



## ACH@BSC-CIEMAT: High-Performance Computing

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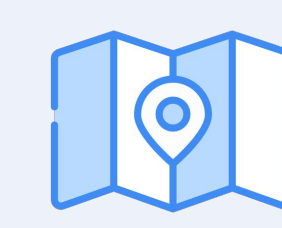
### EUROfusion Advanced Computing Hubs

EUROfusion coordinates theory and advanced simulation through two complementary elements:

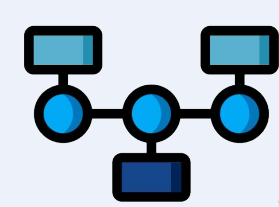
- **Theory, Simulation, Validation and Verification tasks (TSVV)**, which perform fundamental research and channel scientific insight
- **Advanced Computing Hubs (ACHs)** which provide advanced simulation expertise to TSVVs

#### ACH Main Activities

- Performance analysis & optimization of fusion modelling codes
- Refactoring, parallelization & GPU porting for heterogeneous systems
- Software engineering support (Git/GitLab, CI/CD, testing, verification)
- Continuous performance monitoring on reference HPC systems
- User support & technical coordination

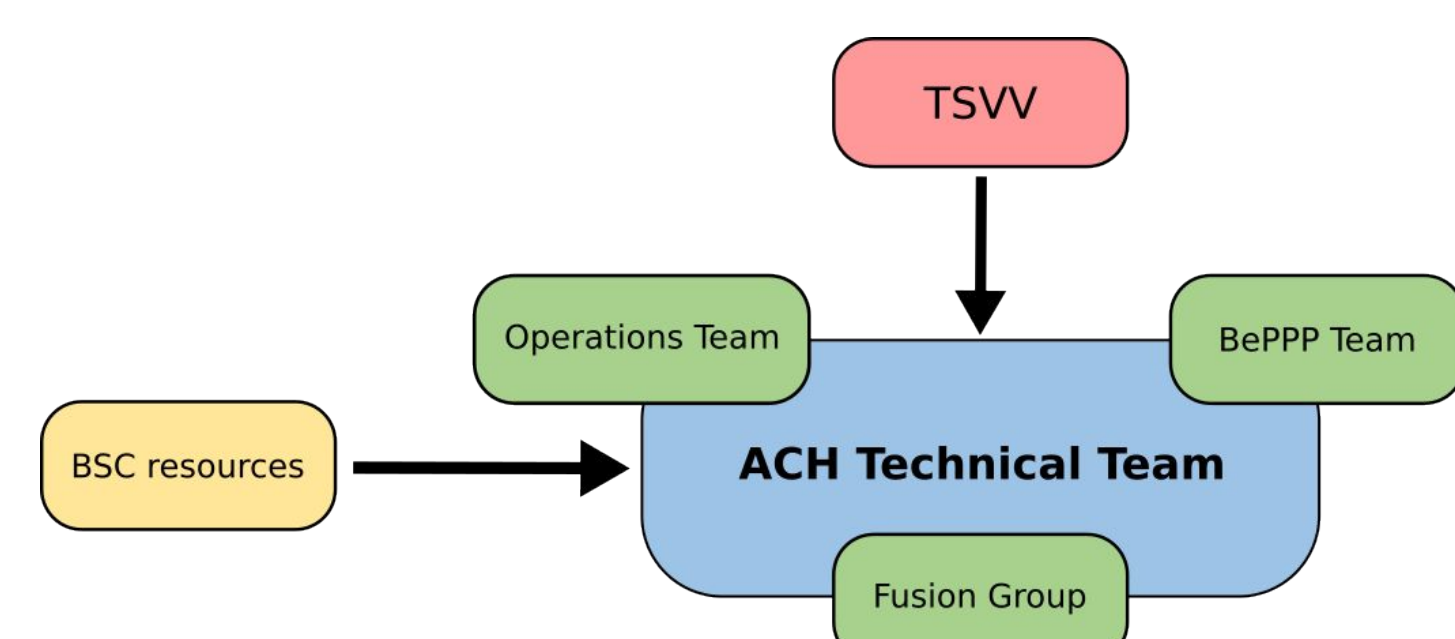


### ACH Network Map



### ACH@BSC-CIEMAT

Provides expert support to users regarding HPC: *scalable algorithms, code parallelization, performance optimization, code refactoring, GPU-enabling, ...*



|  |  |
|--|--|
| <b>BePPP</b><br>Best Practices for Performance and Programmability | Programmability, portability, deep performance analysis tools  |
| <b>Operations</b>  | Optimization and scalability study, parallelization assistant  |
| <b>Fusion</b>  | GPU porting, parallelization of codes (use of HPC libraries), development of parallel algorithms, performance and scalability analysis |

