

|JÜLICH| SUPERCOMPUTING – QUO VADIS ?

Future HPC and Quantum Hardware

AQTIVATE CONFERENCE | SEPTEMBER 28, 2026 | THOMAS LIPPERT | JSC

Mitglied der Helmholtz-Gemeinschaft

JÜLICH Forschungszentrum | JÜLICH SUPERCOMPUTING CENTRE

SCIT ENIM QUO EXITURUS SIT QUI UNDE VENERIT MEMINIT

Seneca

HE WHO REMEMBERS WHERE HE CAME FROM KNOWS WHERE HE IS GOING

JUGENE: #4 worldwide, #1 in Europe

IBM Blue Gene/P

72 racks, 294912 cores

1 Petaflop/s peak

144 Tbyte memory

6 Pbyte disks

25 PByte tape capacity

Highest scalability



Blue Gene/Q at Jülich: JUQUEEN

28 Racks = 458,752 cores

- Peak double-precision floating-point performance: 5.87 PFlops
- 448 TBytes memory
- 1.5 Mio. Hardware threads

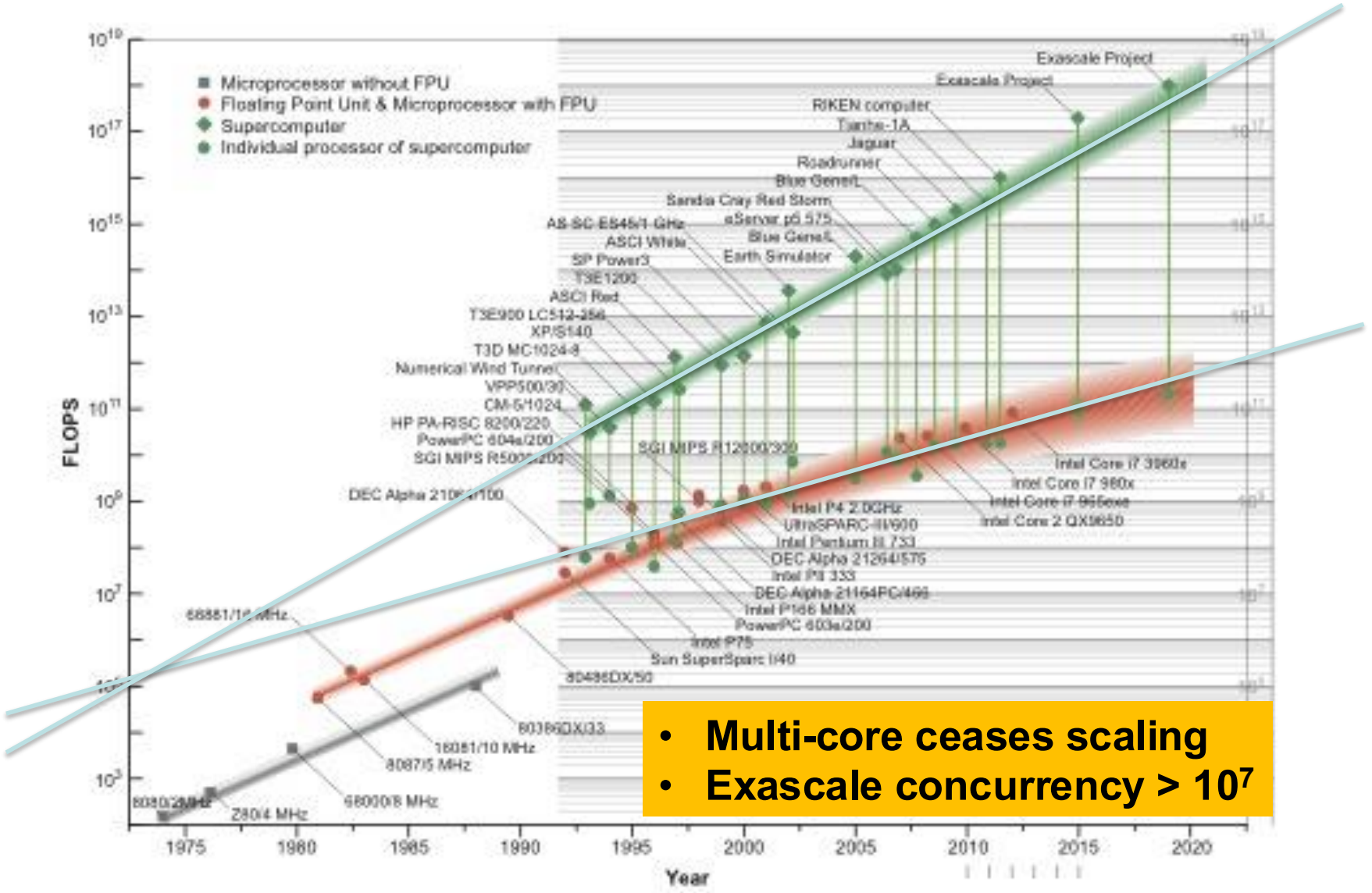
  → High Q Club



Storage

- Storage capacity 8 PB on JUST
- Data rate: 200 GB/s
- Disk failure ~3/week
- GSS: Declustered RAID concept – rebuild-time 2 minutes
- End-to-end data security!

End of Moore's Law! Meuer's Law Forever?



- **Multi-core ceases scaling**
- **Exascale concurrency > 10^7**

THE BET





Der gewöhnliche Probierstein: ob etwas bloße Überredung, oder wenigstens subjektive Überzeugung, d.i. festes Glauben sei, was jemand behauptet, ist das Wetten.

Immanuel Kant – Kritik der reinen Vernunft

The usual touchstone: whether something is mere persuasion, or at least subjective belief, i.e. firm belief, what someone claims, is betting.

The Exascale Bet (2010)

- **Build a system before 2020 that will be #1 on the TOP500 list with an Rmax > 1 Exaflops**
- **Personal bet (Horst Simon with Thomas Lippert) that we will not reach this goal by November 2019 (€3000)**



Th. Lippert, G. Cicotti, H. Simon, A. Osseyran, Review of CSCS, Zürich, May 14, 2010
Photo courtesy of Dominik Ulmer



PATHFINDERS

Implementing the Modular Supercomputing Architecture

2× MSA pilots



JUPITER

MSA
Pre-Exascale
@Lux, @It

Modular
Supercomputing
Architecture
(MSA)

EuroHPC

SEA
Projects

EU PEX

HPC|QS

LEONARDO

MELUXINA



FP7 - H2020

DEEP
Projects

Jülich Supercomputing Centre (JSC)



~384 Employees (~332 FTE)

270 Scientists

31 PhD Students

27 Students

fz-juelich.de/jsc


JUPITER Rising – Fanfare – Christian Hagitte, Berlin

ANYONE CAN BUILD A FAST CPU.
THE TRICK IS TO BUILD A FAST SYSTEM.

Seymour Cray

JUPITER – MODULAR EXASCALE COMPUTER



> 1 EB

Parallel High Capacity Data System

Parallel High Bandwith Flash Module

High Capacity Backup/Archive System



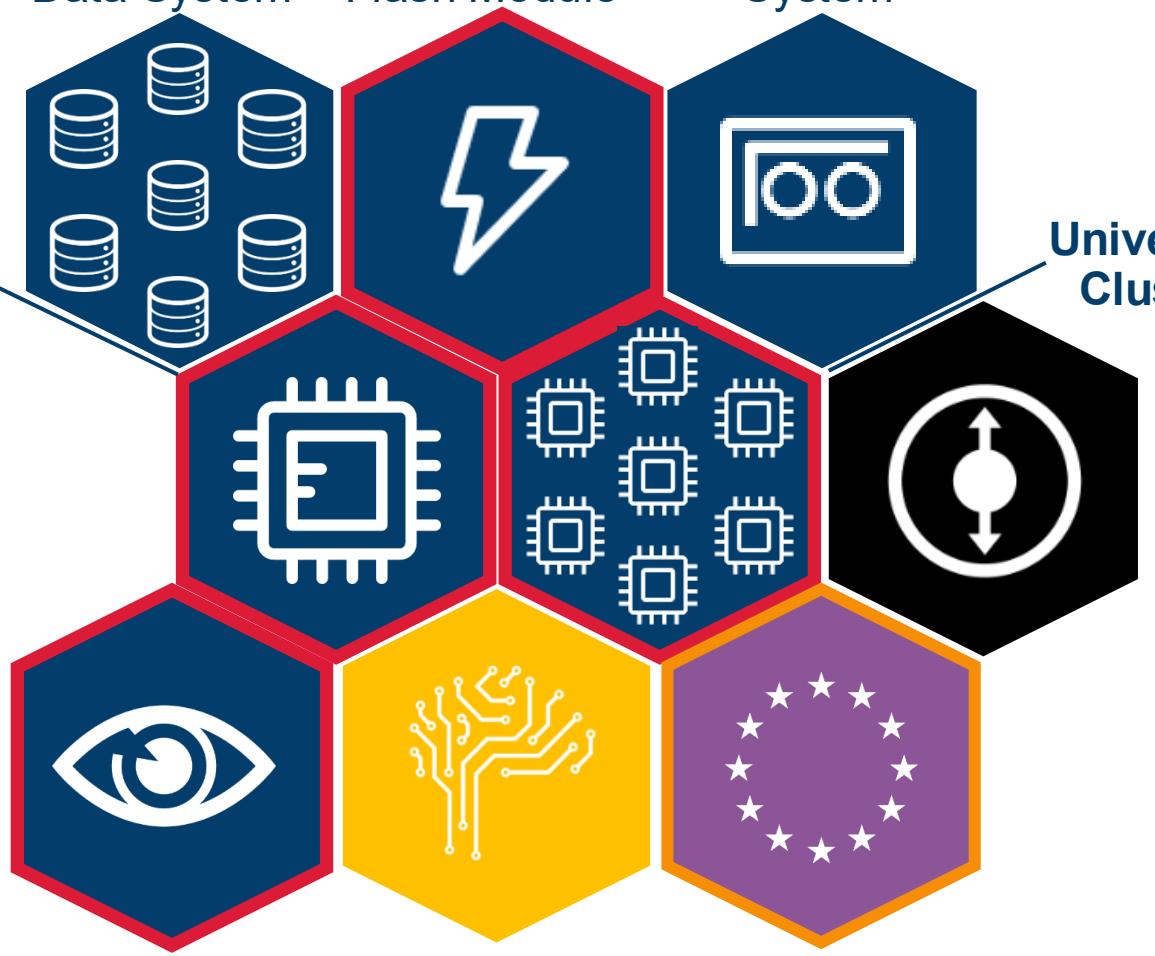
GPU Booster

Universal Cluster



1 EF 64-bit HPC

90 EF 8-bit AI



Quantum Module

Interactive Computation and Visualization

Neuromorphic Module

JARVIS Inference Engine


COLONIA
0221 / 956 86-0
www.COLONIA.info
COLONIA

JEDI

JUPITER Exascale Development Instrument

Rank	TOP500 Rank	System	Cores	Rmax (PFlop/s)	Power (kW)	Energy Efficiency (GFlops/watts)
1	189	**JEDI** - BullSequana XH3000, Grace Hopper Superchip 72C 3GHz, NVIDIA GH200 Superchip, Quad-Rail NVIDIA InfiniBand NDR200, ParTec/EVIDEN EuroHPC/FZJ Germany	19,584	4.50	67	72.733

JUNE 2024

TOP500 The List.

