First half-a-year of the Advanced Computing Hub in Finland

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Open Business Days 2022
4.5.2022

HELSINGIN YLIOPISTO
HELSINGFORS UNIVERSITET
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EUROfusion E-TASC enables 19 theory and advanced simulation projects

- *“The EUROfusion consortium for the realisation of fusion energy has awarded funding for nineteen research projects in theory and advanced simulation to scientists across Europe. The fourteen research projects and five advanced computing hubs selected for the Work Plan 2021-2025 will strengthen understanding and predicting of fusion processes in the European fusion programme.”*

- The 14 TSVVs started 1.4.2021 and the 5 ACHs 1.7.2021

FinnFusion
VTT
Aalto University
Åbo Akademi University
CSC

E-TASC SYSTEM
ACH categories

- **Category 1**: **High Performance Computing** (scalable algorithms, code parallelization and performance optimization, code refactoring, GPU-enabling etc.) **MPG, BSC** and **EPFL**

- **Category 2: Integrated Modelling and Control** (code adaptation to IMAS, IMAS framework development, code integration etc.) **IPPLM**

- **Category 3: Data Management** (open access, data management, data analysis tools, aspects of AI and VVUQ etc.) **VTT**

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Premises

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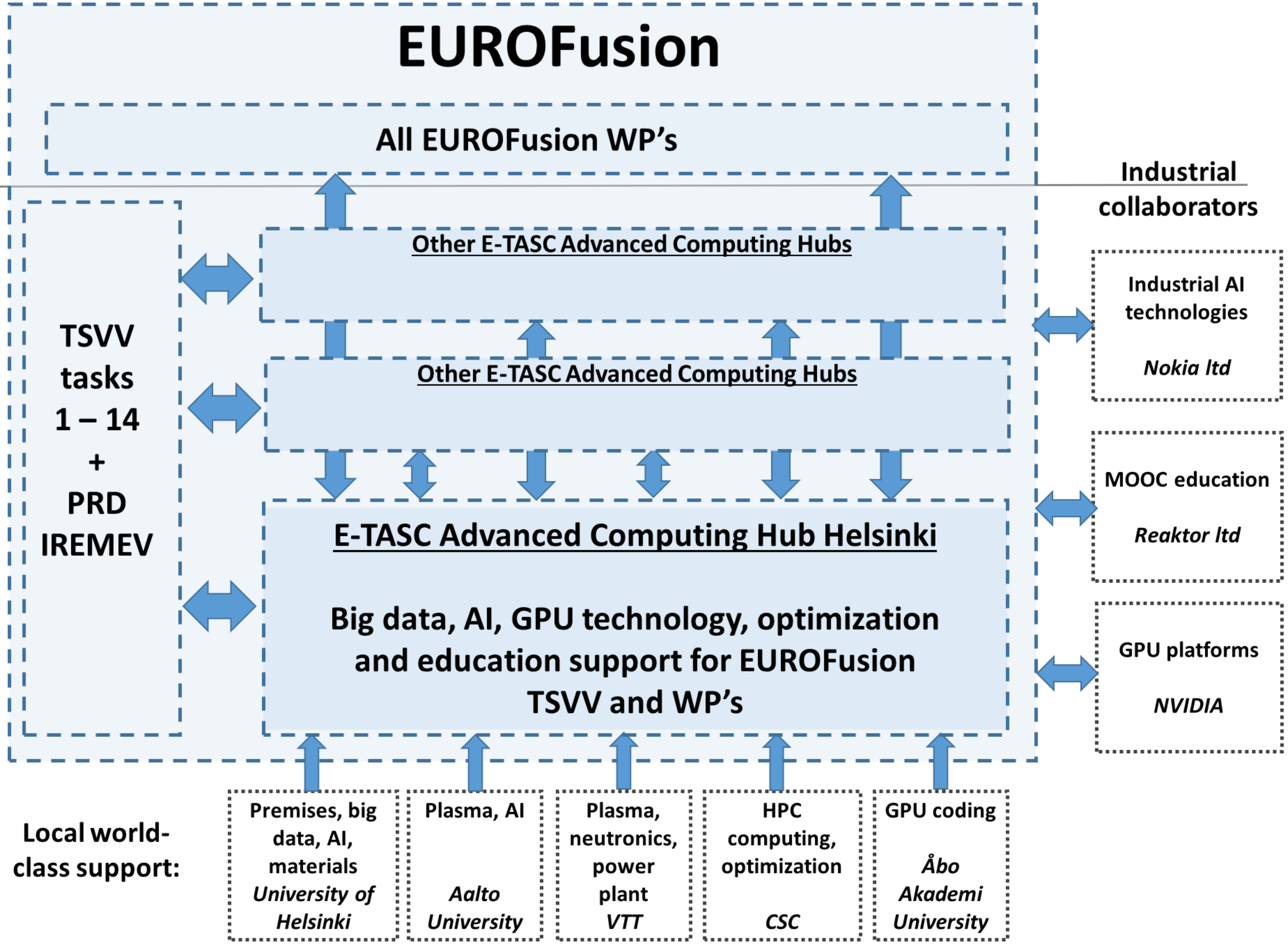
Structure



