EUROfusion

FUSION SCIENCE DEPARTMENT

# E-TASC KOM

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# Background: Role of theory & simulation in fusion research in the 2020s

**Europe is ready to play an important role in ITER operation and DEMO conceptual design**

- **T&S can save many M€/y in operational cost (ITER: ~300 M€/y)**
- **T&S (incl. control schemes) is needed to ensure machine protection (ITER: ~B€)**
- **T&S has the potential to accelerate the development of fusion energy (DEMO design)**

**Statement from the 2018 Fusion Roadmap**

**"a strong theory and modelling programme is essential because empirically based predictions are uncertain in unexplored environments like ITER and particularly DEMO, and this will be a stronger focus than foreseen earlier"**

# Mission of the TSVVs and ACHs

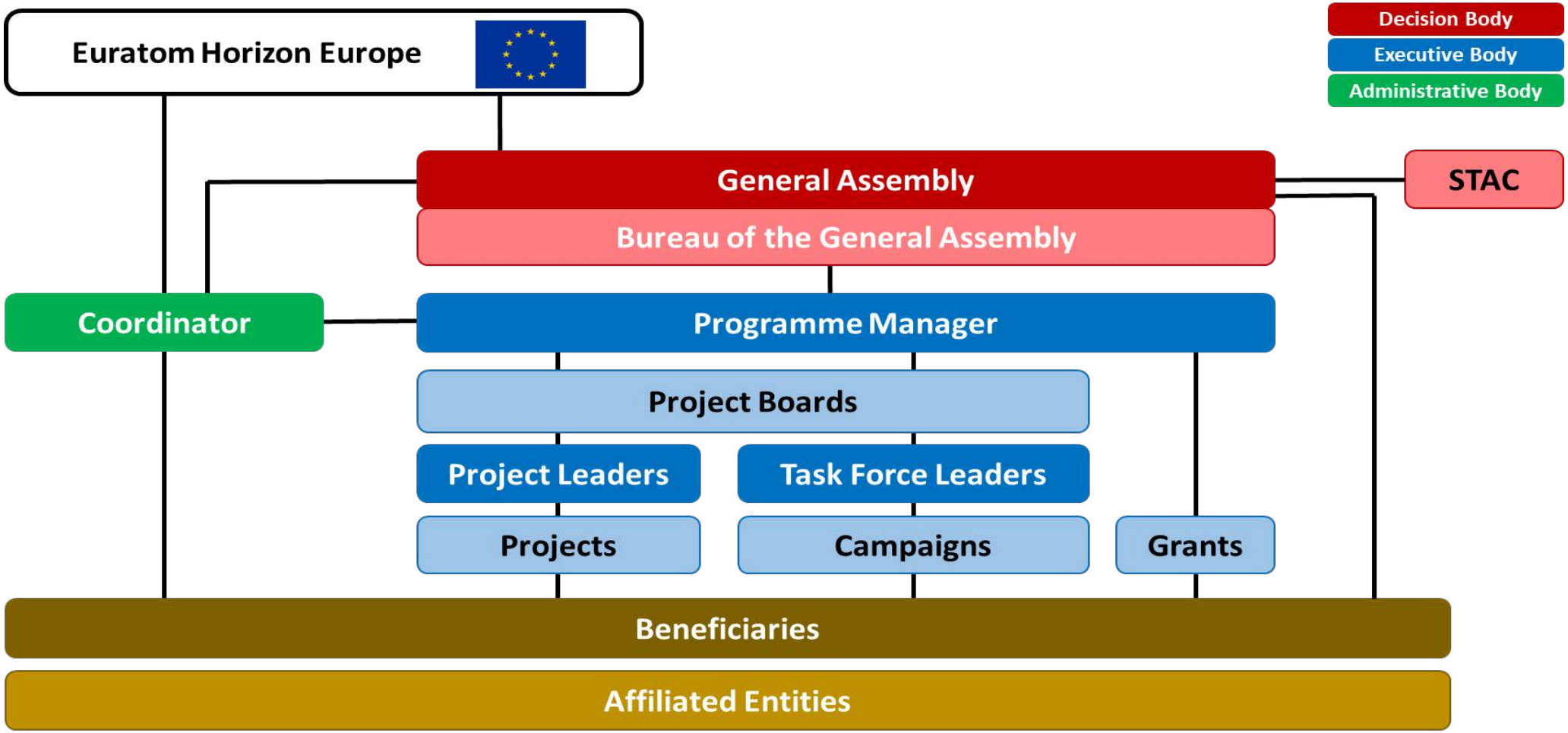
From Grant application, Annex 1B:

