Barcelona Supercomputing Center
Centro Nacional de Supercomputación
www.bsc.es

The Spanish Supercomputing Network (RES)

Sergi Girona

EXCELENCIA SEVERO OCHOA

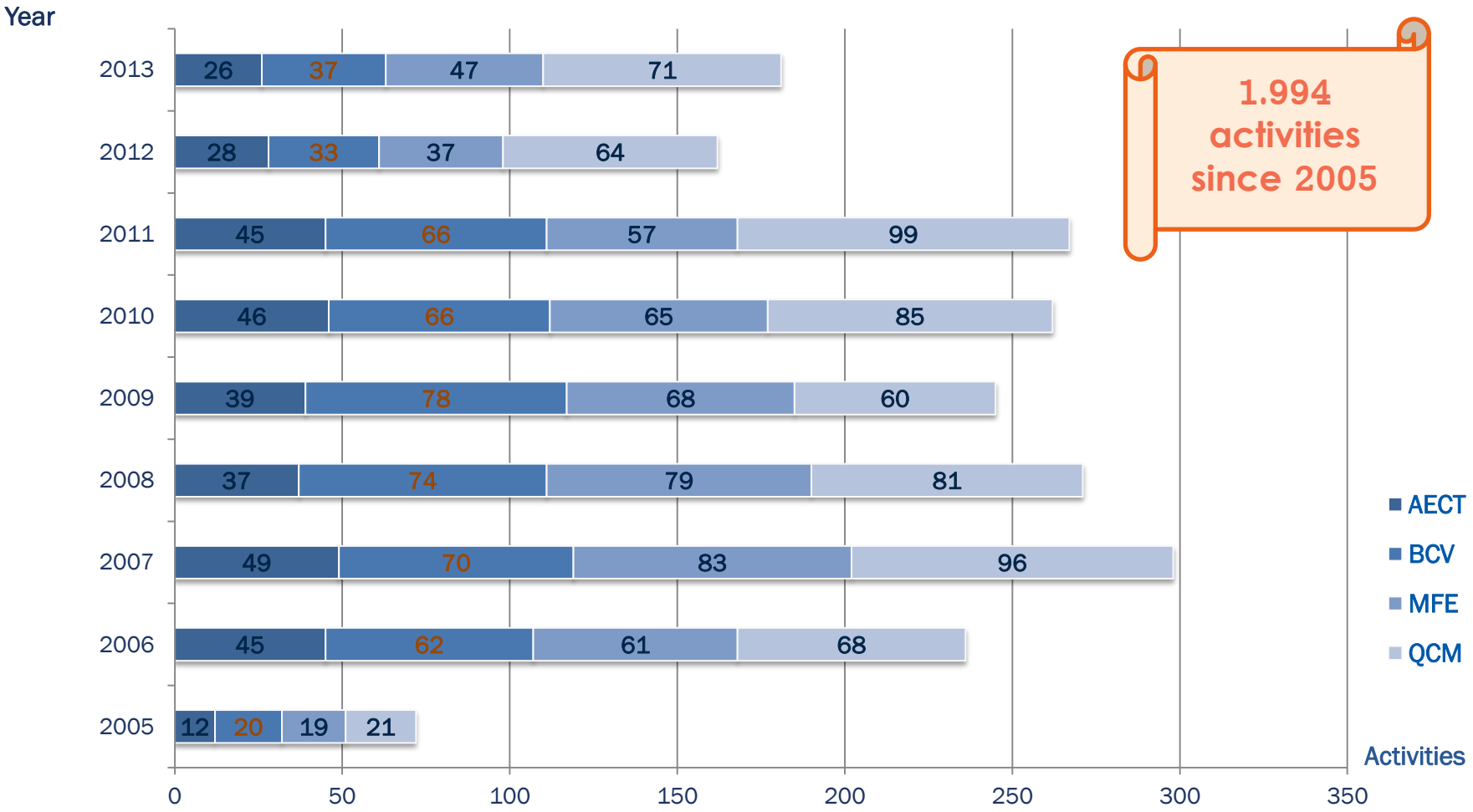
Barcelona, September 12th 2013

RED ESPAÑOLA DE SUPERCOMPUTACIÓN

RES: An alliance

- The RES is a Spanish distributed virtual infrastructure.
- A interconnection of supercomputers that manage their computing capacity and provide service to Spanish researchers.

