



EuroHPC
User Days

Dublin Ireland
22→24
September 2026



EuroHPC
Joint Undertaking



The Scientific and Innovation Case for HPC in Europe 2026–2034

Hartmut Wittig

Johannes Gutenberg University Mainz



Partnership for Advanced Computing in Europe

Scientific and Innovation Case for Computing in Europe 2026 – 2034

Editors

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Conveners

Simone Hochgreb^d, Frank Jenko^e, Boris J.P. Kaus^f, Petros Koumoutsakos^g,
Simone Montangero^h, Modesto Orozcoⁱ, Matej Praprotnik^j, Luciano Rezzolla^k,
Simon Scheidegger^l, Bertil Schmidt^m, Philippe Segersⁿ Frank Wilhelm-Mauch^o,



Previous document

The Scientific Case for Computing in Europe 2018–2026



Purpose and Scope

- ❖ Chart progress in topical research that relies on computing
- ❖ Identify user requirements in a rapidly changing environment and make recommendations
- ❖ Target audience:
Scientific community, funding agencies, policy makers

Panels and Chapters

Climate, Weather and Earth Sciences (Boris Kaus)

Energy, Net-zero Strategy (Frank Jenko)

Engineering and Industrial Applications (Simone Hochgreb)

Fundamental Sciences (Luciano Rezzolla)

Life Sciences (Modesto Orozco)

Materials (Matej Praprotnik)

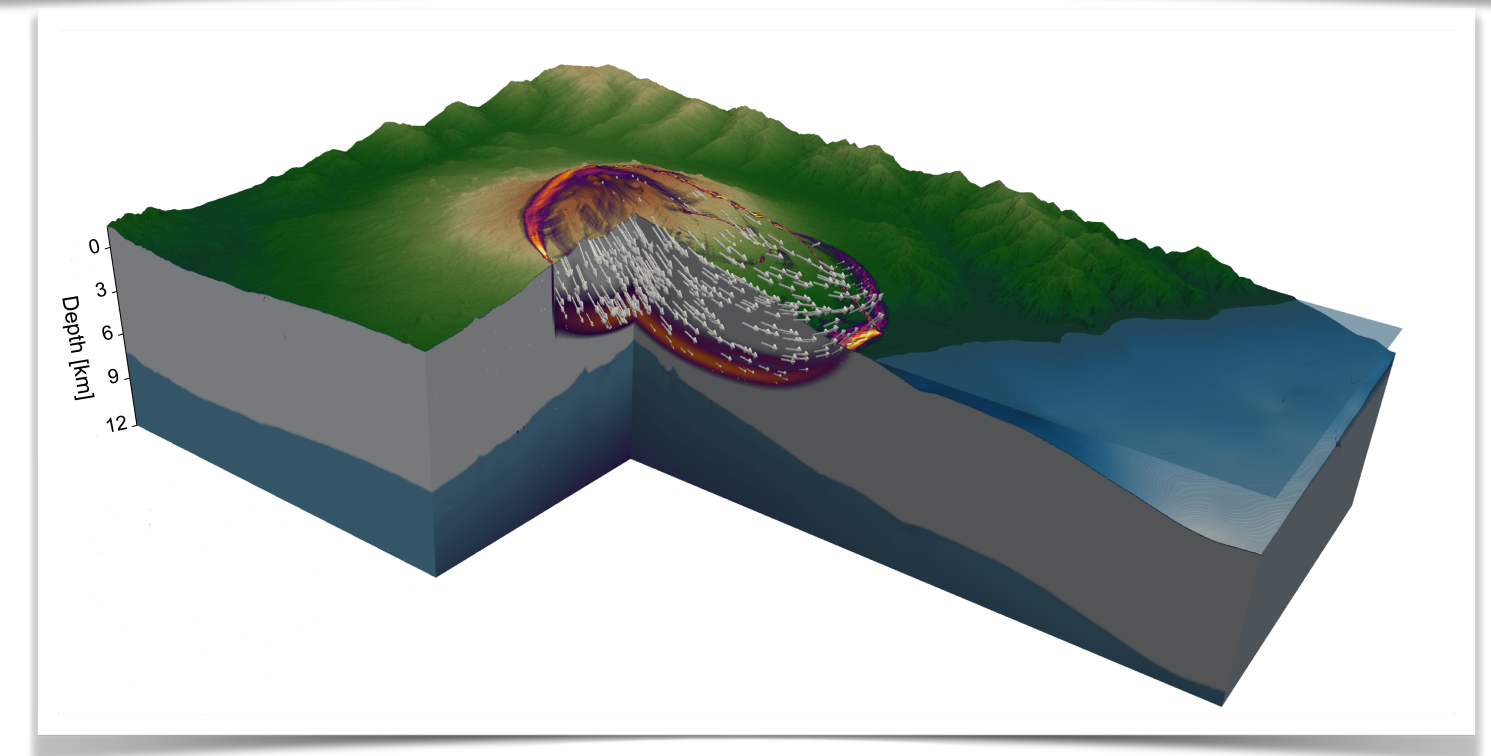
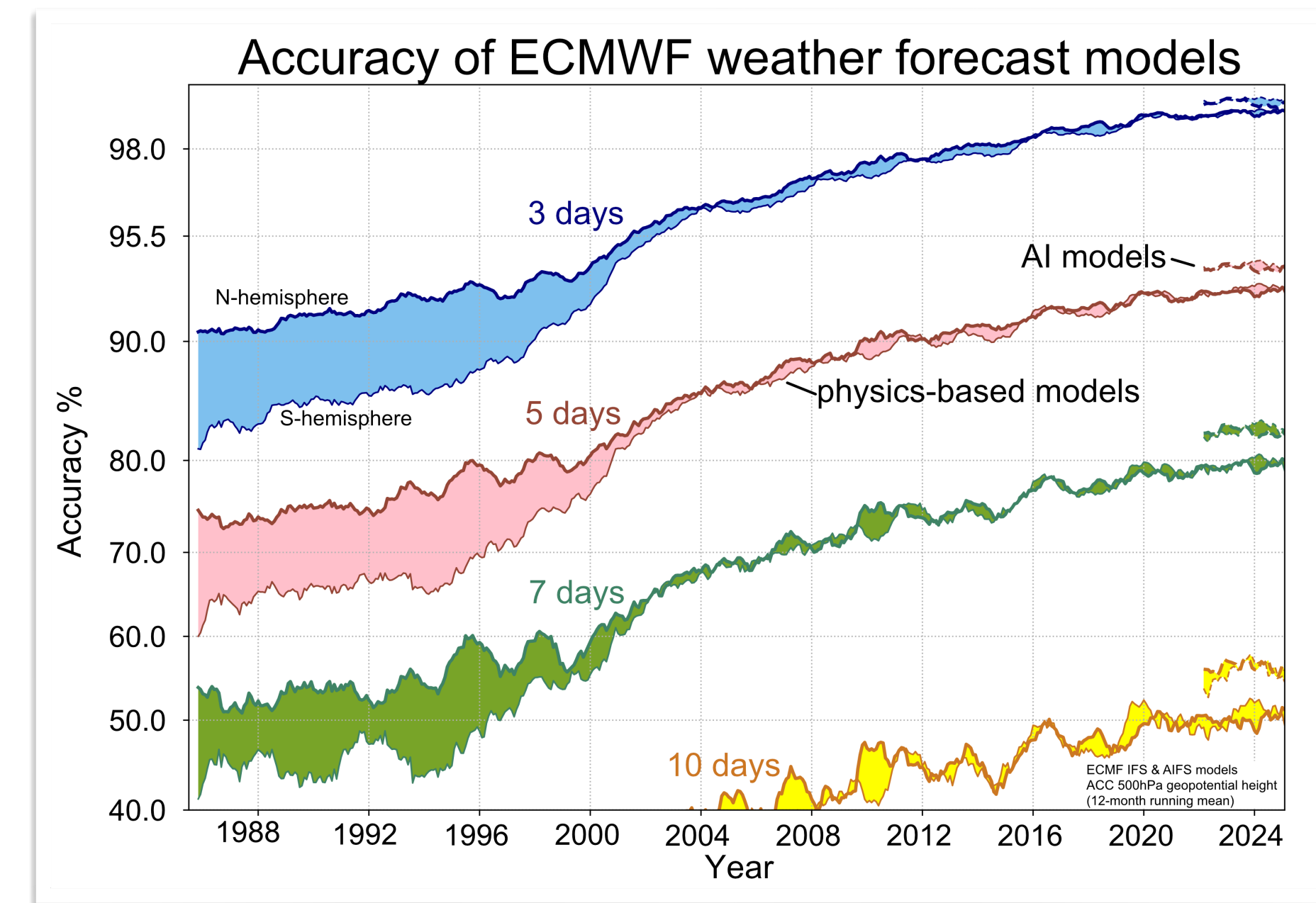
Social Sciences and Humanities (Simon Scheidegger)

