



# JÜLICH SUPERCOMPUTING CENTRE (JSC) INTRODUCTION

NOV 11, 2024 | BERND MOHR

# JÜLICH SUPERCOMPUTING CENTRE AT A GLANCE

## ▪ Supercomputer operation for

- Centre – FZJ
- Region – RWTH Aachen University
- Germany – Gauss Centre for Supercomputing (GCS)  
John von Neumann Institute for Computing (NIC)
- Europe – EuroHPC JU, EU projects

## ▪ Application support

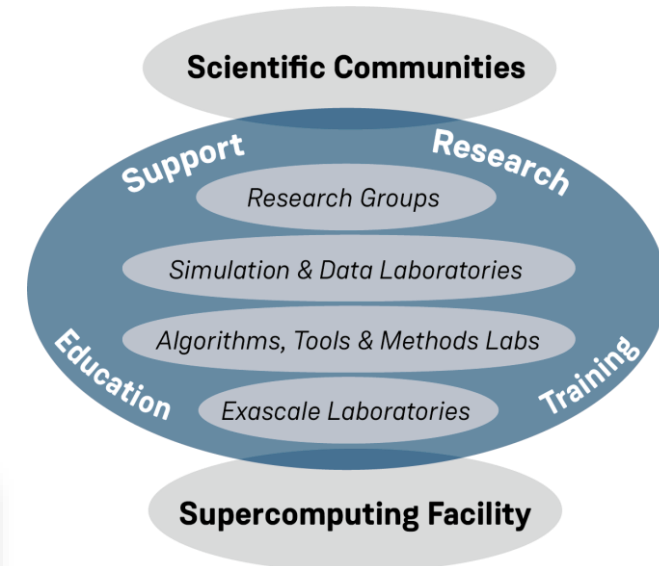
- Unique support & research environment at JSC
- Peer review support and coordination

## ▪ R&D work

- Methods and algorithms, computational science, performance analysis and tools
- Scientific Big Data Analytics with HPC + AI
- Computer architectures, Co-Design, Modularity, Exascale Labs together with IBM, Intel, NVIDIA

## ▪ Education and training

Mitglied der Helmholtz-Gemeinschaft



DEEP



JÜLICH  
Forschungszentrum

# ACCESS TO SUPERCOMPUTING RESOURCES AT JÜLICH

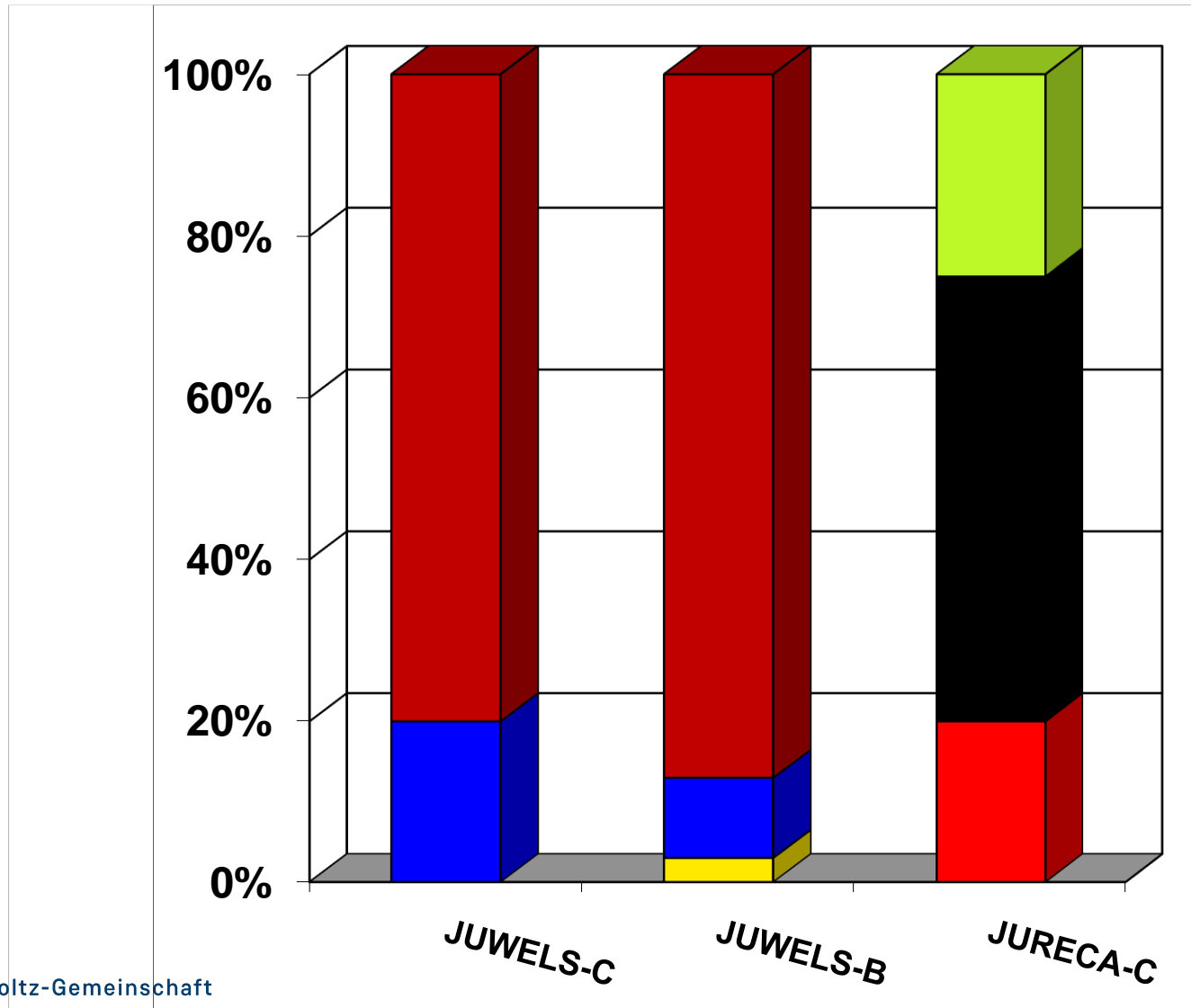
- **Access to JUWELS through biannual Call for Proposals (CfP) via**
  - Gauss Centre for Supercomputing (GCS)  
(JUWELS compute time proposals are evaluated by NIC);  
Large-scale project:  $\geq 2\%$  of expected annual compute power of the total system (cluster + booster)
  - ESM partition for Earth System scientists only (20% of JUWELS Cluster and 10% of JUWELS Booster)
  - AI partitions (HAICORE, HDFAI) ( $\sim 2.5\%$  of JUWELS Booster only)
- **Access to JURECA-DC through biannual CfP via**
  - Kommission zur Vergabe von SC Ressourcen (VSR) – Jülich internal

# GAUSS CENTRE FOR SUPERCOMPUTING (GCS)

- **GCS is the leading Tier-0 HPC centre in Europe**
  - Alliance of the three German Tier-1 centres
  - High Performance Computing Centre Stuttgart (HLRS)
  - Jülich Supercomputing Centre (JSC)
  - Leibniz Rechenzentrum (LRZ), Garching
- **Key facts**
  - To date in sum more than 140 Petaflops (continuously expanding)
  - 600 people for operation, HPC R&D, services, training
  - Extensive know-how in key scientific fields