…**coordination** is required that can integrate the world-class fusion science and engineering with emerging advanced computing capabilities – this is the vision for E-TASC, which stands for the EUROfusion – Theory and Advanced Simulation Coordination, (EUROFUSION GA (18) 24 - 4.6 and see also Chapter 2) which is implemented under WP AC.

A set of TSVV tasks are established, with **connection to relevant Work Packages** as listed in this chapter.

The ACHs will provide essential expertise and support in computer science, scientific computing, data management, code integration, and software engineering, as well as in the development of a suitable portfolio of **EUROfusion standard software codes**.

# The EUROfusion FP9 structure



# Relations between the various stakeholders

Work Package
**Advanced Computing**

PWIE **PB**

TE **PB**

W7X **PB**

BENEFICIARIES

Theory **PB**

Approval of resources and work plan (PEP); resolution of potential conflicts

Experts from beneficiaries

E-TASC **SB**

Advise and ensure coherence of the scientific work; monitor the scientific activities, prepare input to the PB

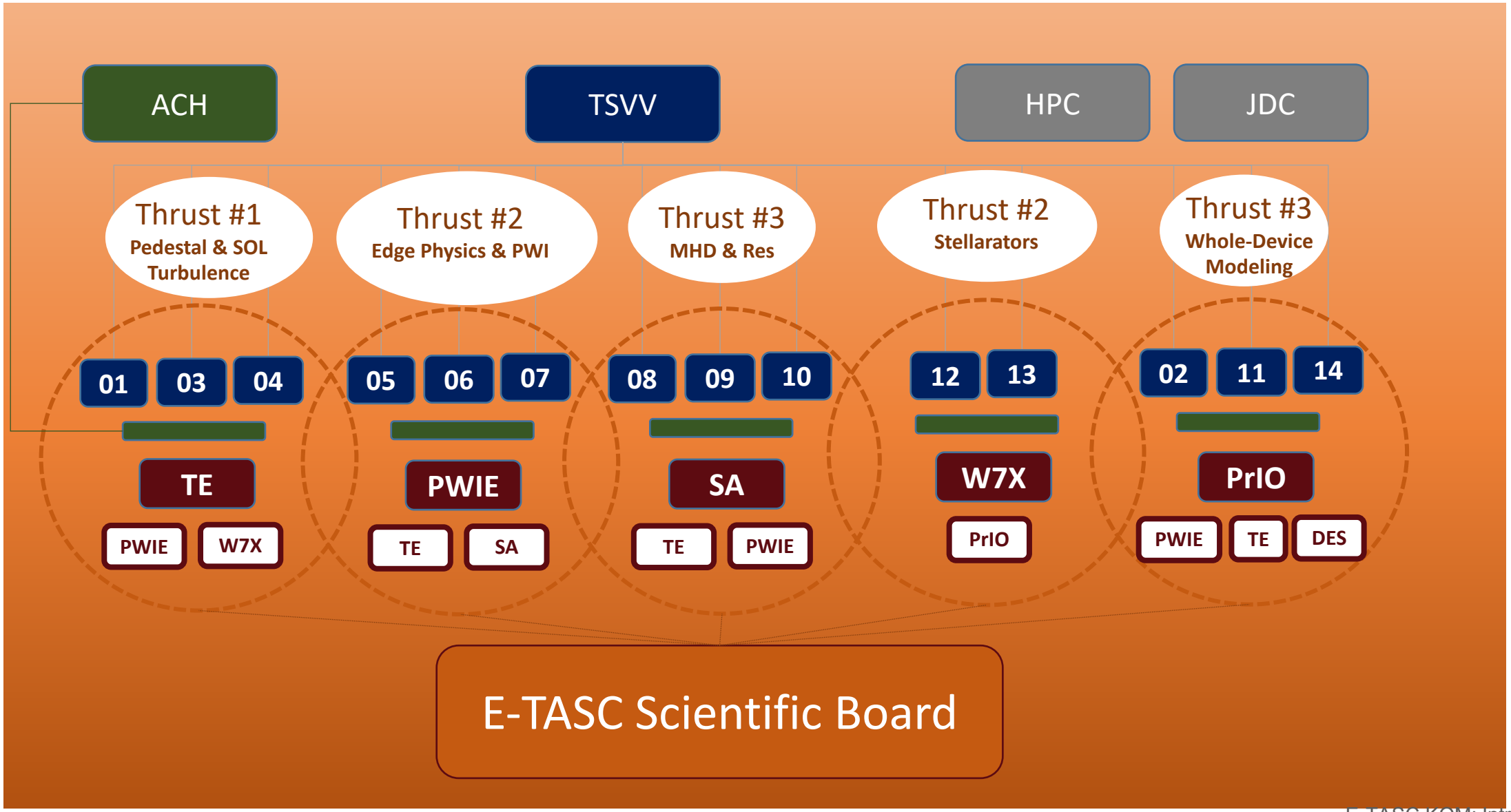
TSVV

Develop state-of-the-art codes for the WPs to also be used for ITER and DEMO

ACH

Support the TSVVs in code development

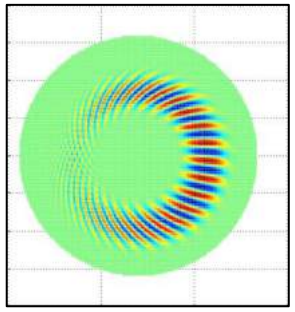
# Implementation of activities (Thrusts)

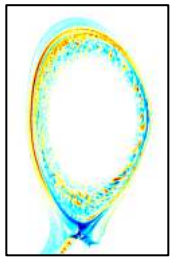


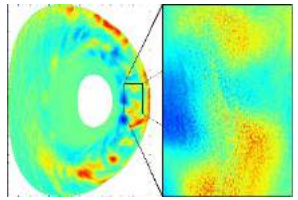

Thrusts coordinate science work and give input to the SB

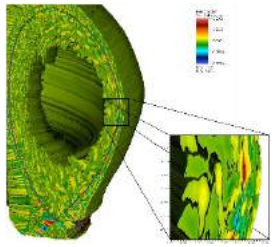
# Challenge #1: From highly idealized models to virtual fusion systems

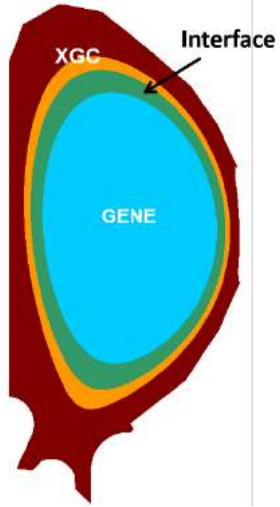
Increasing fidelity & modeling capability with increasing computing power

