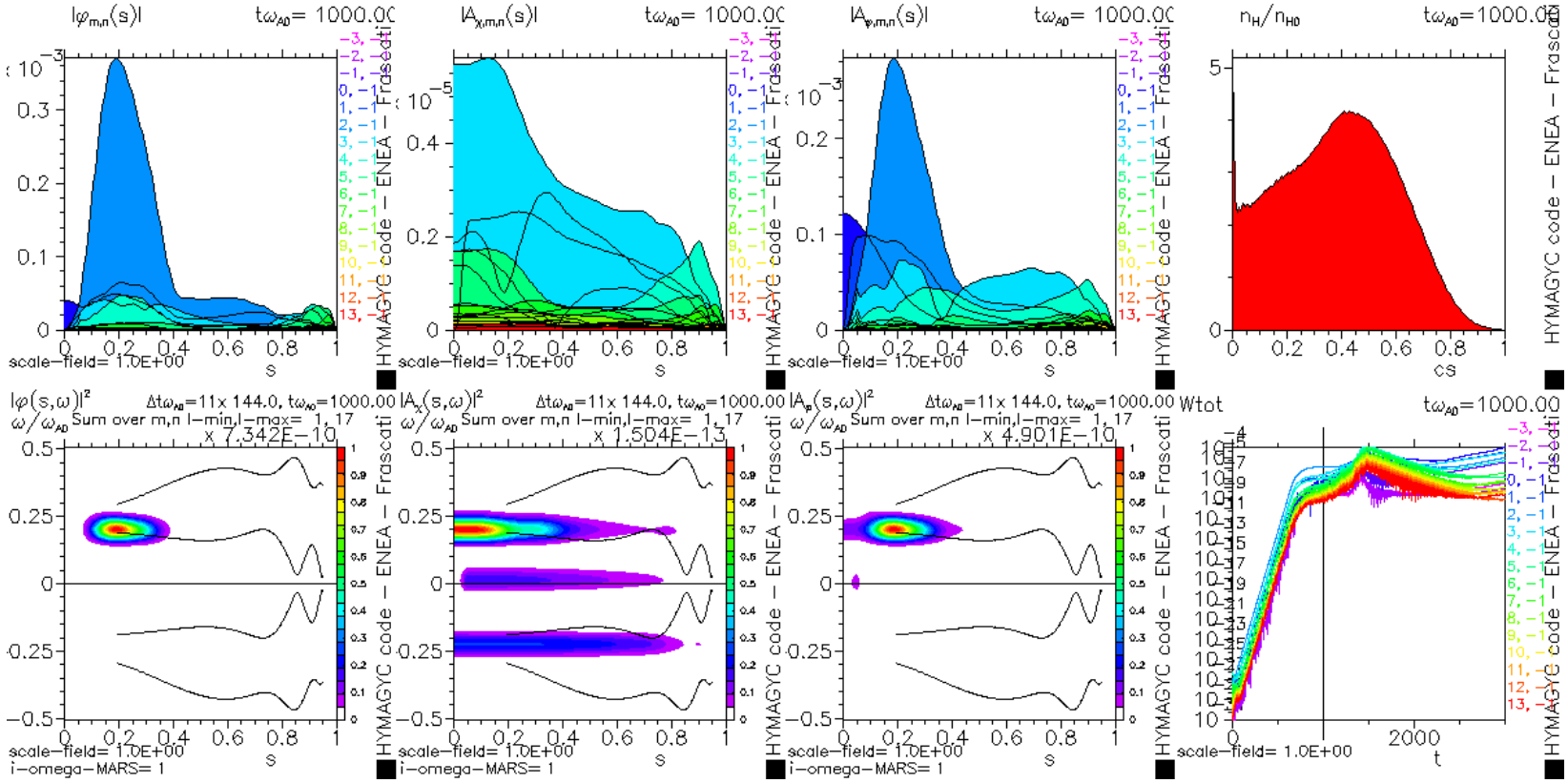
An alternative approach has been recently implemented in HYMAGYC (thanks to S. Briguglio), in order to be able to compute the Energetic Particle pressure tensor in (R, Z) coordinates.

This second approach looks to avoid the excitation of small radial scale perturbations which tend to be developed during the saturated phase when computing Π_{ij} using the (s, χ) grid, in particular when considering only FOW limit.

Note that including the FLR effects is beneficial to smooth out the short scale excitations coming from the coupling terms between the girokinetic and field solvers ($\nabla \cdot \Pi$).

