



# ACH in Category I (HPC) at CIEMAT - Barcelona Supercomputing Center

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- ▶ Spanish **research Centre of Excellence and National Supercomputing Centre**.
- ▶ **EUROfusion** third party via **CIEMAT**.
- ▶ Mission: **research**, **implement**, **manage** and **transfer** technology and knowledge in the **field of HPC**.
- ▶ Founding member of **PRACE**.
- ▶ Bilateral **joint research centres** and **collaboration** agreements with **key HPC players**:

## MareNostrum4 & 5



- **MareNostrum4 13.7 PFLOPS**, 165k cores
- **EuroHPC MareNostrum5** in operation on 2021 for 5 years with **200 PFLOPS**



Lenovo



Microsoft



NVIDIA

arm

Micron™

FUJITSU

Atos

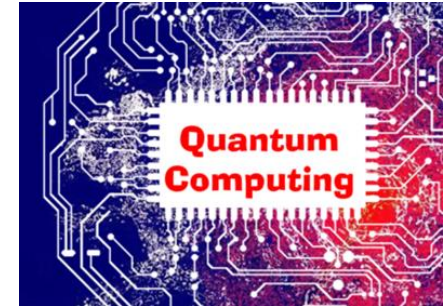


Barcelona  
Supercomputing  
Center  
Centro Nacional de Supercomputación

# BSC in EU-wide research activities and other advanced computing initiatives



- ▶ 192 H2020 projects in 2020
- ▶ 20 H2020 projects coordinated by BSC
- ▶ Involved in 12 out of 15 HPC CoEs, leading 4 of them.

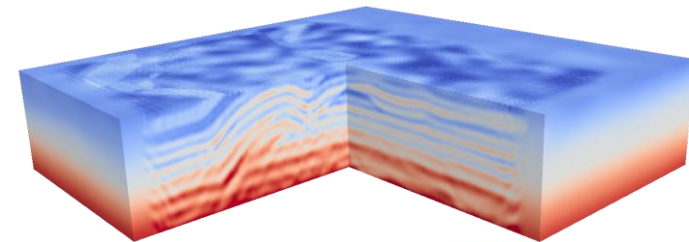
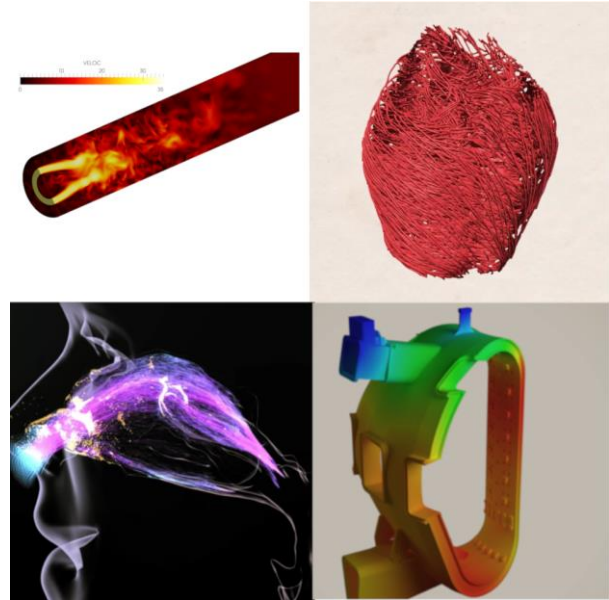




# Synergies and research on HPC numerical methods



- ▶ **Collaboration** is key in everything we do at BSC.
- ▶ Currently, 40 contracts with companies.
- ▶ **Alya**: computational mechanics code with highly scalable numerical methods (part of **6 HPC CoE**)
  - **Highly exploited and disseminated: 1 spin-off company, 10 companies collaborating.**
- ▶ **BSIT**: geophysical exploration of soil (R&D with Repsol).
- ▶ Fulfill industrial standards of **code** and **documentation**, high scalability standards & large efforts in development, verification and validation.
- ▶ Research on **HPC numerical methods**.