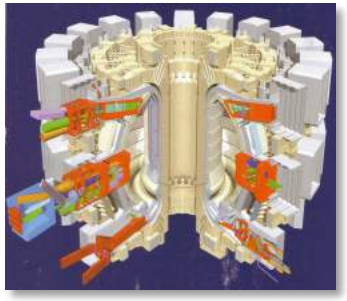


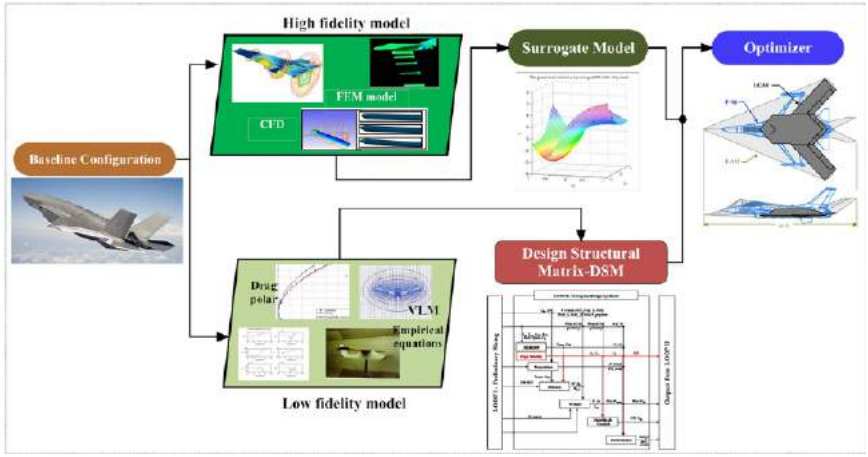


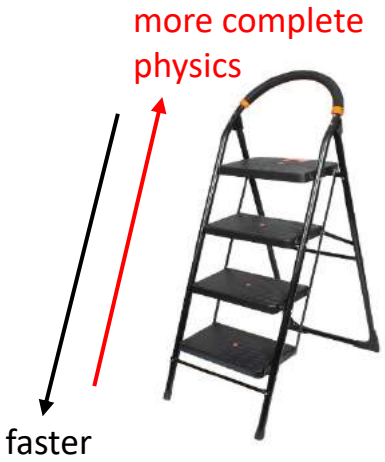









**Multi-fidelity approach:**

- HiFi models for reliable extrapolation/prediction
- LoFi models (based on HiFi models) for high-throughput computing & real-time applications (incl. control)

Both are needed – together

# Challenge #2: From research codes to EUROfusion standard software

An up-to-date release version of the source code used for production runs must be freely available within EUROfusion via a suitable license

Good software engineering practices (version control, regression/unit tests, shared development rules etc.)

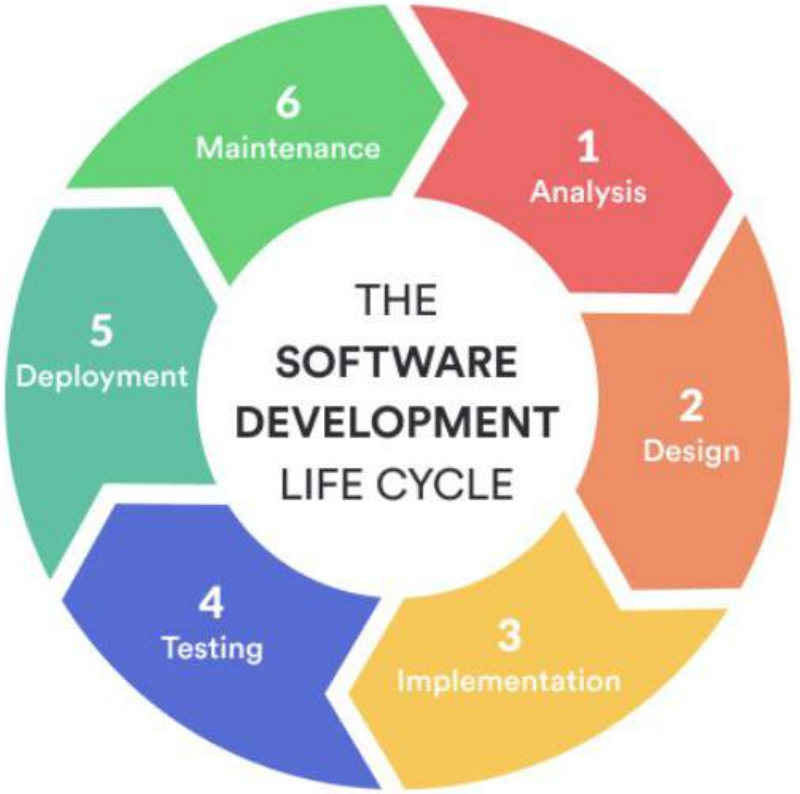
Code documentation (user manuals, reference publications)

Good support for users and co-developers

Specific plans for code verification and validation including aspects of uncertainty quantification