FOW limit, computation in (s, χ) mesh

Energetic Particle pressure tensor Π_{ij} in HYMAGYC computed on the usual curvilinear flux grid (s, χ) (grid points 181×120)

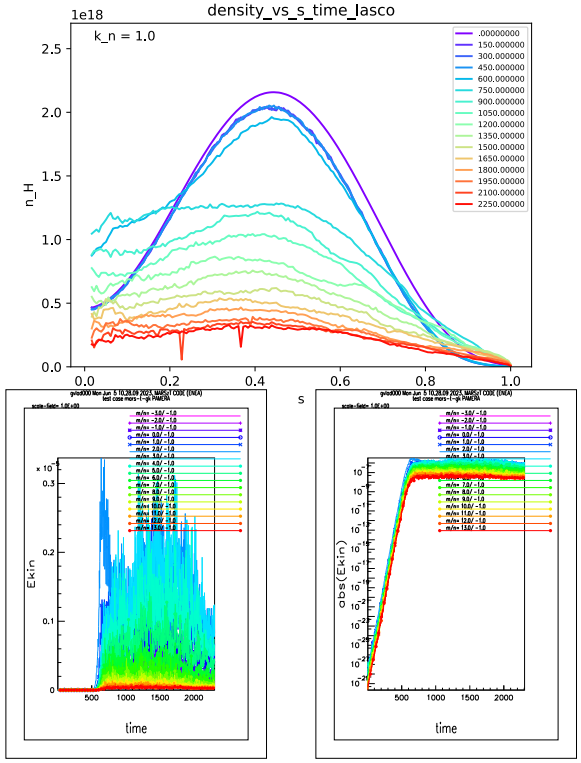


FOW limit, computation in (R, Z) mesh

Energetic Particle pressure tensor Π_{ij} in HYMAGYC computed on (R,Z) mesh

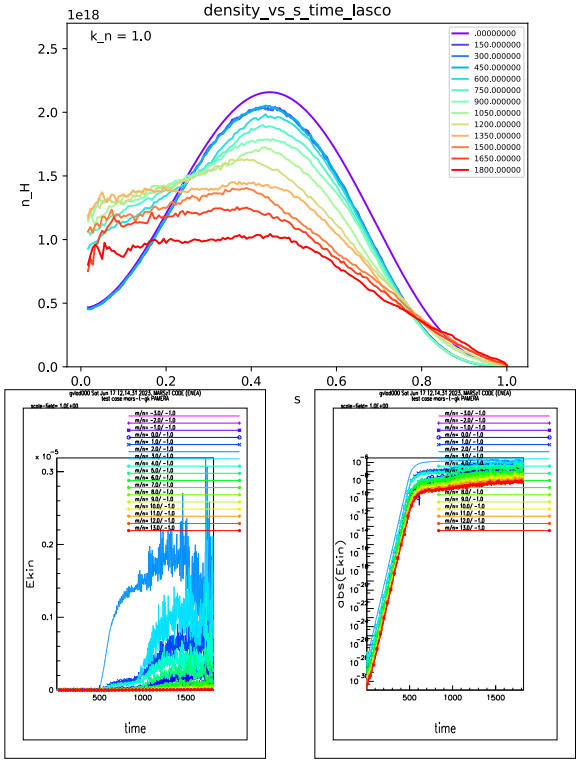
caso_AUG-nonmonotonic-BM-2020-T_H0.093_scaled_n_H_long_output_interfaccia_corretto_all_fields_output-sources_kinetic_sergio_2020_press_rz_3

361 × 361



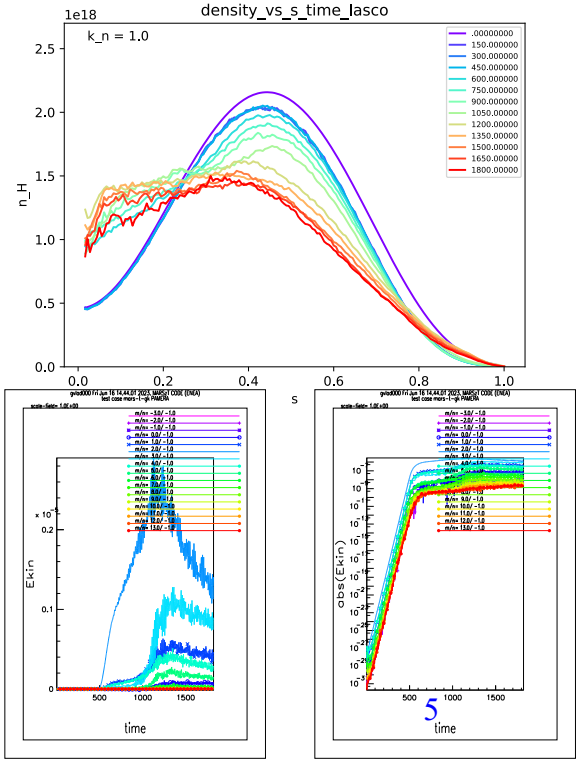
caso_AUG-nonmonotonic-BM-2020-T_H0.093_scaled_n_H_long_output_interfaccia_corretto_all_fields_output-sources_kinetic_sergio_2020_press_rz_3_mappa_s_chi_181_x_181

181 × 181



caso_AUG-nonmonotonic-BM-2020-T_H0.093_scaled_n_H_long_output_interfaccia_corretto_all_fields_output-sources_kinetic_sergio_2020_press_rz_3_mappa_s_chi_121_x_121

