Title: Comparative transport analysis of JET and JT-60U discharges

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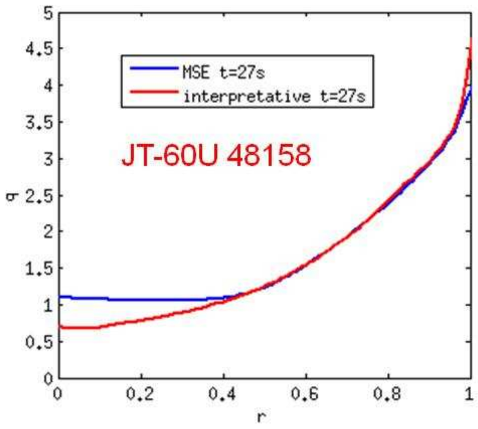
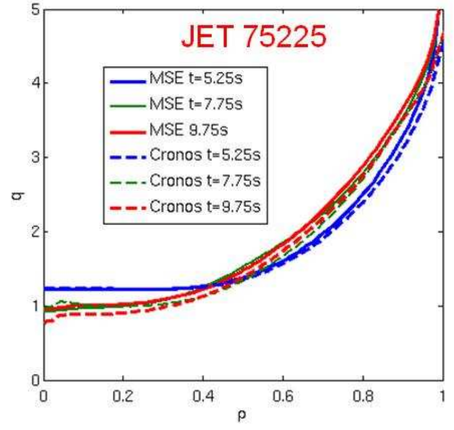
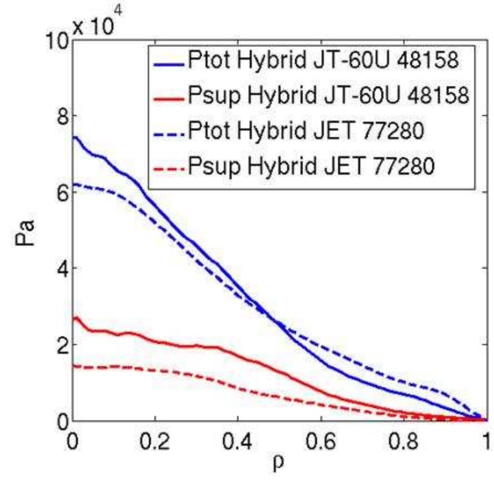
Main goal: Modeling of JET and JT60U plasmas

- Predictive and interpretative simulations of JET and JT-60U plasma scenarios using both the EU and JA suites of codes.
- Benchmark of JA and EU codes and models on discharges of both tokamaks.
- Find key physics similarities and differences between both devices
- Use this information to design JT60SA scenarios

Key physics differences







- q profile evolution well simulated for JET hybrid 75225.
- For JT-60U hybrid 48158, neo-classical resistivity cannot explain q profile
- Fixed MSE measured q profiles are used for JT-60U predictive simulations
- Fast ions contribution to the total pressure is very important for advanced scenarios in JT-60U. Can reach 55% of the total pressure
- The fast ion pressure effect is included in the CDBM model. The original heat diffusivities are mended as follows, with $G(\kappa)=(2\kappa^{1/2}/(\kappa^2+1))^{3/2}$ and κ the elongation
- $$\chi_{CDBM}^{original} = 12\frac{c^2}{\omega_{pe}^2}\frac{v_A}{qR}\alpha^{3/2}F(s,\alpha)G(\kappa) \longrightarrow \chi_{CDBM}^{new} = 12\frac{c^2}{\omega_{pe}^2}\frac{v_A}{qR}\alpha_{th}^{3/2}F(s,\alpha)G(\kappa)$$

Key physics differences

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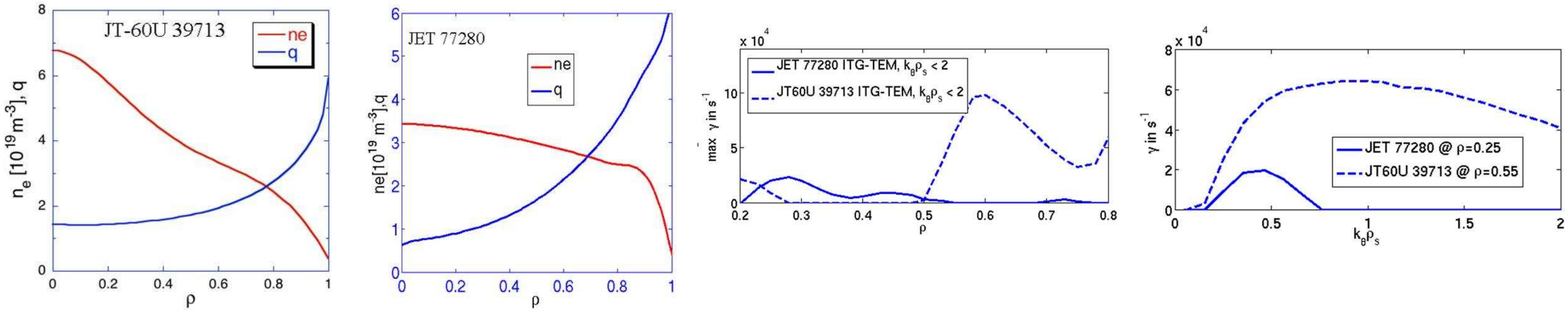

- Linear gyrokinetic analysis carried out with the QualiKiz code
- The ITG modes are dominant at ρ=0.25 for the hybrid JET discharge 77280, with a maximum at $k_\theta\rho_s$=0.3.
- The spectrum for the discharge 39713 at ρ=0.55 reaches the TEM regime at $k_\theta\rho_s$=1.0 and well beyond
- The density peaking can be responsible for such a different behavior