AI and QC (Petros Koumoutsakos, Bertil Schmidt, Simone Montangero, Frank Wilhelm-Mauch)

Infrastructure (Philippe Segers)

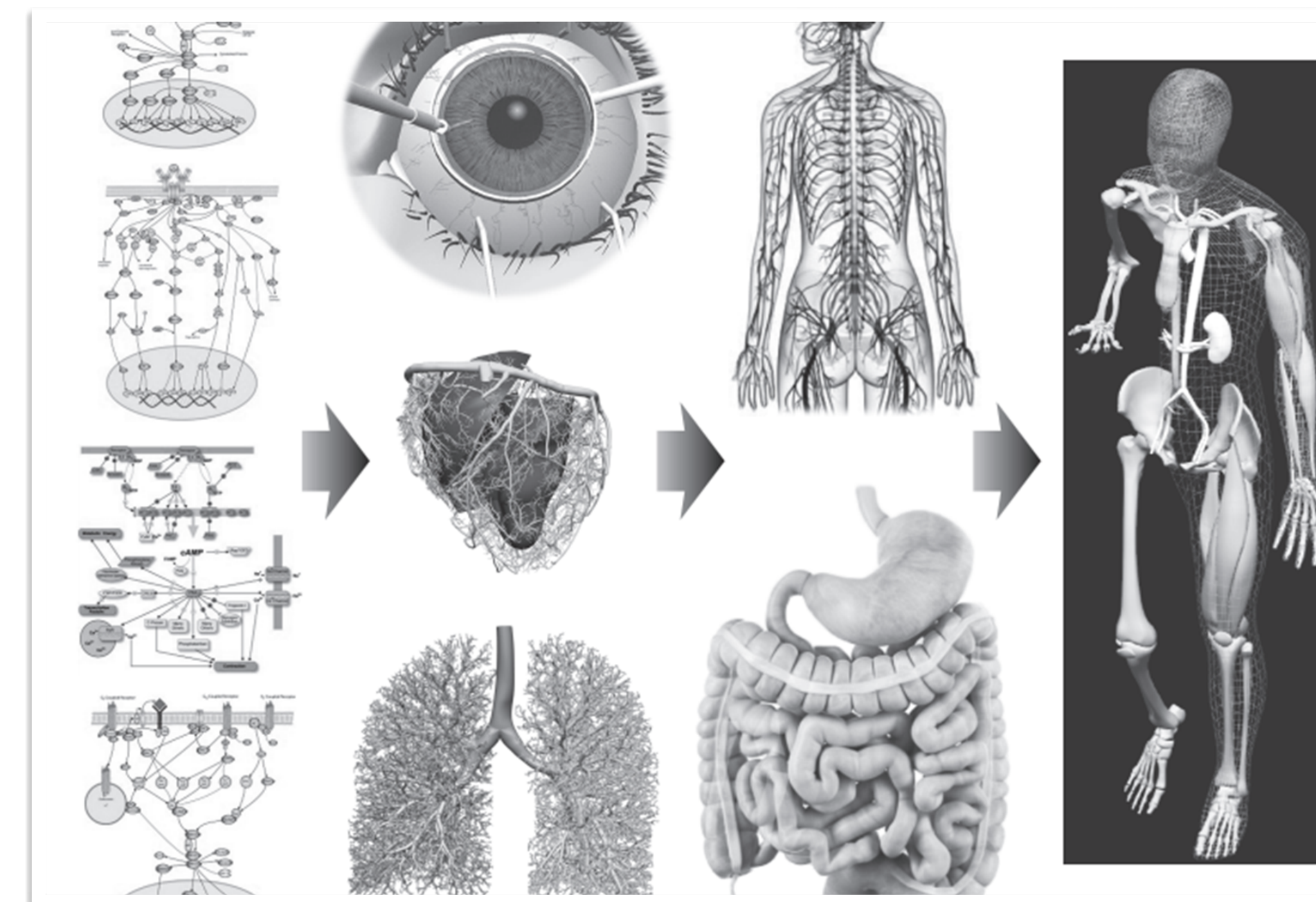
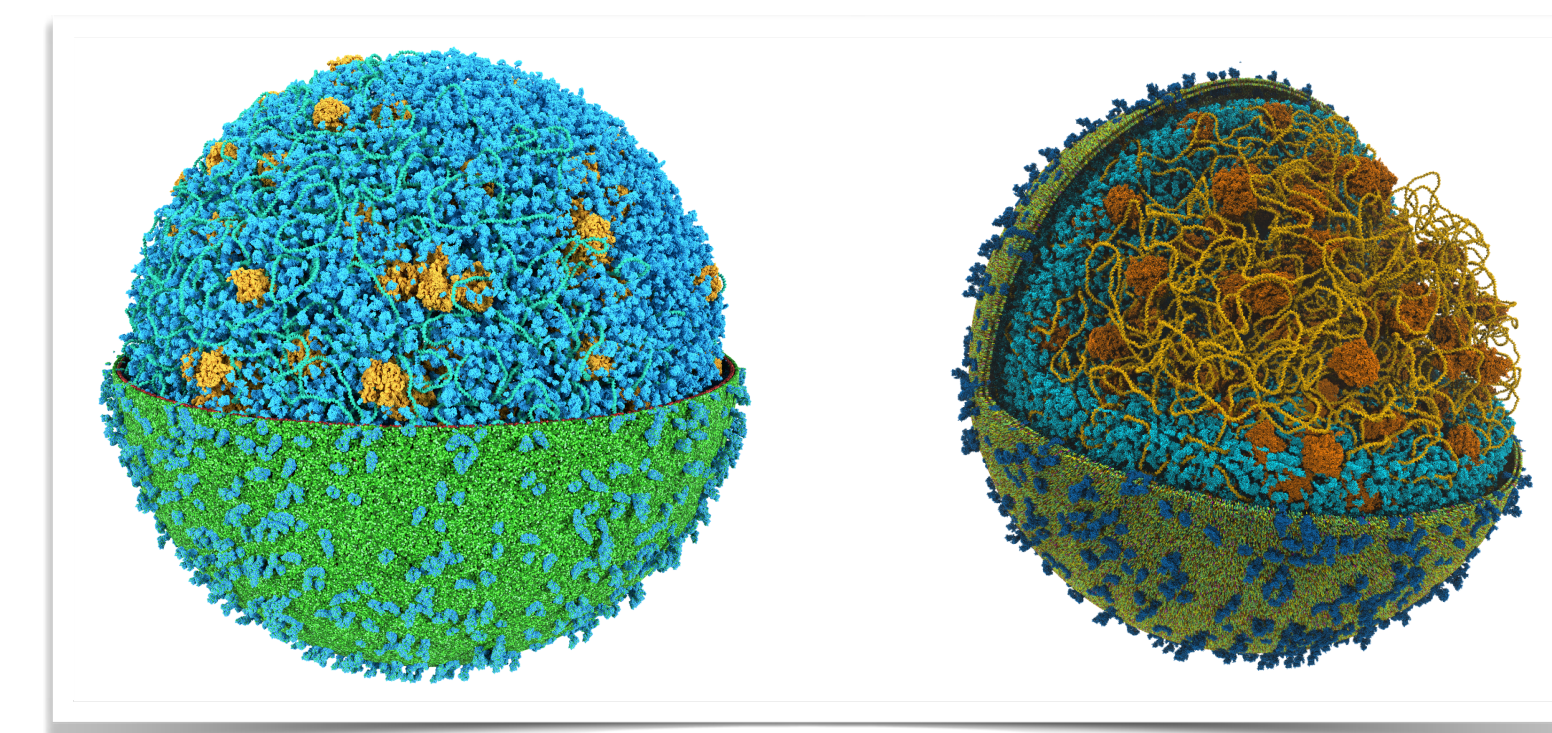
Climate, Weather and Earth Sciences

- ❖ Physics-based simulations remain the gold standard
- ❖ Climate modelling with km-size resolution
- ❖ AI techniques increasingly important
 - outperform traditional simulations in short-to medium-term weather forecasting
 - AI-assisted long-term climate modelling
 - uncertainty quantification in Solid Earth Sciences (seismology, groundwater flow, volcanic activity)



