Thrust 1 Meeting N02 Meeting Minutes

Meeting date/purpose: 21/06/2022:
Attendees: *N. Vianello (NV), C. Roch (CR), T. Goerler (TG), P. Tamain (PT), D. Told (DT), S. Brezinsek (SB), D. Kalupin (DKa), D. Keeling (DK)*

- **Meeting structure**
    1. N. Vianello: WPTE Inputs and high level modelling request
    2. T. Goerler: TSVV1 Status
    3. P. Tamain: TSVV3 Status
    4. D. Told: TSVV4 Status
    5. General discussion
- N. Vianello: WPTE Inputs for Thrust 1 TSVVs

N. Vianello presented an overview of the WPTE new structure of Research Topic for the 2022-2023 D campaigns. For a selected series of them (namely RT22-01, RT22-02, RT22-05 and RT22-07) provide the main modelling requests/needs. Emphasis has been devoted to the

- **Discussion**
    - TG: TSVV6 is already working on impurity effect into the pedestal with Gysela.
    - CR: There is work for complementary work done by TSVV6 i within TSVV1
    - PT: Impact of neutral and density regimes in the edge and SOL and the impact of impurity is already within TSVV3 radar. Development on impurity is lacking behind and unlikely to be able to deliver
    - DT: Not all the code have neutrals and all of them are still in sheath-limited regime
- T. Goerler
    - D1: Analyse degree to which GK codes can reproduce edge/pedestal turbulence. Need reliable profile information and magnetic equilibra at least power balance and as much fluctuation diagnostic as available. ELMy H-mode pedestal looking into and AUG ELM-cycle both linearly and non-linearly. Strong ion-scale TEM transport of pedestal top stabilized in steep gradient region (profile effect), electron-scale (ETG) transport at pedestal foot.

- Other validation in within D1:
  - AUG L-mode edge validation
  - JET Hybrid pedestal study up to first EM global GK sims
  - AUG L and H-mode & QCE discharge pedestal microinstability
  - IBP scenario
  - Linear scans for JET parameters for QuaLiKiz
  - TCV inspier positive/negative
- D2: MHD extension & Er development
  - ion-orbit loss model implemented in Grillix and coupled with SOLPS
  - B. McMillan submitted to JPP: GENE joined GK-MHD (ORB5/MISHKA) comparison with work to improve agreement at low-n kink physics
  - Soledge3X turbulence simulations in more realistic edge simulations for the Er. Increasing of Er well with power
  - GBS w/wo Boussinesq approx identify 4 regimes with possible scaling to be validated
- D5:
  - IMEP with rescale pedestal top condition with major radius R
  - Refined model available within IMEP and an IMAS interface has been
  - QuaLiKiz-based modelling established
- Progress workshop planned for Sep 26-28 2022
- CR: Is there a strategy among the different scenarios explored and possible test the reduced model in the same scenario explored with more detailed simulations.
- DT: Interaction TSVV4 and TSVV1 how this is conceived at the end of 2023
- NV: Ion-orbit loss model available on GRILLIX and on SOLPS. Is this is a standard model for SOLPS which can be used? to be checked

- P. Tamain
  - Reduced turbulence models further developed: RANS models is an intermediate description of anomalous transport. Theory based RANS model derived and closed based on 2D turbulence database. Confrontation to C-mod on top of already performed validation for TCV and WEST. RANS model recovers qualitatively SOL flow asymmetries
  - Realistic magnetic geometries now ubiquitous. For the moment restricted to attached plasmas with ad-hoc BCs. Even applicabile to RMP cases
  - Wall geometry: 3 paths used
    - Mask function + local alignment at strike points (SE3X)
    - Immersed boundary conditions (GRILLIX)

- Finite Elements solver (HDG): not tested in full 3D turbulence
- Code optimization: able to deal with full scale WEST size simulations. GRILLIX run an ITER-scale simulation at realistic parameters
- Neutrals: key point to focus on near future.
    - Rudimentary fluid neutral models implemented in 3D turbulence codes as GRILLIX and SE3X. Larger turbulence structures with faster radial propagation observed in scan with neutrals
    - Kinetic neutrals with the method of characteristics implemented on GBS
    - SE3X is coupled to EIRENE coupled to full ITER-relevant Kotov kinetic neutrals model
- <u>WPTE TE for exploring high density regimes with all 3 codes</u>
- Zdanov closure included in SE3X (as well as SOLPS) at least in 2D cases
- NV: Use the reduce model as well in the high density validated cases to test reduced models into high-recycling regime. BC in high recycling conditions
- DT: neutral models to be included into the GK model. May be interesting to check what JOREK is doing with neutrals
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- D. Told
    - Milestone report for 2021 for Gene-X, Gysela-X and PICLs
    - Studied impact of poloidally localized limiter in GYSELA in circular geometry.
    - GENE-X:
        - added the electromagnetic effects
        - implemented nonlinear polarization density
        - increasingly realistic collisions
        - Extension to 3D
    - Gyrokinetic moment approach:
        - allows smooth transitions from GK down to Brakinski depending on the # of the moments
    - ssV Code: hybrid kinetic/driftkinetic model. Successfully reproduced FK ITG wrogth in delta-f approach.
    - Adding neutral physics: Milestones aim for adding neutral physics to all main GK codes
        - Gkekyll: 6d kinetic neutrals
        - Kinetic characteristics approach (as in GBS)
        - Fluid models
        - MC solver

- **PT**: Density bumb in front of the limiter? can be transitionary effect. How the GK moment approach compare numerically to full GK approach?
- **CR**: Why not adding delta_b_parallel into GENE-X? Plan to be included. GK-BC also in shallow-angle approach. Master student working on arbitrary angle Boundary Condition at EPFL.

Actions	People
Investigate the possibility to use reduced models in seeded scenario	TG
Check effort within TSVV6 for addressing the role of impurities on pedestal	NV
Invitation of D. Told to neutral models meeting of TSVV3	PT
Check possibility to use reduced models on top of 3D full turbulent model to high density WPTE data	PT

Meeting conclusion: 12.07