THE GREEN 500



JEDI in existing JSC data center

FINAL BENCHMARK LISTS

		Booster			Cluster	MSA
Before Dialogue	After Dialogue	GPU	GPU High-Scale	CPU	CPU	
Amber	~~Amber~~	~~✓~~				
Arbor	Arbor	✓	✓			
Chroma	Chroma	✓	✓			
Gromacs	Gromacs (2)	✓				
ICON	ICON (2)	✓				
JUQCS	JUQCS	✓	✓			✓
nekRS	nekRS	✓	✓			
ParFlow	ParFlow	✓				
PIConGPU	PIConGPU	✓	✓			
Quantum ESPRESSO	Quantum ESPRESSO	✓				
SOMA	~~SOMA~~	~~✓~~				
AI-MMoCLIP	AI-MMoCLIP	✓				
AI-NLP	AI-NLP	✓				
AI-ResNet	~~AI-Resnet~~	~~✓~~				
dynQCD	dynQCD				✓	
NAStJA	NAStJA				✓	
Graph500	Graph500			✓		
HPCG	HPCG	✓			✓	
HPL	HPL	✓			✓	
IOR	IOR			✓	✓	
LinkTest	LinkTest			✓	✓	✓
Multi-Flow IP	~~Multi-Flow IP~~			~~✓~~		
OSU	OSU (2)	✓		✓	✓	
STREAM	STREAM	✓			✓	

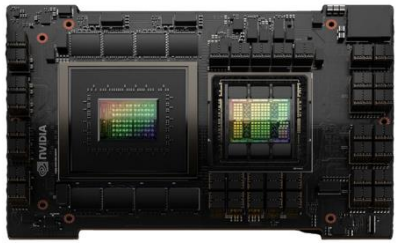
JUPITER MODULES

JUPITER Booster (1ExaFLOP/s)

- 125 Racks BullSequana XH3000
- 5884 Nodes NVIDIA Grace-Hopper
  - 4x Grace (Arm Neoverse V2), 72c (4×128b SVE2)
  - 4x 120GB LPDDR5
  - 4x H100 (132 SMs); 96 GB HBM3
  - NVLink C2C (900 GB/s)

JUPITER Cluster

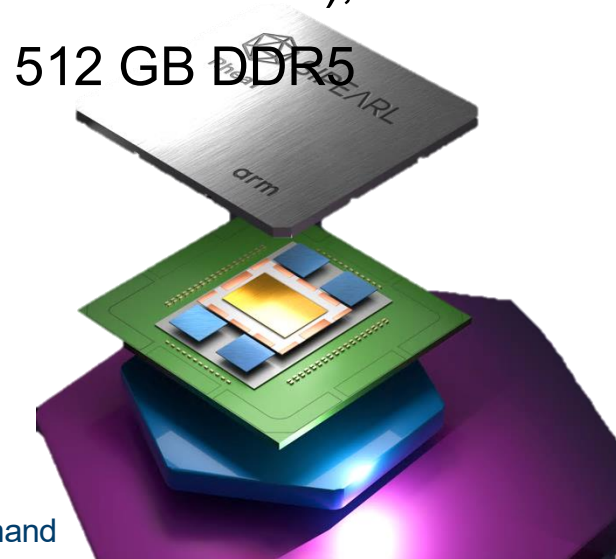
- 10 Racks BullSequana XH3000
- 582 Nodes AMD Turin (Q4/2026)
  - 2x Turn 9655 (x86), 96c, 2,6Ghz
  - 768 GB DDR5 Memory
  - 36 of the Nodes with 1536 GB DDR5
- 162 Node SiPearl Rhea1 (2027)
  - 2x Rhea1 (Arm Neoverse V1), 80c
  - 64 GB HBM2e, 512 GB DDR5



ExaFLASH: 29PB (raw) NVMe, IBM SSS6000

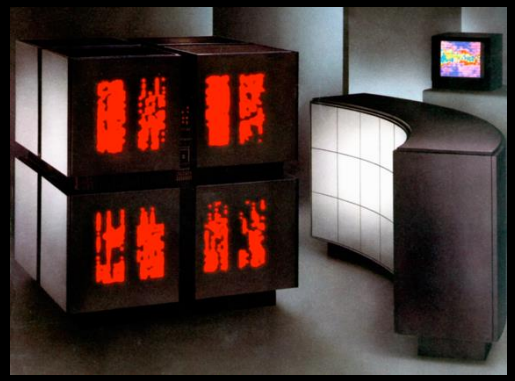
ExaSTORE: 308PB (raw) HDD*, IBM SSS6000

ExaTAPE: 370PB Tape*, LTO9



*Upgrade budget available, depending on demand

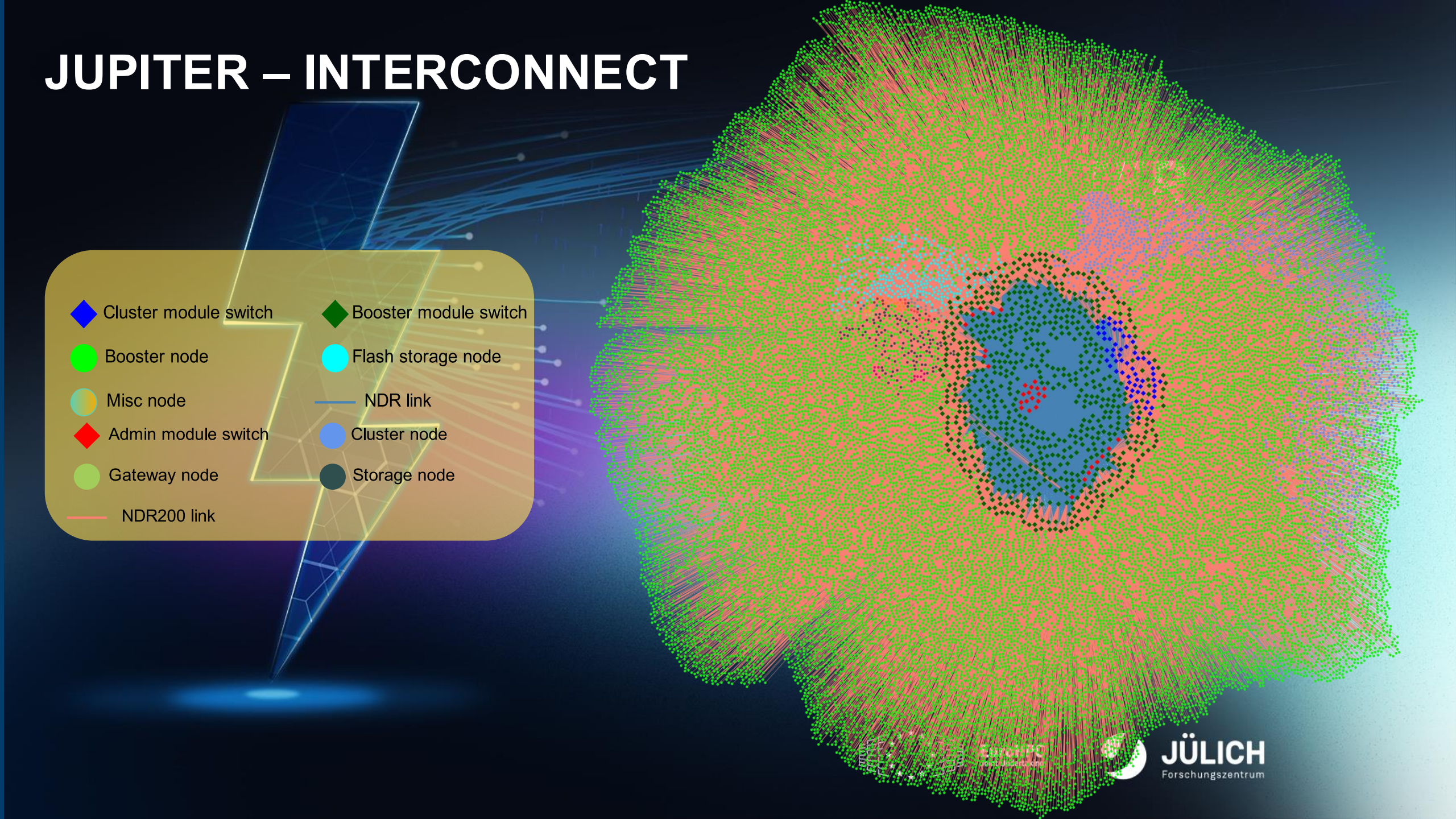
JUPITER

1  = 10^9 

THERE'S SOMETHING POWERFUL KNOWING THE SHORTEST WAY

Stephen King – Mrs. Todd's Shortcuts

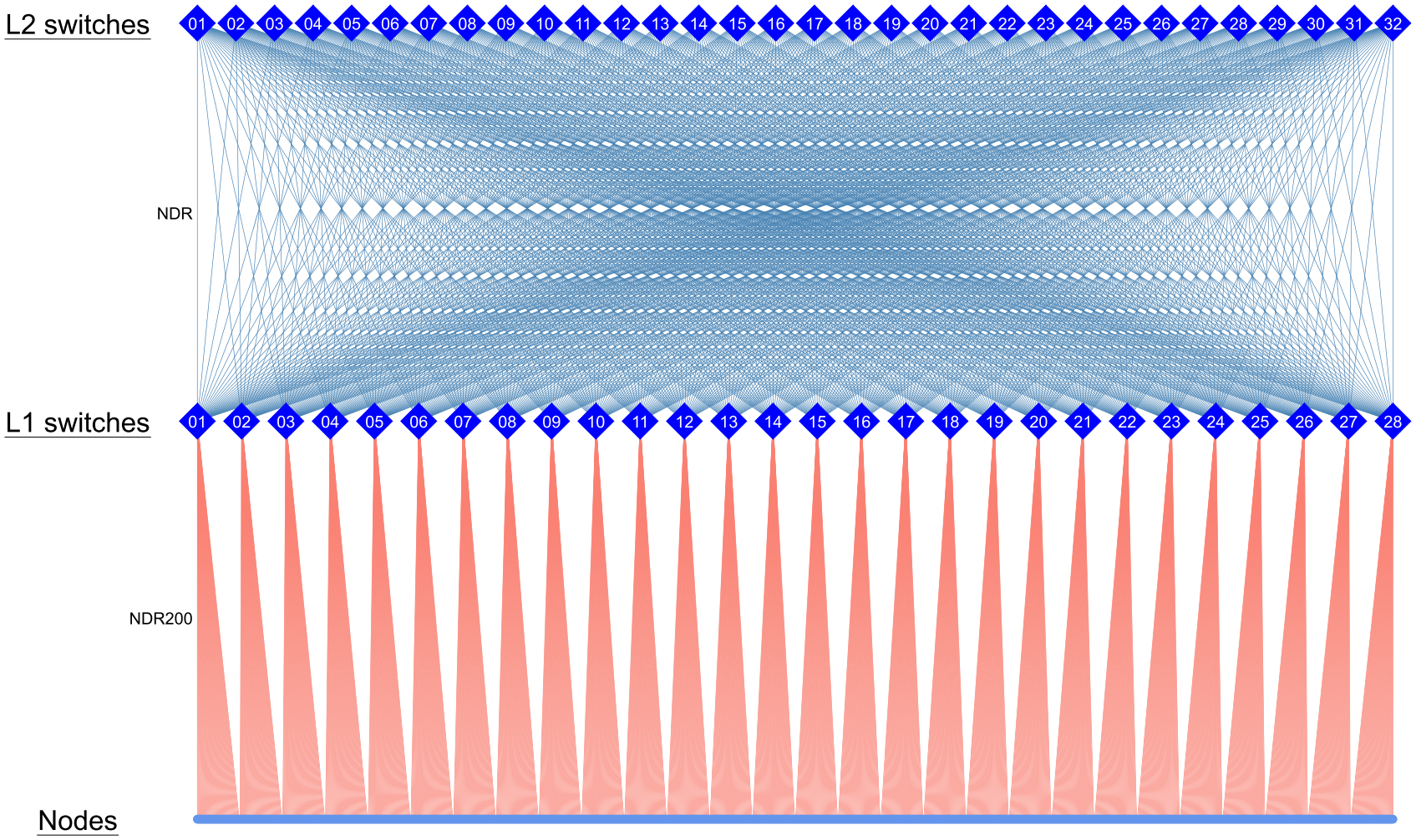
JUPITER – INTERCONNECT



JÜLICH
Forschungszentrum

JUPITER – INTERCONNECT

One Network to Rule Them All



JUPITER – INTERCONNECT

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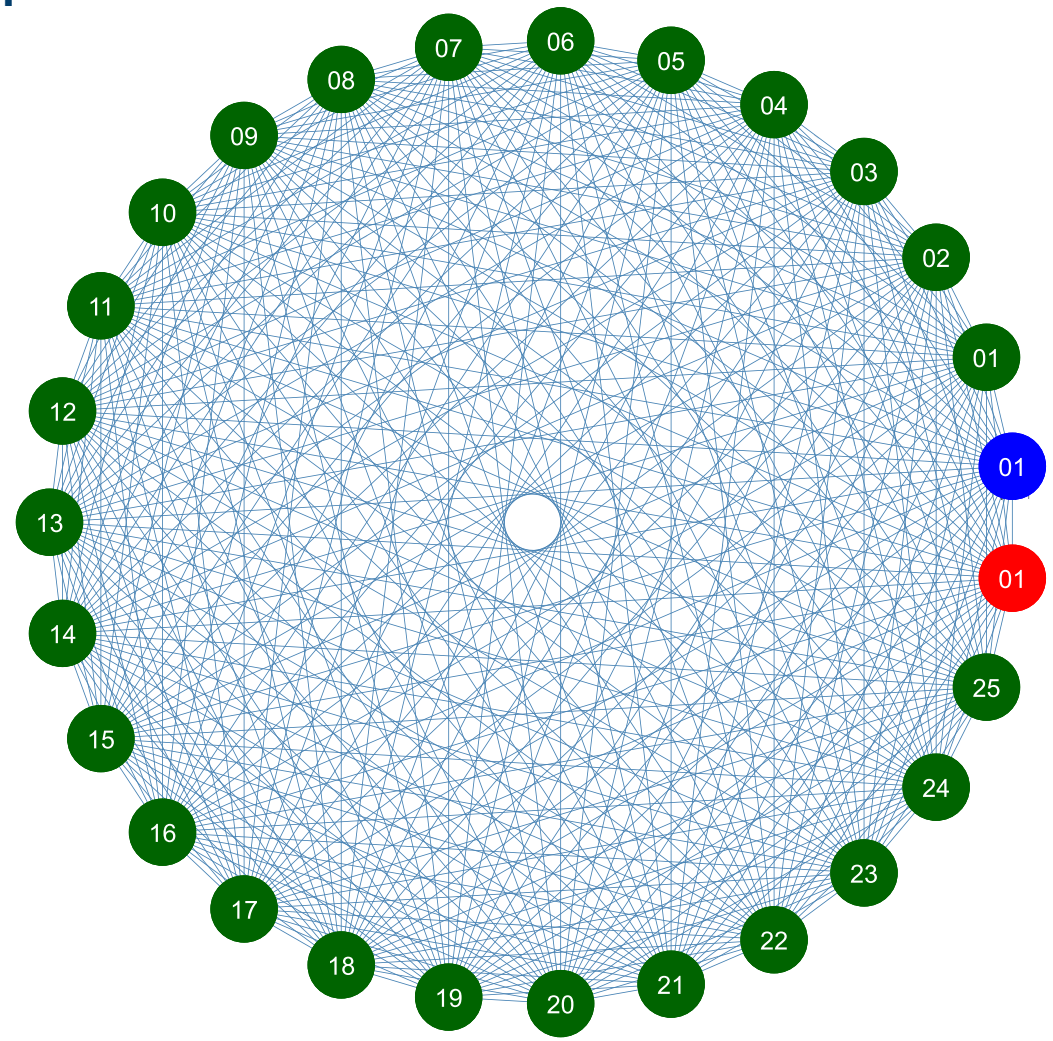