SIMULATION OF JT-60U DISCHARGES

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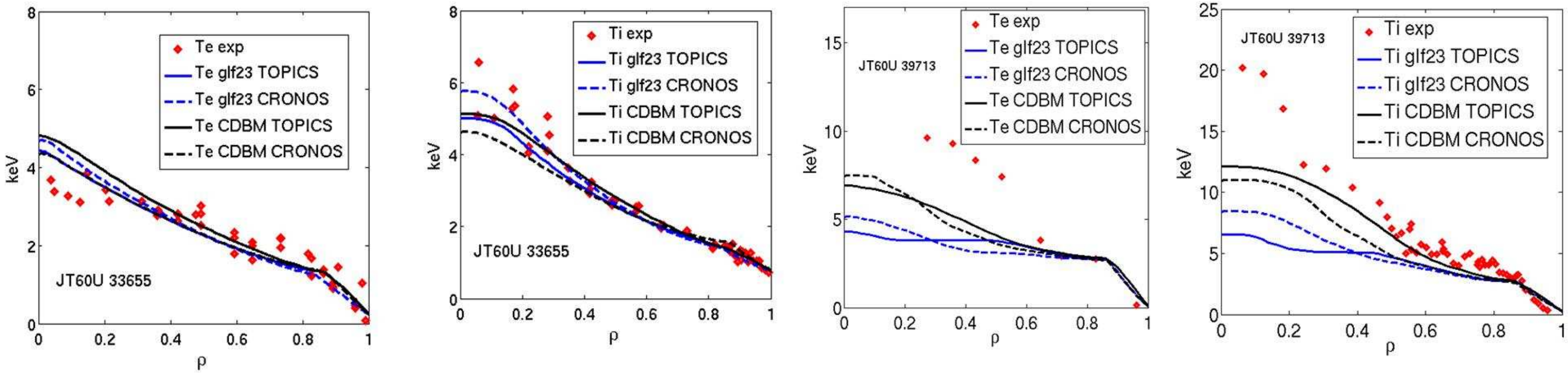

- Good agreement between both codes and for both the electron and ion temperatures for the H-mode discharge 33655
- For the Hybrid shot 39713, although both codes give similar results, they are in disagreement with experimental data, leading to lower temperatures than expected
- Broad region of flat temperatures in the case of GLF23

SIMULATION OF JET DISCHARGES

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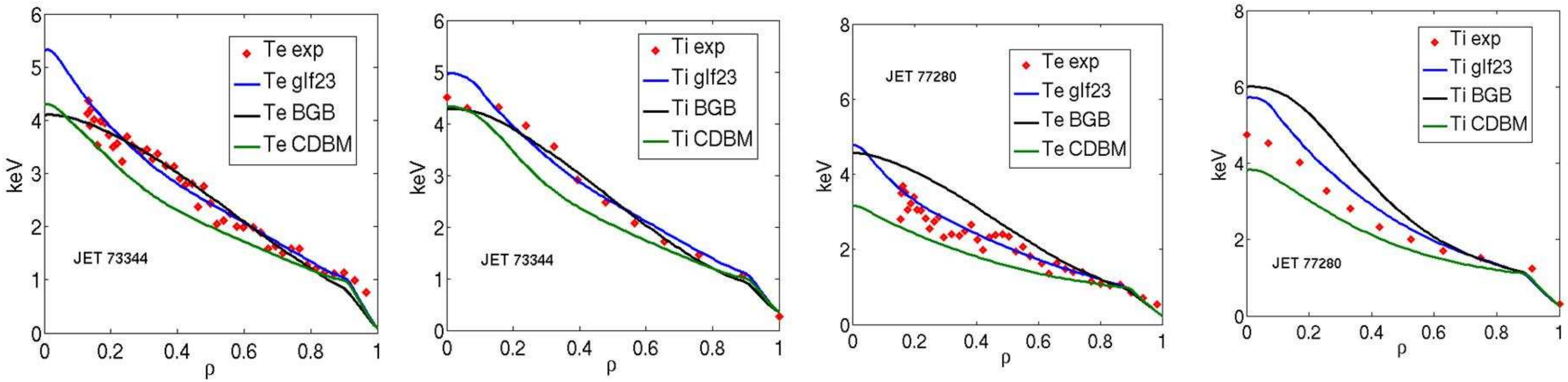

- General good agreement for the H-mode discharge 73344 for both electrons and ions, with some slightly lower temperatures for CDBM transport
- Bohm-GyroBohm transport overestimates both electrons and ions and CDBM slightly underestimates both for JET hybrid shot 77280.
- GLF23 is the model that gets closer to experimental data, although it also overestimates the ion temperature for hybrid shot 77280. The agreement is much better than for JT-60U advanced discharges

Conclusions and perspectives

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• H-modes are reasonably well simulated for both devices with the models available, GLF23, Bohm-Gyrobohm and CDBM

• Advanced regimes seem to be more difficult to reproduce. GLF23 leads to the most reliable results for JET, although it starts to deviate from experimental data mainly for ions

• For hybrid discharges on JT-60U, all the models clearly deviate for both electrons and ions, leading to underestimated temperatures for the discharge 39713
• 3 major differences found between both devices found: density peaking (very high for JT-60U), q profile evolution (not neoclassical for JT-60U hybrids) and fast ion population (very high for JT-60U hybrid plasmas) .

• The work shown here is just the initial step towards a full analysis of the physics differences between JT-60U and JET plasmas

• This work will involve the simulation of additional discharges in order to analyze different plasma conditions, the inclusion of the Bohm-GyroBohm model in TOPICS, the simulation of density, rotation and pedestal