10% Mathematicians  
20% Physicists  
70% Computer scientists

- Presented works in 7 workshops  
- Presented a webinar for the code developers (JOREK)

Published 6 papers

62 meetings with developers

Participated in 6 hackathons (3 BIT1, 2 XTOR-K, 1 ERO2)

- Chair of the Ticket Committee (TC)  
- Member of the Operations Committee (OC)

### Tasks done and on going



2025

10 code requests  
8 TSVV + TE + TRED

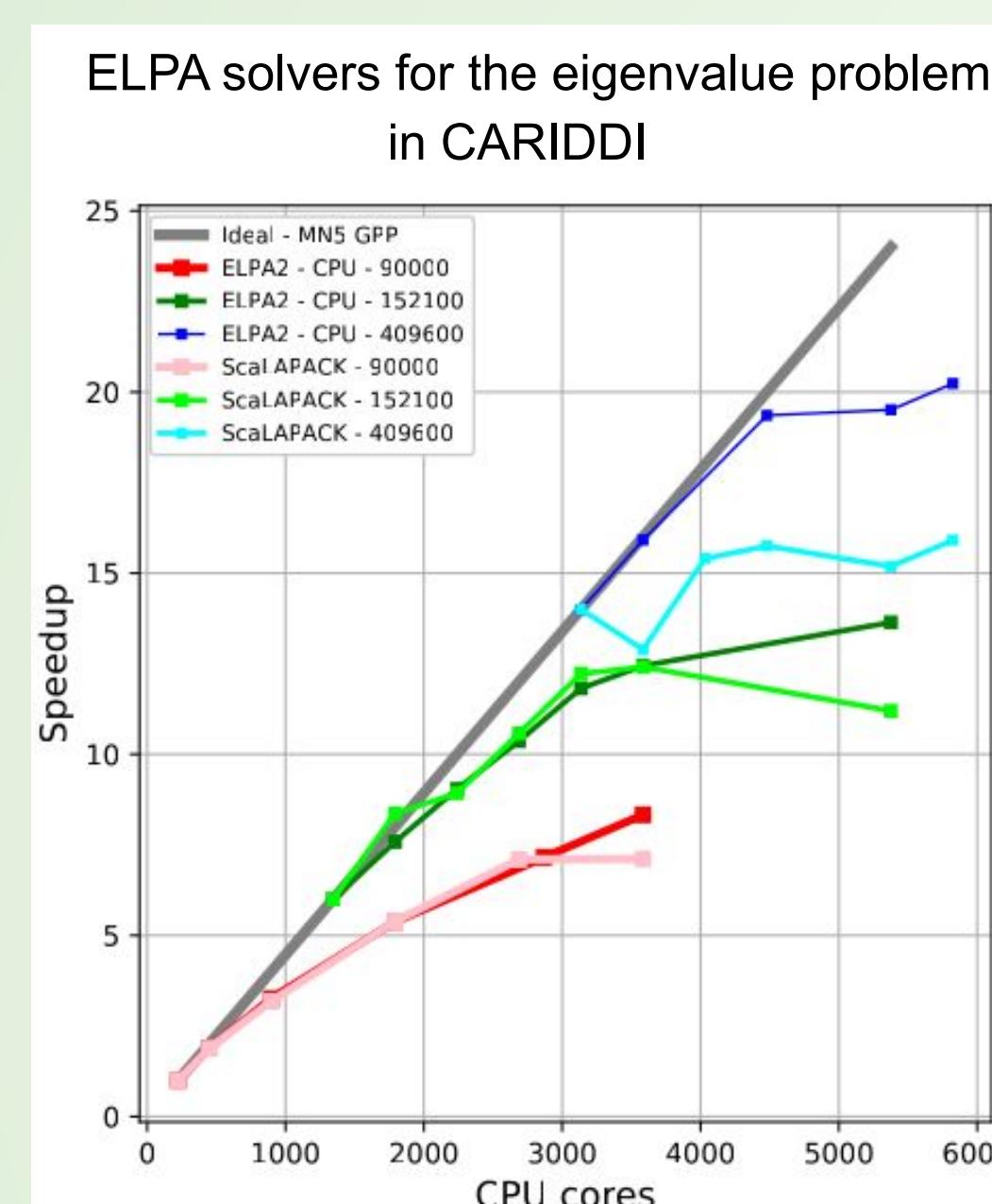
2026

11 code requests  
3 new requests for our ACH  
1 request from another ACH  
6 TSVV + PWIE + TE + TRED

