Summary 3rd TSVV10-TSVV11 meeting dedicated to **high beta, low s modelling challenge (even in absence of Energetic Particles).**

EU-DEMO is expected to operate in the hybrid regime, in flux pumping conditions. By removing ST one removes seeds for NTM. And also would allow for on axis ECCD (more efficient).
ITER Q=10 is expected to be sawtoothing, but often it is modelled with a flat post ST reconnection profile.

When attempting the Q=10 case modelling with GENE-TANGO up to 0.65, the on-set of KBM lead to very large heat and particle fluxes, making convergence almost unreachable. In agreement with the ITER team modelers, it was decided to use rather a relaxed q profile. Some adjustments were made on the particle source as well. For now, without EP interplay, A. Di Siena reports almost converged profiles expect for density flux above the target flux.

- P. Mantica, A. Di Siena and C. Bourdelle will discuss the present assumption for particle source.
- Emiliano suggested to scale the particle flux x 10 (same for the source), but this assumes ss. Francis raised the question of the timescale separation between background and fluctuations, if this unable avalanches or not.
- Fulvio raised the point of how the assumed thermodynamic equilibrium can be challenged
- Philipp asked for the saturated k spectra, to see if indeed k is smaller as expected for KBMs
- Alessandro said that indeed checking GENE resolution against ORB5 for such cases before adding EP would be very valuable
- GPU ressources, Paola suggested to see with Duarte Borba (other codes are blocked if all Leonardo is used in a single run: need for a larger machine with more nodes available)

Yann presented GKW local nonlinear vs quasilinear simulations on JET 75225 hybrid at rho=0.15. He showed that the QL approximation seems to capture the beta and shear impacts. It was suggested to add synthetic diagnostics to these simulations. This verification against a reduced QL model TGLFsat2 was presented by Anass. He explained that to keep KBM in one has to remove the default filter but then spurious modes appear (cured with filtering out odd modes). So ideally TGLFsat2 options should be extended to include Anass's suggestions. Next week at ITPA T&C a discussion with Gary Steabler will take place with Clemente and Francis in remote.

Fulvio addressed details of KBM destabilization and nonlinear evolution within a general theoretical framework based on the nonlinear gyrokinetic theory. Main points: existence of unstable continua (destabilized by the ion temperature gradient, related to the AITG); possibility to have an unstable KBM near the ideal ballooning stability threshold; interesting physics when BAE and KBM are nearly degenerate; importance of kinetic and global effects becoming zeroth-order contributions for Alfven waves since nonlinearities (Maxwell and Reynolds stresses) cancel exactly in the Alfvenic states; generation of small radial scales when KAWs are only weakly damped (high-beta burning plasmas); a "Zoo" of nonlinear mechanisms (parametric decay, modulational instability, nonlinear scattering); drastic changes in nonlinear transport properties depending on the "fidelity" (MHD vs. GK). Finally, a simple set of KBM testcases has been proposed which should establish a clear correspondence between the simulation output data and the theoretical concepts described in the talk.

Alexey showed a number of global nonlinear simulations using ORB5 both in the KBM and EM-ITG regimes for a simple large-aspect-ratio tokamak geometry and for ASDEX-Upgrade. Low-shear high-beta regimes have been addressed. The change in the mode structure is observed when the turbulence regime changes indicating shift in the main nonlinear saturation mechanism (sheared-flows vs. finger-line structures, zonal flow generation vs. profile relaxation; a partial Maxwell and Reynolds stress cancellation at a higher beta; nonzonal transition). In both geometries, reversal of the particle flux has been observed when the turbulence enters the KBM regime. Effect of the fast

ions on the ambient turbulence has been studied in the both geometries. The turbulence suppression has been observed except in the cases when the BAE is destabilized at a higher beta. Finally, some of the main theoretical concepts have been mentioned (modulation and forced-driven flow generation, Alfvenic states, nonlinear gyrokinetic system of equations). In simulations, the forced-driven regime is universally seen. The modulation regime is more difficult since it requires that the turbulence amplitude is larger than some threshold. It can be observed in some simulations but it seems that the growth rate of the modulation instability is smaller than it is for the forced-driven case. Finally, an example is shown for a low-n instability nonlinearly driven by the turbulence (modulation instability).

General action:

- Would be ideal to all work with our tools on the same highest beta low shear case we have experimentally, this means a JET pulse. ORB5 team is already working with JET input, Alessandro has already some GENE-TANGO cases on JET (99912 at 8.9s and 99896 at 8.5s). Integrated modelling could be added as well as stand alone GKW vs TGLFsat2 comparaisons. Then the guidance of diagnostics in simulations could help understand better the saturation at play and make progress towards better reduced model. The validation on the JET case could then be extended to other pulses and to ITER? At least without EP interplay. With EP interplay we cannot avoid global modelling.
- Need to collect the pulse/data used for ORB5 and GENE-TANGO on JET.
- Run JETTO+TGLFsat2
- Stand alone TGLFsat2, GKW Ql and GKW NL, compare to ORB5 and GENE, diagnose. Test saturation models etc
- Improve reduced model and test it in integrated modelling
- Understand better the basics of the KBM nonlinear physics combining theory and simulations