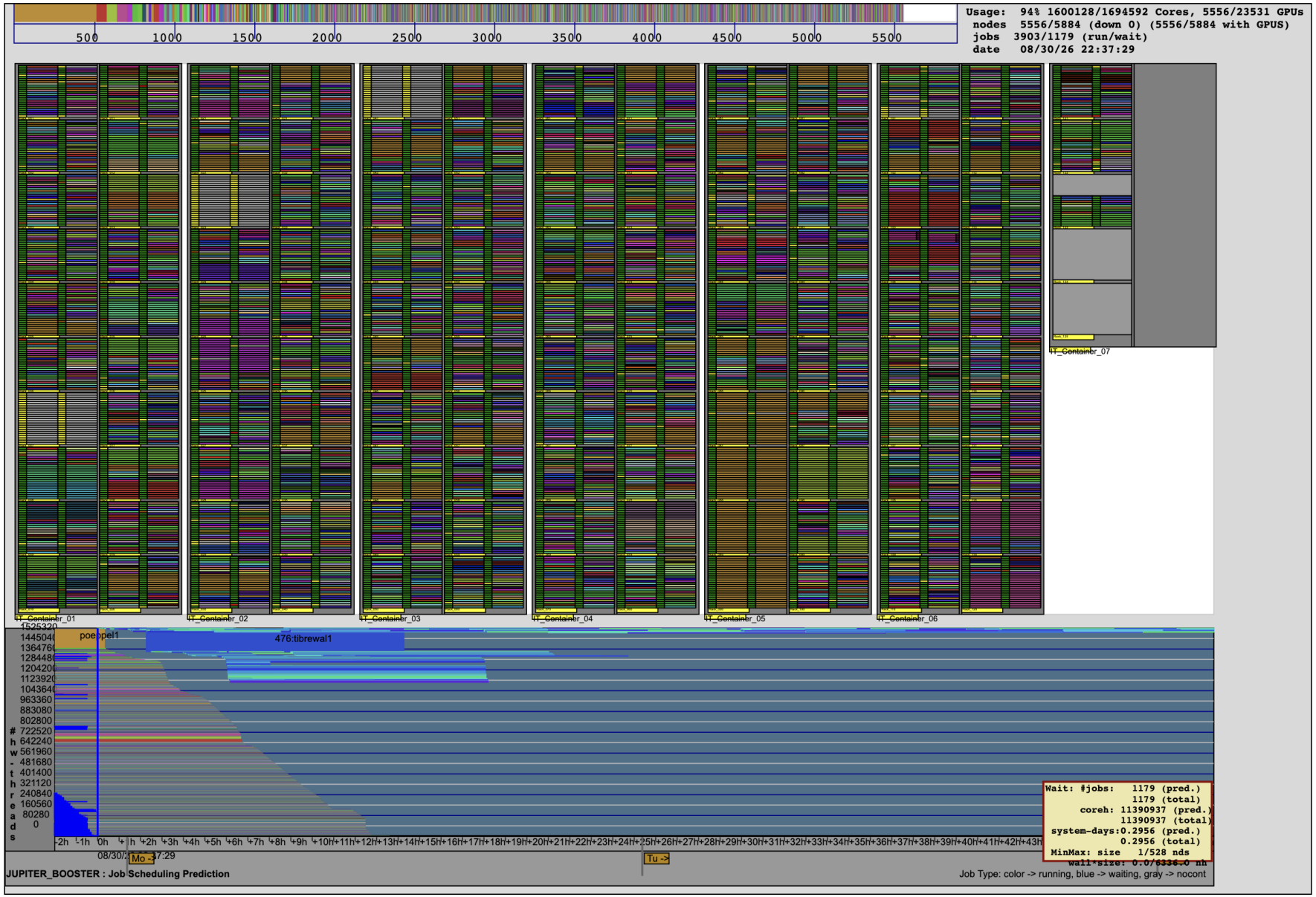

CPUs	Userid	cpuh	wall	Class	Spec
9216	merlo1	10.8h of	12:00	booster	n32.p288.t00
9216	nogga2	11.6h of	11:59	booster	n32.p04.t00
8640	adami3	11.2h of	11:59	booster	n30.p288.t00
864	kotov2	0.5h of	12:00	booster	n03.p04.t00
6912	mousakhan1	0.5h of	6:00	booster	n24.p16.t00
576	fischer13	0.5h of	12:00	booster	n02.p02.t00
576	schneider16	8.0h of	12:00	booster	n02.p288.t00
576	ibrahimi1	3.3h of	12:00	booster	n02.p04.t00
576	liu47	0.5h of	12:00	booster	n02.p288.t00
576	wiese5	10.3h of	12:00	booster	n02.p02.t00
576	colturi1	2.7h of	12:00	booster	n02.p04.t00
576	sagresti1	10.8h of	12:00	booster	n02.p24.t00
576	schneider16	6.4h of	12:00	booster	n02.p288.t00
576	yildirim1	10.8h of	12:00	booster	n02.p04.t00
576	schneider16	6.3h of	12:00	booster	n02.p288.t00
576	ta2	7.6h of	12:00	booster	n02.p04.t00
576	yildirim1	10.8h of	12:00	booster	n02.p04.t00
576	ta2	7.5h of	12:00	booster	n02.p09.t00
576	lechtenboerger1	5.9h of	12:00	booster	n02.p01.t00
576	ta2	7.4h of	12:00	booster	n02.p09.t00
576	ta2	7.6h of	12:00	booster	n02.p09.t00
576	schneider16	7.6h of	12:00	booster	n02.p288.t00
576	yildirim1	10.8h of	12:00	booster	n02.p04.t00
576	ibrahimi1	11.1h of	12:00	booster	n02.p04.t00
576	liu47	0.5h of	12:00	booster	n02.p288.t00
576	wiese5	10.4h of	12:00	booster	n02.p02.t00
576	farid1	4.7h of	12:00	booster	n02.p12.t00
576	liu47	5.7h of	12:00	booster	n02.p288.t00
576	ta2	7.6h of	12:00	booster	n02.p09.t00
576	kerssies1	1.6h of	6:00	booster	n02.p04.t00

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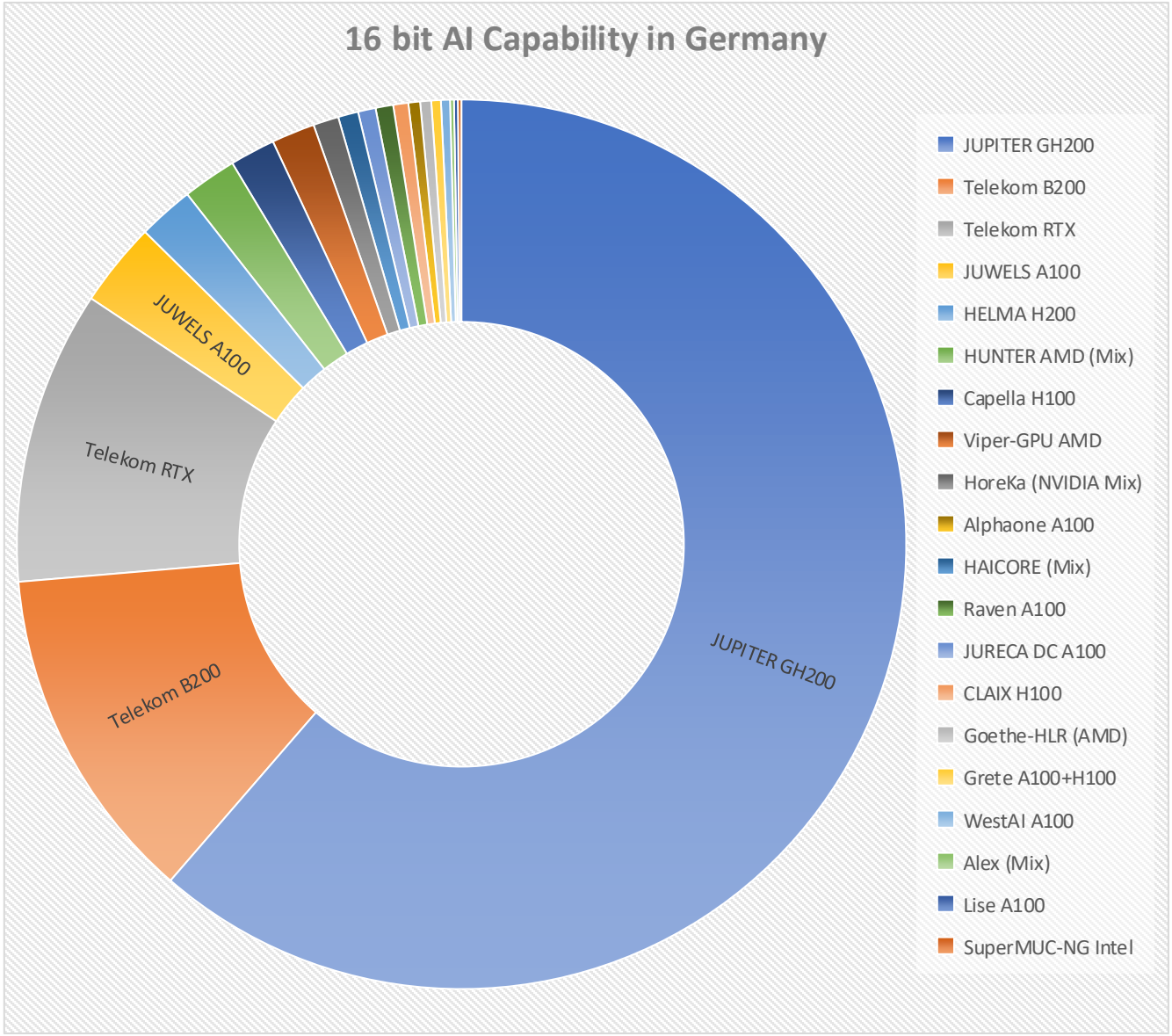
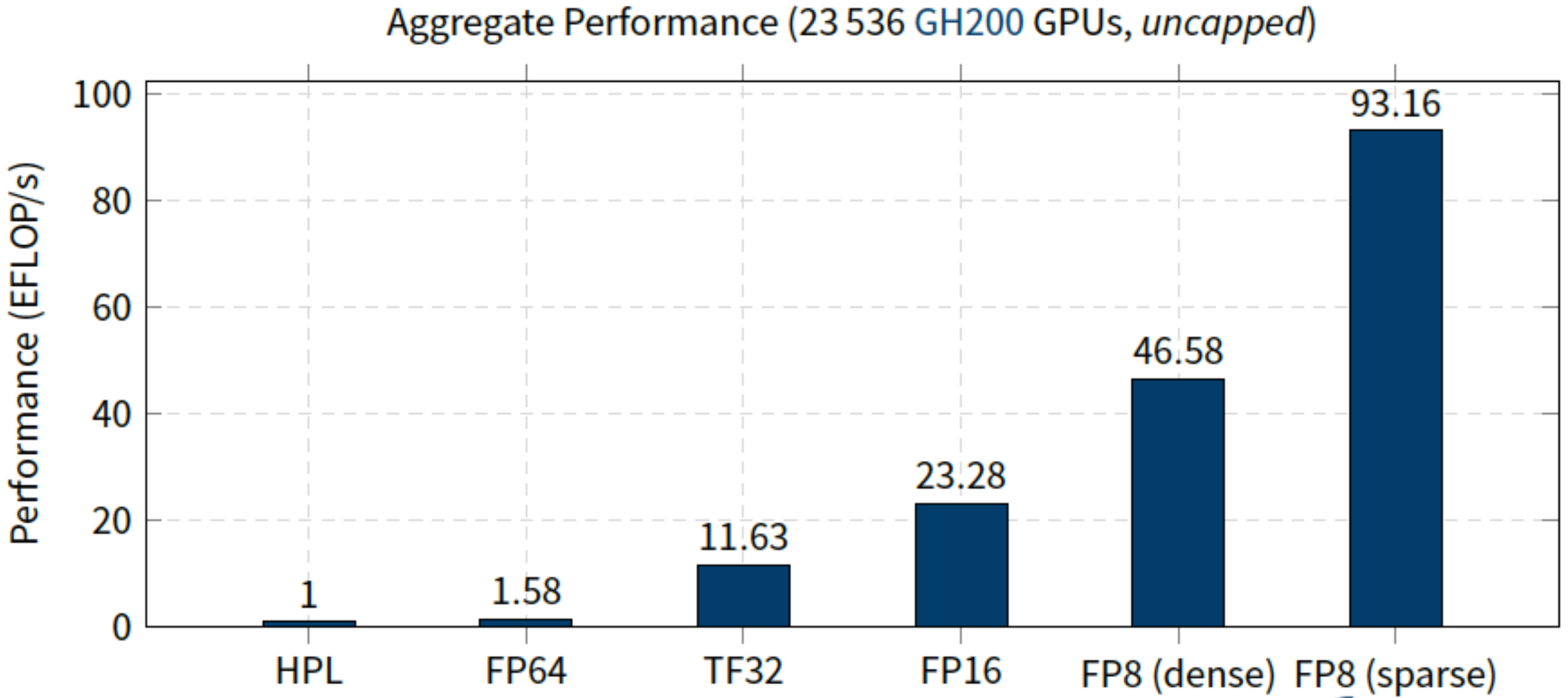
A BETTER AI MAKES FEWER MISTAKES.
A BETTER AGI MAKES MORE MISTAKES.