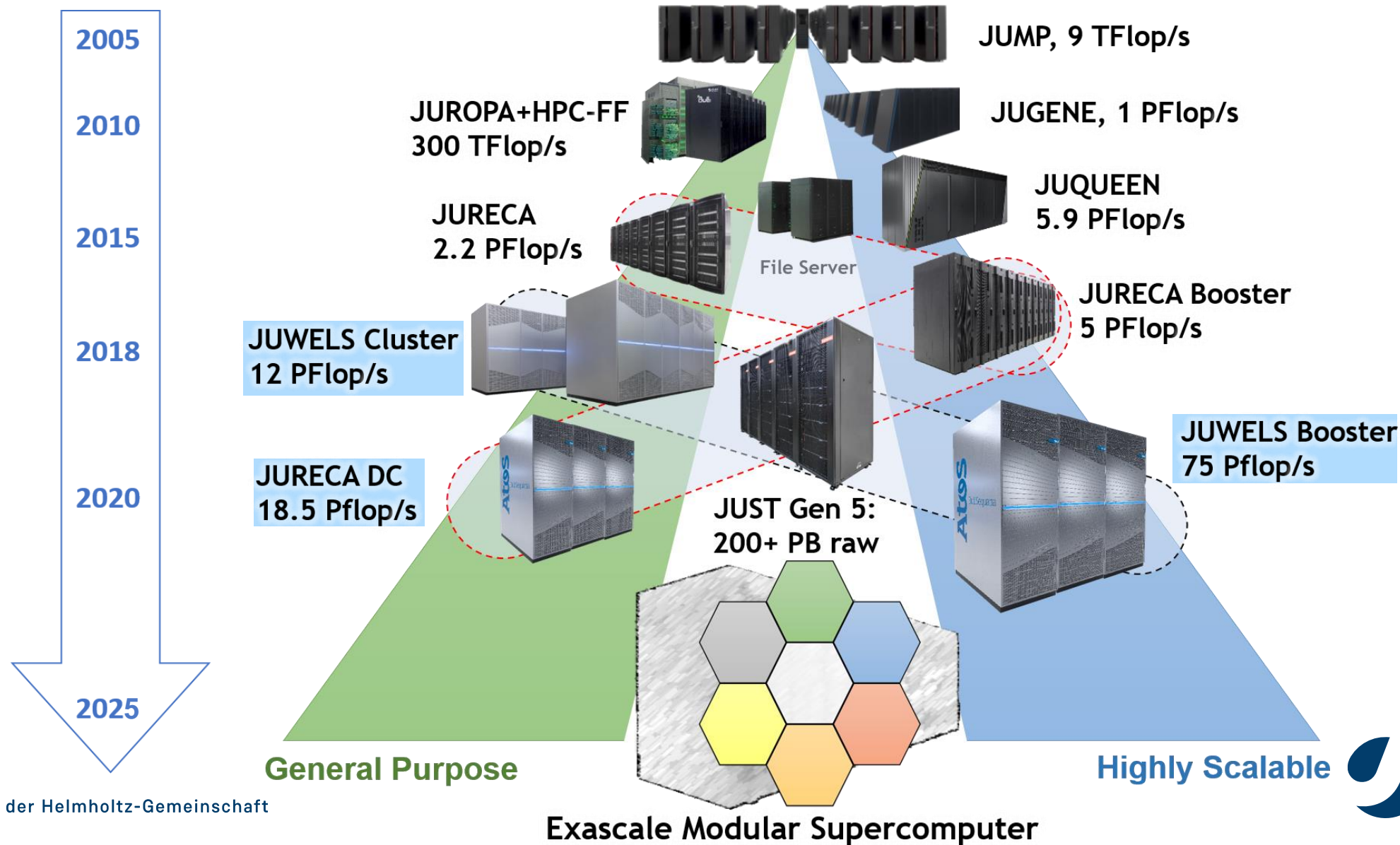
# STAKEHOLDER'S COMPUTE TIME SHARES



**80% of the available time is being granted!**

- FZJ obligations
- FZJ projects
- NIC (Germany)
- GCS/NIC (Germany)
- European share
- ESM partition
- HAICORE

# (DUAL) HARDWARE STRATEGY AT JSC



# JUWELS @ FZJ/JSC: CLUSTER AND BOOSTER MODULE IN PRODUCTION



# GCS SYSTEM @ JÜLICH

## JUWELS (Jülich Wizard for European Leadership Science): Modular Supercomputer

### JUWELS Cluster

- Intel Skylake based system with **12 PF** peak (CPU:10.6 PF, GPU: 1.7 PF)
- 10 cells with altogether more than 2,500 nodes or 120,000 cores
- Mellanox InfiniBand EDR fat-tree network (2:1 pruning at leaf level)
- Entered #23 in Jun 2018 Top500