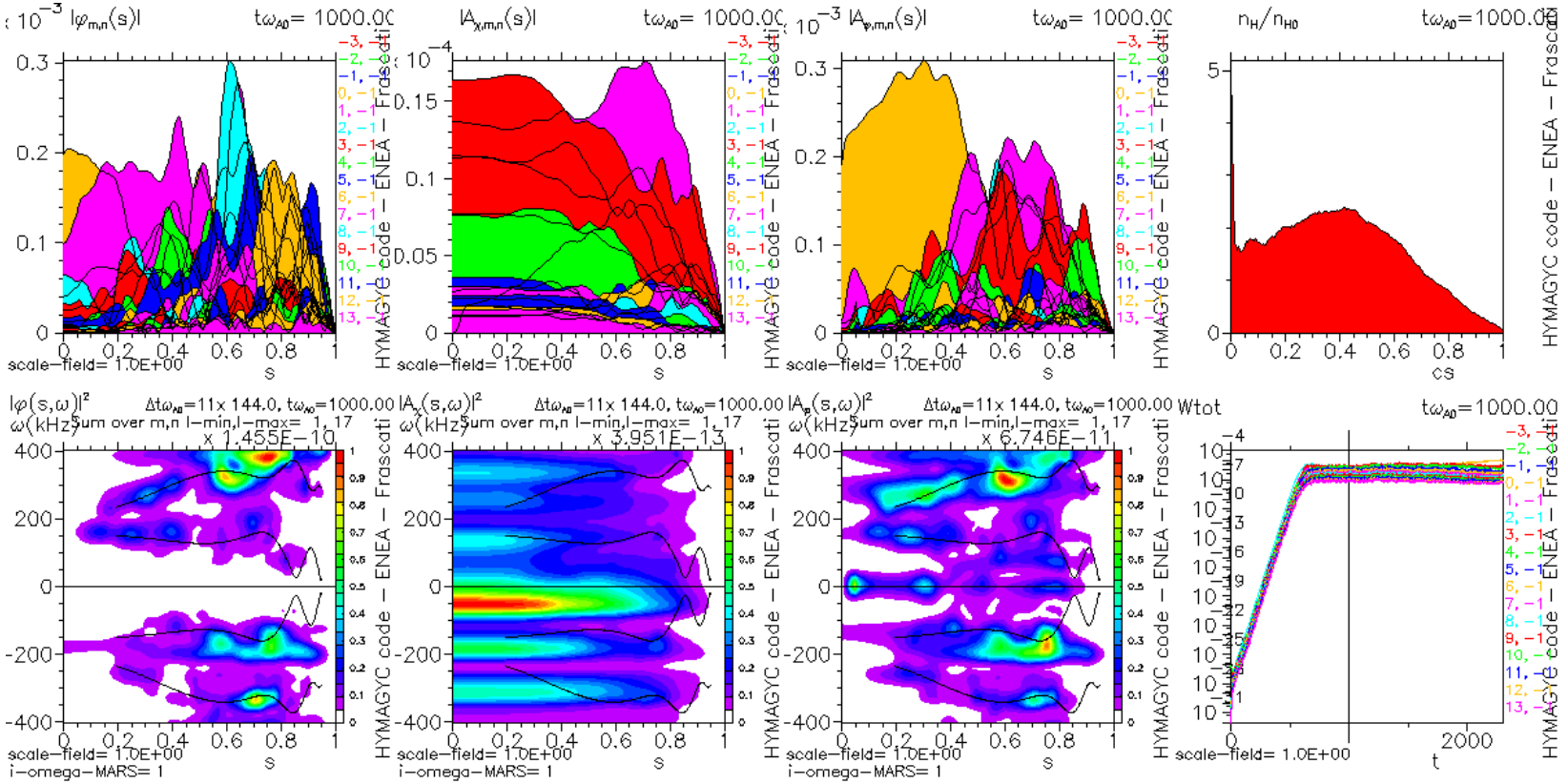
121 × 121



FOW limit, computation in (R, Z) mesh

Energetic Particle pressure tensor Π_{ij} in HYMAGYC computed on (R,Z) mesh

(R, Z): 361 × 361

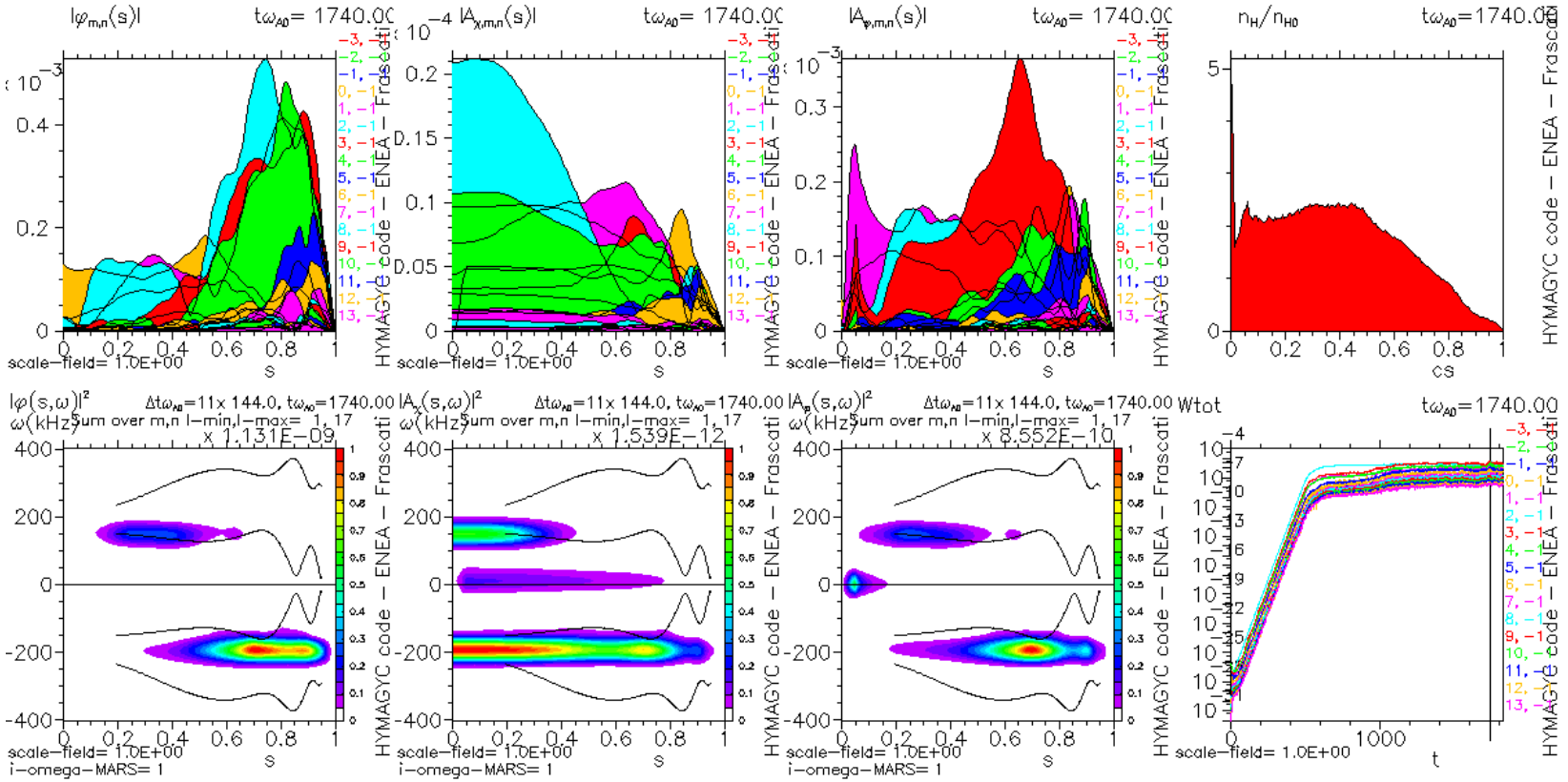


Fusion Unit EUROfusion

FOW limit, computation in (R, Z) mesh