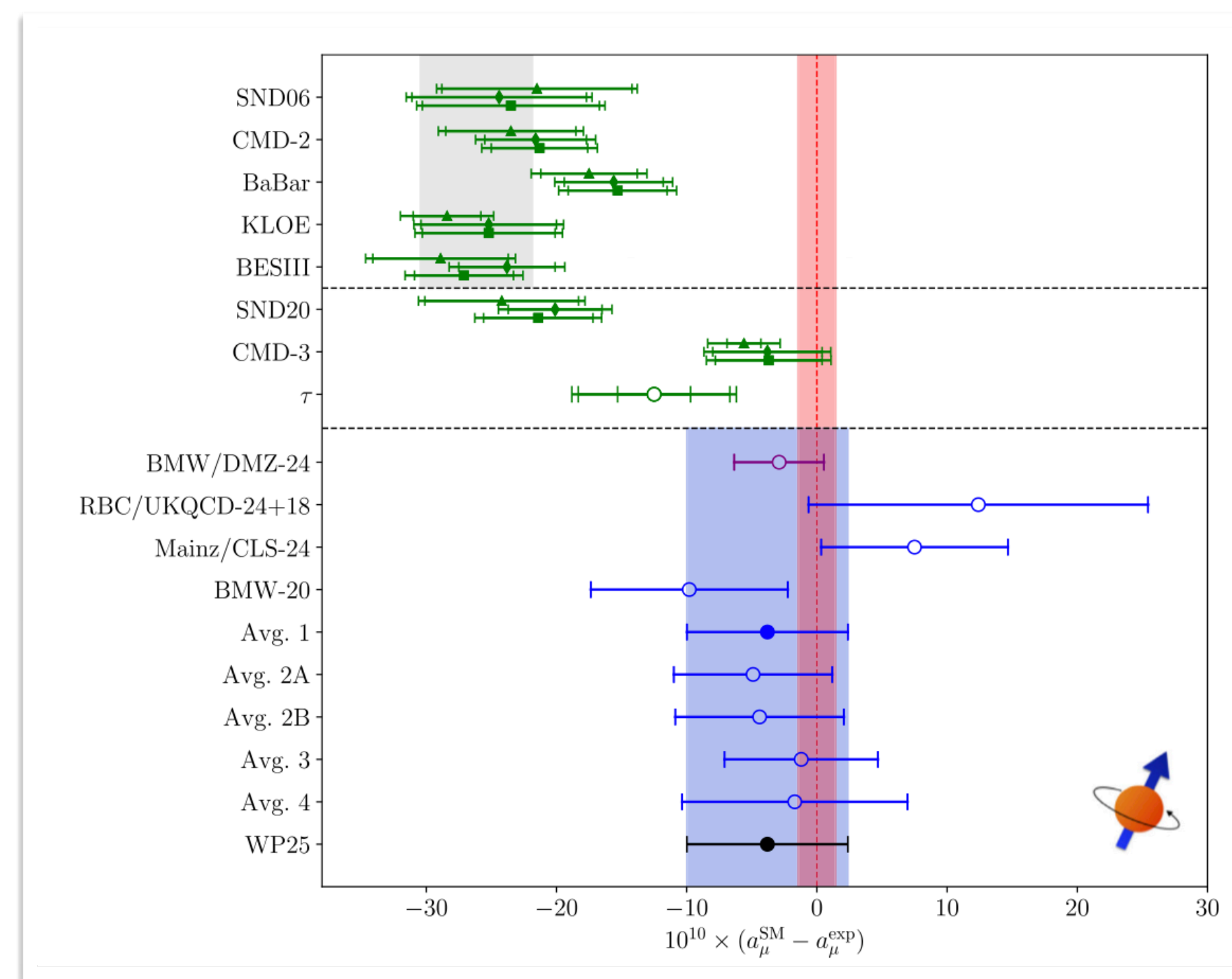
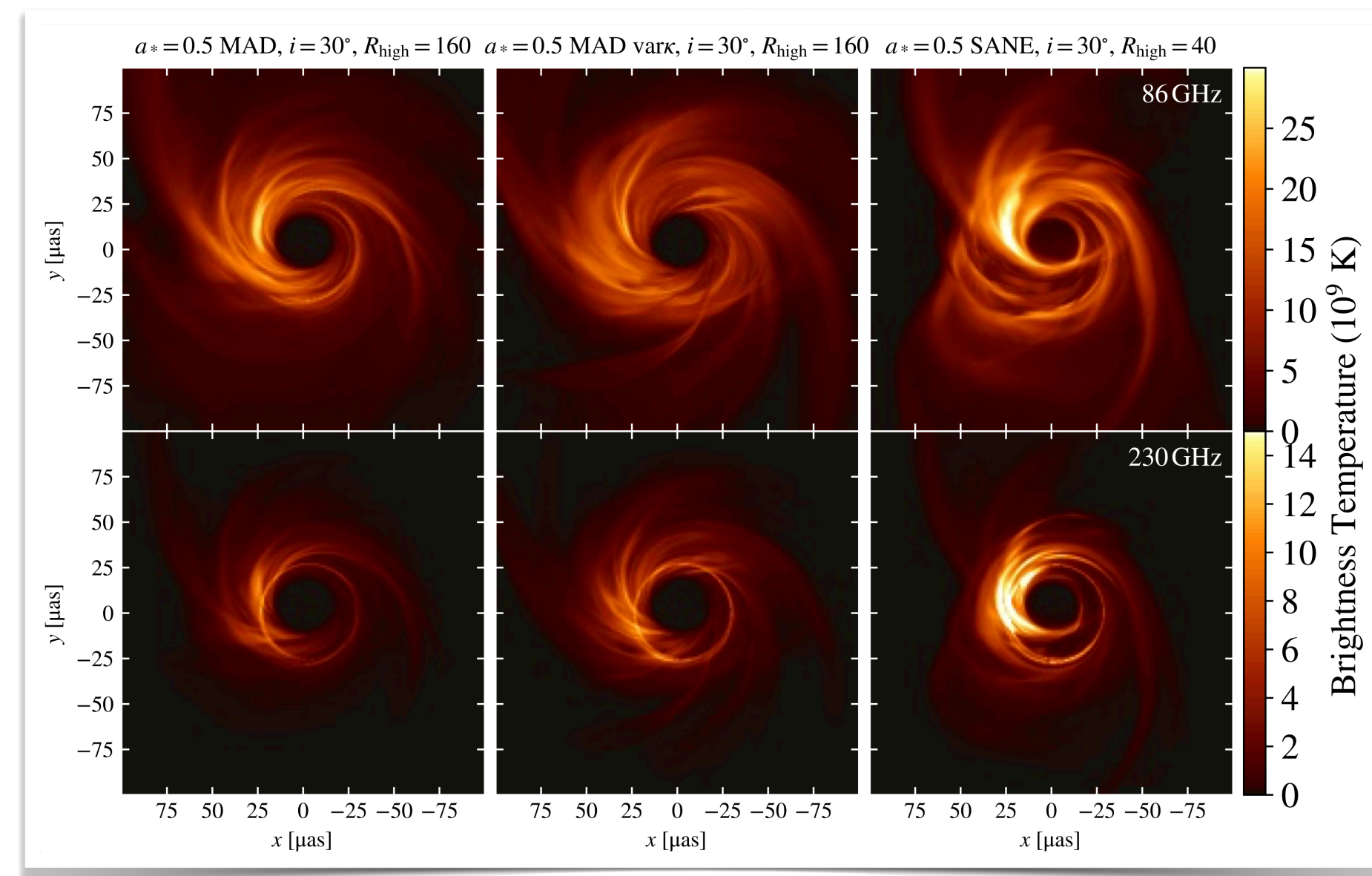
Life Sciences