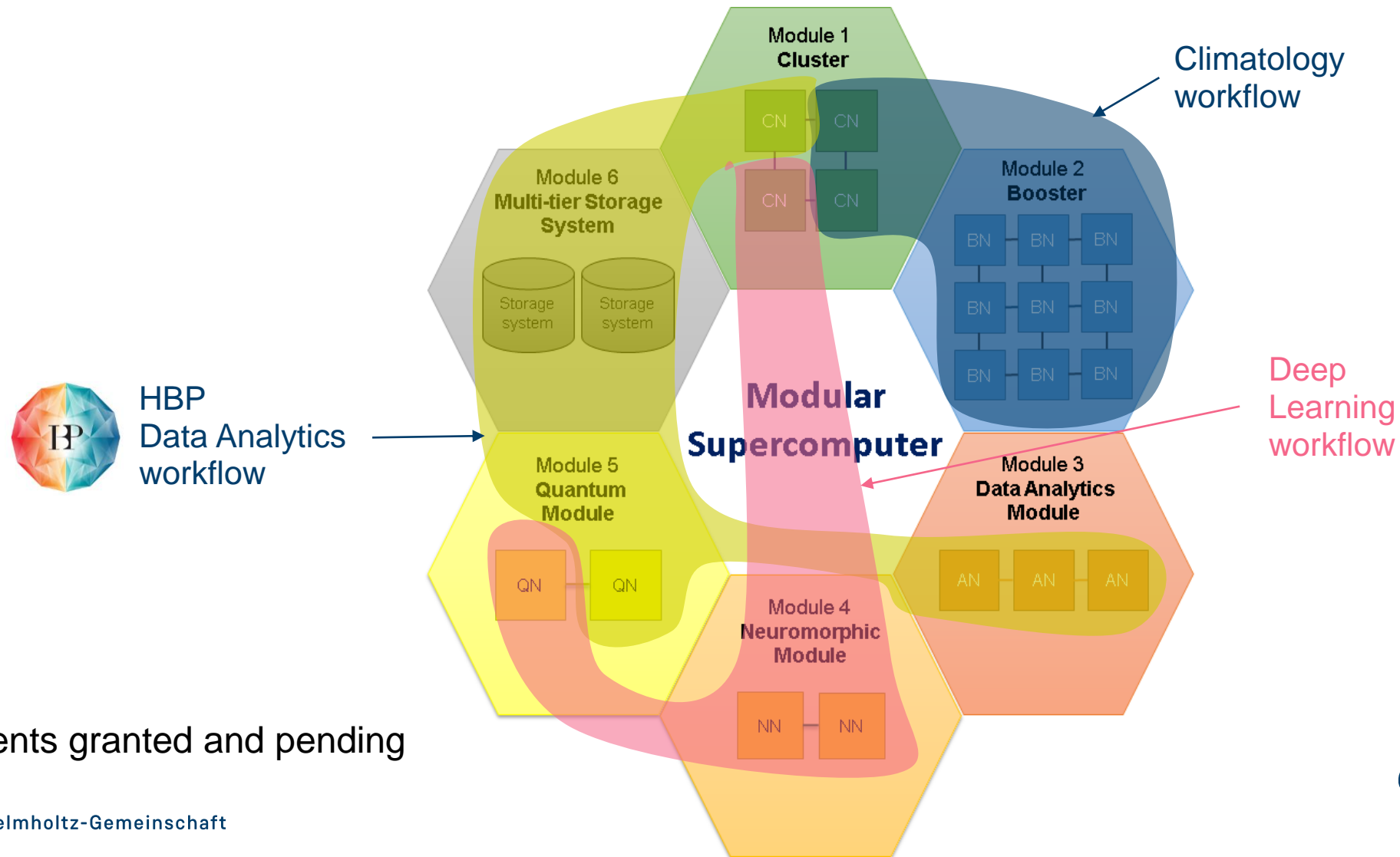
### JUWELS Booster

- Nvidia A100 based system with **75 PF** peak (CPU: 2 PF, GPU 73 PF)
- 936 nodes with 4 Nvidia A100 graphics cards each
- Mellanox InfiniBand HDR DragonFly+ topology with 20 cells - 5 TB/s connection to Cluster
- Entered #7 in Nov 2020 Top500, #1 in Europe, #1 in Green250

→ Connected to file server **JUST** with about **100 PB disk** capacity and more than **300 PB tape** capacity