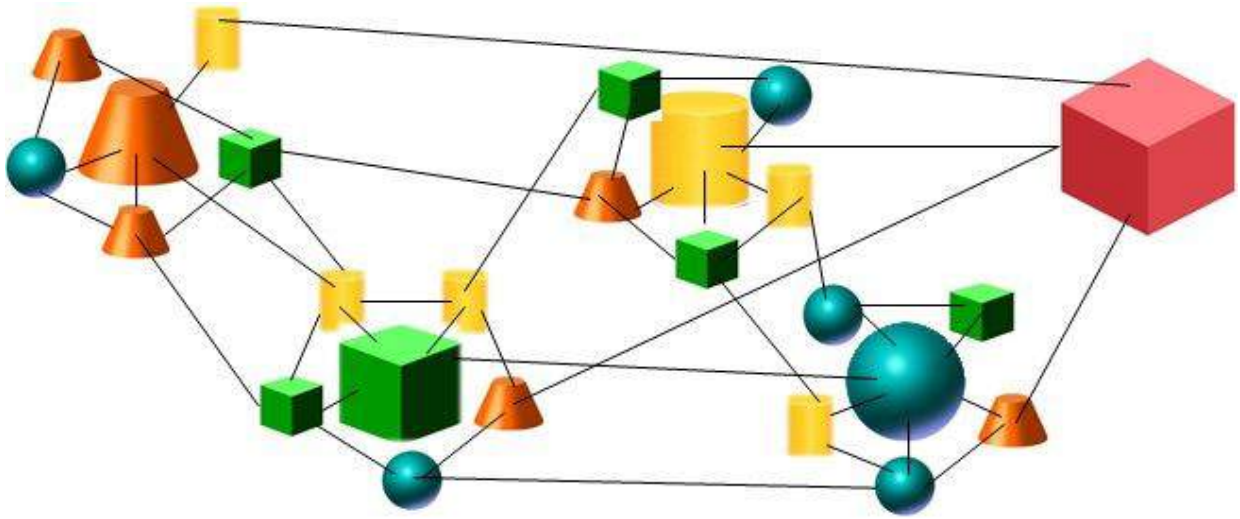
Specific plans to provide interfaces to IMAS (if applicable)

Specific plans for code dissemination



# Challenge #3: From a „wildflower garden“ to a „team of teams“

## Team of teams



Shared purpose

Strong connectivity

Free information sharing

Empowered execution

Leaders as gardeners

# **Preliminary** Thrust composition (based on input provided to the SB)

**Thrust 1: Pedestal & SOL Turbulence**

Facilitator: N. Vianello (M. Wischmeier) **[WPTE]**

Involving: T. Görler; P. Tamain; D. Told **[TSVV 1, 3, 4]**

A. Alonso; S. Brezinsek **[WPW7X, WPPWIE]**

E. Serre; C. Roach **[E-TASC SB]**

**Thrust 2: Edge Physics & PWI**

Facilitator: S. Brezinsek **[WPPWIE]**

Involving: D. Borodin; G. Ciraolo; D. Matveev **[TSVV 5, 6, 7]**

A. Alonso; C. Sozzi; M. Wischmeier **[WPW7X, WPSA]**

A. Hakkola; E. Tsitrone **[WPTE]**

B. Braams, D. Tskhakaya **[E-TASC SB]**

**Thrust 3: MHD & REs**

Facilitator: C. Sozzi **[WPSA]**

Involving: M. Hölzl; E. Nardon; O. Mishchenko **[TSVV 8, 9, 10]**

S. Brezinsek; I. Calvo **[WPPWIE, WPW7X]**

E. Joffrin; A. Hakkola **[WPTE]**

F. Zonca, R. Coelho **[E-TASC SB]**

**Thrust 4: Stellarators**

Facilitator: I. Calvo **[WPW7X]**

Involving: P. Helander; J. Regana **[TSVV 12, 13]**

X. Litaudon **[WPPrIO]**

L. Villard; F. Jenko **[E-TASC SB]**

**Thrust 5: Whole-Device Modeling**

Facilitator: X. Litaudon **[WPPrIO]**

Involving: J. Ball; C. Bourdelle; J. Morris **[TSVV 2, 11, 14]**

A. Dinklage; S. Brezinsek **[WPW7X, WPPWIE]**

B. Labit, E. Joffrin **[WPTE]**

P. Strand; A. Kirschner **[E-TASC SB]**

# Roles and responsibilities

**TSVV/ACH PIs** will lead their respective projects on a day-to-day basis, according to the research plan outlined in their proposals; they are responsible for the implementation and reporting of the planned activities

