4th Annual Meeting of EUROfusion HPC ACHs, Garching, Germany

ACH CIEMAT-BSC

Report of the Team Leader

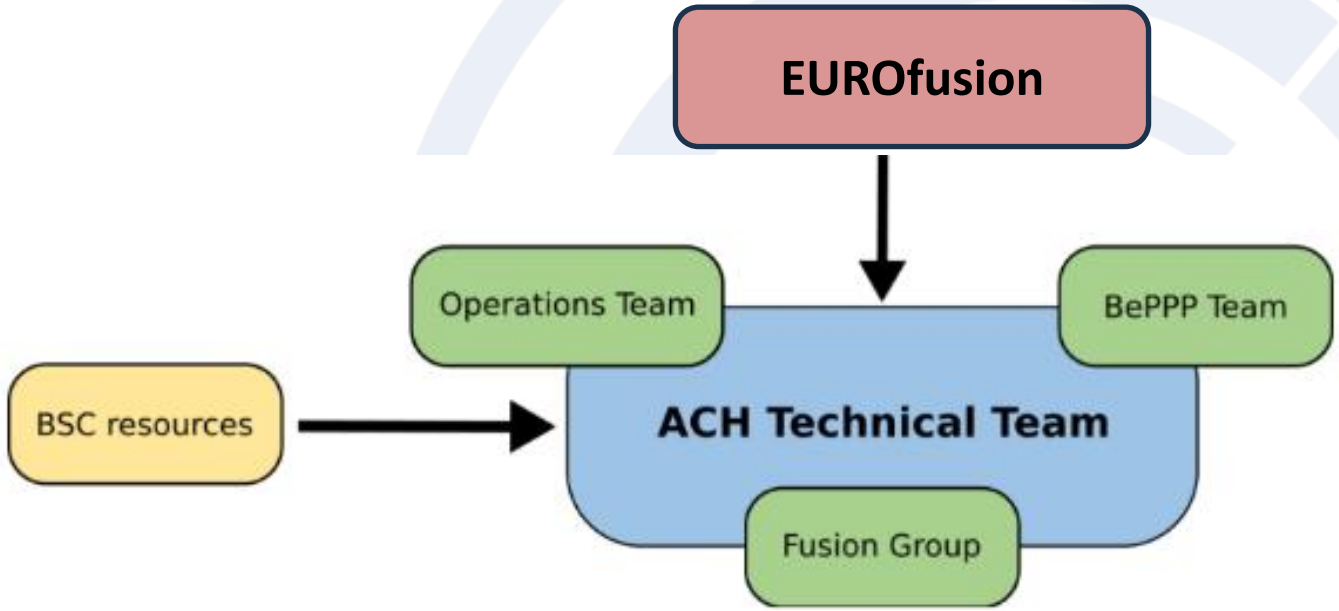
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ACH CIEMAT - BSC

- BSC, affiliated to EUROfusion via CIEMAT, hosts one of ACHs **in HPC**
- Recently described in Saez et al. PPCF 2024 and Saez et al. submitted to Applied Sciences 2026
- Involves **three groups** at BSC:
  - 6-7 people in Fusion Group
  - 2 people in Operations
  - 2 people in Best Practices for Performance and Programmability (BePPP)
- **Total effort**: 400 pms ≈ **33 ppy in 2021-2026;** 72 pms in 2026.



Key issue for planning: Extension of EUROfusion ACHs beyond the end of 2027

BSC ACH codes and tasks (2021-2026)

Up to now, **17 codes supported.**

Code characteristics:

- Mainly plasma physics codes
- Mostly CPU-only
- Written in C, C++ and Fortran
- MPI and/or OpenMP
- Under active development by physicists, mathematicians etc.

ACH tasks mainly on

- performance optimization
- GPU-enabling
- scalable algorithms
- code parallelization

Our general principles:

- Maximize performance
- Aim for good portability between architectures
- Aim for least modification to the code/no rewrite

14 codes supported by CIEMAT/BSC ACH in 2021-2025

Project/Work Package	Code	Main work
TSVV-03	BIT1	Optimization, GPU porting.
TSVV-04	GENE-X	Reordering strategy
TSVV-07	ERO2.0	Optimization, GPU porting.
	SPICE2	Optimization, Petsc inclusion.
TSVV-08	JOREK	SVD using ScaLAPACK, Eigenvalues using ELPA and ScaLAPACK
TSVV-10	X-TORK	Optimization, GPU porting.
TSVV-12	KNOSOS	Optimization over MPI
	VM2MAG	Improve parallelisation
	GVEC	Optimization over OpenMP.
	SPEC	Scalability over OpenMP.
	BOUT++	Installation and Optimization.
TSVV-13	STELLA	Improve the initialisation process, ScaLAPACK LU solver.
WPTE	SOLPS	MPI+OpenMP Optimization.
WPTRED	ALYA	Optimization using vectorization and GPU.

2026: 11 codes, of which 3 are new to our ACH

Code(s)	Work Package	Tasks required
JOREK and DREAM	TSVV-F	Couple JOREK and DREAM to coevolve plasma + runaway electron dynamics while running simultaneously
CARIDDI	TSVV-F	Support to efficiently use GPUs for modal decomposition problems emerging in the coupling of MHD plasma models and wall electromagnetic models.
SOLPS-ITER	WPTE	Improve parallelization performance of SOLPS-ITER, with emphasis on OpenMP implementation in Eirene and the new B2.5 wide grids plasma solver
SPICE2	WP PWIE, WP TE	Perform optimization of collision operators for all implemented collision types. Propose optimization possibilities for inter-process communication with respect to possible hybrid OpenMP/MPI parallelization.
BIT-GPU	TSVV-C, TSVV-B and WP-PWIE	Completion of BIT1-GPU development: 1. Completing GPU port - adding OpenACC directives to the remaining code parts; 2 fixing observed bugs, 3. performing optimization of the performance and of the data management for productive scale runs on GPU.
ERO2	TSVV-D	A full-functioning GPU version of the code demonstrated on a full scale
XTOR-K-GPU	TSVV-G	GPU transition of XTOR-K: fluid/particle interface and fluid solver.
Alya	WP TRED	Further optimize Alya's fusion-related physics modules through GPU fine-tuning, performance improvements and enhanced scalability.
STELLA-SCAL	TSVV-J	Continuous assessment to ensure that the performance of the new code versions preserves the scalability achieved so far with the electrostatic and flux-tube implementations and improve the performance and scalability of the latter.
XTAPAS	WPTE	Improve the scalability/performance of the newly developed eXtended Toroidal Accelerated PArticle Simulator (XTAPAS), a hybrid MHD-kinetic code accelerated on GPUs.

HPC leadership roles in EUROfusion Committees

Organization of EUROfusion **Ticket Committee** (TC) meetings.

Participation in

- EUROfusion **HPC Project Committee**
- EUROfusion **Operations Committee**
- EUROfusion **HPC Allocation Committee**

Related activities: Organization of annual Fusion HPC workshops



- Online by zoom
- Call for invited and contributed talks now open until 30th October
- More information: hpcfusion.bsc.es

Thank you



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