David Deutsch

SUPERCOMPUTERS SUITABLE AS AI-TRAINERS IN D



JUPITER AI Performance



JARVIS

- JUPITER AI Factory: AI Factory around JUPITER
  - Services, incl. consulting
  - Data spaces
  - Training, inference
- Partners: FZJ, RWTH, Fraunhofer, hessian.AI
- Target: Science, Industry, Start-ups
- Systems

JUPITER	24 000 GPUs for training *500 M€ invest*
JARVIS	Dynamic, cloud-like resources, mostly for inference; simpler network; closely connected to JUPITER; heterogeneous hardware; procurement starting soon *30 M€ invest*
	Building on experience of JSC Cloud and Blablador



YOU REAP WHAT YOU SOW

Paulus



JUPITER
RESEARCH AND EARLY ACCESS PROGRAM

Since 08/2025
JUPITER
production up to
~512 nodes

10/2025
JUPITER
simulation
scaling with ~5k
nodes

11/2025
JUPITER
AI training
scaling with ~1k
nodes

04/2026
JUPITER
AI training
production with
~1k nodes

04/2026
JUPITER
AI training
scaling with ~4k
nodes

06/2025
JUPITER
simulation
production with
~4k nodes

2024
Small scale
evaluation
JURECA-DC

2024
Petascale
evaluation
JUWELS Booster

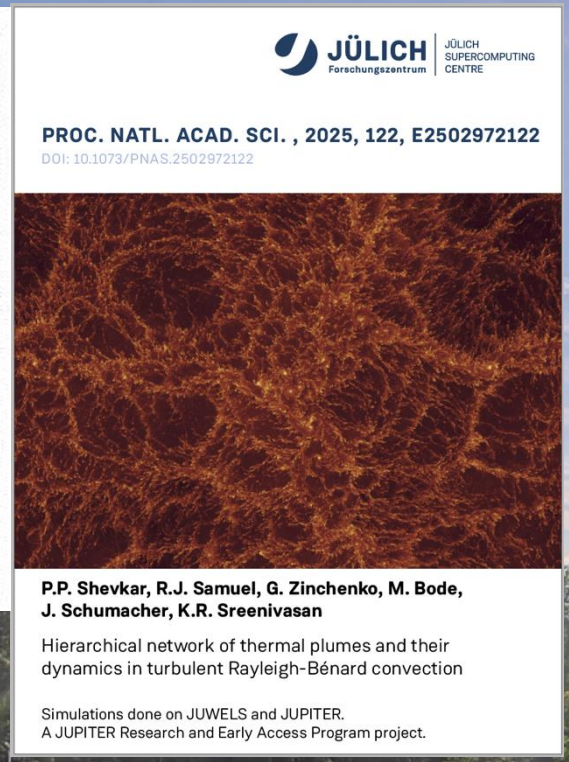
2024/2025
GH200
evaluation
JEDI

~2025
Exascale
evaluation
JUPITER Booster

~2026
Exascale
production
JUPITER Booster



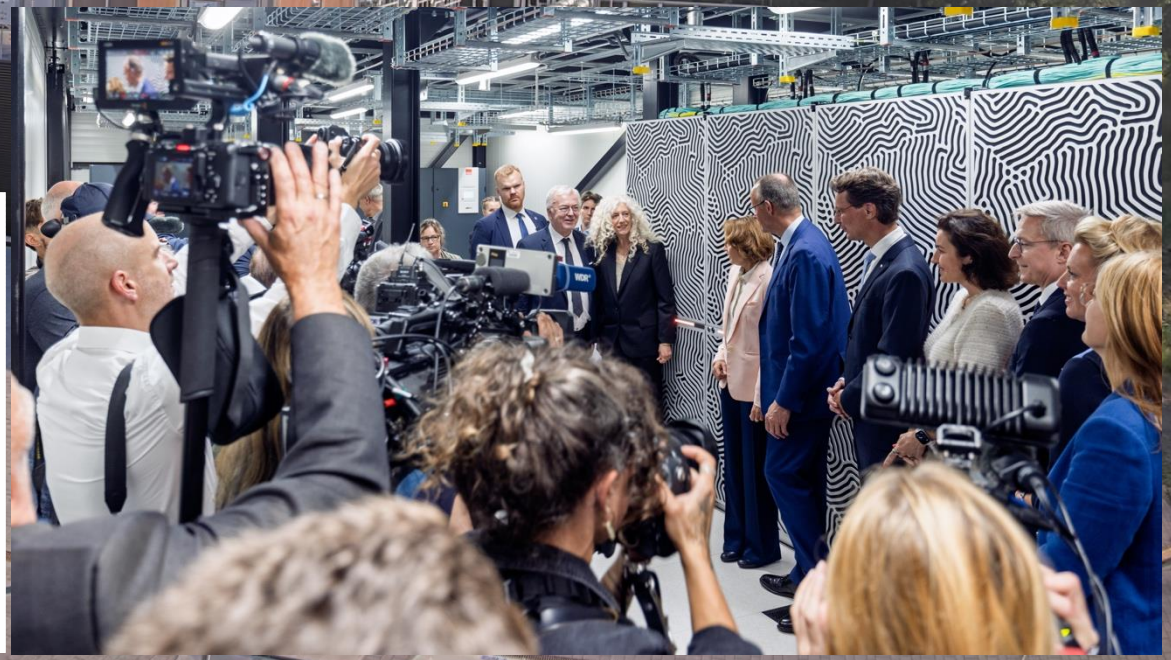




Compute calls 3-6x overbooked







PROJECTS IN PRE-ACCESS ON JUPITER

Pre-Access until acceptance

EuroHPC	GCS

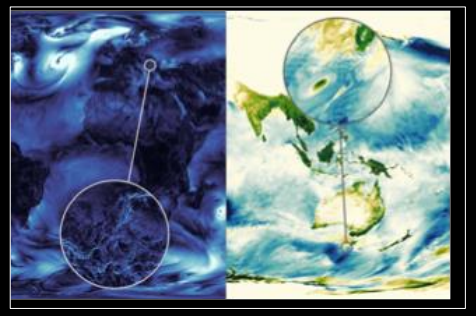
• **JUREAP**
  • 15 projects (completed)
• **Strategic access**
  • 2 projects
• **Extreme Scale access**
  • 13 projects
• **Regular Scale access**
  • 14 projects
• **Development access**
  • 19 projects
• **Benchmark access**
  • 2 projects (completed)
	• **JUREAP**
	  • 18 projects
	• **Exascale Pioneer Call**
	  • 18 projects
	• **Large Scale access**
	  • 11 projects
	• **Regular Scale access**
	  • 119 projects
	• **Gauss AI Compute Competition**
	  • 7 projects

The underlying physical laws … are completely known, and the difficulty is only that the exact application of these laws leads to equations much too complicated to be soluble.

Paul Dirac

JUPITER BREAKTHROUGHS ACROSS SCIENCE

From simulation to AI



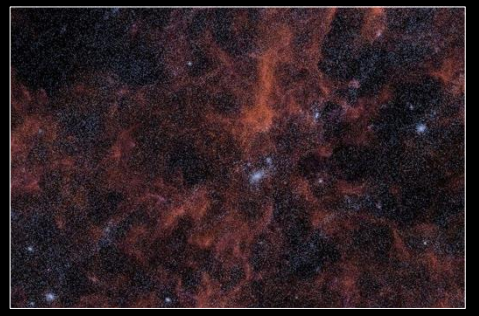
Climate simulation



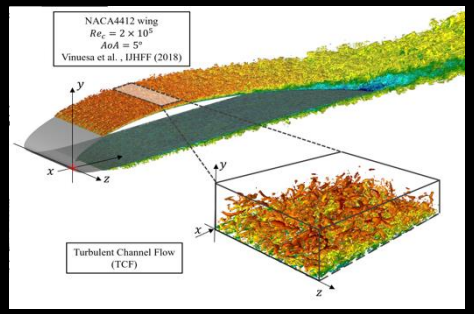
Quantum simulation



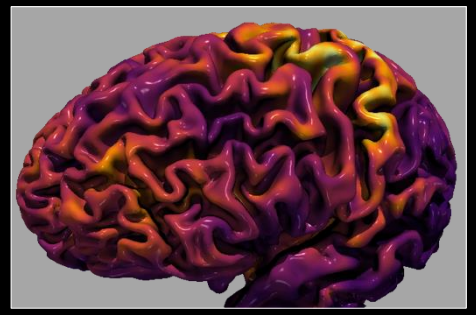
MD simulation



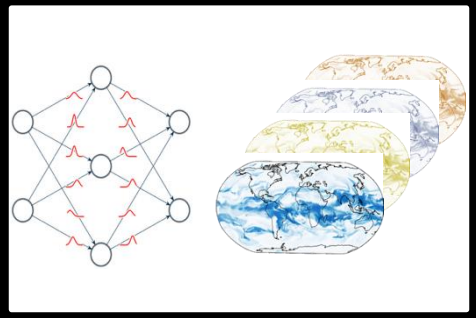
Galaxi simulation



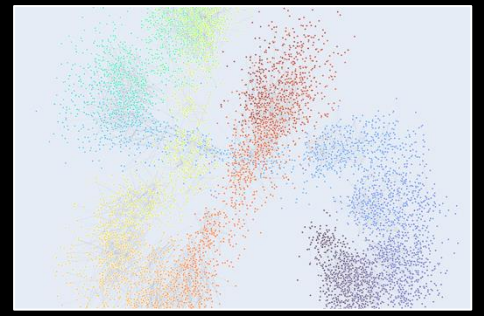
Flow control



Brain foundation model



Bayesian climate model

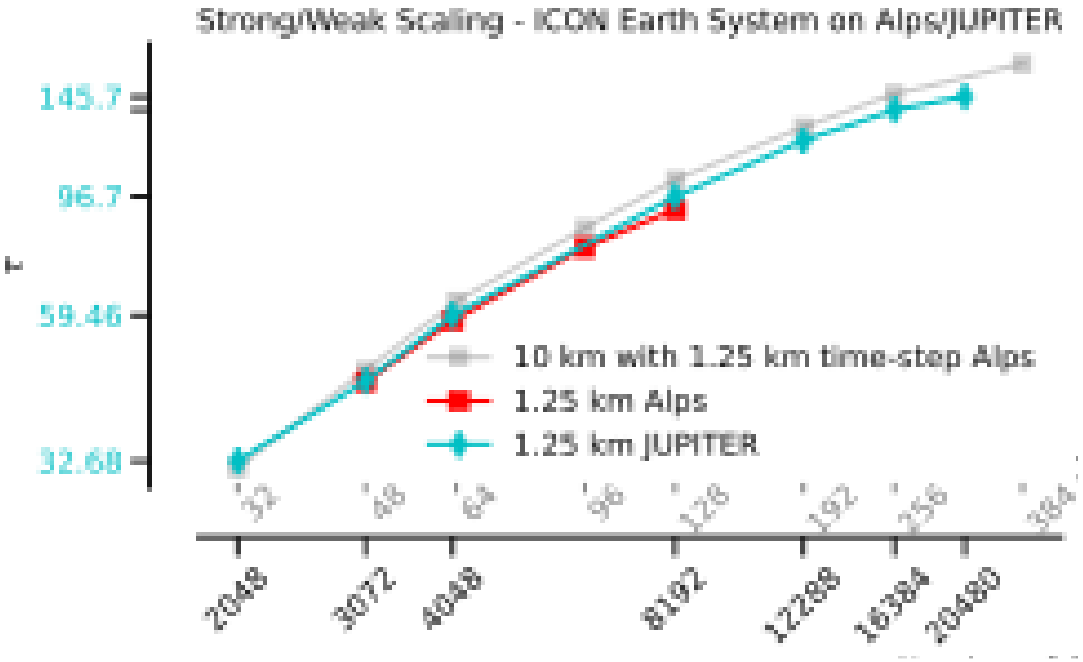


Personal medicine: Genetics

From engineering to medicine

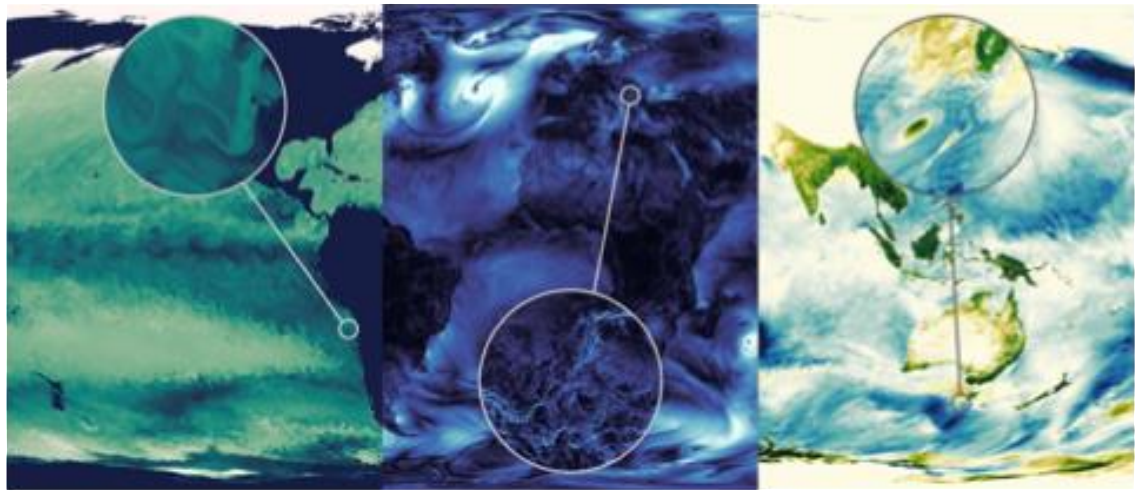
FULL EARTH SYSTEM SIMULATIONS WITH ICON

- **ICON:** Weather / climate modeling program, MPI-Met, DKRZ, etc.
- 20,480 GH200 of JUPITER; **CPUs and GPUs jointly**