**Thrusts** will provide a platform for discussion and interaction between (subsets of) **TSVV PIs**, **PLs/TFLs**, and **E-TASC SB members** throughout the year. **TSVV PIs** can bring new results and developments to the attentions of the **PLs/TFLs**, while the latter can bring needs and opportunities to the attention of the former, and **E-TASC SB members** can help to make sure that E-TASC operates as a joint effort of all 14 TSVVs and 5 ACHs

In addition, the (entire) **E-TASC SB** - including the PLs - will interact with them twice per year (in meetings involving 35-40 people), mainly to:

- monitor the progress of each TSVV
- suggest possible modifications to the research plan (if and when necessary)
- facilitate the coherence within the overall E-TASC activities (all TSVVs and ACHs)

# Some practical issues

**Annual meeting cycle** (additional meetings can be scheduled as needed)

| | |
|---|---|
| Mar | Thrust meeting |
| June | E-TASC SB meeting with TSVV/ACH PIs |
| Sept | Thrust meeting |
| Dec | E-TASC SB meeting with TSVV/ACH PIs (AWP, incl. review of annual reports) |

**Annual reporting cycle**

TSVV/ACH PIs submit brief reports and updated work plans to the E-TASC SB prior to the Dec meeting
These will be assessed, possibly with modifications, by the E-TASC SB before being recommended to the Theory PB

**Publications**

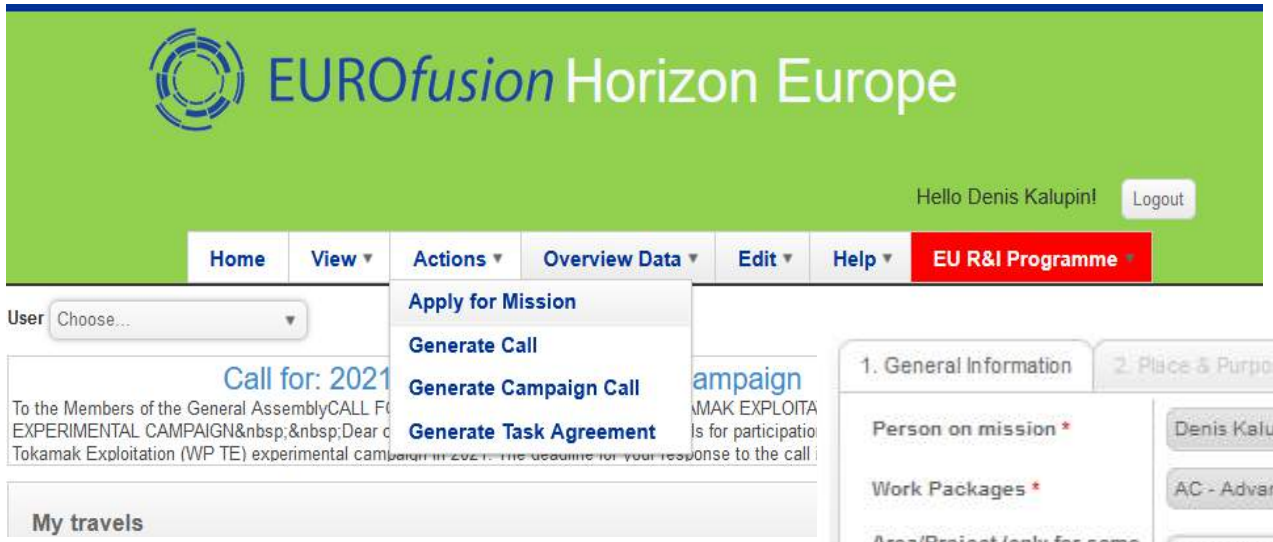
All publications and presentations to international conferences must follow the EUROfusion publication rules: https://users.euro-fusion.org/webapps/pinboard/EFDA-JET

