PRACE introduction

EUDAT – PRACE Summer School on managing scientific data from analysis to long term archiving, 23-27 September 2019, Trieste, Italy

Leon Kos, University of Ljubljana

Partnership for Advanced Computing in Europe

- **PRACE** is an international not-for-profit association under Belgian law, with its seat in Brussels.
- **PRACE** has 25 members and 2 observers.
- **PRACE** is governed by the **PRACE** Council in which each member has a seat. The daily management of the association is delegated to the Board of Directors.
- **PRACE** is funded by its members as well as through a series of implementation projects supported by the European Commission. Computing resources are made available by a group of members (Hosting Members)

PRACE | members

Hosting Members

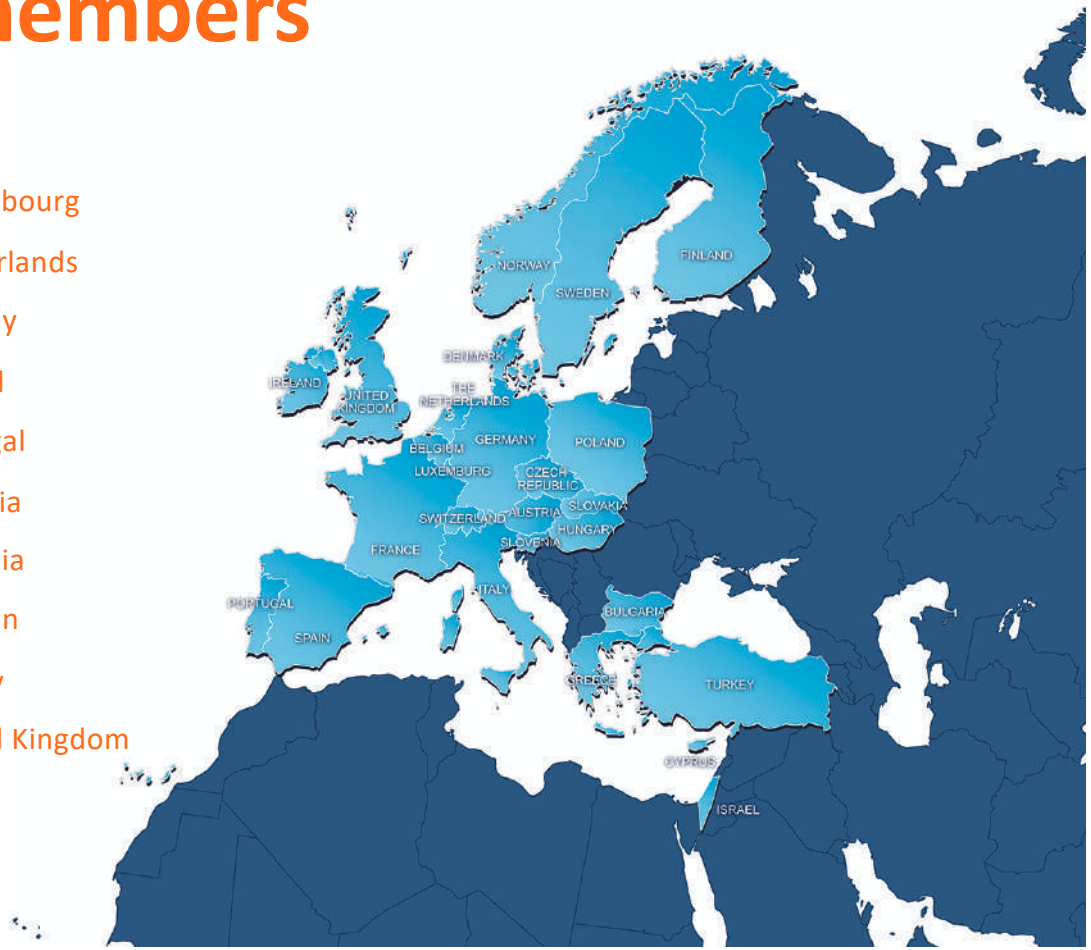
- France
- Germany
- Italy
- Spain
- Switzerland