RES: Activity volume



** In 2005 RES only award hours for 3 months.*

*** In 2012 MN did not provide service for 3 months due renewal of the facility.*

**** For 2013 Accounting of the first 8 month of the year.*

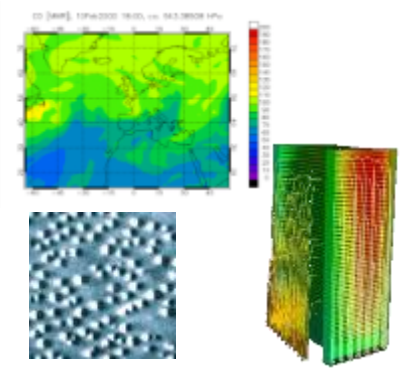
PARTNERSHIP FOR ADVANCED COMPUTING IN EUROPE

PRACE → the European HPC Research Infrastructure

- Enabling world-class science through large scale simulations
- Providing HPC services on leading edge capability systems

- Operating as a single entity to give access to world-wide supercomputers

- Offering its resources through a single and fair pan-European peer review process to academia and industry



PRACE at a glance

530M euros of funding for the **2010-2015** period

25 member states, including **4 Hosting Members**
(France, Germany, Italy, Spain)

252 scientific projects **enabled**

>6.8 billion core hours awarded since 2010

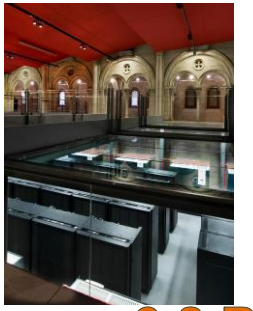
15 Pflop/s of peak performance on **6 world-class systems**

Open R&D access for **industrial users**

PRACE's achievements in 3 years:

In 2013, nearly 15 Pflop/s provided

MareNostrum: IBM IDPX at BSC, >48 000 cores

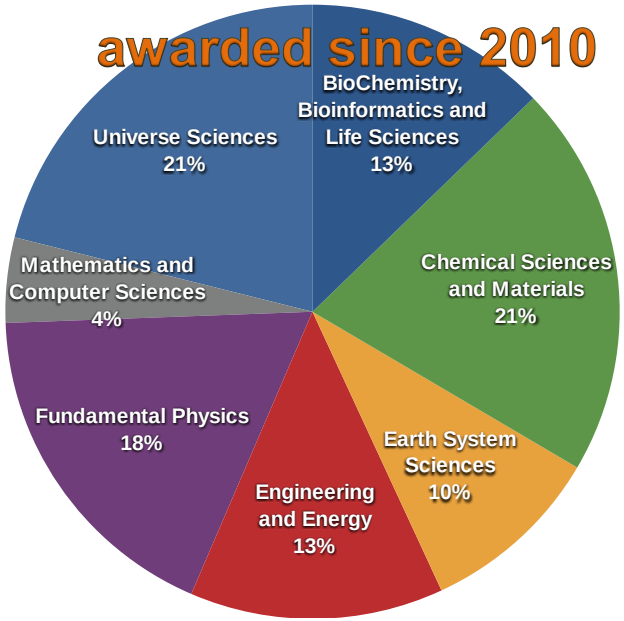


JUQUEEN: IBM BlueGene/Q at GCS partner FZJ, >458 000 cores

FERMI: IBM BlueGene/Q at CINECA, >163 000 cores

SuperMUC: IBM IDPX at GCS partner LRZ, >155 000 cores

>6.8 BILLION CORE HOURS awarded since 2010



CURIE: Bull Bullx at GENCI partner CEA >90 000 cores.