Energetic Particle pressure tensor Π_{ij} in HYMAGYC computed on (R,Z) mesh

(R, Z): 181 × 181

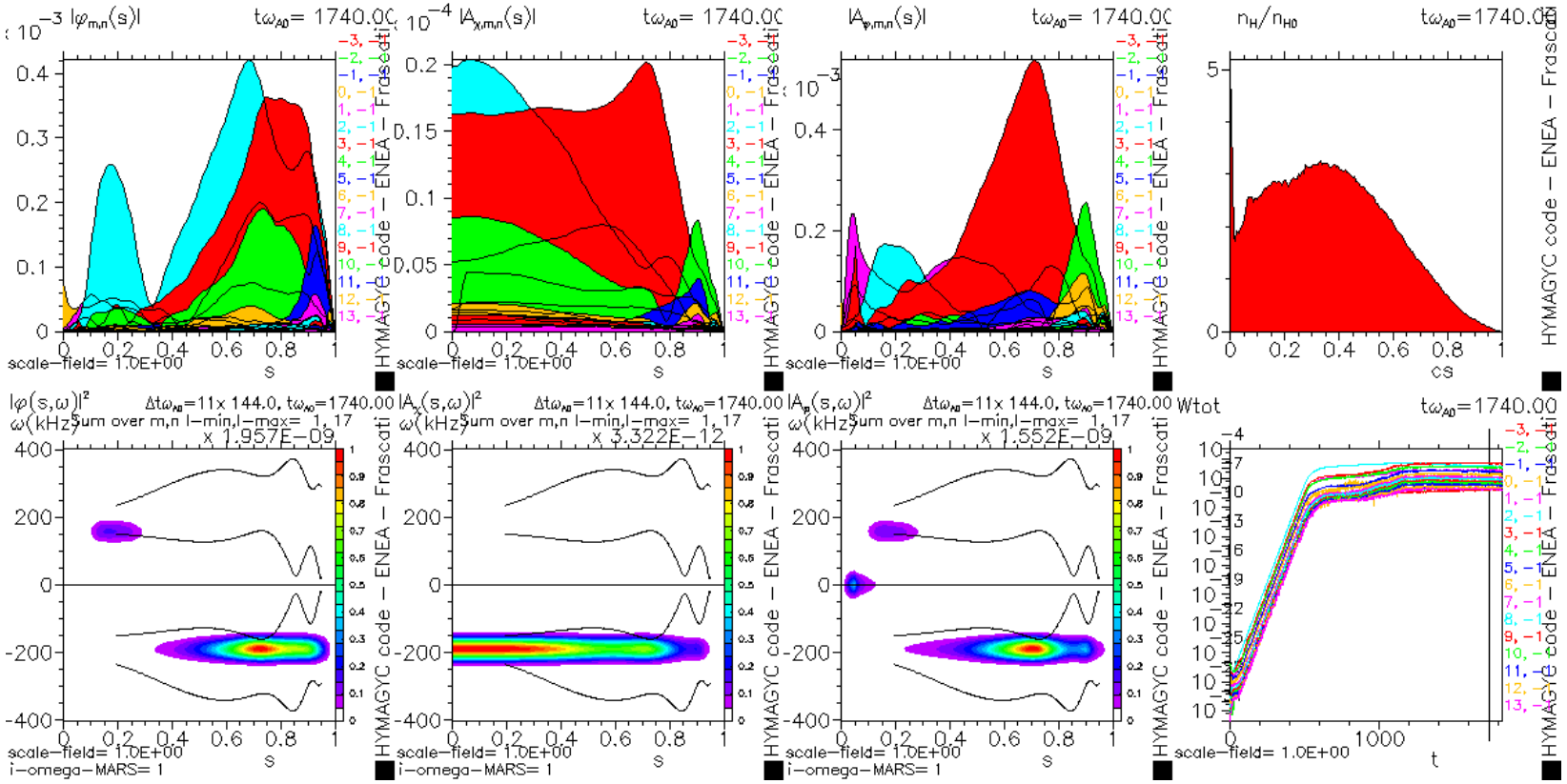


Fusion Unit EUROfusion

FOW limit, computation in (R, Z) mesh

Energetic Particle pressure tensor Π_{ij} in HYMAGYC computed on (R,Z) mesh

(R, Z): 121 × 121