First ever global simulation of full earth system at 1.25 km grid spacing

- Includes flow of energy, water, carbon
- Atmosphere (GPU), ocean/land (CPU)
- Simulating τ=145 days in one actual day
- Gordon Bell Climate Prize Winner

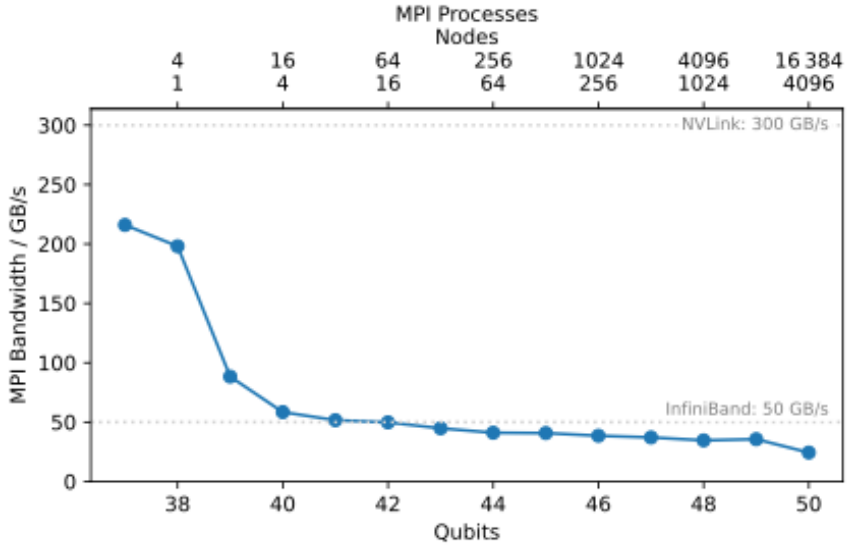


Phytoplankton Near-Surface Wind Air-Sea CO_2 Flux

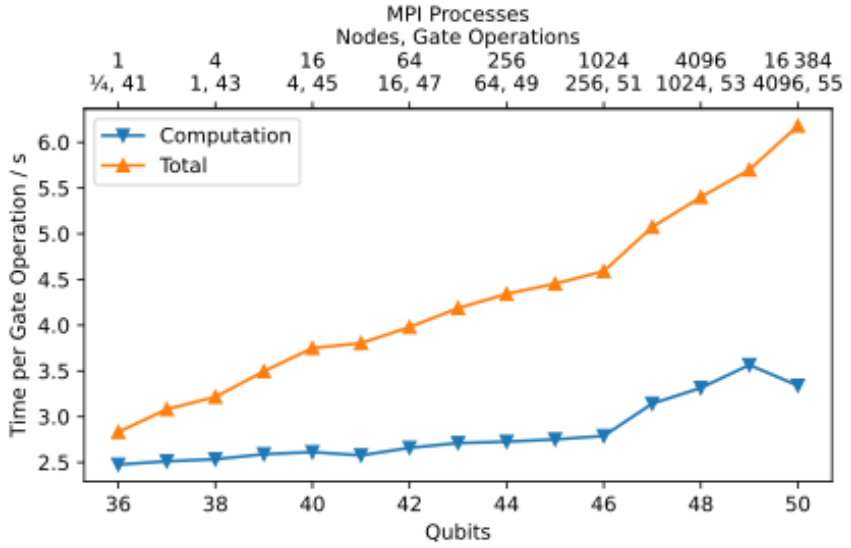
Klocke et al. (2025), Computing the Full Earth System at 1km Resolution, SC'25.

QUANTUM SIMULATIONS WITH JUQCS

- **Profs. de Raedt / Michielsen**
  JUQCS: Developed at JSC
- Extremely communication-intensive
- 16 384 GH200 (214), using CPU and GPU jointly



World Record: 50 Qubit Simulation

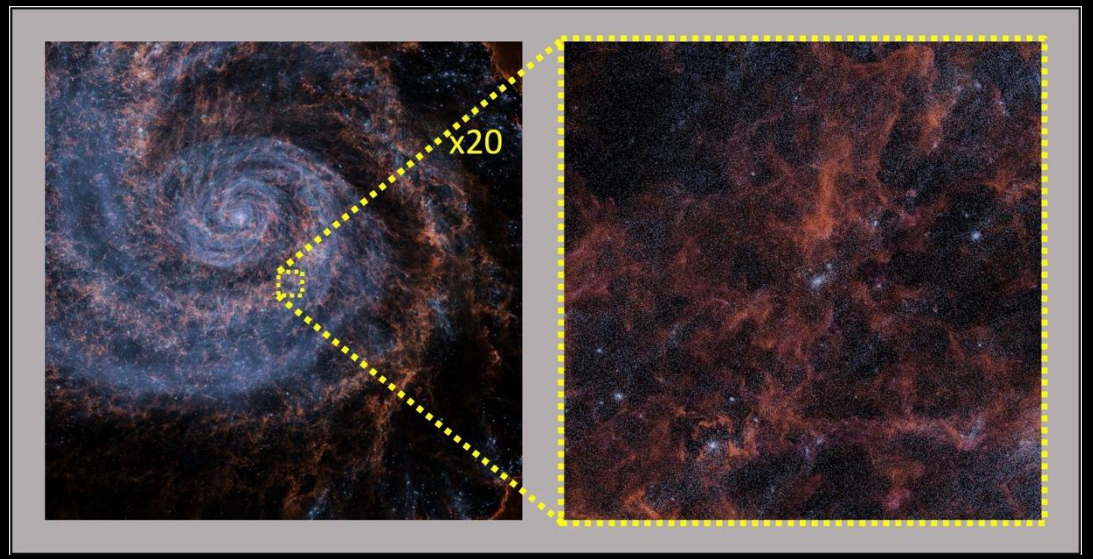


- Limiter: memory – JUPITER: 3.5 PB allocated
- **11× speed-up over previous 48 Qubit record**
  (JUQCS on K Computer vs. 48 Qubit on JUPITER)

De Raedt et al. (2026), Universal Quantum Simulation of 50 Qubits on Europe`s First Exascale Supercomputer Harnessing Its Heterogeneous CPU-GPU Architecture, Future Gener. Comput. Syst.

MILKY-WAY GALAXY SIMULATION RESOLVING INDIVIDUAL STARS

- **Dr. Keiya Hirashima** (RIKEN)
  and **Prof. Michiko Fujii** (University of Tokyo)
- ASURA-FDPS-ML: N-body/smoothed particle hydrodynamics code for astrophysics combined with AI surrogate model for supernova explosions



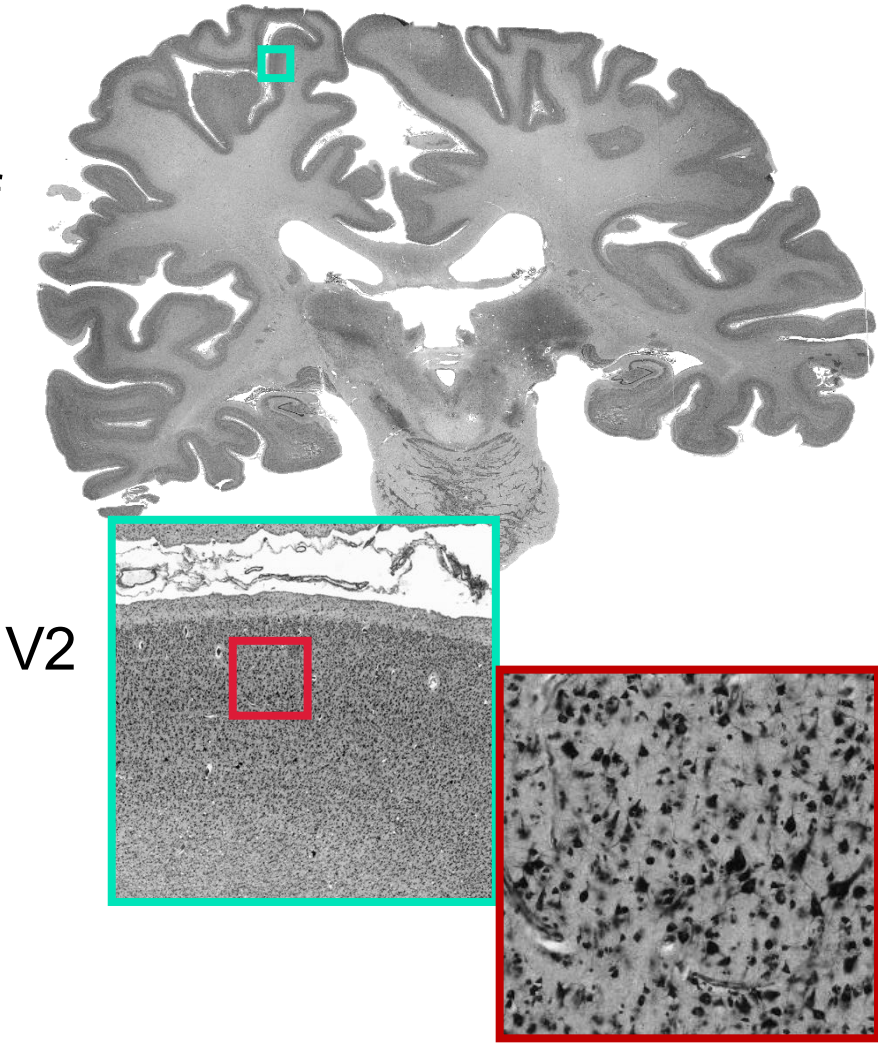
The highest resolution for a Milky-Way galaxy model

- **2.2 trillion particles on 20736 GH200 GPUs**
- 136B / s particles processed (3x speed-upto SC25 Gordon-Bell Prize finalist, 46.6B/sec)
- First **star-by-star** simulation of Milky-Way galaxy model including multiple physic

Hirashima et al. (2026), Architecture-Agnostic Exascale Star-by-Star Simulation of Our Galaxy, accepted.

DECODING THE ARCHITECTURE OF THE HUMAN BRAIN

- **Prof. Katrin Amunts** – FZJ & HH Uni Düsseldorf
- **CytoNet:** Foundation model for decoding the architecture of the human brain at cellular resolution trained on **ATLaS**



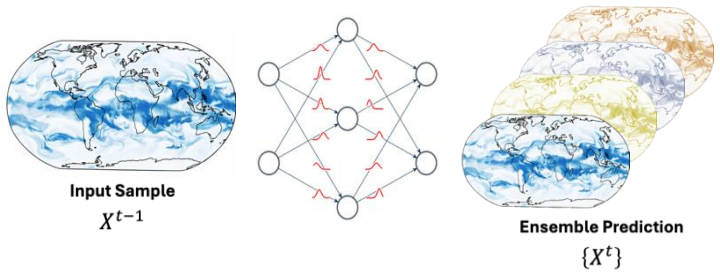
Self-supervised learning of human cytoarchitecture at unprecedented scale

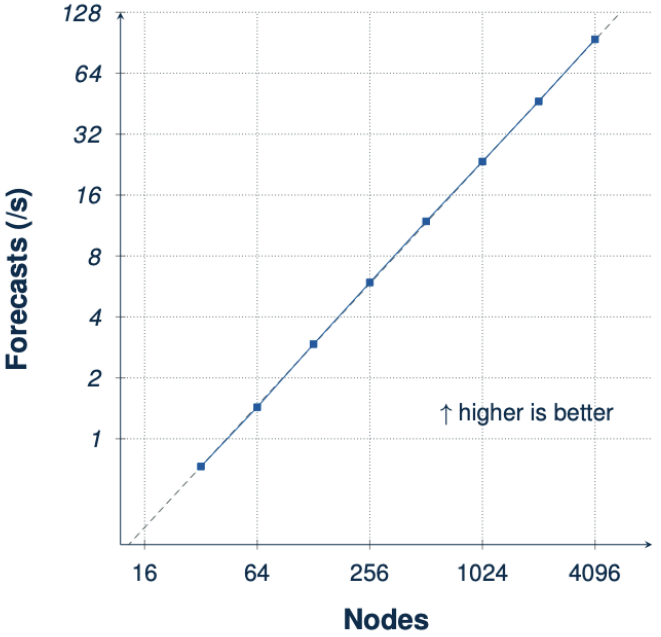
- Training on **5 PB** of images from 21 human brains, SWIN-H V2 architecture (655M parameters), 2048x2048 px/image
- **4096 GH200, 90 hours, 98% avg. GPU utilization**
- Superhuman analysis performance and novel insights into structural and functional human brain organization

Schiffer et al. (2025), CytoNet: A Foundation Model for the Human Cerebral Cortex at Cellular Resolution, arxiv.2511.01870.