Publications are endorsed by the TSVV/ACH PI and one of the Thrust's PLs/TFLs

# Missions

IMS mission application is required – **approval by the PMU**

**Limited mission funds are available for TSVV / ACH team members** for travelling within their projects or for TSVV staff visiting ACH (Missions of TSVV / ACH team members related to WP activities must be funded through the relevant WP)





Mission rules in FP9 have changed:

- no unit costs, all missions will be done on **actual costs**
- **tickets are eligible**
- support level: **70%** (indirect costs are eligible)

# Use of the Gateway for TSVV/ACH activities (input from Gateway Expert Group)

The role of the Gateway (GW) evolves to include:

- A home for joint code development including all of the necessary compilers, libraries, and software (incl. VC)
- A host for EUROfusion scientific software development with repository, trouble ticket, and CI/CD infrastructure
- A home where codes that are developed within the TSVVs, ENRs, and other parts of EUROfusion are deployed (as part of their deliverables), including all codes in the European Standard Software stack
- A home for EUROfusion developed scientific databases
- A place where medium scale (non-HPC) codes can be run (assuming they are being used for EUROfusion work)
- A home for cloud deployable software (that could be run on the Gateway or in the academic or commercial clouds)

In addition, a Long Term Simulation Storage Facility (LTSSF) be established (as a part of the GW or separate) where simulation results from across EUROfusion can be stored, catalogued, and made available to others (subject to access rights determined by the owner), with a minimum guaranteed storage period of 10 years.

**Recommendation report for GW renewal is due by the end April — please send any comments to David.Coster@ipp.mpg.de*

# Concluding remarks

**Points for (future) discussions**

Suitable ways of freely sharing information

Hosting and sharing of source codes

**The main purposes of today‘s meeting**

Networking within the (core) E-TASC community, within Thrusts and beyond

Matchmaking between TSVV leaders and ACH leaders, refining existing ideas or creating new ones

(Note: The resulting plans will be reviewed by the E-TASC SB well before July 1, 2021)

# Annex

# Communication (1/3)

## IMS – information (financial) management

The contractual information for all TSVV/ACH projects will maintained in https://IMS.euro-fusion.org.

**PIs** will get access to their project area (implemented under the WP AC) and must maintain Task and Deliverable description following recommendation from the SB. **PMU** (in consultation with PIs) will maintain the financial planning of the project in IMS. IMS must be also used to manage all the missions by the project participants.

## IDM – document management

The contractual documents (e.g. Task Agreement) and reporting is to be done through https://IDM.euro-fusion.org.

**PIs** will get access to the stored documents and the possibility to upload reports.

All systems are linked to the EUROfusion Active Directory (AD) and share user credentials, but the access must be authorized separately.

# Communication (2/3)

## WIKI pages – project working area

All TSVV / ACH projects will maintain a Wiki page accessible to all EUROfusion members (same as e.g., WPs or TF Wikis) which documents the team, deliverables, scope, meetings, results, links with various WPs, use of experimental data, reports, publications.

https://wiki.euro-fusion.org/wiki/WPAC_wikipages:_Advance_Computing_Work_Package

## INDICO – meetings & presentations

All TSVV / ACH projects will receive a dedicated space at

https://indico.euro-fusion.org/category/273/ (TSVV)

https://indico.euro-fusion.org/category/288/ (ACH)

These must be used to organise meetings and store meeting materials. Principal Investigators are given the management right to the INDICO category (folder) dedicated to their project. Please note that, any materials uploaded to the EUROfusion INDICO system will remain there for the entire Horizon Europe framework (at least).

# Communication (3/3)

To simplify communications between different stakeholders following mailing lists have been established:

**ACH-PI@euro-fusion.org** - Mailing list - consists of emails from all ACH PIs

**ETASC-SB@euro-fusion.org** - Mailing list – consists of emails from all E-TASC SB members

**FSD_PL_TFL@euro-fusion.org** - Mailing list - consists of emails from all FSD PLs/TFLs

**TSVV-PI@euro-fusion.org** - Mailing list - consists of emails from all TSVV PIs

**Denis Kalupin:** denis.kaluipn@euro-fusion.org (also through ZOOM); **dkalupin** (SKYPE); tel: +49 89 3299 4203