| 2025   | TSVV  | 2026   | TSVV  |
|--|---|--|---|
| ERO2.0<br>BIT1<br>XTOR-K<br>JOREK<br>SPICE2<br>SOLPS<br>Stella<br>Alya<br>GENE-x<br>GVEC | TSVV-2<br>TSVV-4<br>TSVV-3<br>TSVV-7<br>TSVV-8<br>TSVV-10<br>TSVV-12<br>TSVV-13<br>TE<br>WP TRED (Training and Education) | XTAPAS (JOREK-DREAM)<br>CARIDDI<br>ERO2.0<br>BIT1<br>XTOR-K<br>SPICE2<br>SOLPS<br>Stella<br>Alya | TSVV-F<br>TSVV-C<br>TSVV-B<br>TSVV-D<br>TSVV-G<br>TSVV-J<br>WP-PWIE<br>WPTE<br>WP TRED (Training and Education) |
| CINCOMP(2025)<br>TC (2023)   | AC-HPC<br>TC (2023)   | CINCOMP(2025)<br>TC (2023)   | AC-HPC<br>TC (2023)   |

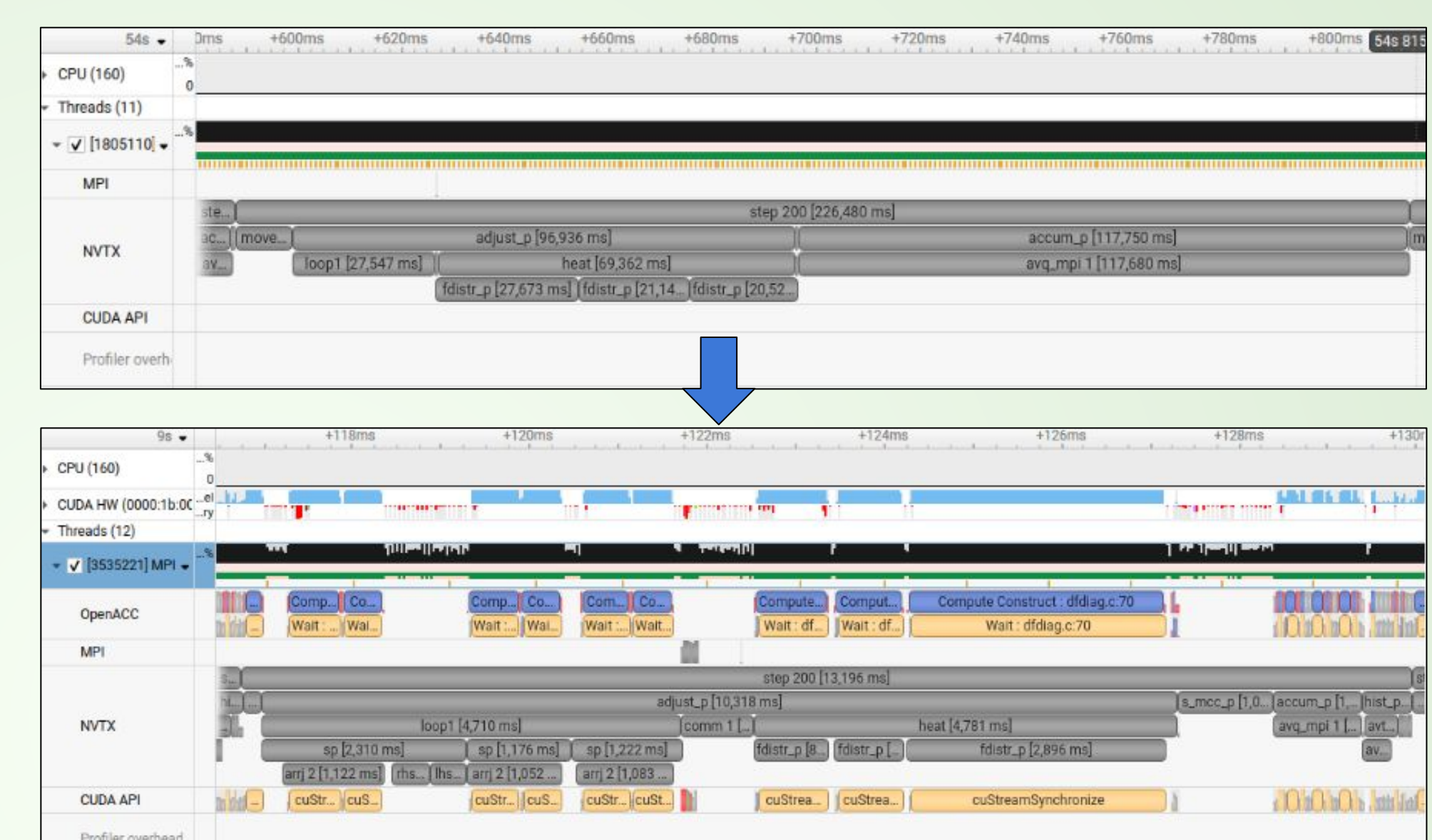