AIRBUS



SIEMENS

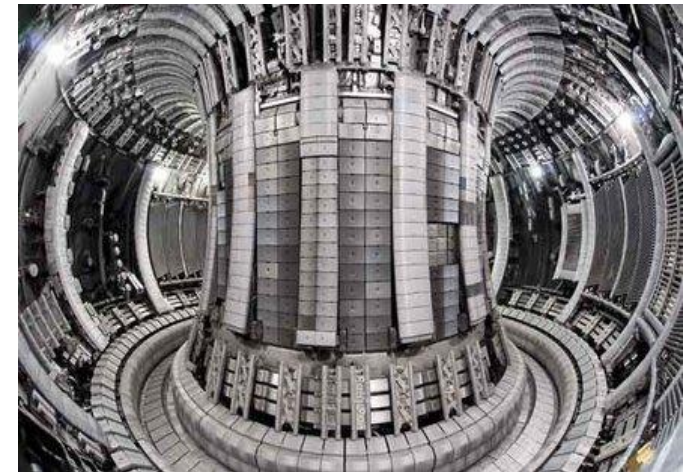
REPSOL





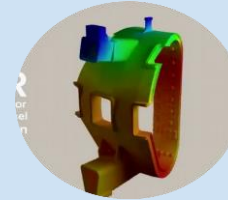
- ▶ EUROfusion **ACH** managed by **BSC Fusion group** ([fusion.bsc.es](http://fusion.bsc.es)) under leadership of M. Mantsinen, supported by BSC PMO
- ▶ Group actively participates in the **EUROfusion research programme** as third party **via CIEMAT** since 2013. Previous participation in EU fusion project EUFORIA.
- ▶ Key HPC contributions through **WPISA HLST staff member**; WPCD and WPMAG EUROfusion Engineering Grantees.
- ▶ Development and participation in **IMAS**
- ▶ Experienced in codes on heating, MHD, turbulence, fluids, electromagnetism, transport, solid mechanics, thermohydraulics...
- ▶ EUROfusion participation in WPs **JET1, W7X, MST1, S2, CD, TRA, MAG, TE, ISA** and **EDU**.
- ▶ **Scientific coordinators** for specific **JET** and **MST1** experiments and tasks

**Ciemat**





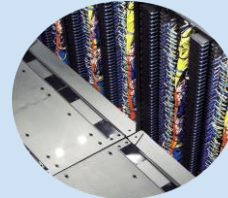
Focus on **HPC activities**:  
**performance** and **emerging technologies**



Connect BSC's reference  
HPC performance teams  
to E-TASC



Infrastructure to support  
TSVV cycle and **active role** in  
development of **standard**  
**EUROfusion software**



Use **cutting-edge HW** and  
provide **heterogeneous**  
**architectures** to prepare  
fusion codes for exascale



Bring **existing top HPC** and  
AI/ML **training** at BSC to  
ACH & add **new courses**  
focused on HPC in fusion



**Dedicated ACH team**  
**embedded** in a growing  
**interdisciplinary centre** with  
**+500 researchers on HPC**



## Storage and cloud

- **>10.000 cores available for Cloud and HTC.**
- **At the end of 2020 >150PB on disk for MareNostrum5 pre-exascale.**

## HPC compute

- **11.1 PFLOPS General purpose machine**, 165,000 cores intel SKL
- **1.6 PFLOPS with accelerators**, IBM POWER9 and NVIDIA V100 GPUs.
- 2 new clusters ongoing
  - **ARMv8** (same architecture as the future Post-K supercomputer - possibly one of the first exascale machines)
  - **AMD cluster with AMD EPYC Rome processors + MI50GPU** (500TFlops)

**MareNostrum5** will start operating on 2021 with **~200 PFLOPS**. It will be one of the three **pre-exascale machines of EuroHPC**.



# Long track record in performance, optimization & heterogeneous architectures with top partners



- ▶ BSC hosts **one of the most heterogeneous clusters** for research in Europe (Intel, NVIDIA, ARM, ATI, IBM Power9) and research groups working with other architectures (Xilinx, Altera, etc).
- ▶ BSC has a **long history** of **preparing codes** for **emerging technologies** with **top partners** as well as lot of experience in **porting codes to new architectures**.
- ▶ BSC built the first cluster in the world on **ARM** (Montblanc). It is the architecture used in the **most powerful supercomputer** in the world, Fugaku.
- ▶ BSC hosts the “**ARM** - BSC Centre of Excellence for continued innovation”, is “**NVIDIA** GPU Centre of Excellence”, hosts the “**Intel-BSC** Exascale lab”, “**IBM-BSC** Future of Computing Center”, all recognising the excellence in its research.
- ▶ Experience and excellence in heterogeneous and emerging architectures with top partners will be **available to TSVVs via BSC ACH**.





