EUROfusion

Summary Session

2nd E-TASC General Meeting | Garching | Feb 9-13, 2026

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Progress towards EUROfusion Standard Software

- According to regular self-evaluations, we have been making tangible progress towards ESS since 2021
- Remaining gaps are supposed to be closed as much as possible until the end of 2027
- List of E-TASC codes (incl. brief description) and respective „code coordinators“ will be updated and posted

- An increasing number of E-TASC codes are made available as Open Source software (in line with IO/EU policies)
- Fusion startups can be handled via appropriate licencing (in line with EUROfusion Consortium Agreement)

- Move emphasis from software development to „software use“
- Offer trainings for casual users and committed power users (online and/or in-person); limited mission budget

From Open Source to Open Data

- IO has started making IMAS datasets publicly available on Zenodo to support ITER modeling (towards FAIR):
  - Partial ITER machine description in IMAS: https://zenodo.org/records/17113713
  - ITER simulation results in IMAS: https://zenodo.org/records/17062700
- Publish datasets along with journal publications and benchmarks from ITPA groups
- Publish simulation data (using IMAS data model, along with metadata) on LTDSF or via Zenodo
- A plan will be put forth within the next few months by Par Strand et al.
- We will need to establish (evolving) working practices (embargo period?)
- Take a look at exisiting Open Data policies (Leuven, DIFFER etc.)
- Link Open Data policies to EUROfusion publication rules towards FP10?
- EUROfusion should train experimentalists in Open Data practices (beyond E-TASC)

Possible extension of IMAS to stellarators

- The IMAS data model could be extended — ideally by the stellarator community (including the private sector) — to better support objective comparisons across tokamak-stellarator worlds; this would also enable stellarator codes to be more easily applied to tokamaks
- Extend the existing 3D equilibrium capabilities of IMAS
- Two separate tasks: (1) IMAS extension (2) IMASification of experimental data (W7-X, LHD, tokamaks etc.)
- Use cases?
- Currently not a lot of enthusiasm, but more discussions are needed
- Possible target for FP10

Taking advantage of the AI revolution

- Creation and use of **agentic AI models** – The IO plans to start working on this in 2026, using LLMs
- **Software can now be written by AI**; rapid growth of AI capabilities; EF could provide trainings
- **AI can help with mapping data and adapting software to IMAS** since it understands the IMAS data model
  - This could be pushed by a pilot project (e.g., IMASify JET data via AI tools)
- Ideally, EUROfusion could maybe provide access to respective AI tools
- The IO would be glad to help with such efforts (to be discussed during the March 2026 meeting)

- We need to explore **optimized combinations of model-based and data-driven modeling to create Digital Twins of fusion systems**
  - Our situation is fundamentally different from Big Tech companies: less data, but prior knowledge

Towards systematic and reproducible VVUQ

- **Much of the existing validation is not systematic**
  - Workflows are often poorly documented and not fully reproducible
  - Individual choices vary, and parameters may be tuned to improve agreement — meaning two people may not obtain the same result
  - The lack of systematic validation makes UQ particularly challenging
- **VVUQ is only meaningful if workflows are reproducible**
- **A number of positive examples exist. – But how can we foster a wider adoption of UQ?**
  - Possible barriers: Lack of a general (multi-fidelity) methodology, lack of realism, high dimensionality etc.
- **Greater visibility via a EUROfusion Science Meeting?**

Interesting conceptual paper: https://doi.org/10.1063/1.2928909

Enabling data-driven fusion science

- Implementation of the Data Management Plan (DMP)
    - Ambitious goal is a production-ready, federated data management ecosystem for harmonised access to experimental and simulation data across EUROfusion sites and users
- Staged approach towards FAIR access to data: moving from prototyping to production use
- IMASification of experimental data should progress faster
- Standardized tools for curating fusion data at scale (via AI?) would be a game changer (extending existing tools)
- Standardized metadata across devices and codes would enable advanced validation & UQ
- Integrating simulation /modelling data output
- Towards Open Data access; candidate devices: WEST, TCV (role of WPTE?); inclusion of non-EU devices?