PROBABILISTIC WEATHER FORECASTING WITH LARGE-SCALE BAYESIAN NEURAL NETWORKS

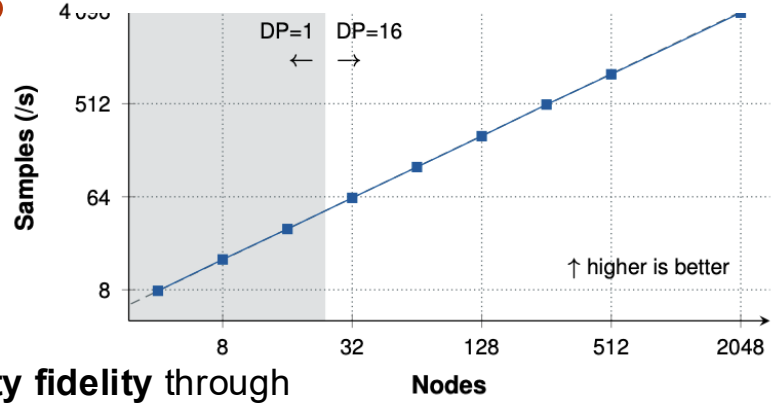
- **Dr. Charlotte Debus** – KIT
- Bayesian Neural Networks capture the model uncertainty





4-dimensional parallelization strategy (Domain,Tensor, Sample, Data) → 5.4 EF/s

- 2.6 billion parameter Bayesian SWIN Transformer for atmospheric forecasting at 30 km global resolution
- High-fidelity extreme event forecasting
- Training emulators on reduced data

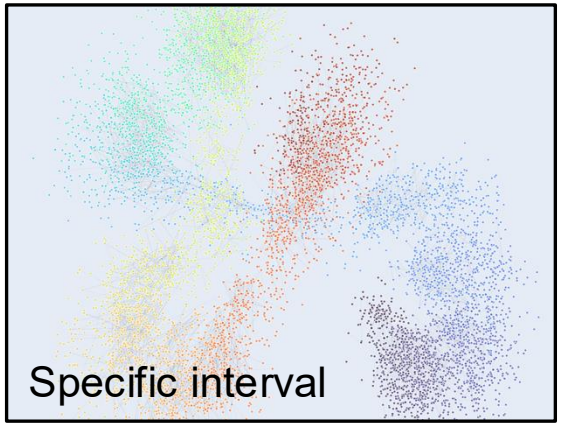


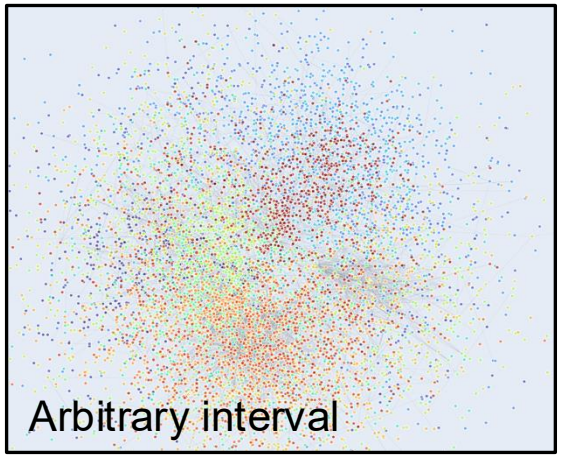
Higher uncertainty fidelity through increase sample evaluations

Kieckhefen et al. (2026), 4D Parallelism Unlocks Exascale Bayesian Neural Networks for High-Fidelity Atmospheric Modeling, accepted.

LARGE SCALE GENOMIC LANGUAGE PREDICTION: FROM THE CODE TO THE FUNCTION OF LIFE

- **Prof. Ingo Kurth** – Uniklinik RWTH Aachen
- Utilizing **genomic foundation models** to mine nucleotide dependencies for pathogenicity prediction and the discovery of functional genomic elements





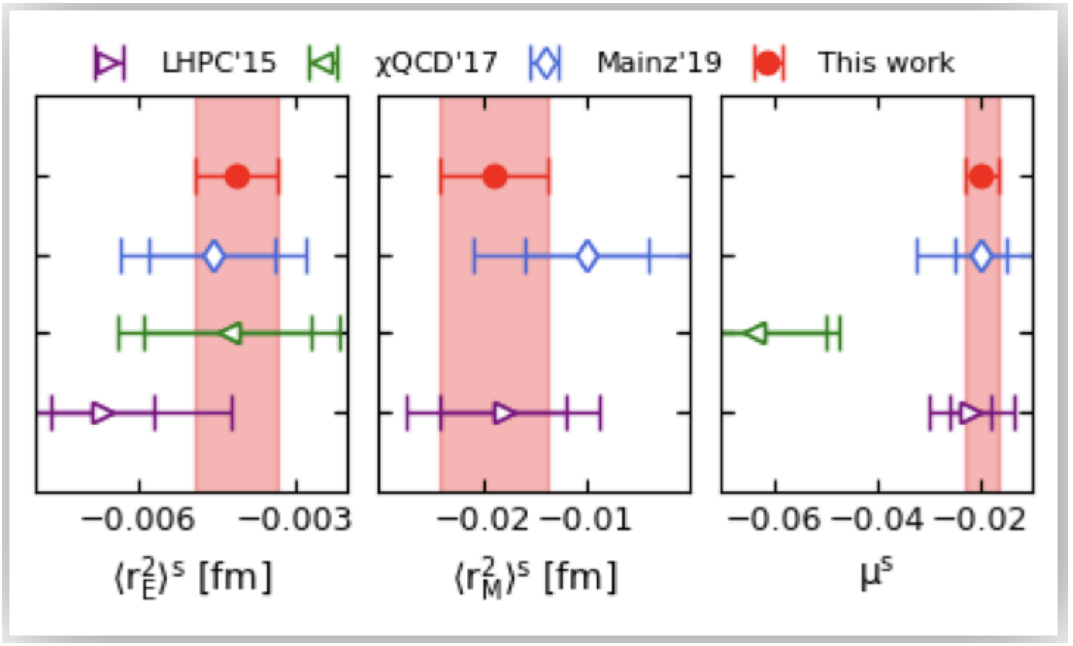
Genomic dependency modeling at unprecedented scale

- **In silico mutation** of all 3.2 billion bases
- Large context windows to capture complex regulatoric elements
- First genomewide **Sequence-to-Function** modeling

Krause et al. (2026), The perturbational architecture of the human genome, submitted.

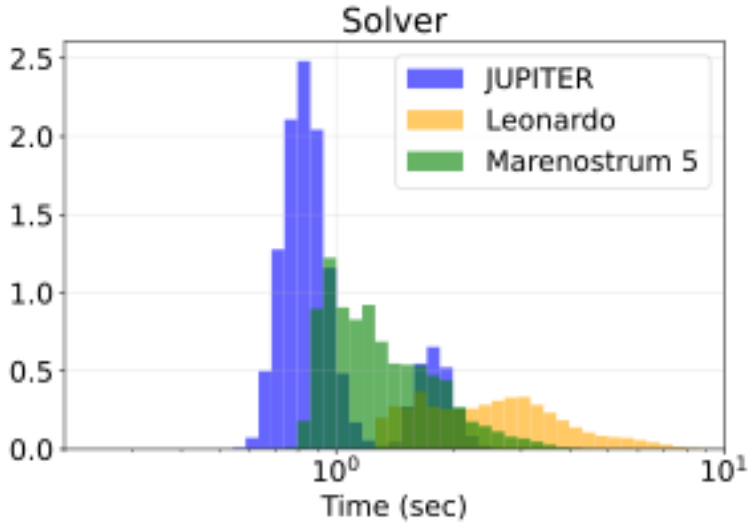
NUCLEON STRANGE ELECTRO-MAGNETIC FORM FACTORS

- **Prof. Dina Alexandrou** – Cyprus
- Ab initio calculations of nucleon structure using lattice QCD
- PLEGMA with QUDA's multi-grid solver



High statistics, fine-grained ensembles, largest box sizes possible, 13 Mi inversions on 49 nodes

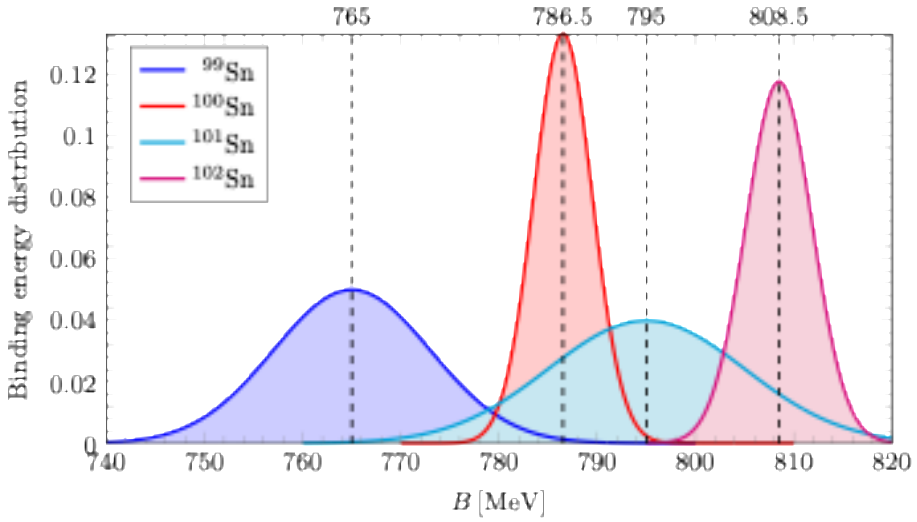
- Time to solution of QUDA's MG solver using 49 nodes with 4D volume (112x112x112x224) is fastest on JUPITER
- First results with a continuum limit using four lattice



Alexandrou et al. (2026), Nucleon strange electromagnetic form factors using Nf=2+1+1 twisted mass fermions at the Physical Point, arxiv.2603.26591.

NUCLEAR LATTICE SIMULATIONS BASED ON CHIRAL EFFECTIVE FIELD THEORY

- **Prof. Ulf-G. Meißner** (Uni Bonn & IAS-4@FZJ)
- *Ab initio* calculations of the tin isotopes ^{99}Sn to ^{102}Sn
- Binding energies reproduced with **~1% accuracy** for the even-even systems