HERMIT: Cray at GCS partner HLRS, >113 000 cores

For Science: some results

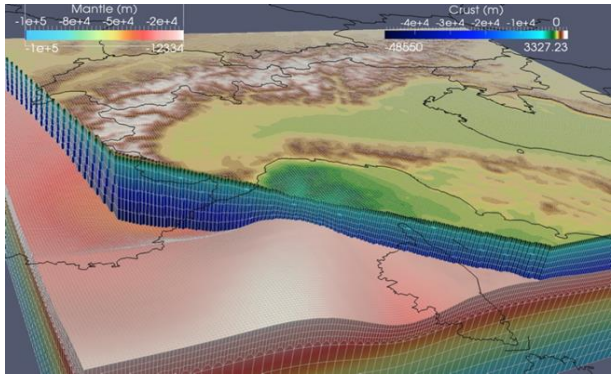
Example 1: Seismology

53,4 million core hours
on SuperMUC
(8760 cores/year)

The massive allocation of computing resources can be used to **explore the non-linearity involved in the dependence of local ground shaking on geological structure**, by analysing suites of physically consistent, and geologically plausible, models.

Team: Dr. Andrea Morelli – Instituto Nazionale di Geofisica e Vulcanologia, Italy

Goal: Produce an estimate of **the impact of ground shaking on Northern Italy after major earthquakes.**
Provide better foundations for decision-making processes for societal preparedness for earth quakes.



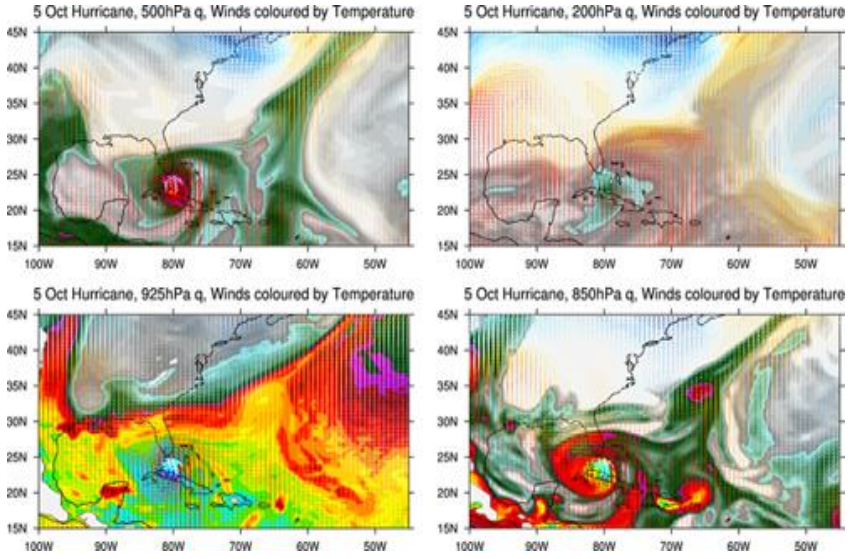
Example 2: Climate

144 million core hours
on Hermit
(16438 cores/year)

PRACE will give to UK **Meteorology** office a 3-year advance in the development of their models.

Team: Prof. Pier Luigi Vidale (NCAS-Climate, Dept of Meteorology, Univ. of Reading and UK Met Office, Exeter, UK)

Goal: to develop high resolution global **weather & climate models** (12km)




BSC
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Supercomputing
Center
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BARCELONA SUPERCOMPUTING CENTER

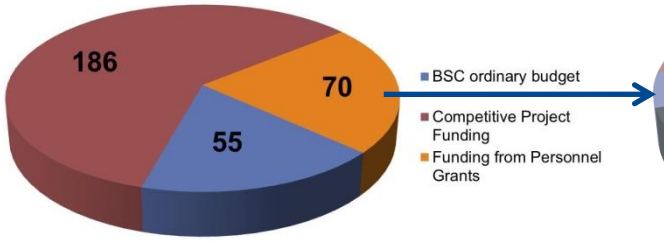
Barcelona Supercomputing Center
Centro Nacional de Supercomputación