- ❖ Simulation-based methods (MD) account for sizeable fraction of supercomputer usage
- ❖ Computational biology transformed by AI/ML
 - predicts alternative conformations of proteins
 - AI-driven simulation techniques (MLFFs)
- ❖ Topics and challenges:
 - *in silico* representations of multi-scale models
→ European Virtual Human Twin
 - large-scale agent-based simulations



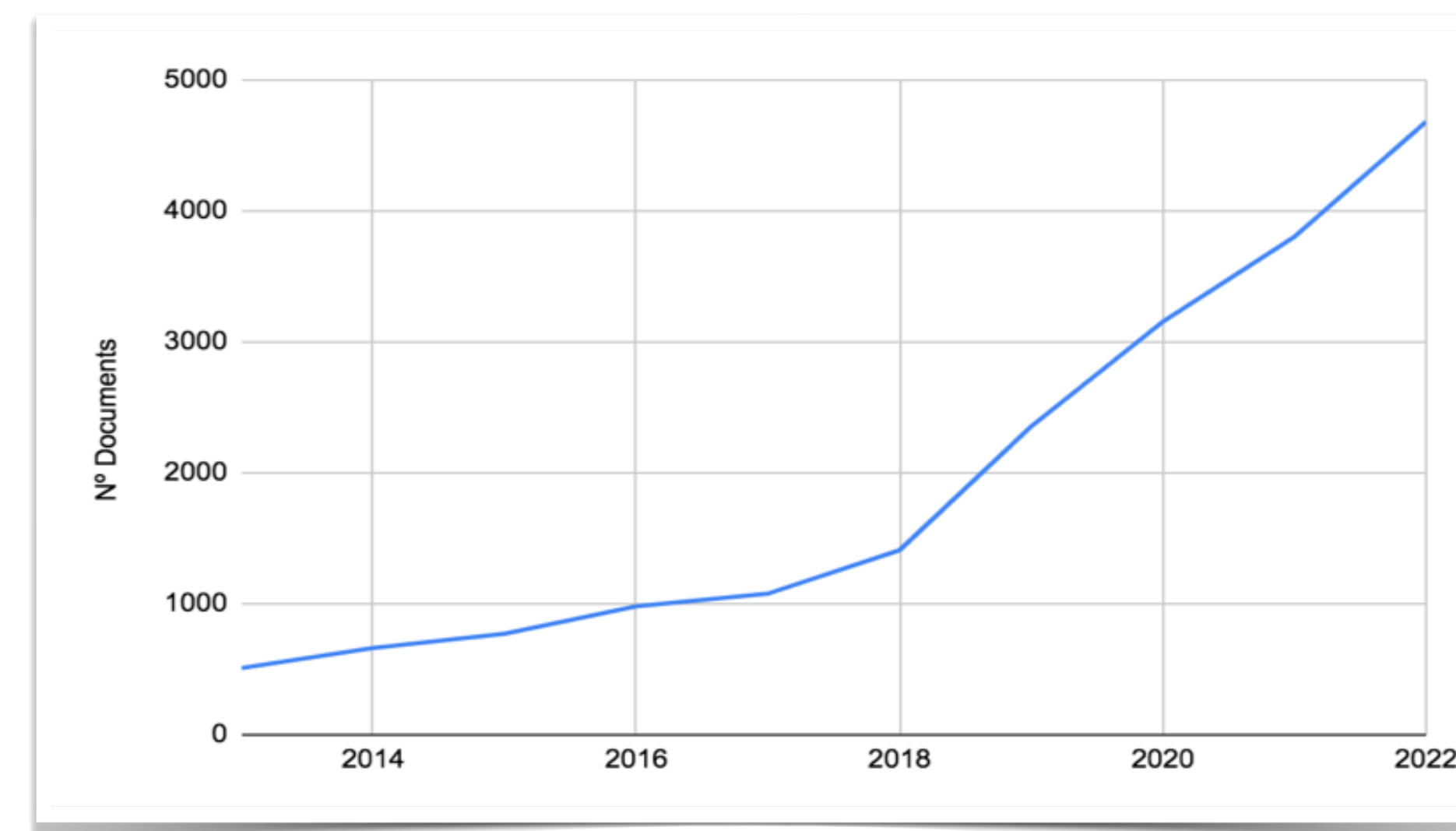
Fundamental Sciences

- ❖ Confront theoretical predictions with experiment
 - basic constituents of matter (→ lattice QCD)
 - origin and evolution of the Universe
- ❖ Rely on leadership-class computational infrastructure — AI plays minor role
- ❖ Lattice QCD:
 - early adoption of GPU hardware
 - contributes to R&D effort on Quantum Computing