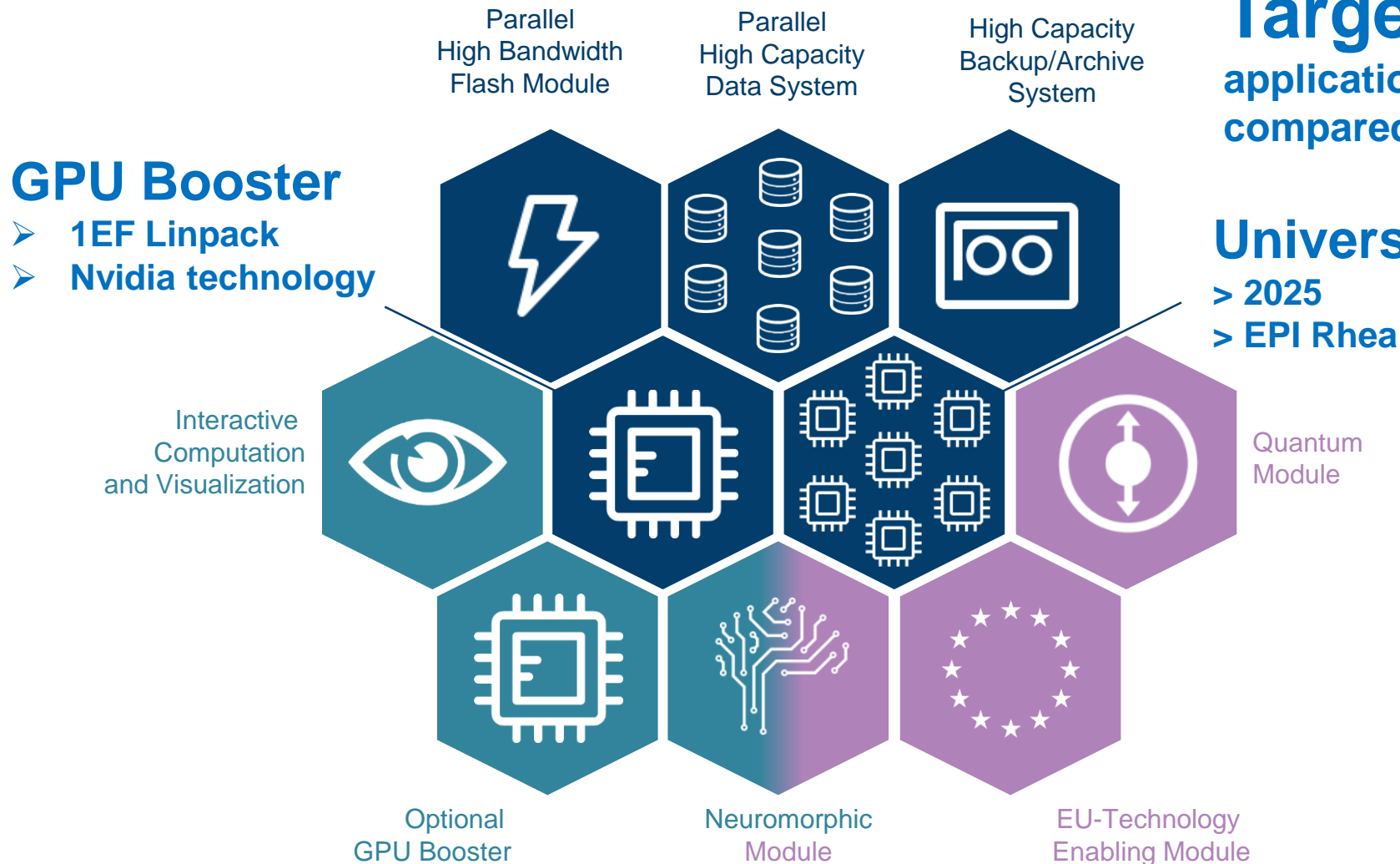


# ... AND EVOLUTION TO A MODULAR SUPERCOMPUTING ARCHITECTURE



\*Patents granted and pending

# JUPITER – MODULAR EXASCALE COMPUTER



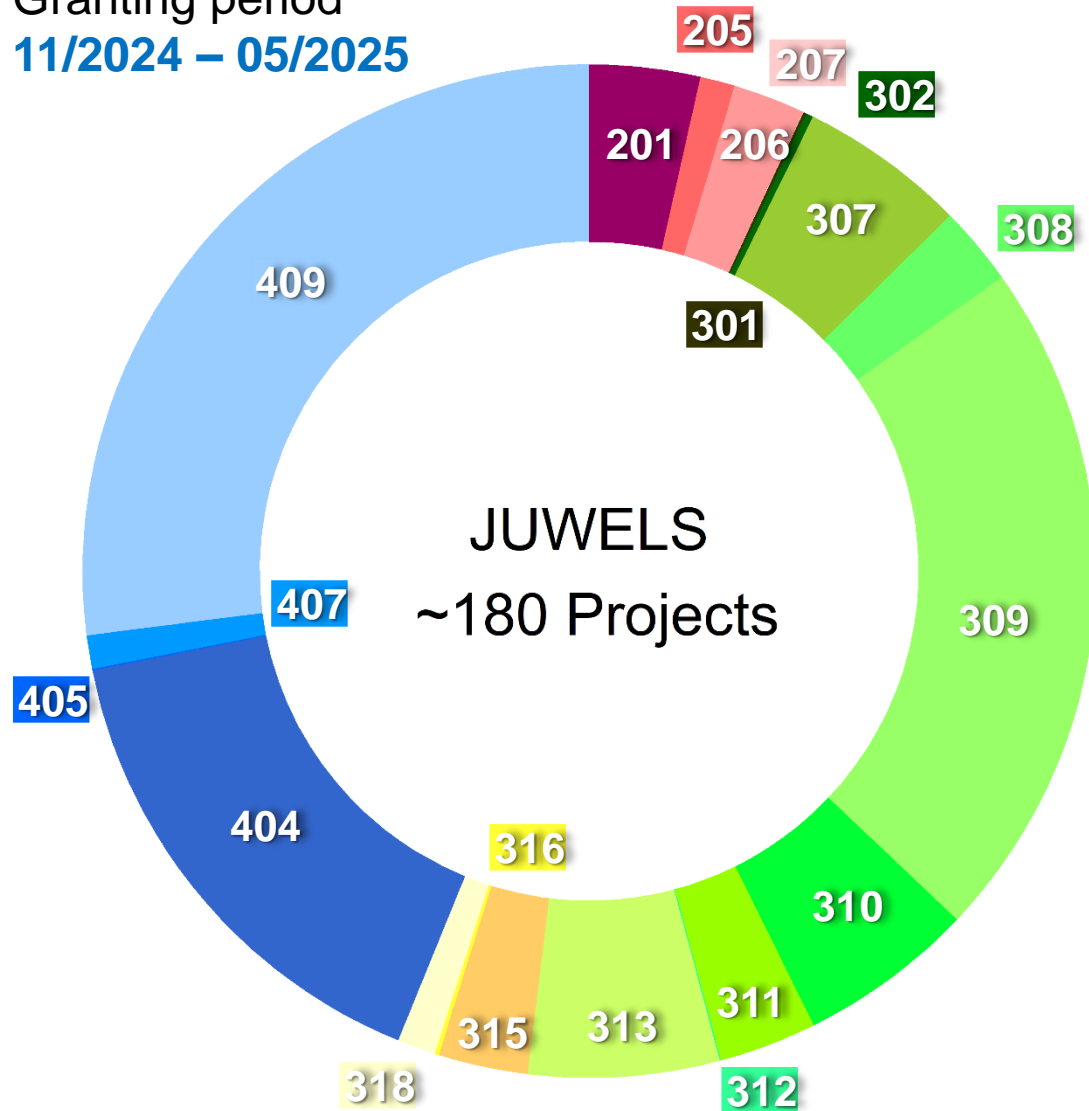
**Target >20x**  
application performance  
compared to JUWELS Booster

**Universal Cluster**  
> 2025  
> EPI Rhea



# JUWELS (CLUSTER + BOOSTER): GCS RESEARCH FIELDS

Granting period  
11/2024 – 05/2025

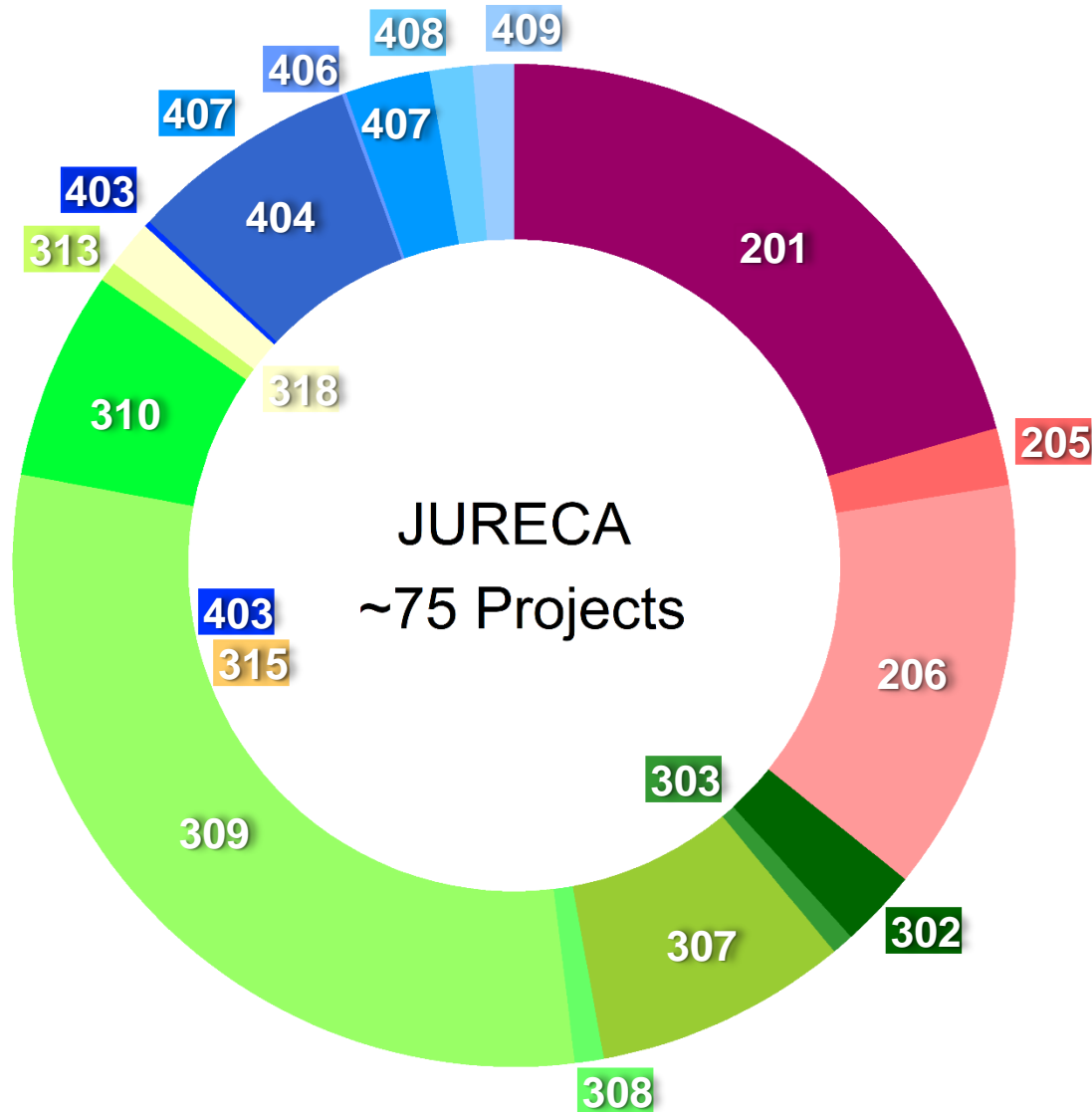


## Research Fields

- 201** Basic Biological and Medical Research
- 205** Medicine
- 206** Neurosciences
- 207** Agriculture, Forestry and Veterinary Medicine
- 301** Molecular Chemistry
- 302** Chemical Solid State and Surface Research
- 307** Condensed Matter Physics
- 308** Optics, Quantum Optics and Physics of Atoms, Molecules and Plasmas
- 309** Particles, Nuclei and Fields
- 310** Statistical Physics, Soft Matter, Biological Physics, Nonlinear Dynamics
- 311** Astrophysics and Astronomy
- 312** Mathematics
- 313** Atmospheric Science, Oceanography and Climate Research
- 315** Geophysics and Geodesy
- 316** Geochemistry, Mineralogy and Crystallography
- 318** Water Research
- 404** Heat Energy Technology, Thermal Machines, Fluid Mechanics
- 405** Materials Engineering
- 407** Systems Engineering
- 409** Computer Science