General Partners (PRACE 2)

- Austria
- Belgium
- Bulgaria
- Cyprus
- Czech Republic
- Denmark
- Finland
- Greece
- Hungary
- Ireland
- Israel
- Luxembourg
- Netherlands
- Norway
- Poland
- Portugal
- Slovakia
- Slovenia
- Sweden
- Turkey
- United Kingdom

Observers

- Croatia
- Romania



PRACE AISBL as persistent pan-European supercomputing infrastructure

Mission: enabling world-class science through large scale simulations

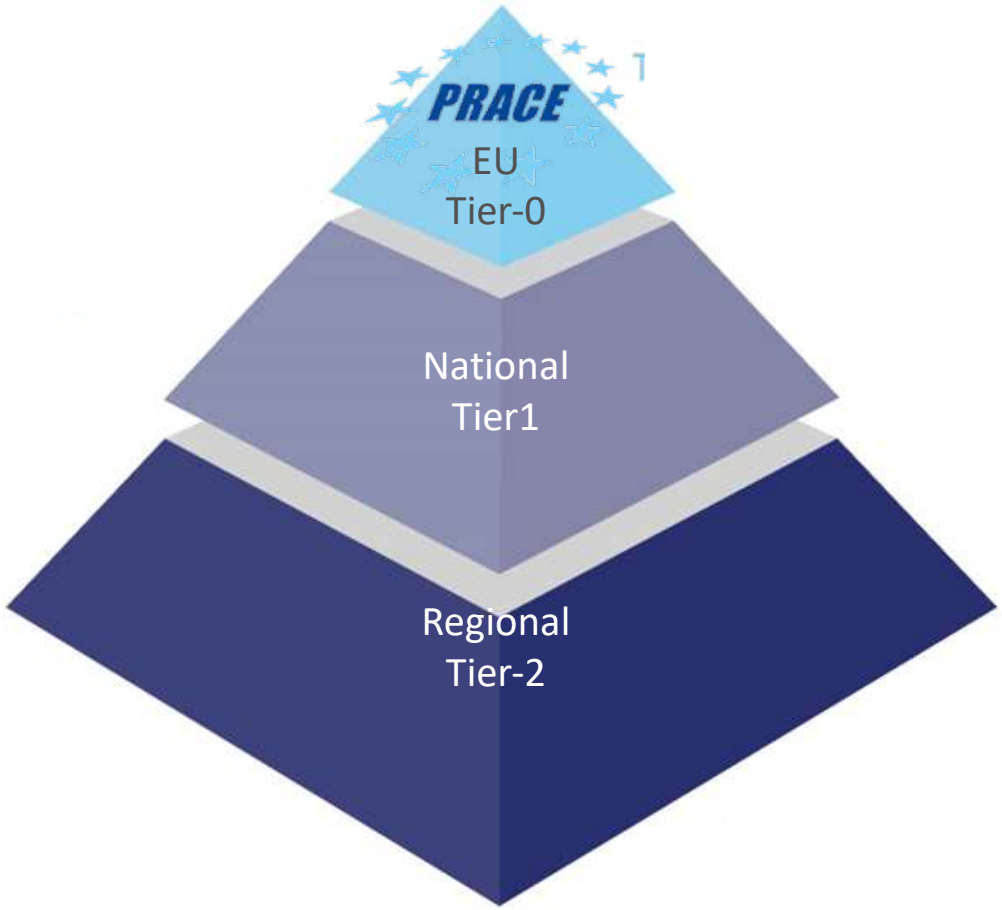
Offering: HPC resources on leading edge capability systems

Resource award: through a single and fair pan-European peer review process for open research