Social Sciences and Humanities

- ❖ Dramatic surge in applying HPC and AI
 - model trade policies, market stability, effects of climate change
 - data acquisition and analysis of visual content and texts using LLMs
- ❖ Skills gap between natural and social sciences
- ❖ Usage patterns of HPC differ substantially in Social Sciences
 - must be reflected in access patterns



Executive Summary

- ❖ Scientific Computing is undergoing a huge transformation, driven by the emergence of Artificial Intelligence and Machine Learning
- ❖ Shift in computing paradigms across many scientific disciplines
- ❖ Implications for preferred hardware: CPU / GPU / TPU
- ❖ GPU/TPU: optimised for AI applications and low arithmetic precision
- ❖ Computational requirements increasingly defined by industry (*“Science is not in the driving seat”*)

Executive Summary

- ❖ AI challenges “traditional” massively parallel supercomputer concept with double-precision capability
- ❖ QC on the horizon: transformative technology, still fraught with considerable technical difficulties
- ❖ Dramatic shift in geopolitical landscape
- ❖ Economic stability, global supply chains, digital autonomy

Recommendations

- ❖ Recommendations designed to
 - ensure leading role of European science and industry
 - satisfy needs of different scientific communities
- ❖ Requirements
 - Diverse and powerful hardware environment
 - Significant investments in new technologies
 - Data accessibility that conforms to societal and judicial standards

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3. Enable Broad, Equitable and Flexible Access to Computing and Data Resources
access policies must reflect workflow patterns; data-intensive analyses; urgent computing

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hardware-software co-design; modernisation of legacy codes; portability;
EU-wide initiatives: Centres of Excellence, long-term funding lines for SW-development

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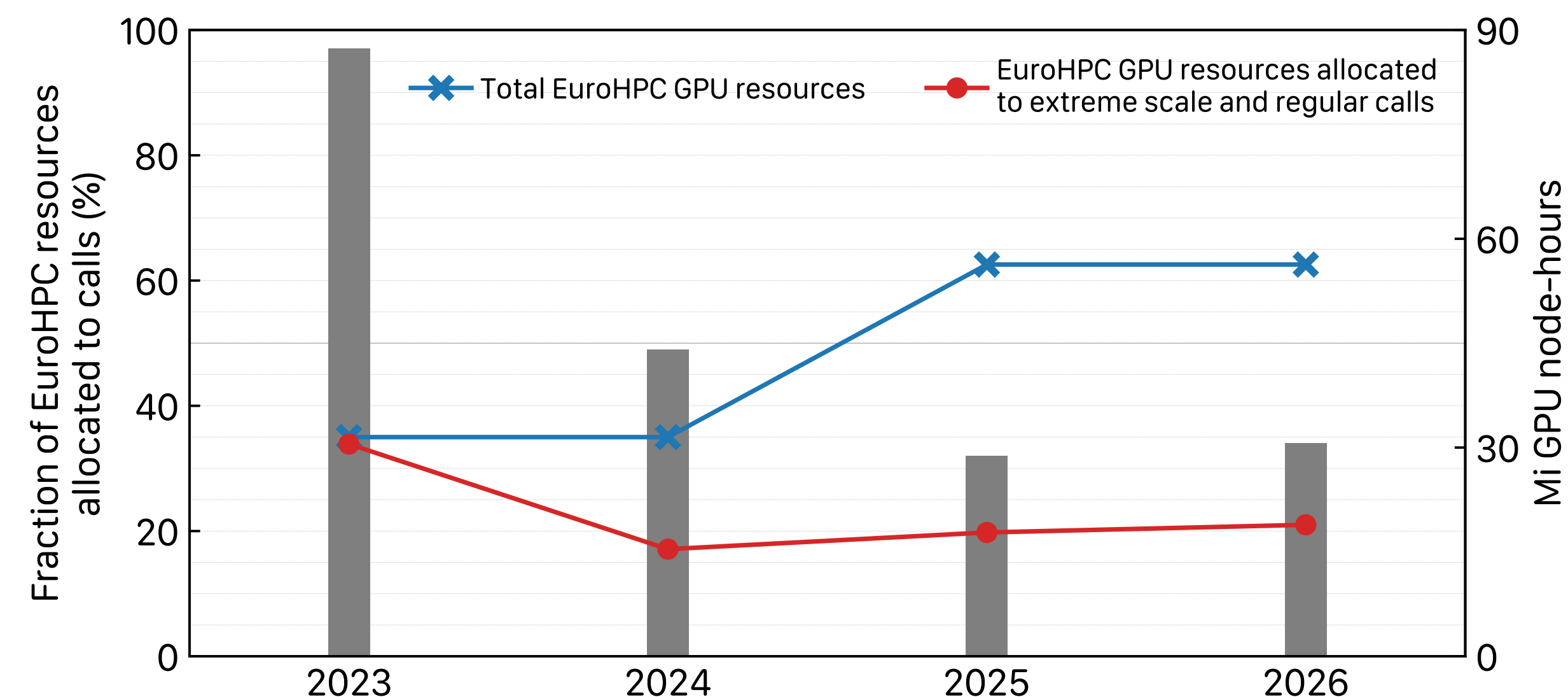
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Recommendations

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EU-wide initiatives: Centres of Excellence, long-term funding lines for SW-development
5. Integrate AI, Data and Simulation in a Responsible and Trustworthy Framework
convergence of AI with physics-based modelling, simulation and data-driven approaches
(“digital twins”);
ethical governance framework, transparency, accountability and societal trust

Infrastructure

- ❖ EuroHPC JU oversees transformation of Europe's computing landscape
- ❖ Legacy Platforms to AI Factories
- ❖ Fraction available to non-AI projects has decreased over time
- ❖ Necessitates compensation for simulation-based science



Summary and Outlook

- ❖ Scientific excellence is a driver of innovation
- ❖ Huge progress enabled by AI applications should not come at the expense of simulation-based science
- ❖ Distribution of resources must be science-driven and accompanied by full accountability
- ❖ AI/QC revolution in the US largely driven by risk-capital; resources vastly exceed European public funding
- ❖ Europe must draw in the private sector if it is to compete successfully

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Thank you!