# RESEARCH FIELDS ON JURECA (CLUSTER)

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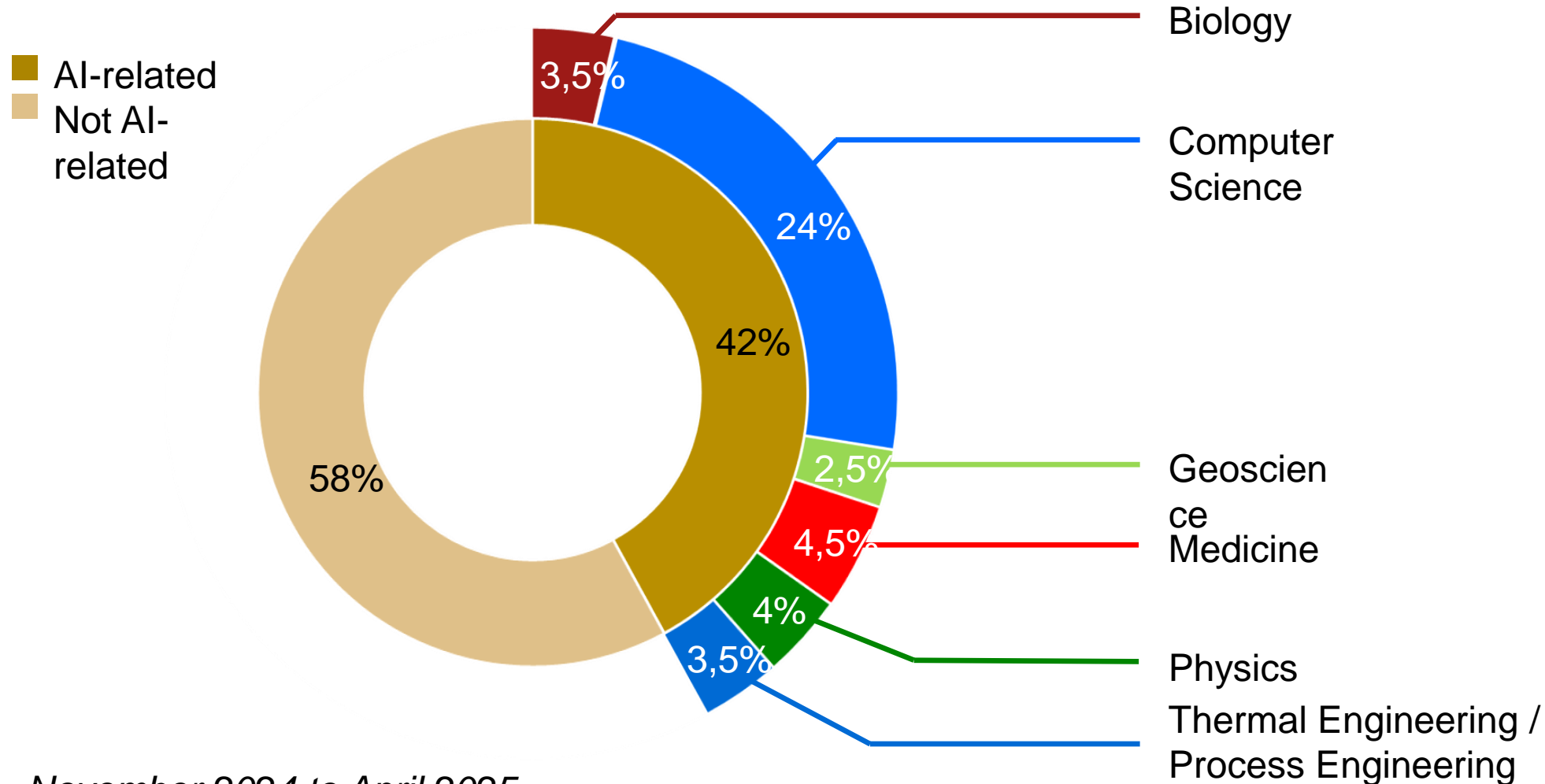


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- 310** Statistical Physics, Soft Matter, Biological Physics, Nonlinear Dynamics
- 313** Atmospheric Science, Oceanography and Climate Research
- 318** Water Research
- 403** Process Engineering, Technical Chemistry
- 404** Heat Energy Technology, Thermal Machines, Fluid Mechanics
- 406** Materials Science
- 407** Systems Engineering
- 408** Electrical Engineering and Information Technology
- 409** Computer Science