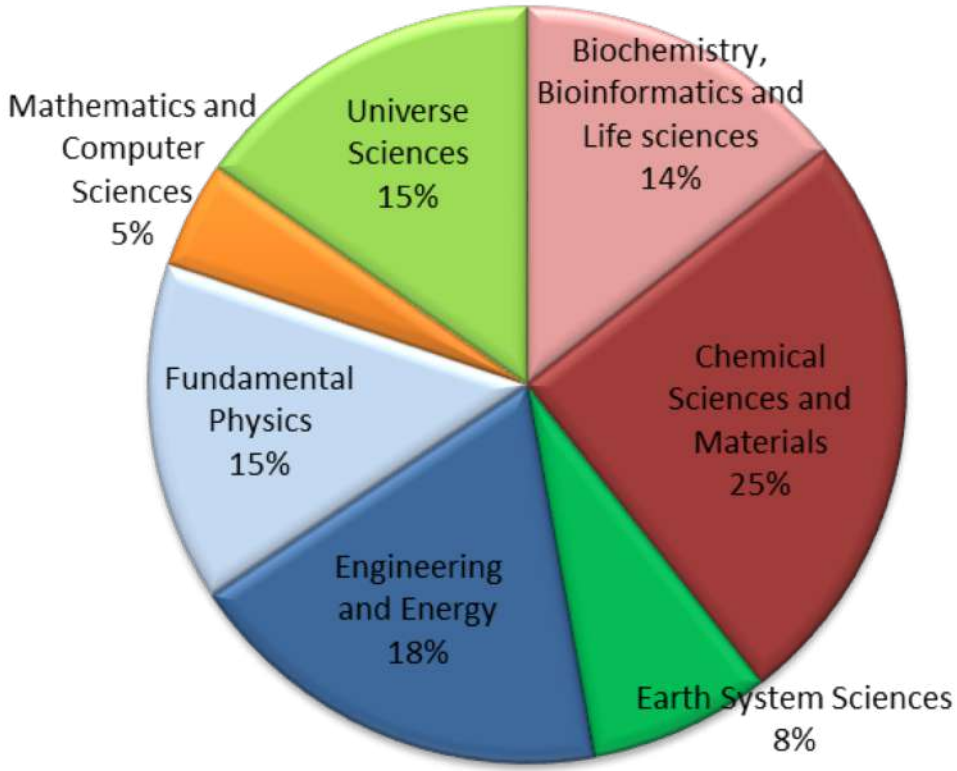
PRACE | what we do

- Open access to world-class HPC systems to EU scientists and researchers
- Variety of architectures to support the different scientific communities
- High standards in computational science and engineering
- Peer Review at European level to foster scientific excellence
- Robust and persistent funding scheme for HPC supported by national governments and European Commission (EC)
- Support the development of intellectual property rights (IPR) in Europe by working with industry and public services
- Collaborate with European HPC industrial users and suppliers

Crown of Europe's HPC Provisioning Pyramid



Distribution of resources by science domains



PRACE | Tier-0 Systems in 2019

MareNostrum: IBM
BSC, Barcelona, Spain
#25 Top 500

Piz Daint: Cray XC50
CSCS, Lugano, Switzerland
#5 Top 500

NEW ENTRY 2018/2019
SuperMUC NG : Lenovo cluster GAUSS @ LRZ, Garching, Germany #8 Top 500

JUWELS (Module 1): Bull Sequana GAUSS @ FZJ, Jülich, Germany #26 Top 500
NEW ENTRY 2018

NEW ENTRY 2018
JOLIOT CURIE : Bull Sequana
GENCI/CEA, Bruyères-le-Châtel, France
#40 Top 500

MARCONI: Lenovo
CINECA, Bologna, Italy
#19 Top 500

Hazel Hen: Cray GAUSS/HLRS, Stuttgart, Germany #30 Top 500

Close to 110 Petaflops cumulated peak performance

Access through PRACE Peer-Review

Free-of-charge required to **publish results at the end of the award period**

Preparatory Access (***2 to 6 months***)

SHAPE Programme (***2 to 6 months***)

Project Access (***12, 24 or 36 months***)