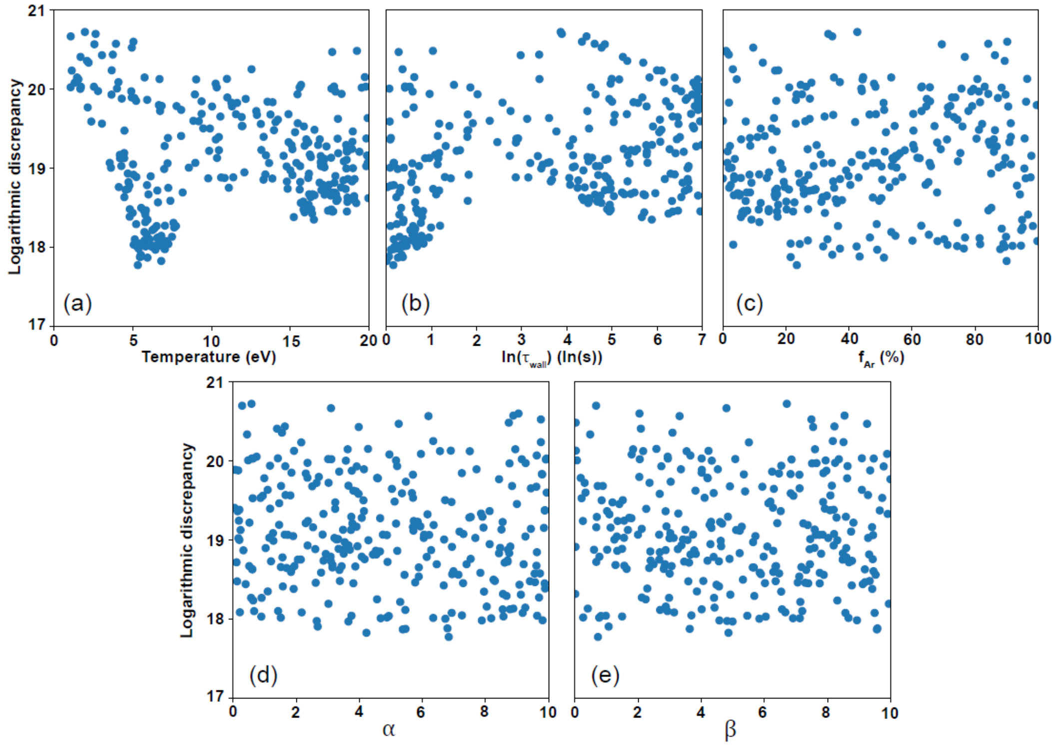
EUROFusion
All EUROFusion WP's
TSVV tasks 1 – 14 + PRD IREMEV
Other E-TASC Advanced Computing Hubs
Other E-TASC Advanced Computing Hubs
E-TASC Advanced Computing Hub Helsinki
Big data, AI, GPU technology, optimization and education support for EUROFusion TSVV and WP's
Industrial collaborators
Industrial AI technologies
Nokia ltd
MOOC education
Reaktor ltd
GPU platforms
NVIDIA
Local world-class support:
Premises, big data, AI, materials
University of Helsinki
Plasma, AI
Aalto University
Plasma, neutronics, power plant
VTT
HPC computing, optimization
CSC
GPU coding
Åbo Akademi University

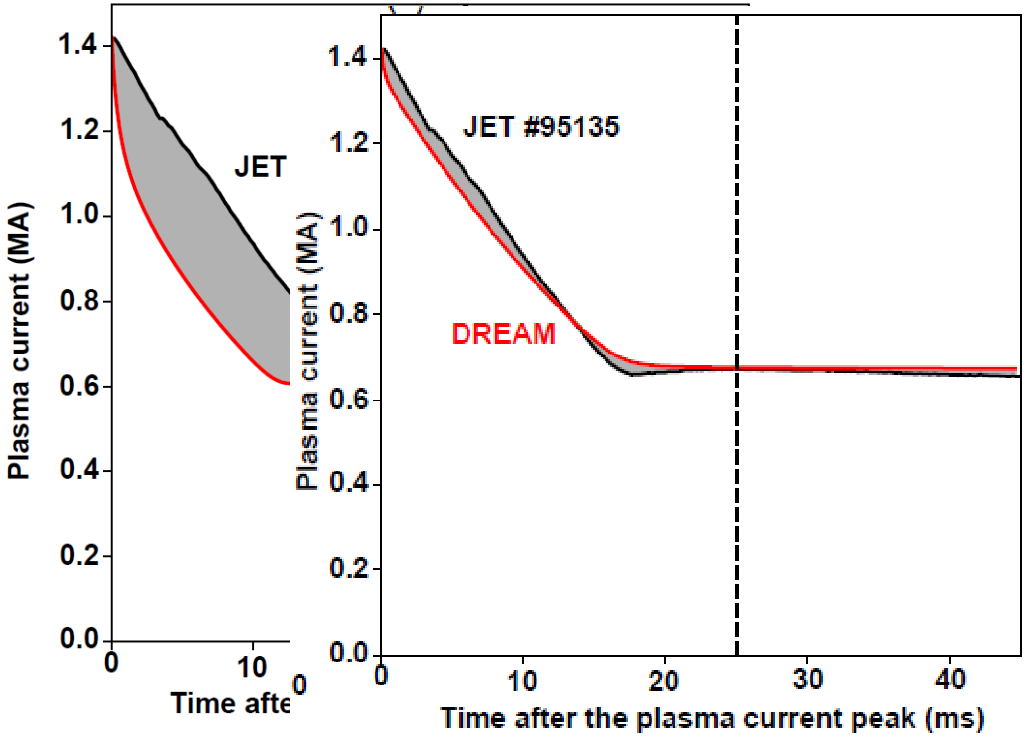
Few examples, almost finalized
Linear solver -> quad-precision GPU iterative solver