# AI: RESOURCE SHARES OF JSC PROJECTS

Granting period  
11/2024 – 05/2025



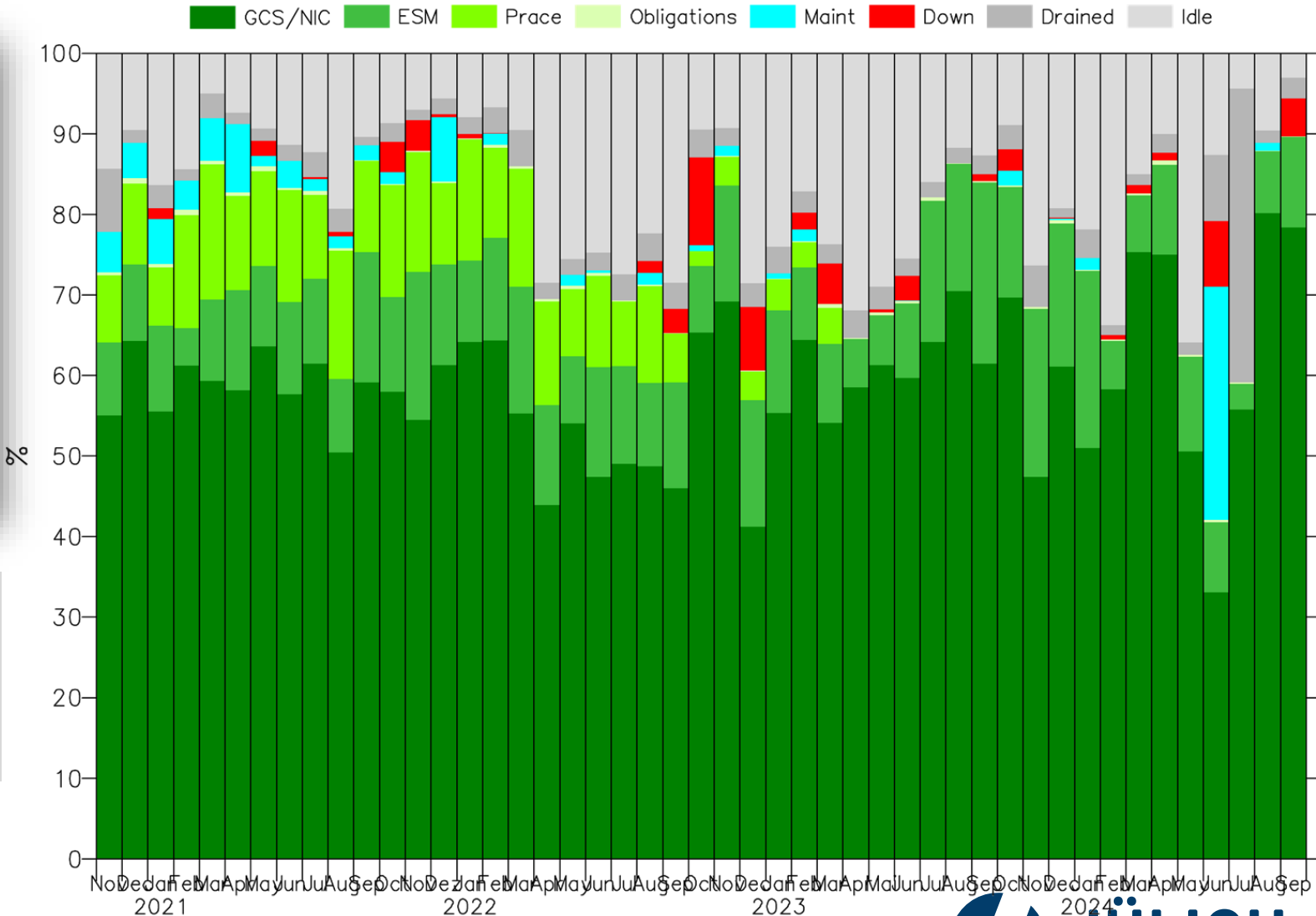
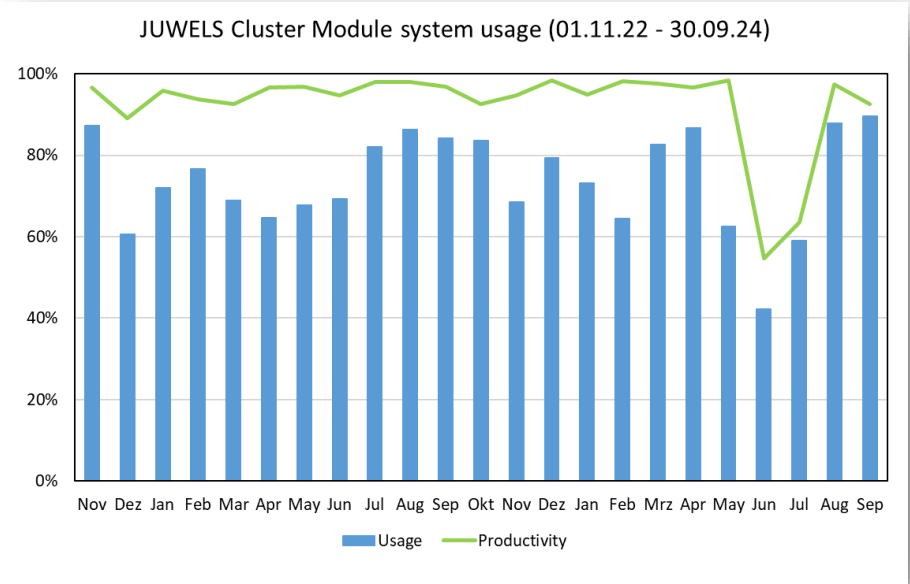
November 2024 to April 2025

# NATIONAL AND EUROPEAN USER GROUPS



- Proposals for computer time accepted from Germany and Europe
- Peer review by international referees
- CPU time is granted by independent Scientific Councils

# JUWELS CLUSTER USAGE



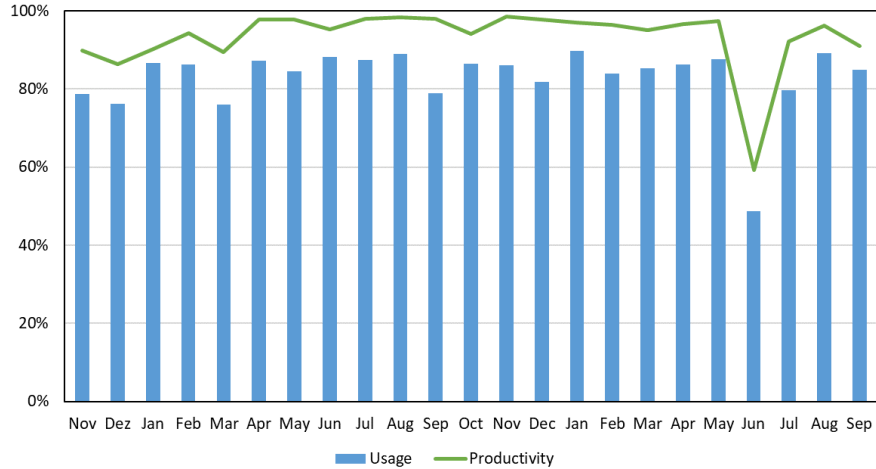
2024:

- JUST6 migration / Power outage datacenter
- 2x leakage in heat-exchanger (in JUWELS racks)