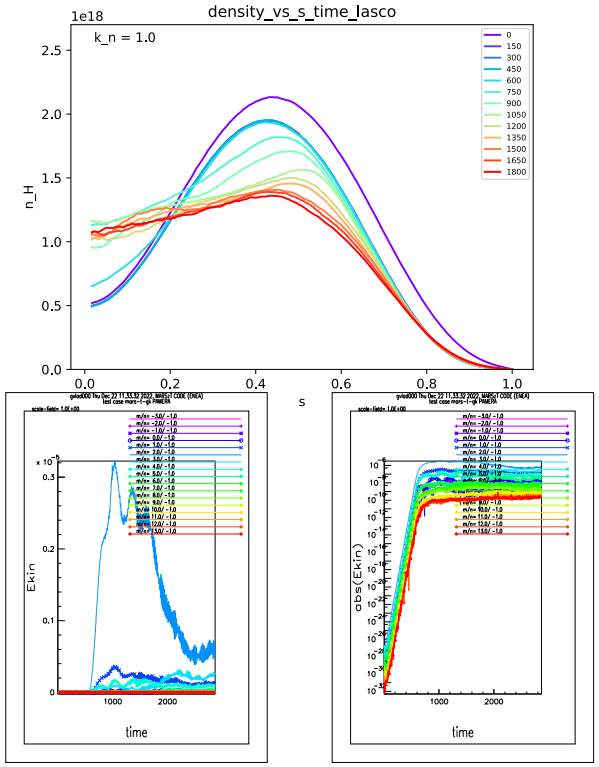


Fusion Unit EUROfusion

FLR limit, computation in (s, χ) and (R, Z) meshes

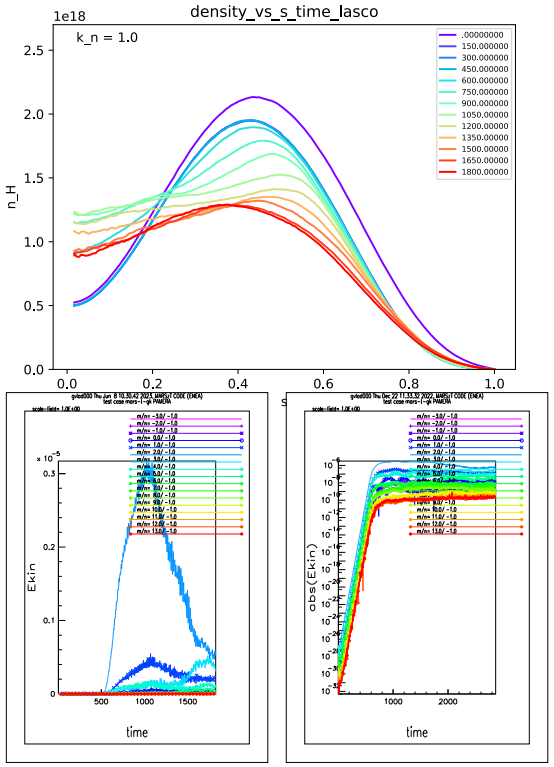
caso_AUG-nonmonotonic-BM-2020-T_H0.093_scaled_n_H_long_FLR_all_Aperp_output_interfaccia_corretto_all_fields_output

press (s,chi) mesh (181 × 120)