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Future Requirements of Lattice Field Theory Calculations on European High-Performance Computing Facilities

Antonio Rago – Chair EuroLFT
EuroHPC User Forum Feedback Session

EuroLFT represents Europe's LFT community

A new generation of calculations is needed to meet the experimental demand in terms of precision and to further our understanding of the fundamental building blocks of the universe.

Represented institutions across Europe · a shared voice for HPC

European network for Lattice Field Theory

EuroLFT connects the European LFT community, representing its interests in dialogue with EuroHPC-JU and CERN.

Related U.S. setup: USQCD

Representing the majority of LFT research in the USA.



LFT's EuroHPC track record

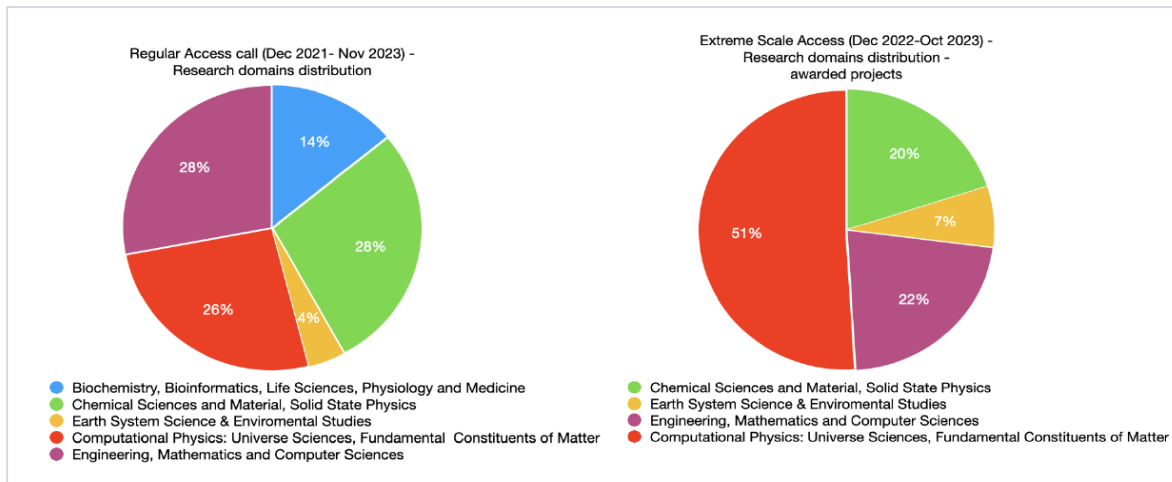
Regular and Extreme Scale calls: Lattice Field Theory accounts for a large share of Computational Physics allocations

26%

Regular Access calls
Computational Physics allocation

51%

Extreme Scale calls
Computational Physics allocation



Lattice is a recurring Extreme Scale user

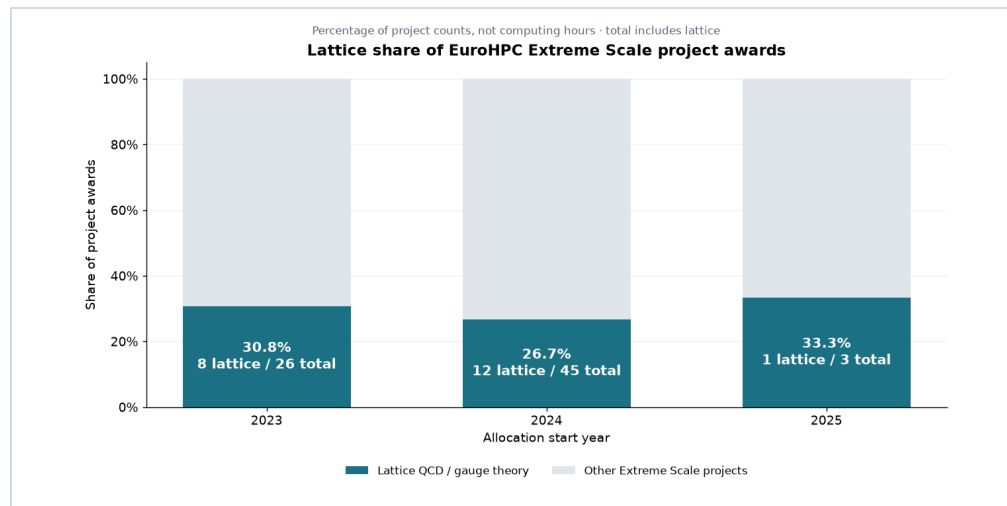
Project counts show a 27–33% lattice share in 2023–25

21

Lattice projects
of 74 awards, 2023–25

~30%

Lattice share in each
year, by project count



Lattice QCD codes are engineered to scale

Decades of algorithm, software, and hardware co-design have carried lattice workloads across successive HPC architectures

Architecture-aware software

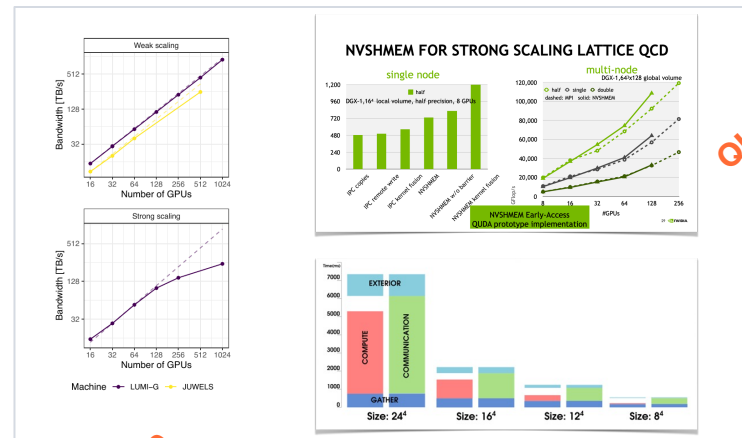
Data layout, kernels, solvers and communication evolve with hardware

Scalable production codes

Community codes run from a node to large CPU/GPU partitions

Co-design and benchmarking for decades

Co-design and benchmarking of processors, accelerators, and interconnects.