Criterion: Scientific Excellence Assessed by an improved review process

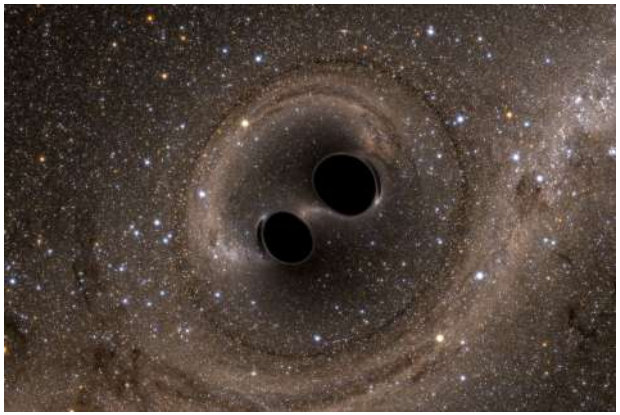
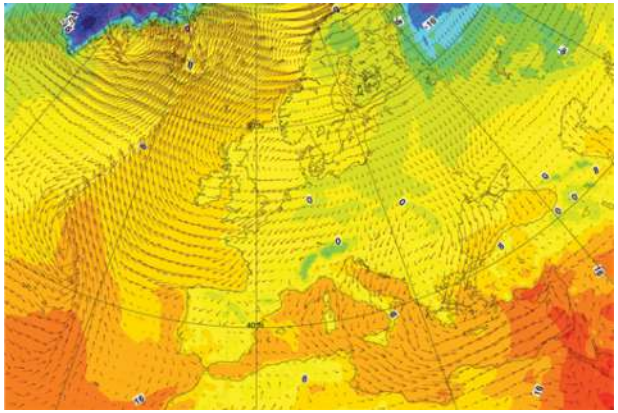
Centers of Excellence : 0,5 % of the total resources available for the 11th call for CoE

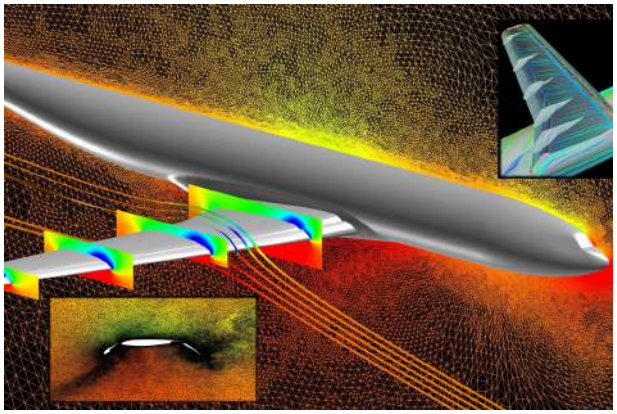
www.prace-ri.eu/call-announcements/

PRACE | achievements

- 688 scientific projects enabled
- >21 000 000 000 (thousand million) core hours awarded since 2010
- Of which 63% led by another PI nationality than the HM
- R&D access to industrial users with >50 companies supported
- >12 000 people trained through PRACE Training
- ~110 Petaflops of peak performance on 7 world-class systems
- 26 PRACE members, including 5 Hosting Members
  (France, Germany, Italy, Spain and Switzerland)
- PRACE is the only e-infrastructure Landmark on the ESFRI Roadmap 2016

European Computing | Solves Societal Challenges


PRACE's goal is to help solve these challenges. The days when scientists did not have to care about the hardware are over, and so are the days when compute centers did not have to worry about the scientific application!