- BSC-CNS objectives:
  - R&D in Computer, Life, Earth and Engineering Sciences
  - Supercomputing services and support to Spanish and European researchers

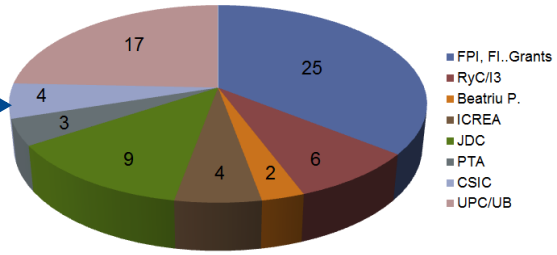
- BSC-CNS is a consortium that includes:
  - Spanish Government 51%
  - Catalonian Government 37%
  - Universitat Politècnica de Catalunya (UPC) 12%

- +300 people, 40 countries

BSC STAFF 2012

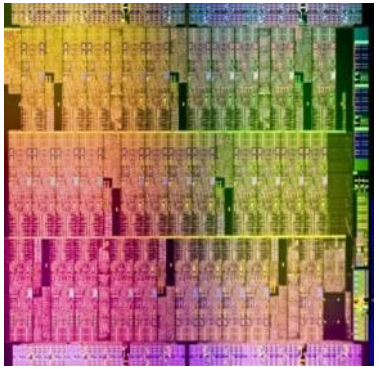


Funding from Personnel Grants 2012



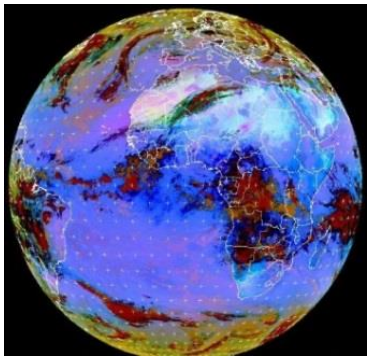
Mission of BSC Scientific Departments

COMPUTER SCIENCES



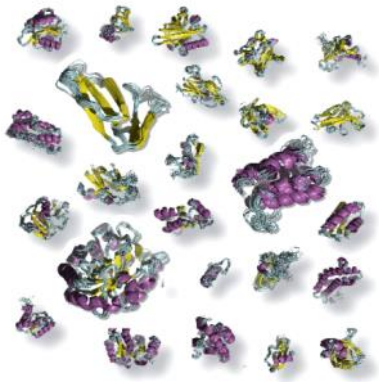
To influence the way machines are built, programmed and used: programming models, performance tools, Big Data, computer architecture, energy efficiency

EARTH SCIENCES



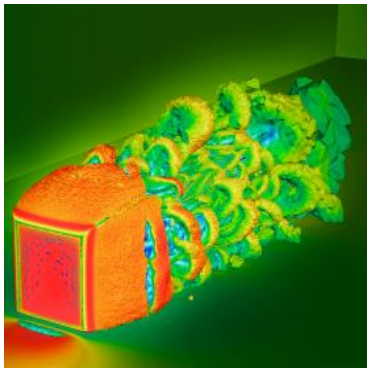
To develop and implement global and regional state-of-the-art models for short-term air quality forecast and long-term climate applications