### JOREK

- **Matrix compression in the JOREK-CARIDDI coupling**



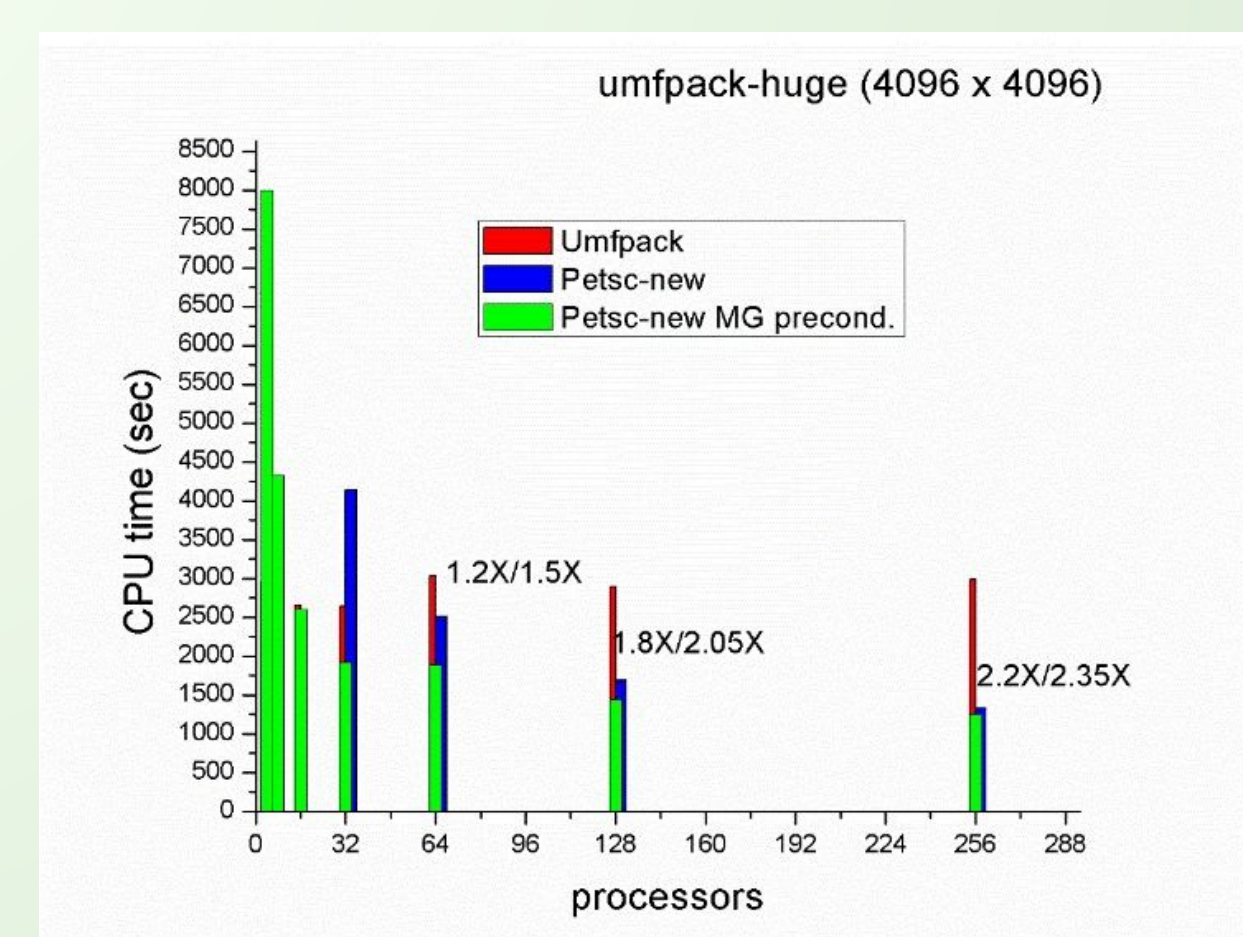
### BIT1

- **Porting to GPU (~7x faster)**



### SPICE2

- **Parallel solver based on PETSc to simulate larger domains**



### ACH@BSC - Key Outcomes and Impact

- **Key HPC enabler for EUROfusion**, providing essential HPC expertise
- **Ensures scalable, exascale-ready fusion codes**, improving code performance
- **Drives innovation through GPUs and AI**
- **Maximizes performance and efficient use of HPC resources**
- **Strengthens the EUROfusion ecosystem**, through coordinated support, training, and collaboration across European HPC centers