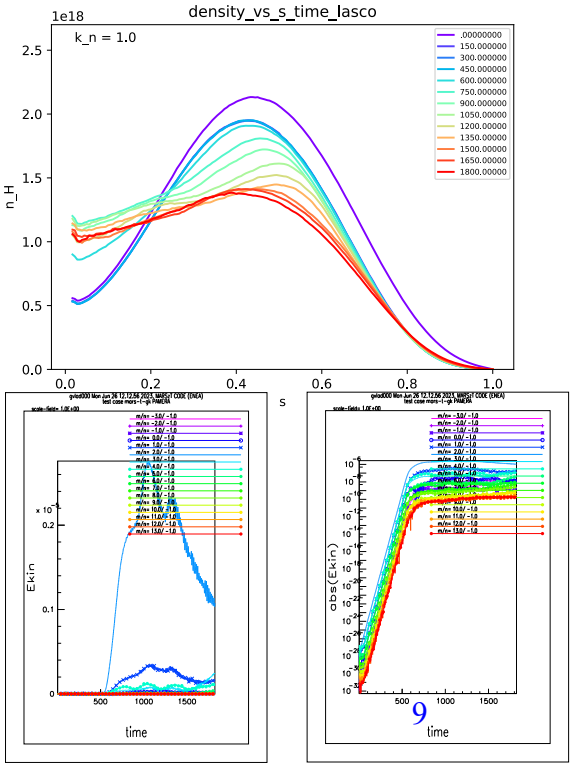
caso_AUG-nonmonotonic-BM-2020-T_H0.093_scaled_n_H_long_FLR_all_Aperp_output_interfaccia_corretto_all_fields_output-sources_kinetic_sergio_2020_press_rz_3

press (R,Z) (361 × 361)



caso_AUG-nonmonotonic-BM-2020-T_H0.093_scaled_n_H_long_FLR_all_Aperp_output_interfaccia_corretto_all_fields_output-sources_kinetic_sergio_2020_press_rz_3_mappa_s_chi_121_x_121

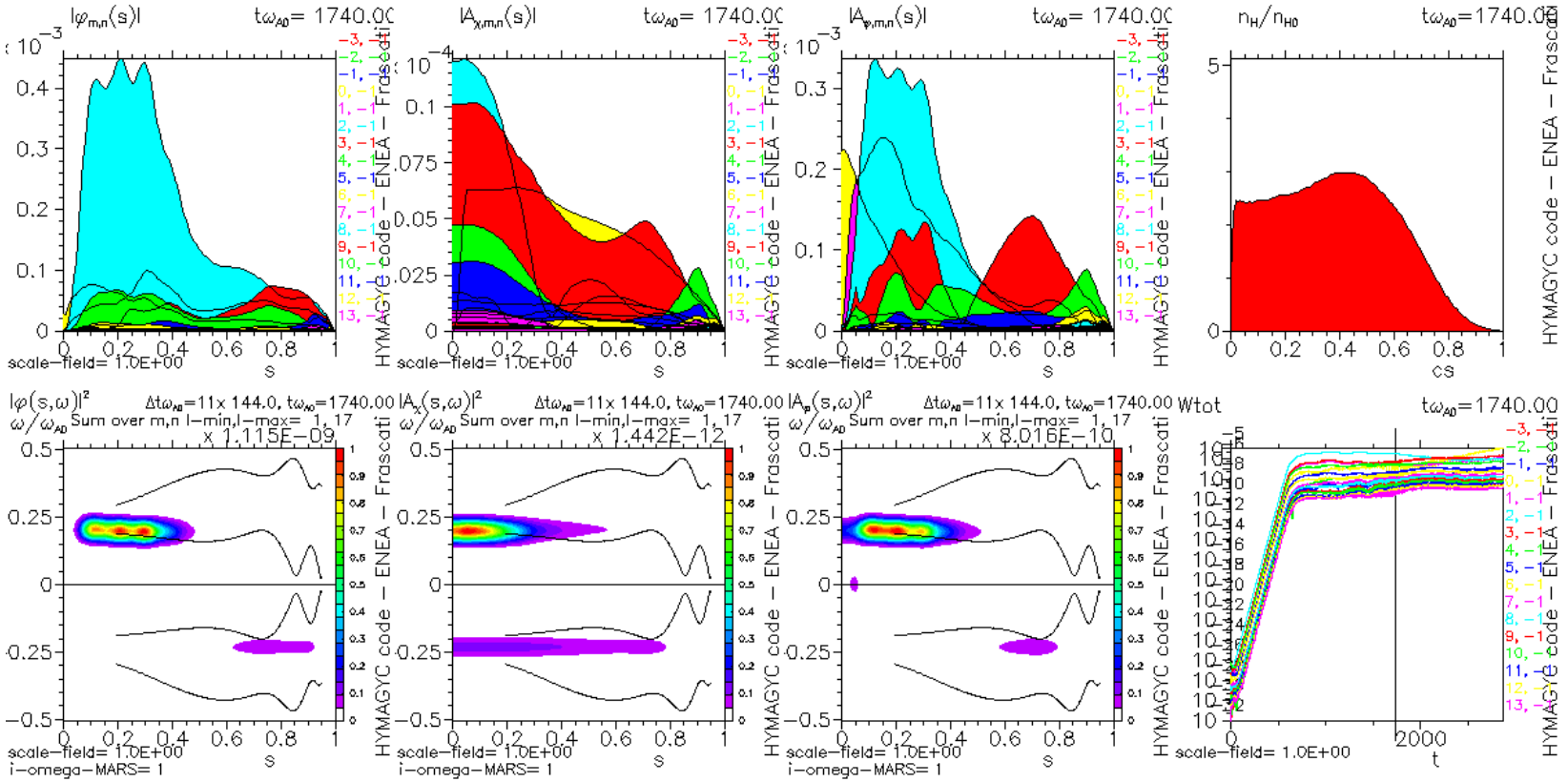
press (R,Z) (121 × 121)