PRACE – Scientific Case

- **Scientific applications**
  - urgent need for more compute cycles, AND
  - huge demands memory bandwidth & I/O
- **Need new approaches**
  - scaling via ensembles, deep learning, and statistical models
  - systems able to handle tens of thousands of active jobs and large I/O requests
- **Software & algorithms** take longer to change than hardware
  - PRACE & Europe need a much more ambitious strategy to develop the SW part of next-generation computing

"Future Infrastructures and operations will need to be much more diverse to support HPC, Data Science and different types of accelerators - but we also need to avoid fragmentation." - PRACE Scientific CASE

Computing drives Science | and Science Computing

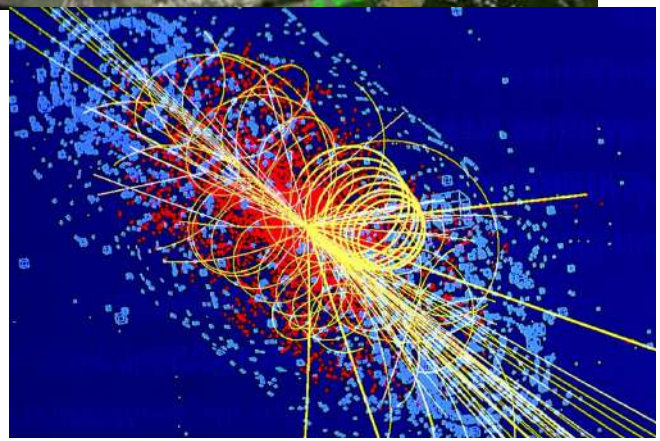
Remarkable Repeated Success Stories:

- Recurring core part of Nobel Prizes in Physics & Chemistry
- Saving billions with better weather forecasting
- Improving human health with genomics, personalized medicine
- 3-4% better fuel efficiency of aircraft & wind turbines every year
- Disrupting communication, transportation and manufactoring
- Design of future materials from scratch based on desired properties
- Batteries & supercapacitors
- Artificial intelligence, machine learning, sensors, open data

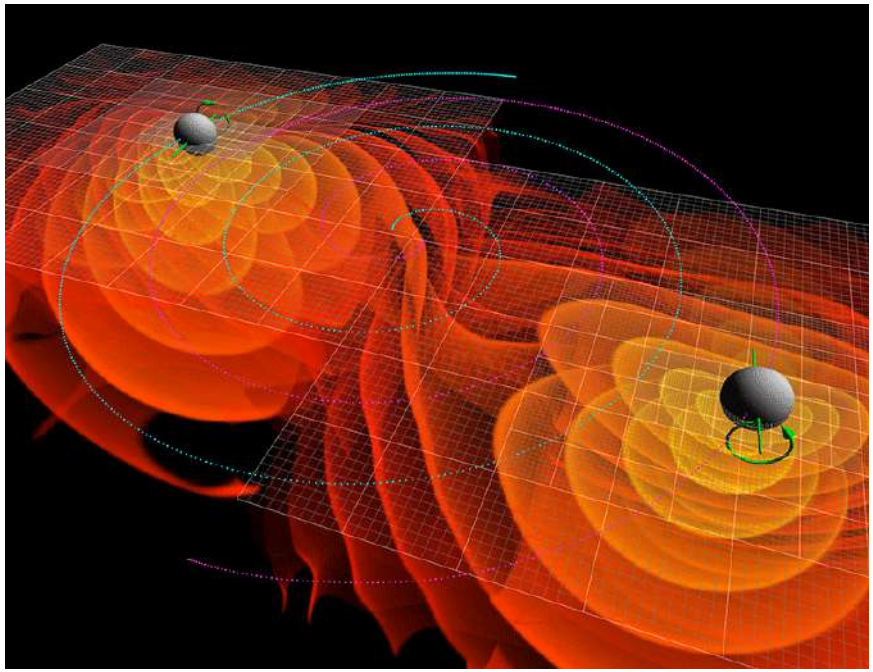
Scientific computing keeps delivering impact, but European impact is limited by resources.