HiRep 2.0

Grid

QUDA

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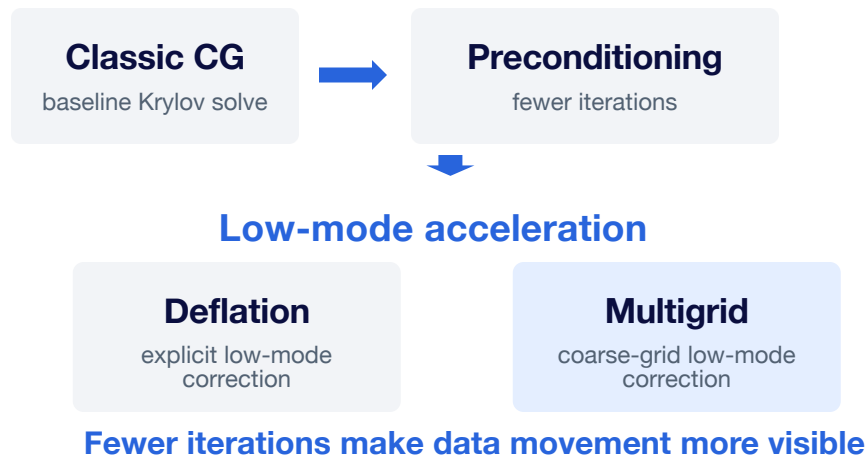
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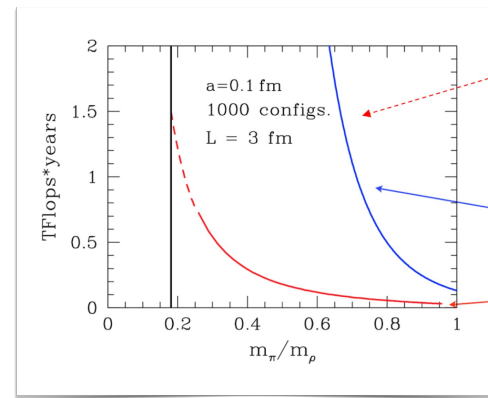


FLOPs are not enough

Fewer iterations expose data movement



Memory bandwidth, latency, communication, and overlap increasingly determine time-to-solution.



The Berlin Wall (2001)

Ukawa (2001)

Luscher (2004)

Historical example: solver advances moved the "Berlin wall"

A balanced system

Useful science depends on the whole node-to-network path

Memory bandwidth

Sparse Dirac kernels

Memory capacity

Working sets + subspaces

**Usable
science**

Interconnect

Low latency + high bandwidth

Precision

Reliable FP64 / mixed precision

I/O and storage

Ensembles, observables, and long-lived data

A software ecosystem that makes it usable

A reliable code path is part of the infrastructure

Portable performance

Maintained CPU/GPU paths and a stable toolchain over the system lifetime.

Centre-side CI

Representative lattice codes catch compiler, stack, and hardware regressions early.

Shared expertise

RSE capacity and co-design link science teams with centres.

Knowledge hubs

Centres of Excellence share proven approaches and identify common needs across related scientific communities.

ILDG: configurations as primary data

Programmatic access keeps lattice configurations useful after generation

Programmatic access

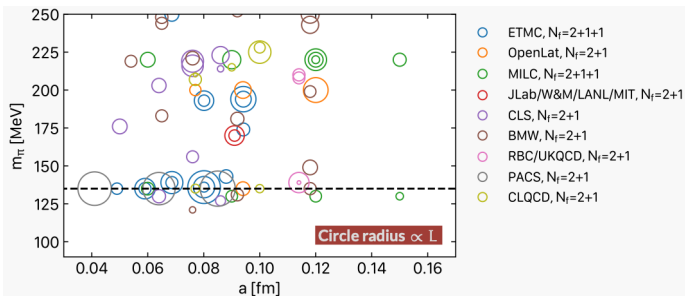
Configurations are primary data. Shared identifiers and metadata let analysis workflows locate and retrieve them reproducibly.

10–100 TB

storage per ensemble

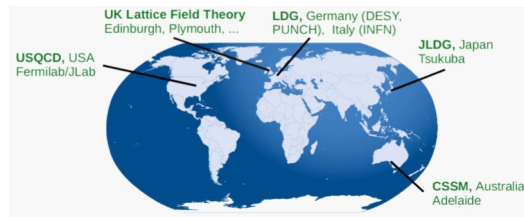
10+ years

independent reuse



Federation of regional grids

Since 2003, ILDG has connected repositories in Europe, the UK, the US, Japan and Australia.



ILDG 2.0 today

Token-enabled access, redeployed catalogues and updated metadata are fully operational.

Five enablers

An operating model for usable scientific capacity

- | | | |
|---|---|--|
| 1 | Recognise domain experts in review | Include relevant scientific expertise in allocation and technical review panels. |
| 2 | Use science-specific benchmarks | Run community benchmarks during procurement and acceptance of new systems. |
| 3 | Publish a 5–10-year roadmap | Give communities time to plan software ports, co-design and training. |
| 4 | Build RSE and CoE capacity | Support their creation and sustained collaboration across scientific communities. |
| 5 | Host data infrastructure | Provide storage, catalogues and programmatic access alongside compute allocations. |

More usable science

Not just more FLOPs

**Balanced hardware + Sustainable software +
Expertise + Data**

**A successful European system turns allocation into durable
scientific value.**