Sn isotopes near the proton dripline

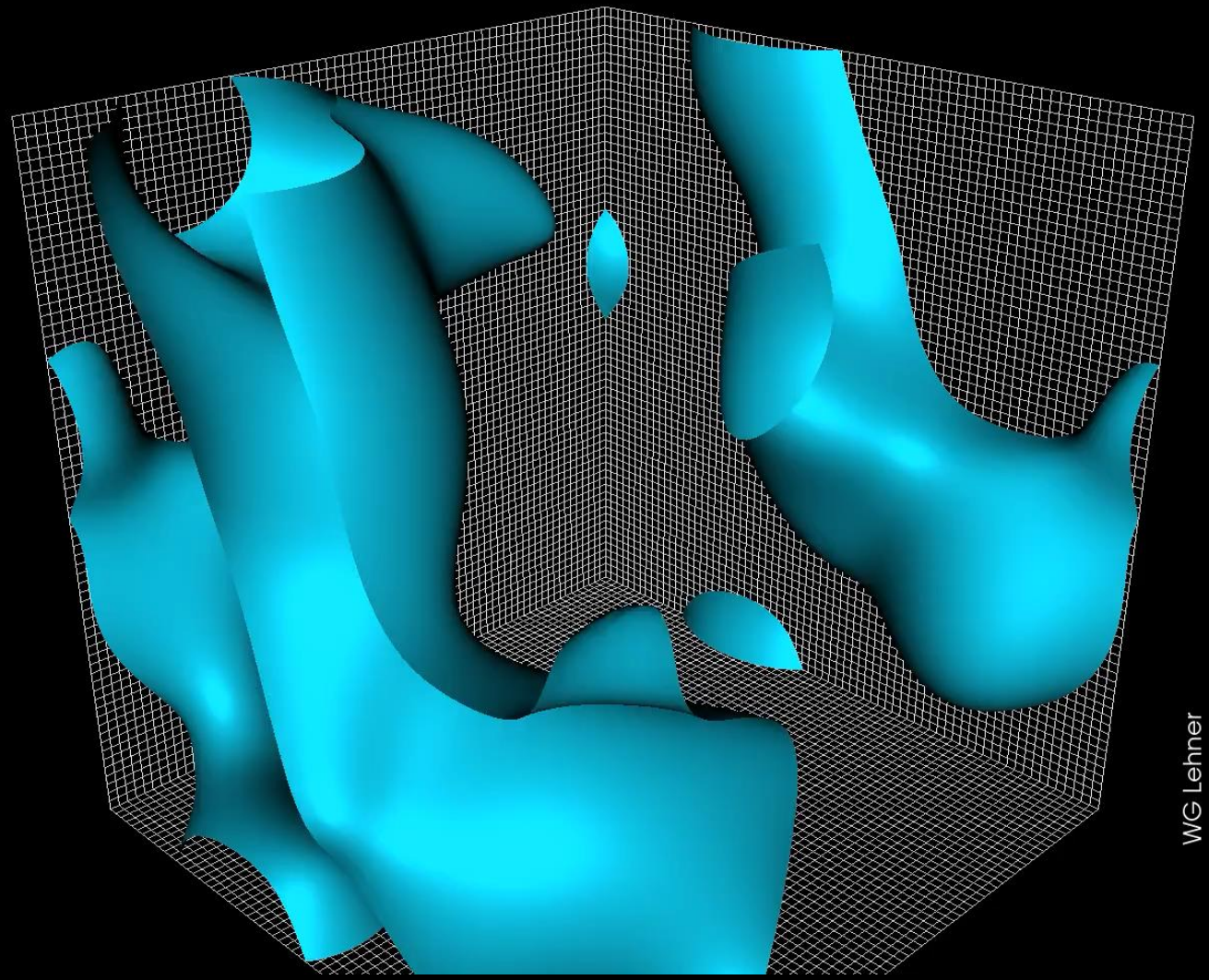
- Results confirm the N=50 shell closure and reveal that the binding energy of ^{99}Sn lies below values extrapolated from heavier isotopes
- No other ab initio method allows to study all these isotopes at present

Hildenbrand et al. (2025), Lattice calculation of the Sn isotopes near the proton dripline, Phys. Rev. Lett.

CHIRAL FERMIONS AT THE EXASCALE

- **Prof. Lehner**
- New algorithm to generate QCD gauge configurations (FTHMC) inspired by normalizing flow models
- New method to control topological freezing using autograd methods
- Start of new high-precision heavy-quark physics era

JUPITER allows generation of a first ever 10 GeV chiral fermion ensemble



WG Lehner

Lehner et al. (in prep), Chiral fermion ensembles at 10 GeV.

AND MANY MANY MORE…

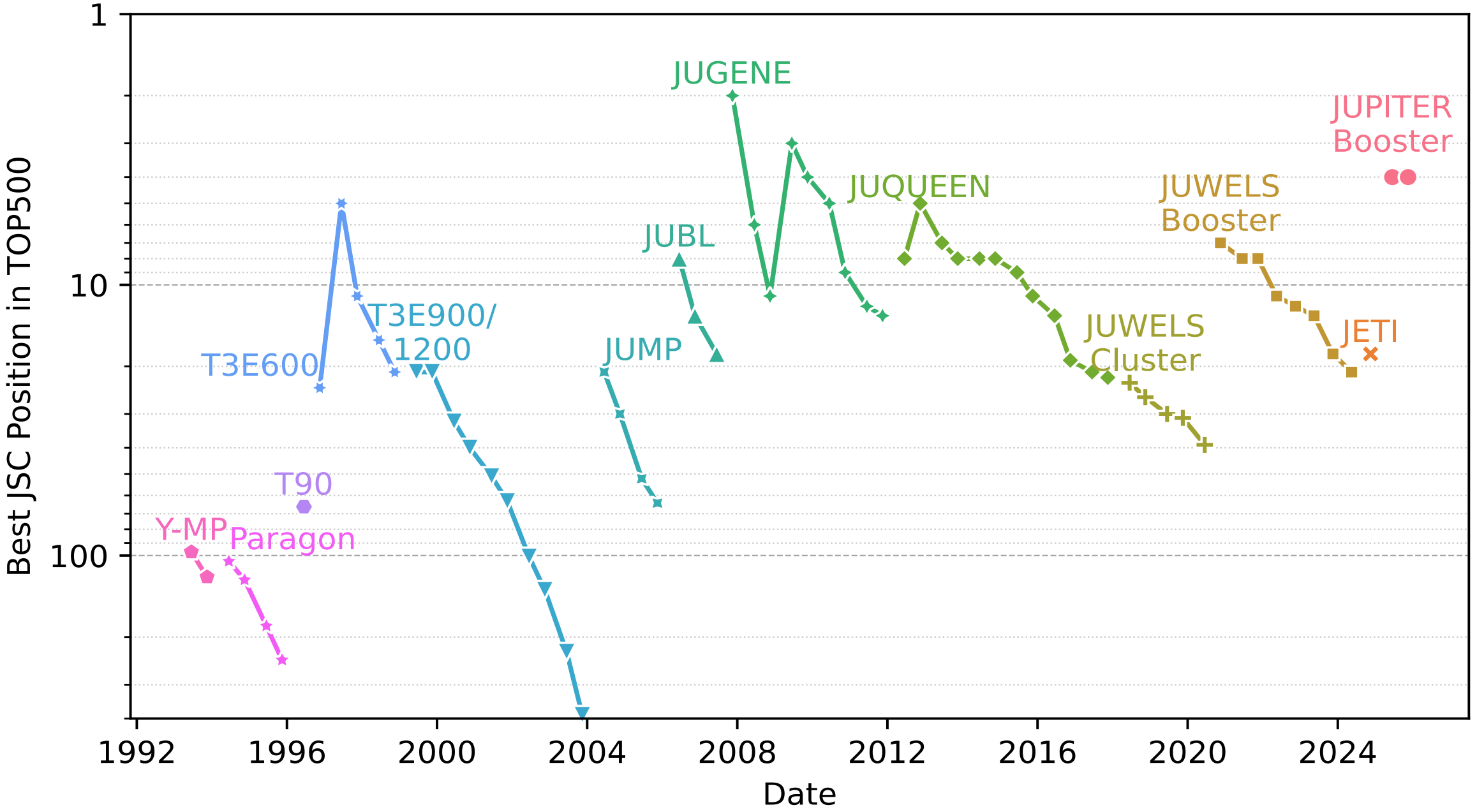
- He et al. (2026), Latent Medial Meshes: A Structured and Controllable Representation for 3D Shape Synthesis (submitted to Computer Graphics Forum).
- Ahmed et al. (2026), Cross-Layer Energy Analysis of Multimodal Training on Grace Hopper Superchips, SC ‘26 (accepted).
- Pan et al. (2026), Scaled Block Vecchia Approximation for High-Dimensional Gaussian Process Emulation on GPUs, arxiv.2504.12004 (submitted to IEEE Transactions on Parallel and Distributed Systems).
- Tsai et al. (2026), What Will the Grace Hopper-Powered JUPITER Supercomputer Bring for Sparse Linear Algebra?, SCA/HPCAsia '26, 228-235.
- Tsai et al. (2025), Enabling Ginkgo as numerics backend in nekRS employing a loosely-coupled configuration file concept. Procedia Computer Science, 267, 72-81.
- …



The future is seldom the same as the past

Seymour Cray

JSC IN TOP500 OVER TIME



FUTURE DIGITAL COMPUTING SYSTEMS



- Mixed-precision computing
- Digital photonic architectures
- Digital cryo-computing

STRAWMAN OF A HYPOTHETICAL CRYO COMPUTER

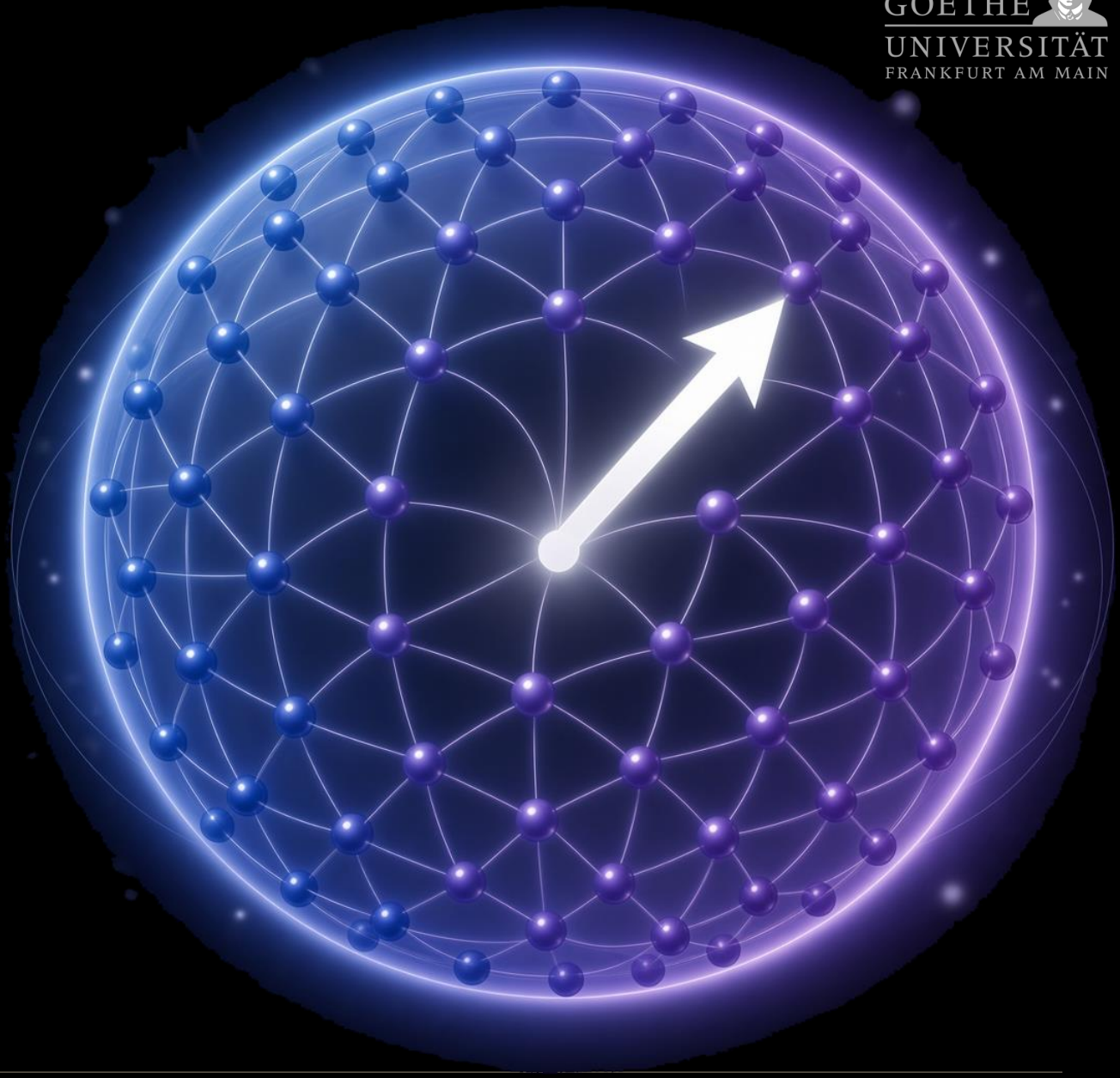
2032

- Josephson Cores at 100 GHz in 2030, 64 bit prec
- 5 PF/s per „GPU“
- 50 EF/s (64 bit) with 10,000 SC Chips
- 100 Cryostats = 2 MW, energy consumption of chips negligible
- 1 Zettaflop/s for 8-bit AI

2038

- Josephson Cores at 1000 GHz in 2035, 64 bit prec
- 50 PF/s per CHIP
- 500 EF/s with 10,000 SC Chips
- 1 ZF/s with 20,000 SC Chips
- 100 ZF/s AI