The Scientific Case for Computing in Europe showcases the achievements we predict will come true within the next 5-10 years with a factor 50-100x more computing power in Europe

Expanding the Frontiers | of Fundamental Sciences



Simulation of traces producing Higgs Boson (Nobel Prize 2013)



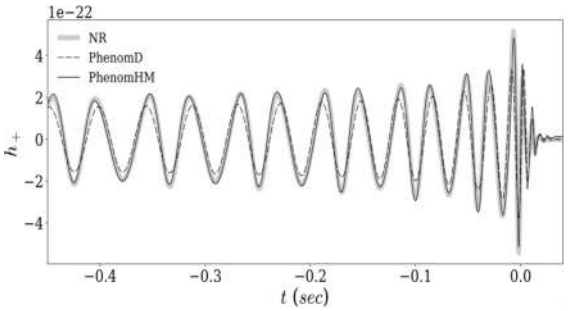
LIGO gravitational wave interference (Nobel Prize 2017)

Modelling Gravitational Wave Signals

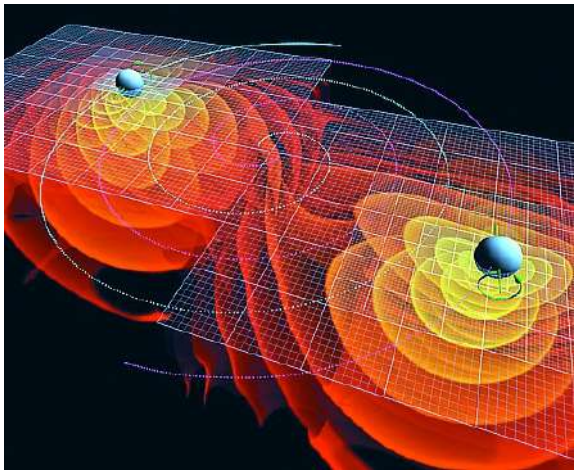
Models For Nobles

Barcelona Supercomputing Center
Centro Nacional de Supercomputación

Lead Institution: UIB (Spain) - collaborators from UK, Germany, India; 33 Mio Core hrs



- Identification of gravitational wave signals from merging black holes
- Model signals across the parameter space of plausible binary mergers ≧ 7 dimensions!
- Model Input: solutions of Einstein's Equations
- 1 point in parameter space ~ O(10^5) CPU hours
- Templates for analysis: LIGO/Virgo detectors



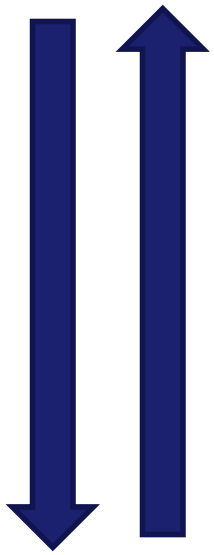
PRACE - EuroHPC Relation

- Position Paper: PRACE in the EuroHPC Era
  - Status Analysis
  - Impact Analysis
  - PRACE in the EuroHPC Era
    - PRACE & EuroHPC – creating synergies
    - Evolution of PRACE Services
    - Towards a partnership

- http://www.prace-ri.eu/prace-eurohpc-positionpaper/
  Published 7 January, 2019

EuroHPC and PRACE | Top-Down vs. Bottom-Up

- Funding Agency for HPC/Data/AI
- Policy maker and interface between EU and participating member states
- Infrastructure Investment
- Fund Research and Innovation
- Fund HPC operation and user support

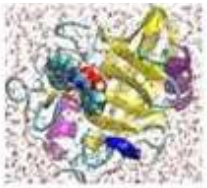


- Science driven (SSC)
- Infrastructure: provide access to member state funded resources & EC funded services

Realisation of a Partnership

- PRACE to detail which processes and activities it can offer as a partner of EuroHPC
- Discuss and establish a cooperation agreement
  - Scope of services provided by PRACE in the future
  - Leverage PRACE high-quality services
  - Benefit from experience of all 26 PRACE members
  - Enable EuroHPC JU to focus on its core mission
- Explore and establish appropriate funding models
  - Secure sustained operation of PRACE services and IP-Project culture

H2020 Centres of Excellence in HPC



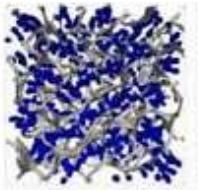
BioExcel
Centre of Excellence for Biomolecular Research
(Led by KTH)