FLR limit, computation in (s, χ) and (R, Z) meshes

Energetic Particle pressure tensor Π_{ij} in HYMAGYC computed on (s, χ) mesh

(s, χ): 181 × 120

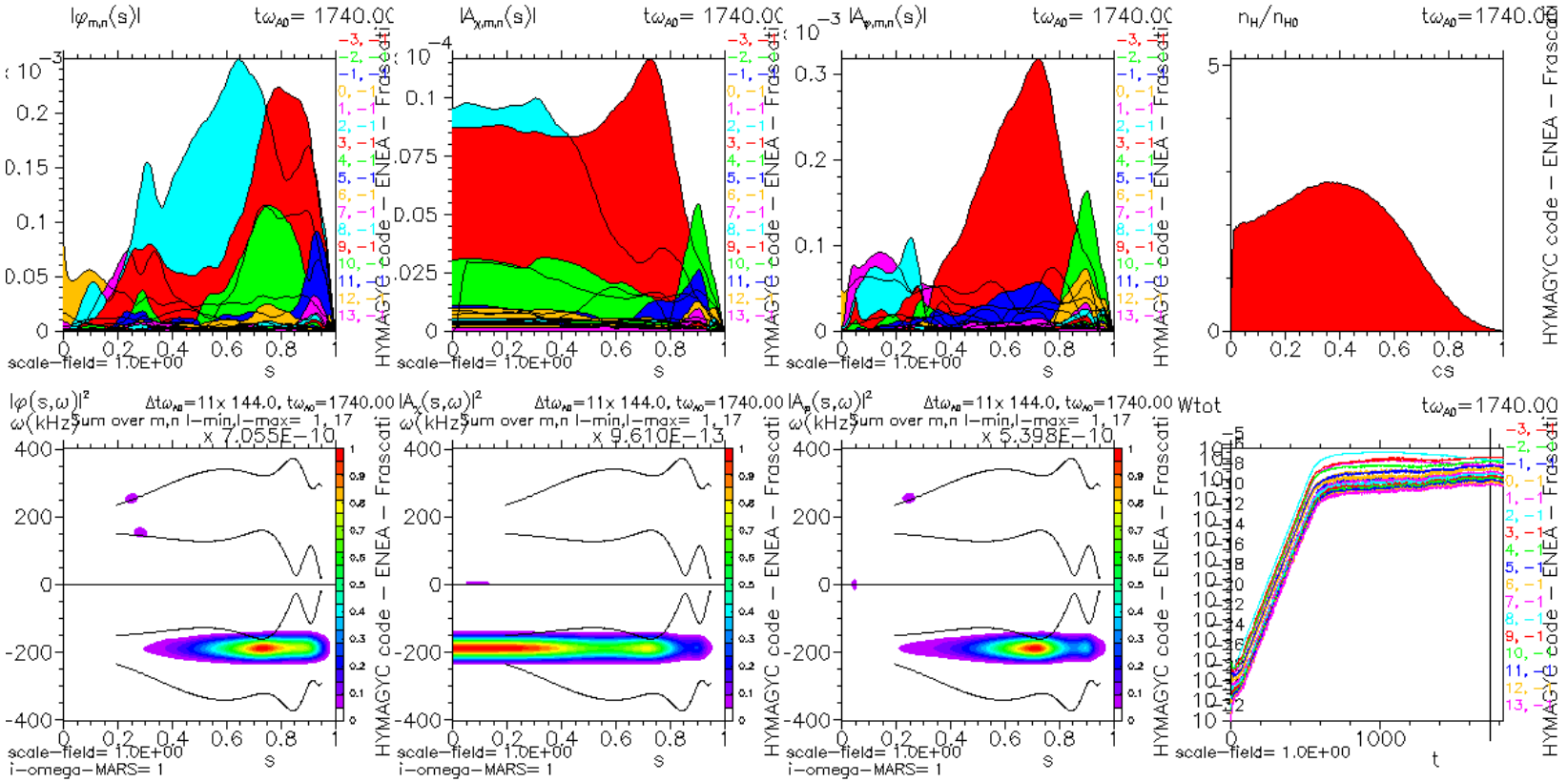


Fusion Unit EUROfusion

FLR limit, computation in (s, χ) and (R, Z) meshes