LIFE SCIENCES



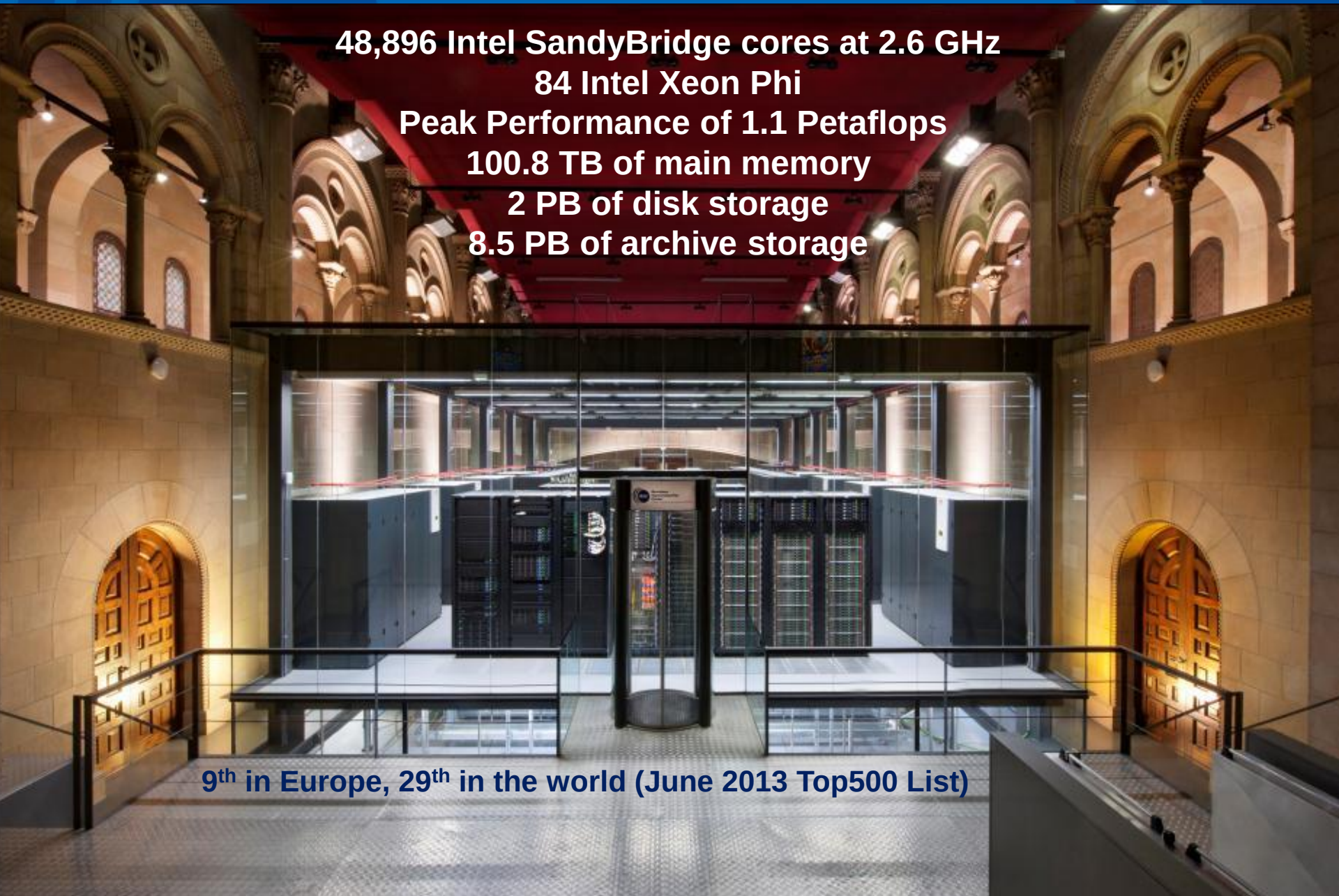
To understand living organisms by means of theoretical and computational methods (molecular modeling, genomics, proteomics)

CASE



To develop scientific and engineering software to efficiently exploit super-computing capabilities (biomedical, geophysics, atmospheric, energy, social and economic simulations)

MareNostrum 3



48,896 Intel SandyBridge cores at 2.6 GHz
84 Intel Xeon Phi
Peak Performance of 1.1 Petaflops
100.8 TB of main memory
2 PB of disk storage
8.5 PB of archive storage

9th in Europe, 29th in the world (June 2013 Top500 List)

BSC at a glance

EXCELENCIA SEVERO OCHOA

One of only 13 centres recognised with prestigious Severo Ochoa award for excellence

