EuroHPC and supercomputing

Dr. Giuliano Taffoni
INAF- OATs
HPC pillars in Europe

- HPC resources from member countries
- FET-HPC European Investment
The HPC history by milestones

- **Ancestor** 2002 – DEISA Project
- **First Ideas** 2003 – HPC-Euro Interest Group
- **Closing in** 2006 – HPC in Europe Task Force (HET)
- **ESFRI** 2006 – HPC on the Roadmap
- **PRACE MoU** 2007
- **PRACE Signature** 2010
- **PRACE II** 2016

- **FETHPC H2020** European Research
PRACE Role and Services

- **Open access** to leadership HPC systems for EU researchers.
- **Peer Review** at European level.
- **Operation of a unified set of services.**
- **Architectural variety** meeting all sorts of algorithmic needs.
- **Training** (Seasonal Schools, etc).
- **Enabling Applications** and support for Center of Excellence.
Supported entirely by countries
From FET-HPC to EuroHPC: issues

EU has no top ranked supercomputers and depends on non-EU technology

• Weak integration of EU technology in HPC supercomputers
• Weak European Supply chain

• Insufficient coordination of national investments
• Investments in skill and expertise are mandatory
European strategy: build an ecosystem

**EUROPEAN HPC ECO-SYSTEM**

- **HPC TECHNOLOGY SUPPLY CHAIN**: The strength of the European HPC Supply Chain (technologies and applications)
- **HPC APPLICATIONS**: Tools for industrial simulation & prototyping
- **HPC RESEARCH INFRASTRUCTURE**: Tools for addressing the Grand Societal Challenges

**European Multi-annual HPC Technology Roadmap**

**European Economy**

**European Science**

**European Society**

[Diagram of the European HPC ecosystem showing the interconnections between HPC technology, applications, research infrastructure, and their impact on economy, science, and society.]
From FET-HPC to EuroHPC: the Joint Undertaking

- It is not a new program: it is a joint initiative between EU countries, EU Commission and supporting countries.
- Build an ecosystem but also technologies.
- Develop and attract new engineers.
- JU is a legal entity.
- Pool funds from countries and government.
EuroHPC JU objectives

• Coordinate EC/MS activities
• Pool public and private resources at EU level
• **Procure world-class infrastructure**
• Close the chain from R&D to procurement
• Become lead Users
• Create a competitive supply industry
• Lead in Applications
Co-invest on a leading HPC and data infrastructure

For our scientists, industry and the public sector and support the development of technologies and applications across a wide range of fields.

#EuroHPC (high performance computing)

Joint Undertaking

The European High Performance Computing Joint Undertaking (EuroHPC JU) will pool European resources to develop top-of-the-range exascale supercomputers for processing big data, based on competitive European technology.

Its member countries are Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and Turkey.
EuroHPC Governance

**Intelligence gathering**

**Stakeholders**
- (a) Users forum
  - Science Users
  - Users of PRACE and HPC Centres of Excellence
  - Industry Users
- (b) Technology forum
  - PRACE, GEANT
  - Tier-0 supercomputing centres
  - Industry (ETP4HPC, BDVA PPP, etc.)

**Decision making & Advice**

**Governor Board**
- Public Members
  - The decision making Board

**Industrial and Scientific Advisory Board**

**Research & Innovation Advisory Group**
- [academia & industry advising on Pillar 2 activities]

**Infrastructure Advisory Group**
- [academia & user industry advising on Pillar 1 activities]

**Implementation**

- R&I activities
- JU funded
- HPC machines
- Member State-funded activities
- PRACE activities
- IPCEI activities
- ...

**CSA to cover operating costs of the Advisory Board Members**

_from Dr. Gustav Kalbe presentation at EuroHPC info day_
_(Interim Executive Director EuroHPC Joint Undertaking)_
EuroHPC Actions: building the infrastructure

<table>
<thead>
<tr>
<th>Precursors to exascale</th>
<th>Petascale</th>
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<tr>
<td><strong>At least 2 Precursors to exascale</strong></td>
<td><strong>At least 2 Petascale</strong></td>
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<tr>
<td><strong>EU contribution:</strong>  ≤50% of CAPEX and ≤50% of OPEX</td>
<td><strong>EU contribution:</strong>  ≤35% of CAPEX</td>
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<tr>
<td><strong>MAX EU budget:</strong> 250 M€</td>
<td><strong>MAX EU budget:</strong> 30 M€</td>
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Pre-exascale timeline (indicative)
Status of the Infrastructure

8 hosting sites has been selected: Sofia (Bulgaria), Ostrava (Czechia), Kajaani (Finland), Bologna (Italy), Bissen (Luxembourg), Minho (Portugal), Maribor (Slovenia), and Barcelona (Spain).

CINECA will host the Leonardo super computer at the Tecnopolo

Total cost: 240 Meuro (co-financed by MIUR and European commission)

Computing Power: 270 petaflops
Tecnopolo in Bologna

- INFN – Tier0
- CINECA
- European Centre for Medium-Range Weather Forecasts

and

- INAF computing center
Leonardo Supercomputer

Booster
- 3500
- Low Ram/core
- 4GPUs

General Purpose
- 1000
- CPU computing

Data centric
- 500
- High RAM/core
- Fast IO

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<tr>
<th>Storage (scratch and work space)</th>
<th>Capacity: 150 PB, bandwidth: 1 TB/s</th>
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<tbody>
<tr>
<td>Storage (high IOPS tier and home space)</td>
<td>Capacity: 5 PB, bandwidth: 1 TB/s</td>
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<tr>
<td>HPL Targeted Performance (peak)</td>
<td>150-180 PFlops (210-250 PFlops); Top 3</td>
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<tr>
<td>HPCG Targeted Performance</td>
<td>2.8-3.3 PFlops; Top 3</td>
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Leonardo Supercomputer: partitioning

Italian Community

EuroHPC & PRACE
EuroHPC Research and Innovation calls

• Towards Extreme Scale Technologies and Applications
  • Extreme scale computing and data driven technologies
  • HPC and data centric environments and applications
  • Industrial software codes for extreme scale computing environments and applications

• Innovating and widening the HPC use and skills base
  • HPC of excellence!

New paradigm: 50% co-funded
Th role of computing infrastructure

• to capture the complexity of the formation of cosmic structures
• as interpretative framework for the “tsunami” of observational data
• to optimize the design and operation of such large facilities
• to prepare methods and tools of analysis
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ICM bulk velocities of a simulated Perseus-like clusters with a 100 ksec exposure with Athena
The role of computing infrastructure

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Facilities are not only “telescopes”

New exascale capable laboratories allow to increase dramatically the dynamical range (from cosmological scales down into galaxies)

Crucial for scientific exploitation of a variety of observational data !!!!!

New experiments require new exascale capable laboratories!

Are Astrophysical (HPC) codes ready for that?
Conclusion

- New projects and facilities requires HPC and HPDA resources
- Codes for data analysis and reductions will approach HPC, also in interactive way
- We should be able to use the new resources
- EuroHPC is an opportunity
- We should become actors and not users