Energetic Particle pressure tensor Π_{ij} in HYMAGYC computed on (R, Z) mesh

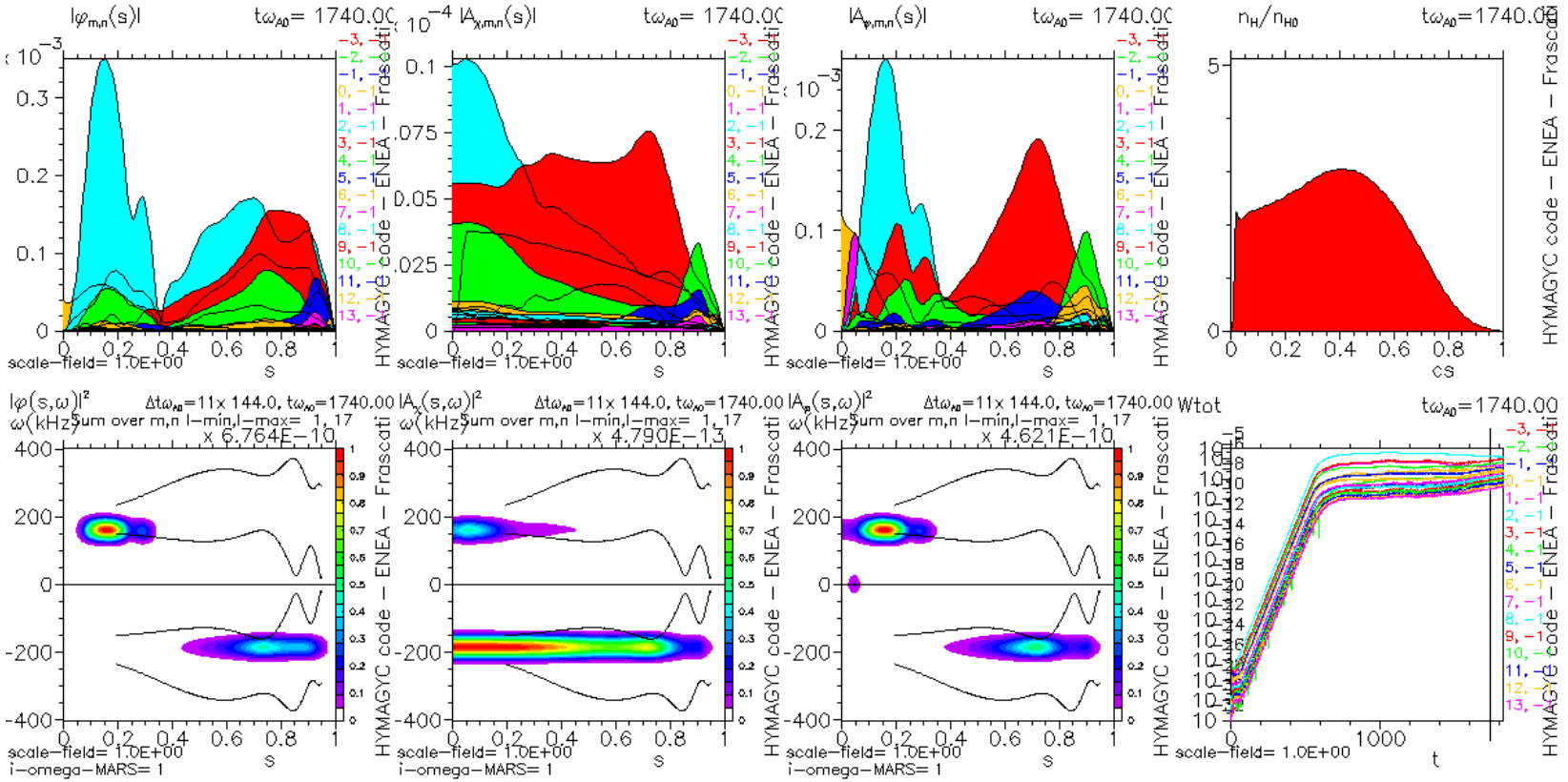
(R, Z): 361 × 361



FLR limit, computation in (s, χ) and (R, Z) meshes

Energetic Particle pressure tensor Π_{ij} in HYMAGYC computed on (R, Z) mesh

(R, Z): 121 × 121



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