National & European HPC Infrastructure

- *Spanish national HPC lab*
- *PRACE Tier-0 Hosting Partner*

Bridge to Latin America

- *Extensive network of contacts*
- *Coordinator, RISC and OpenBio projects*

Computer Sciences

- *Architecture, Programming Models, Tools, Cloud and Grid*

Education & Training

- *UPC, PATC, BMW, Pumps*

Life Sciences

- *Molecular and protein modelling, computational genomics etc.*

BSC

+300 staff from +40 countries

Key European Research partner

- *Participation in 79 FP6/7 projects, 14 as coordinator*

Earth Sciences

Atmospheric processes and climate change modelling

Solid Partnerships with Industry

- *Repsol, Microsoft, IBM, Intel, Iberdrola, NVIDIA, Samsung*
- *Leading role in ETP4HPC*

Computer Applications

- *Simulation of complex problems on High Performance Computers*

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Centro Nacional de Supercomputación

Some Strategic Projects

EXCELENCIA SEVERO OCHOA

Severo Ochoa

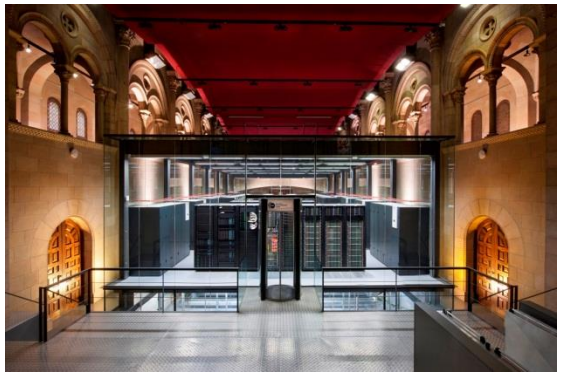
A multidisciplinary research program to address the complex challenges in the path towards Exascale. A set of key strategic scientific projects and improvements in HR management, training, mobility and communication.

Human Brain Project

10-year FET Flagship research project to simulate human brain and design computers based on its workings

Mont-Blanc

Developing an European Exascale approach Based on embedded power-efficient technology



Air quality climate modeling

Global models for climate change and air quality prediction

Riding on Moore's Law

Optimizing performance, energy consumption and reliability of parallel computer architectures through higher level abstraction

Personalised Medicine

Combining Genomics, proteomics and transcriptomics analysis with simulation

Alya Red

Computational mechanics simulation tools designed for biomedical research. Winner 2012 Science-NSF visualisation challenge

Joint Research Centres

EXCELENCIA SEVERO OCHOA

BSC-IBM Technology Center for Supercomputing

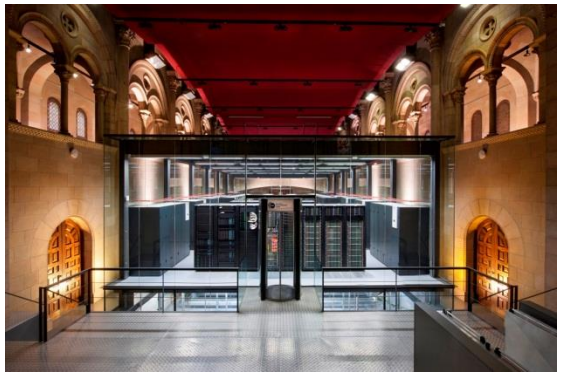
Research into future challenges for supercomputers including power efficiency and scalability, new programming models, and tools for analysis and optimization of applications

Repsol-BSC Research Center

Research into advanced technologies for the exploration of hydrocarbons, subterranean and subsea reserve modelling and fluid flows

BSC-Microsoft Research Centre

Research into the design and interaction of future microprocessors and software for the mobile and desktop market segments



BSC-Iberdrola Research Collaboration

Mathematical models to improve the design of wind farms, including simulation of wind flows for optimal turbine placement

Intel-BSC Exascale Lab

Multi-year agreement focussing on optimising efficiency through research into:

- *Programming Models*
- *Performance Tools*
- *Applications*

BSC-NVIDIA CUDA Center of Excellence

Training in Parallel Programming using CUDA and StarSs
Optimising management of execution resources in multi-GPU environments with GMAC

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Thanks for your attention!