→ replacement of cooling components in racks of JURECA and JUWELS

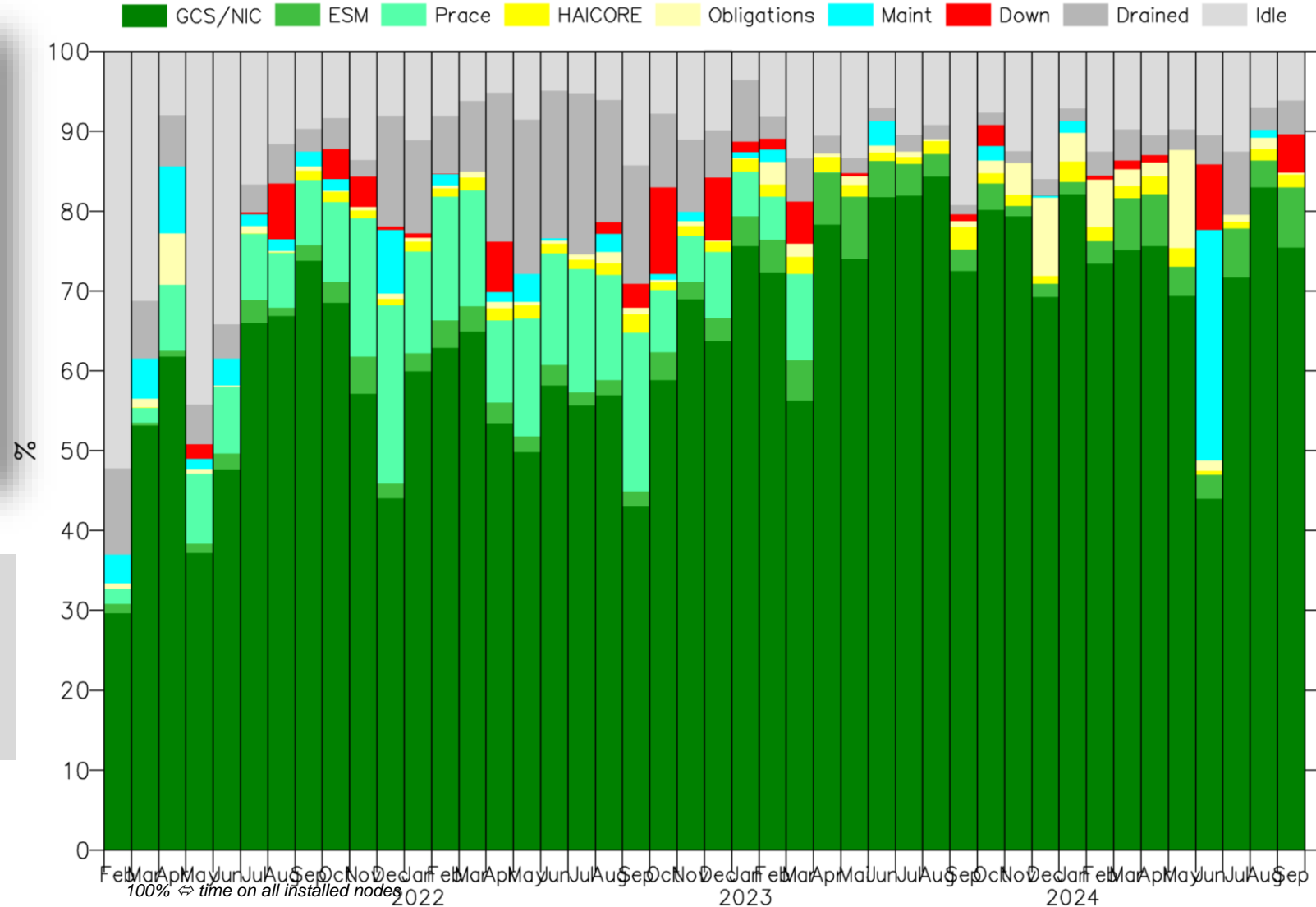
# JUWELS BOOSTER USAGE

JUWELS Booster Module system usage (01.11.22 - 30.09.24)



## 2024:

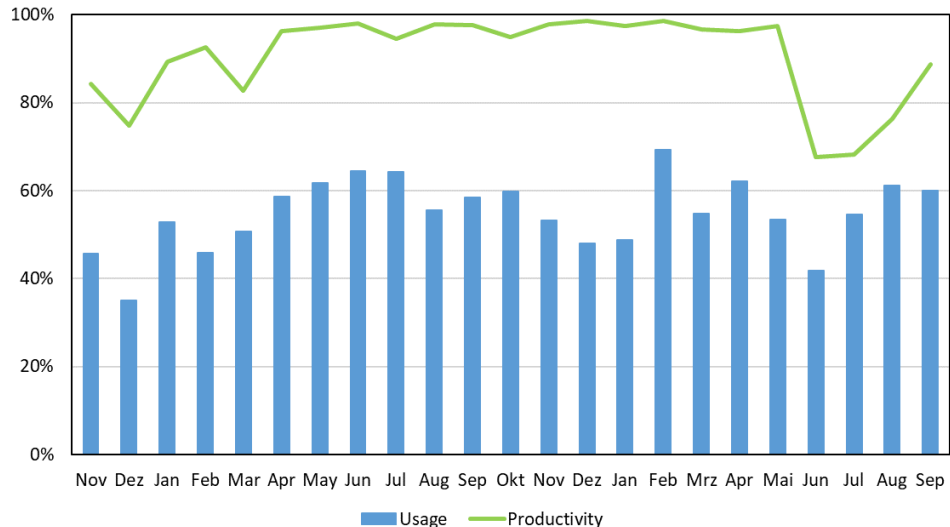
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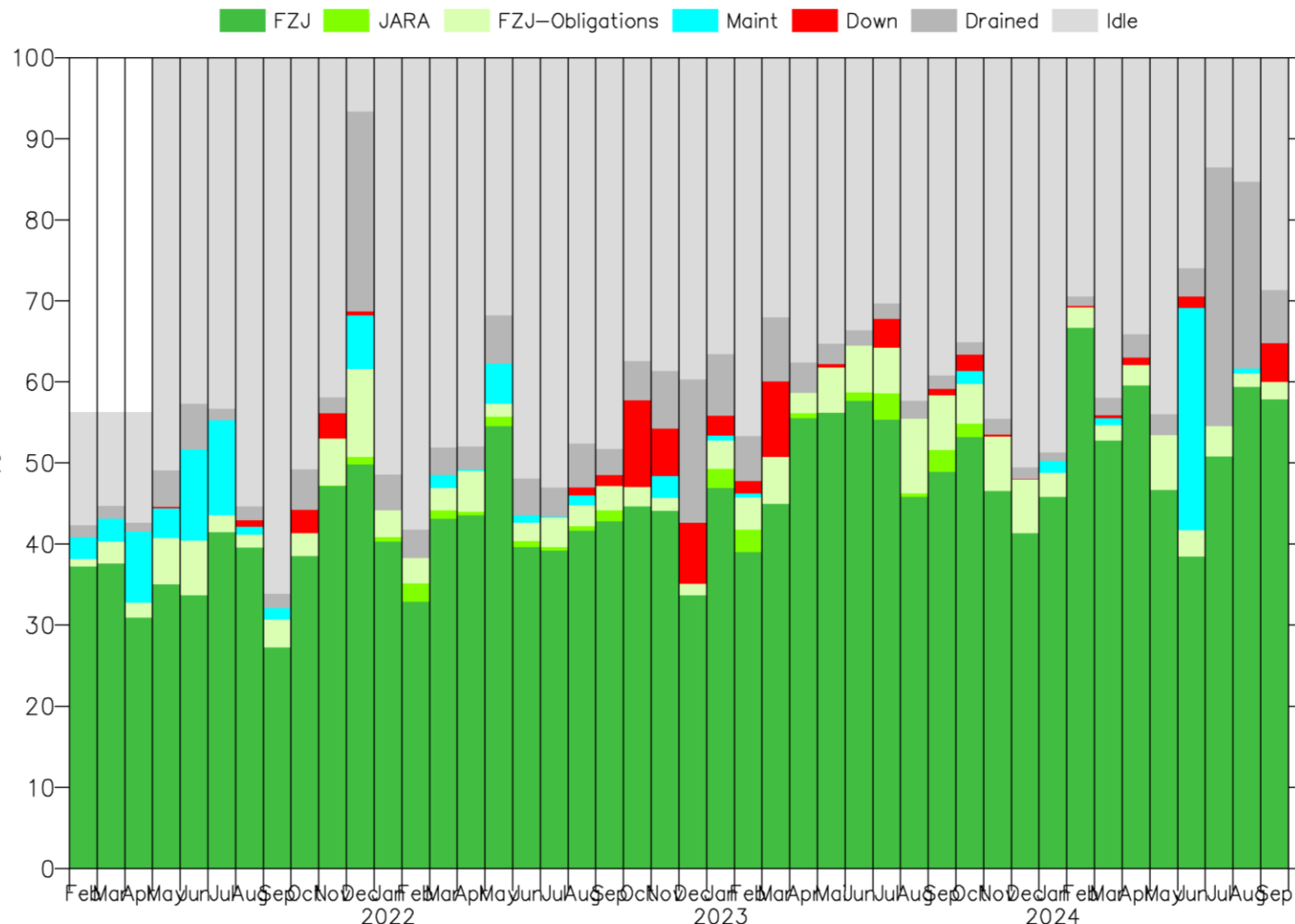
# JURECA-DC USAGE