- The current linear solver not good enough
- Conventional iterative solvers did not yield reliable/correct results
  - Several tested
- However, almost all solvers are double precision
  - Not enough for these simulations, which was identified
- A quad-precision solver was found and verified to yield the correct result
  - Already a very significant improvement
- A quad-precision iterative solver working on GPUs are almost finalized
  - Will help with the increased computational effort needed for the higher precision

Few examples, almost finalized Bayesian approach for validation

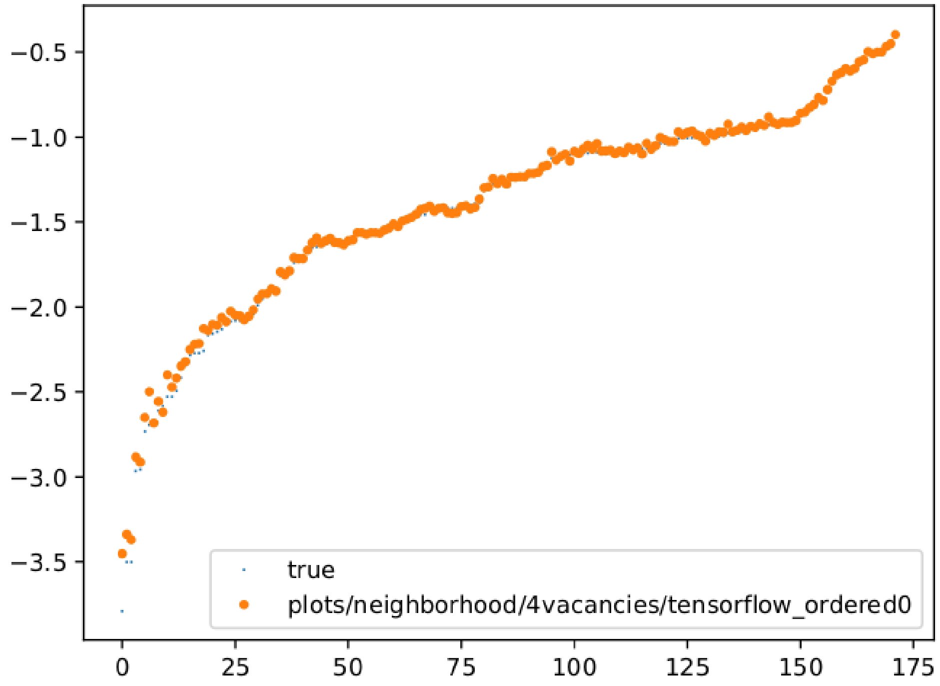
- Utilization of Bayesian approach for determination of uncertain input parameters





Few examples, ongoing
AI in prediction of material properties

- Quantum accurate, DFT based MD simulations can predict very well the properties of certain materials
  - The simulations are very CPU intensive and only a limited amount are feasible to run
- We try to find AI methods based on the achievable data to predict the properties with a much lower computational cost
- The developed methodology and schemes can be adopted to other aspects in materials research



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Few examples, ongoing
Data collection for AI methods

- Currently the experimental (and simulation) data are stored at different places and in different format
  - For instance, JET data, ASDEX upgrade data…
  - IMASification should help here
- AI methods need much data from various places
  - Usually quite small amount of specific data
  - Currently the APIs to get the data are aimed for serial access and few data points
  - Easy to get all data related to a certain experiment, hard to get one parameter from all
- In order to in the future be able to easily access and gather data for AI applications, effort needs to be placed on this

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Few examples, just started
Collaboration with Quanscient

- Possible via the ”EcoFusion” Business Finland project

- Utilization of Cloud and Quantum computing in fusion application
  - Currently a project has started 1st of May 2022

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