COEGSS
Center of Excellence for Global Systems Science
(Led by Potsdam Uni)

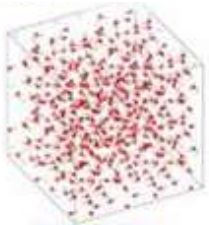
EoCoE
Energy oriented Centre of Excellence
(led by CEA)

E-CAM
Software, training and consultancy in simulation and modelling
(Uni College Dublin)

ESiWACE
Excellence in Simulation of Weather and Climate in Europe
(Led by DKRZ)



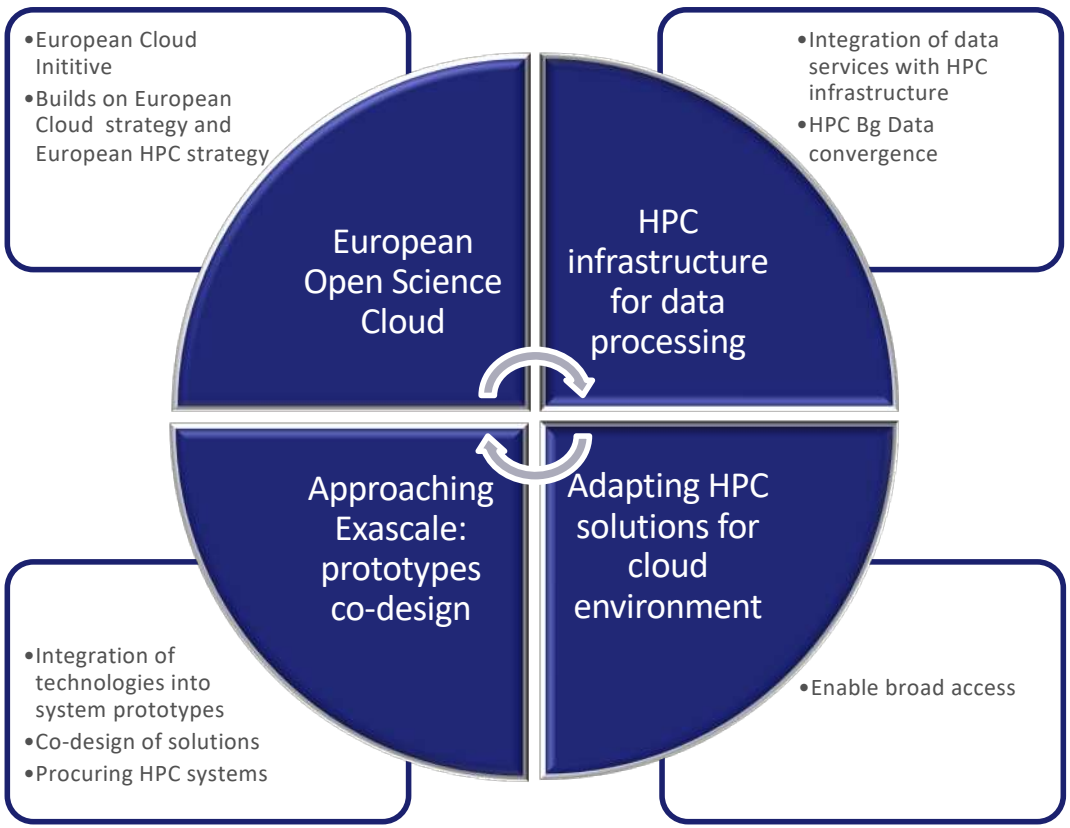
MAX
Materials design at the eXascale
(Led by CNR)



NOMAD
The Novel Materials Discovery Laboratory
(Led by Max Planck)

PoP
Performance Optimization and Productivity
(Led by BSC)

PRACE in the European Research Infrastructure landscape and new EC initiatives



THANK YOU FOR YOUR ATTENTION

www.prace-ri.eu