WPTE: Promoting the reproducibility of published scientific results

- Implementing FAIR principles in WPTE (and EUROfusion):
  - Ensuring traceability and reproducibility across experiments, data, and modelling
  - Ensure that every publication has attached an accessible repository with data/processing/modelling

- During 2026/27, WPTE will strengthen traceability and reproducibility of FP9 analysis in preparation for FP10
- Develop a citable repository framework to support traceability and reproducibility of the results

- WPTE seeks support from E-TASC regarding the creation of respective tools

Modeling needs & opportunities

- **Many modeling requests for the interpretation of available data from TE devices (including JET)**
- Physics gaps for ITER, JT-60SA; FoaK, stellarator-based reactor
- There exist lists of research gaps, with prioritizations (!)
- Basis for identifying research thrusts for FP10
- In FP10, we also need to keep a focus on developing basic understanding

- **How to provide the required personnel and funding? – Needs to be discussed on a EUROfusion level!**
- Some topics related to model application and validation may be supported by IO postdocs
- Some activities may be financial supported by the IO, and if so, will be carried out under separate implementing agreements or contracts

TSVV discussion (1/2)

- Support for ITER research plan
  - Collaboration agreement signed with IO
  - March 2026 workshop on data mapping
  - IMEG

- Simulated data
  - Common repository (LTDSF to set up rules for its use, simDB can be used); **need guidelines (!)**
  - VVUQ using a multi-machine approach

- Training sessions & code dissemination
  - Prospective users should be proactive (?) and committed; WPTE should support missions
  - TSVV-H will organize a session on HFPS; requires access to the Gateway
  - Other codes: GENE-X; JOREK; Stellarator optimization codes; SOLEDGE; GRILLIX

- Private sector involvement
  - Pursue a win-win approach, coordination on the EUROfusion level
  - Extra EC funding: Efficient when public funding goes to public institutions to support private sector
  - Long term vs short term priorities
  - Possible example: Extension of IMAS to stellarators, involving Proxima Fusion

TSVV discussion (2/2)

- Brainstorming on FP10
  - Strong science program to get opportunity of increased EC funding
  - VVUQ as an overarching objective for simulation/modeling
  - Even more focused work (in support to future FOAK and FPP)?
  - Start of ITER operation! How to support it?
  - Digital solutions as a risk mitigation (theory is low cost, but high impact)
  - Ideal: Long-term funding with minimal bureaucracy
  - Basic theory should remain strong

- Links to ACHs
  - Procedure to get support from ACHs: Involve both code coordinator and TSVV PI(s)
  - Share of support per TSVV in 2026/27 to be clarified

- WPTM management
  - Budget constraints (PMs, missions)
  - Consequences on 2027 work plan: Deliverables at risk; activities to be done with extra resources

ACH discussion

- ACHs support budgets per TSVV
- ACH support for codes beyond the TSVV ecosystem
- Travel budget: Ideally one in-person meeting per year
- Appropriate recognition of ACH contributions (co-authorships, acknowledgements)
- Continuation of ACHs in FP10

- Situation with **Pitagora**: The current situation was discussed and recognised as challenging. Users are encouraged to raise tickets for issues they encounter. If they are not adequately addressed, users should contact the chair of the ticket committee either directly or via an ACH contact. CINECA also maintains a webpage containing issues and solutions that can be referred to. If problems persist, EUROfusion may need to put pressure on CINECA, including requesting increased interaction with the hardware provider.

DTE discussion

- Virtual meetings every 2-3 weeks
- Invite DT experts from Eindhoven, USA, UK etc. for inspirational talks
- Communication channels (Mattermost, Wiki)
- Mission funds are VERY limited; needs to be increased
- Discuss and adapt ESS standards
- Pursue IMASification
- Explore links to the private sector (mutual benefit provided)
- Towards building a strong DTE effort in FP10; PPP opportunities
- DT vision (monolithic vs toolbox)

Structural changes in FP10?

- Integrate more engineering projects; improve the physics-engineering communication
- FP10 could be much more FPP-oriented; role of EUROfusion could change a lot; be prepared
- Explore a team-of-teams approach across *all* of E-TASC already in FP9
- Establish communication channels with the private sector