JURECA-DC system usage (01.11.22 - 30.09.24)



## 2024:

- JUST6 migration / Power outage datacenter
- 2x leakage in heat-exchanger (in JUWELS racks)
- replacement of cooling components in racks of JURECA and JUWELS



JURECA-DC: since Dec 2020: 432 (of 768) nodes

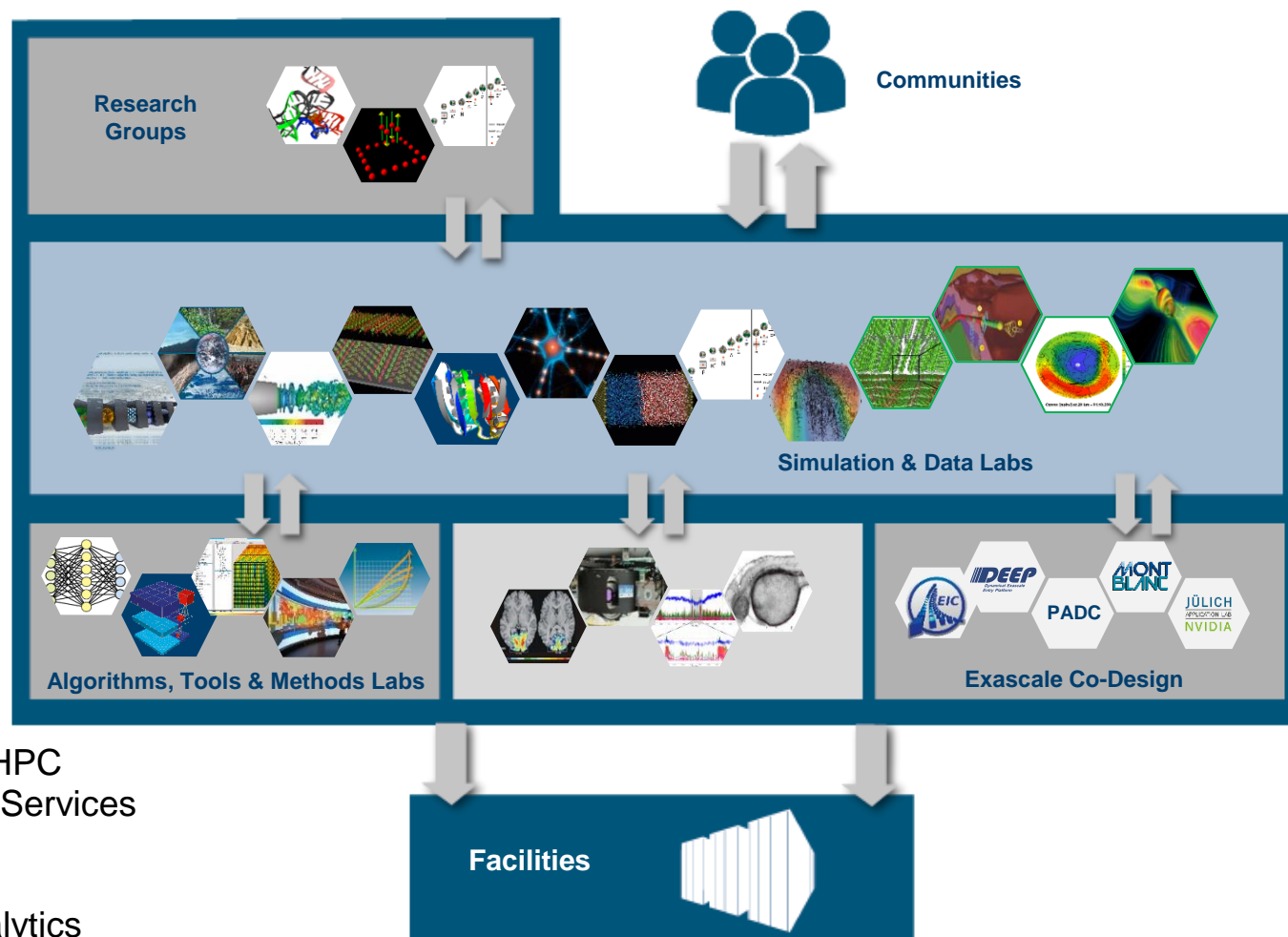
JURECA-DC: since May 2021 768 nodes

100% ⇔ time on all installed nodes

# SUPPORT AND RESEARCH LANDSCAPE AT JSC

- Quantum Information Processing
- Earth System Data Exploration
- Computational Material Science
- Computational Structural Biology
- Next Generation Architectures
- Software for Modular Supercomputers
- RSE
- AI & ML for Healthcare

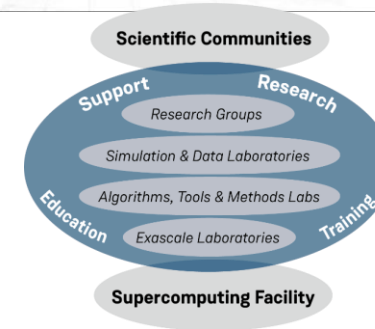
- Deep Learning
- Accelerating Devices
- Parallel Performance
- Application Optimization
- Applied Machine Learning
- Visualization & Interactive HPC
- Federation Technologies & Services
- Concurrency & Parallelism
- Advanced Time Integrators
- Data Management and Analytics
- Numerical & Statistical Methods



- Complex Particle Systems
- Quantum Materials
- Electrons and Neutrons
- Biology
- Neuroscience
- Fluids & Solids Engineering
- Plasma Physics
- Numerical Quantum Field Theory
- Astronomy & Astrophysics
- Climate Science
- Terrestrial Systems
- AI and ML for Remote Sensing

# SUMMARY

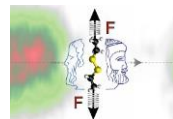
- **The Jülich Supercomputing Centre (JSC) provides**
  - Tier-0/1 HPC resources of the highest perf. class
  - high-end primary and domain-specific user support
  - ...
- **JSC expects to see**
  - breakthrough science
  - parallel applications, using efficient and optimized algorithms & programs on a substantial number of processors simultaneously



Sz. Borsanyi et al.,  
Science **347** (2015) 6229



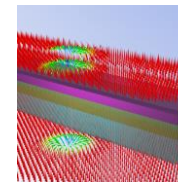
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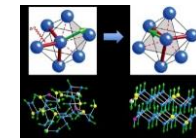
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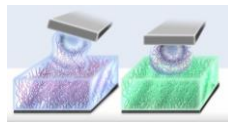
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