Thrust 4: Stellarators

WPAC 2022 scientific goals meeting, September 10, 2021

Iván Calvo

Deputy Task Force Leader for WPW7X and Thrust 4 facilitator
(also on behalf of Andreas Dinklage and Arturo Alonso)

This work has been carried out within the framework of the EUROfusion Consortium and has received funding from the Euratom research and training programme 2014-2018 and 2019-2020 under grant agreement No 633053. The views and opinions expressed herein do not necessarily reflect those of the European Commission.

Thrust 4: Stellarators

- *Thrust 4: Stellarators* is the platform for discussion and regular interaction among TSVVs 12&13, WPW7X, and representatives from WPPrIO (X. Litaudon) and the E-TASC SB (F. Jenko and L. Villard).

TSVVs 12&13 are stellarator-specific and address two of the most important problems in stellarator theory: **Stellarator Optimization** and **Stellarator Turbulence Simulation**.

Developments in TSVVs 12&13 are relevant for the design of next-generation stellarators and for their application to W7-X campaigns, and therefore for the research programme of WPW7X.

Current status of activities in TSVV 12: Stellarator Optimization

2021 deliverables achieved or on track to be achieved

- Development of a gyrokinetic instability model for integration into optimization codes.
- Exploitation of the code SPEC to evaluate MHD stability of stellarator equilibria.
- Improved optimization approach to reduce the number of local minima in the landscape.
- Interface to equip the stellarator optimization code ROSE with new algorithms.

No changes in the research plan for 2022 with respect to the approved scientific proposal

- Assessment of robustness of magnetic configuration topology with SPEC.
- Development of BOUT++ to provide turbulent diffusion coefficients to EMC3-EIRENE.

Current status of activities in TSVV 13: Stellarator Turbulence Simulation

2021 milestones and deliverables achieved or on track to be achieved

- Verification and benchmarking activities involving codes that employ different simulation domains (EUTERPE, GENE-3D, GENE and `stella`).
- Implementation of the full linearized collision operator in `stella` and first applications.
- Development of a full-flux-surface version of `stella`.
- Development of an electromagnetic version of GENE-3D.

No changes in the research plan for 2022 with respect to the approved scientific proposal

- Assessment of the impact of the simulation domain on turbulence (partly, verification and benchmarking activity).
- Study of the interplay between temperature and density gradients in ITG/TEM turbulence in W7-X with different codes.
- Development of synthetic diagnostics for Doppler reflectometer and Phase Contrast Imaging.
- Upgrade of codes to study the impact of neoclassical equilibrium on turbulence.
- Application of adjoint methods to linear gyrokinetics for stellarator optimization.

Interactions within Thrust 4

Coordination of TSVVs 12&13 with WPW7X

- We take advantage of the successful scheme for scientific coordination within the W7-X Team, that has been working for years. Two main elements:
  - Topical Groups.
  - Weekly W7-X Physics Meeting.
- I. Calvo (WPW7X Deputy Task Force Leader and Thrust 4 facilitator) attends the monthly technical meetings of TSVVs 12&13. These meetings are open to the whole W7-X team when relevant.

Thrust 4 meetings

- Two meetings per year that bring together all Thrust 4 members.
- First Thrust 4 meeting on September 3.
  - Suggestion from F. Jenko: think of ways to involve members of the tokamak community.

Further feedback from TSVV Leaders

Tiny mission budget which, in addition, is not under control of the TSVV Leader.

- Major difference with respect to Enabling Research projects, for instance.
- This will become a matter of conflict soon, assuming that travelling becomes normal again.