# BSC ACH links E-TASC to reference HPC performance teams in Europe



- ▶ BSC leads European **CoE** “Performance Optimisation and Productivity” (**POP**) for HPC providing **performance optimisation** and productivity services **in all domains** and hosts Best Practices for Performance and Programmability (**BePPP**) team.
- ▶ **PoP1: +140** performance assessments, **+20** proof of concept studies, **average performance** gain **+30%** and 16 BSC employees. **PoP2 ongoing**.
- ▶ BSC hosts one of the five **PRACE High Level Support Teams (HLST)** with 6 dedicated members.
- ▶ Provides support for **code enabling**, R&D on **code refactoring** and **scaling out** of scientific applications/methods on Tier-0.
- ▶ **Only center** with POP and HLST teams in the **same place**.

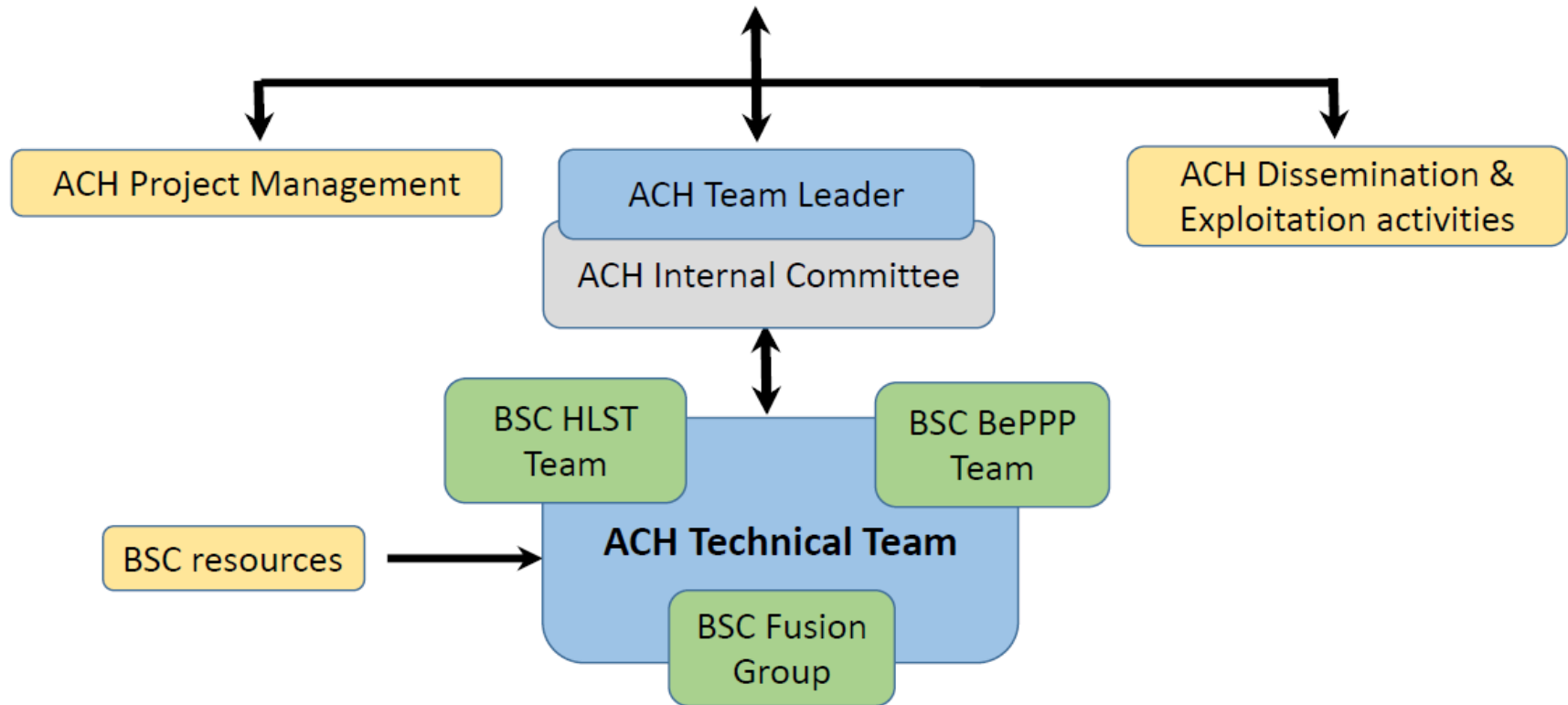


# BSC ACH management structure



**EUROfusion**

E-TASC Scientific Board, ACH PMO  
RO, Communications and FUTTA





# Manpower resources & next steps

Year	PMs
2021	12
2022	44
2023	80
2024	96
2025	96
Total	328

We look forward to making most of this opportunity with you!

ACH technical work from July 2021 onwards.

TSVV1, 4, 12 & 13 have already suggested some tasks preferably to our ACH.

Assessment of those needs and time scales together with task prioritization by SB might be the best next steps.

Thank you for your attention!

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