Technological Developments in Quantum Computing



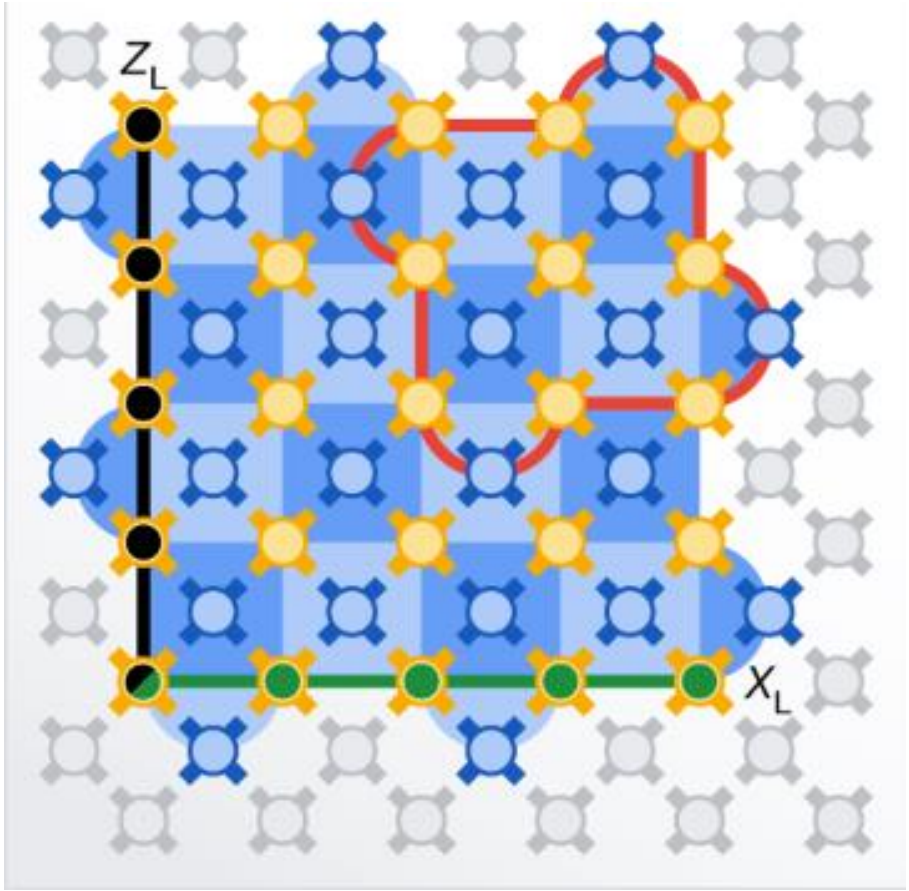
WHAT IS A „LOGICAL QUBIT“ß

A logical Qubit is created through quantum error correction; information is distributed across many physical Qubits

Precision increases by a factor 10^5

Only then, practical algorithms become possible

This is the central technical innovation of the next 5 years



QUALITY OF 2-QUBIT-GATES

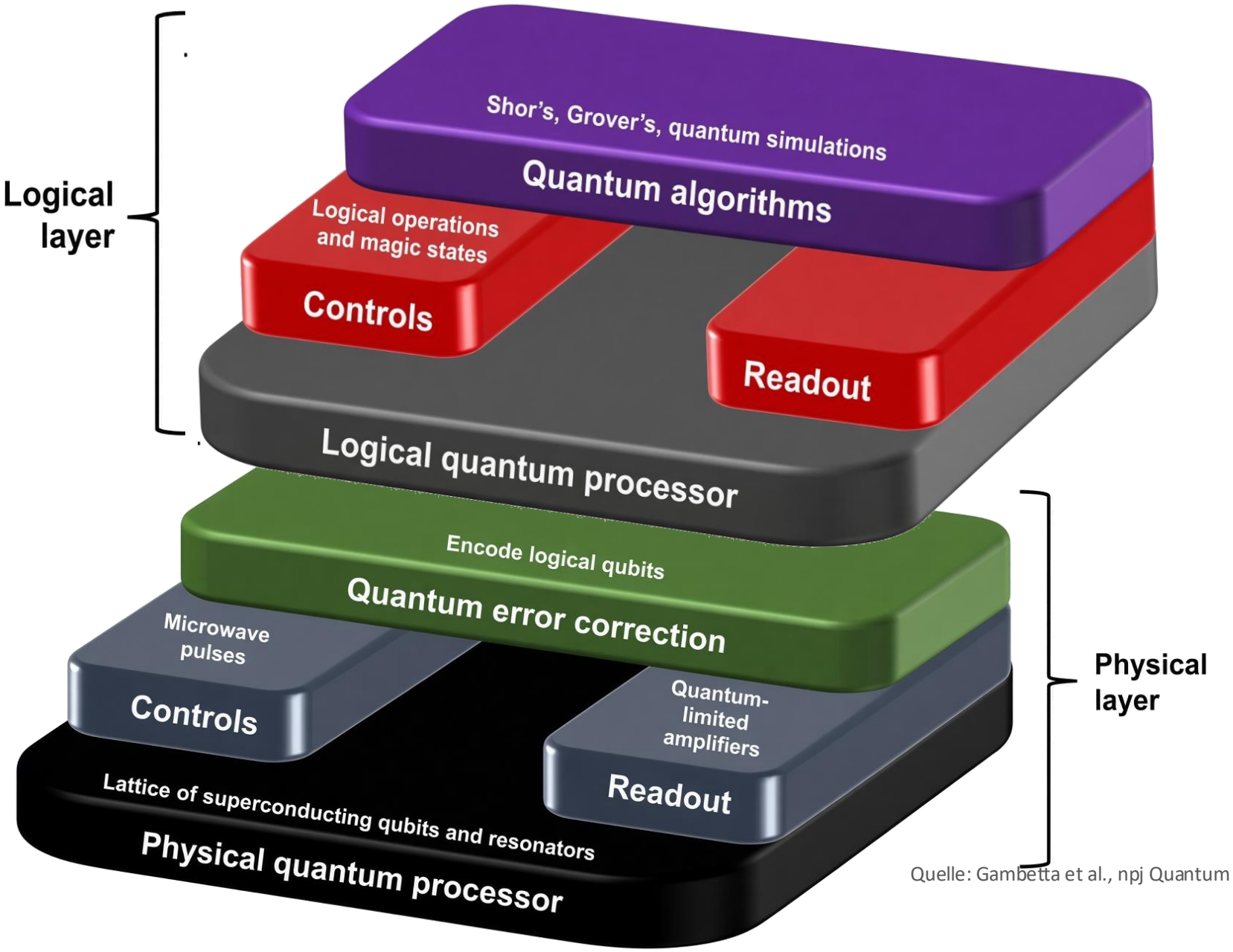
Errors of physical qubits today: $\varepsilon > 10^{-4}$

→ Fidelity of physical qubits: $F < 99,99\ \%$

Error of logical qubits 2030: $\varepsilon > 10^{-9}$

→ Fidelity of logical qubits: $F < 99,9999999\ \%$

Begin of realistic compuations with quantum computers



Quelle: Gambetta et al., npj Quantum Inf. 3, 2 (2017) · CC BY 4.0

SUPERCONDUCTING QUBITS

Unternehmen	Max. phys. Qubits	Max. logische Qubits	Wichtige Roadmap-Ziele	Zeitrahmen	Bemerkung
IBM	1.121 Condor 156 Heron 120 Nighthawk	**1 – 6**	Quantum Advantage Starling: 200 LQB Blue Jay: 2.000 LQB	2026 2029 2033	Clear Roadmap qLDPC / Bicycle Codes, modular
IQM	54 Halocene 150 Radiance	–	5 (10^{-5}) bis 4-36 (d=2 bis 6) > 100 (qLDPC) (10^{-8})	2026 2027 2030	Clear Roadmap Hohe 2Q-Fidelity (99,91 %)
Google	105 Willow	**1**	Long-lived LQs Error-corrected system 1 Mio. PQB	2026 2029 langfristig	Best demonstr. Error Correction Produkt ?
Rigetti	108 Cepheus-1	n/a	150+ PQB 1.000+ PQB	2026 2027–2029	Modular Chiplet-Ansatz


IQM
IQM
IQM
BLUE FORS

NEUTRAL ATOMS

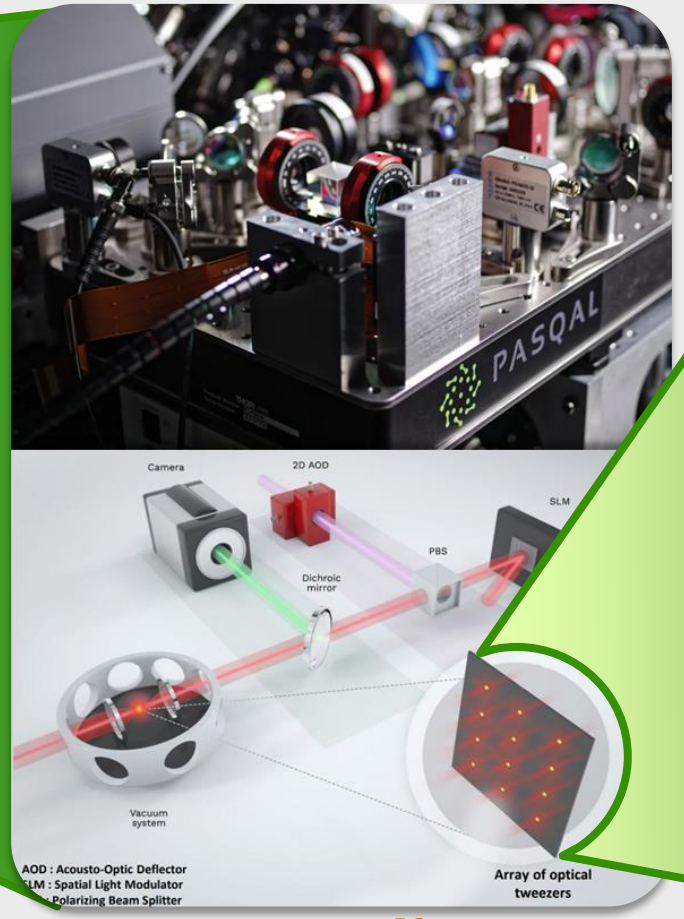
Unternehmen	Max. phys. Qubits	Max. logische Qubits	Wichtige Roadmap-Ziele	Zeitrahmen	Bemerkung
Atom Computing 	1.200 Phoenix	**24** (2:1)	Magne: 1.225 phys. / 50 LQB	2026 2027	d = 5
QuEra 	448 Gemini	**96** (2:1)	Libra: 10.000 PQB / 256 LQB Next-Gen: 20.000 phys./1.000+	2028 2029	d= 6 d = 5
Pasqal 	324 Vela	–	10.000+ PQB 100 LQB	2028 2029	Deployments u.a. Aramco analog + digital
PlanQC 	130 DiNAQC	–	100 PQB 10 x 100 PQB Multi-Core	2027 Q4/2027	Geplant Ulm und LRZ

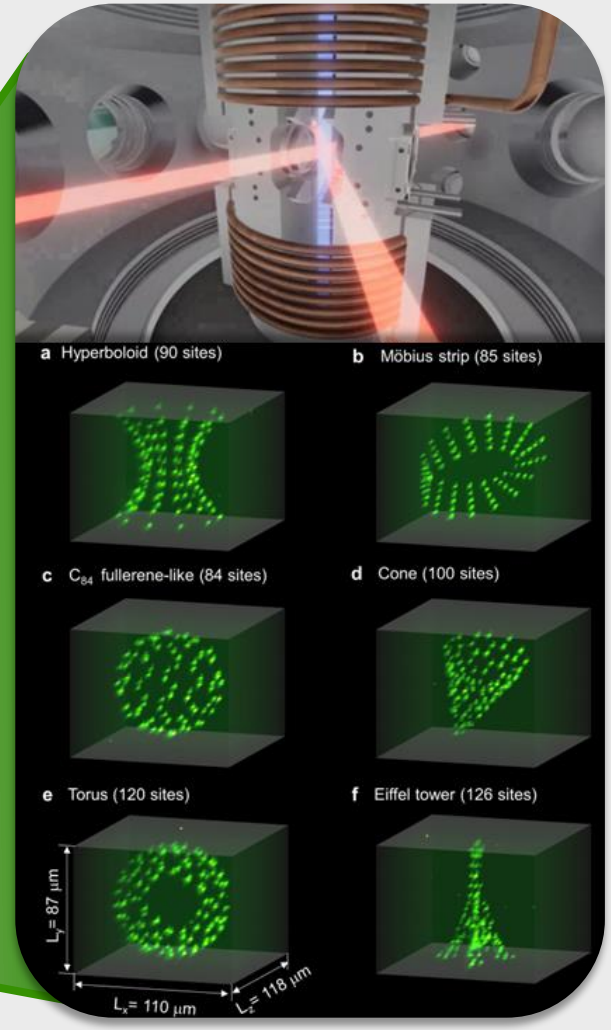
PASQAL **Fresnel**

Quantum **P**rocessing **U**nit

Quantum **R**egister







100 Rydberg atoms trapped in a 3D lattice

JÜLICH Forschungszentrum | JUNIQ QUANTUM USER FACILITY

ION TRAPS

Unternehmen	Max. phys. Qubits	Max. log. Qubits	Wichtige Roadmap-Ziele	Zeitrahmen	Bemerkung
Quantinuum 	98 Helios	48 (2:1)	Sol 192 PQ / 100 LQB < 2:1 Apollo > 200 LQB	2027 2029	Note: d = 15 requires > 225 LQBs
IonQ 	64–256 Tempo	Frühe Demos	256 PQB 10.000 PQ / 800 LQB (12:1) 2 Mio. PQ / 80.000 LQB /12:1)	2026 2027 2030	Aggressive Roadmap, höchste 2Q-Fidelity (99,99 %)
AQT 	12–20 IBEX	**2**	Kompakte Rack-Systeme Keine Angaben 2026+	2025 2026	European Veteran
eleQtron 	6 – 30 (?) MAGIC	–	60	2026	Microwave-Steuerung Große Schaltzeiten
neQxt 	> 6 (12?)	–	> 200 PQB	2027	Rheinland-Pfalz Hessen Bayern

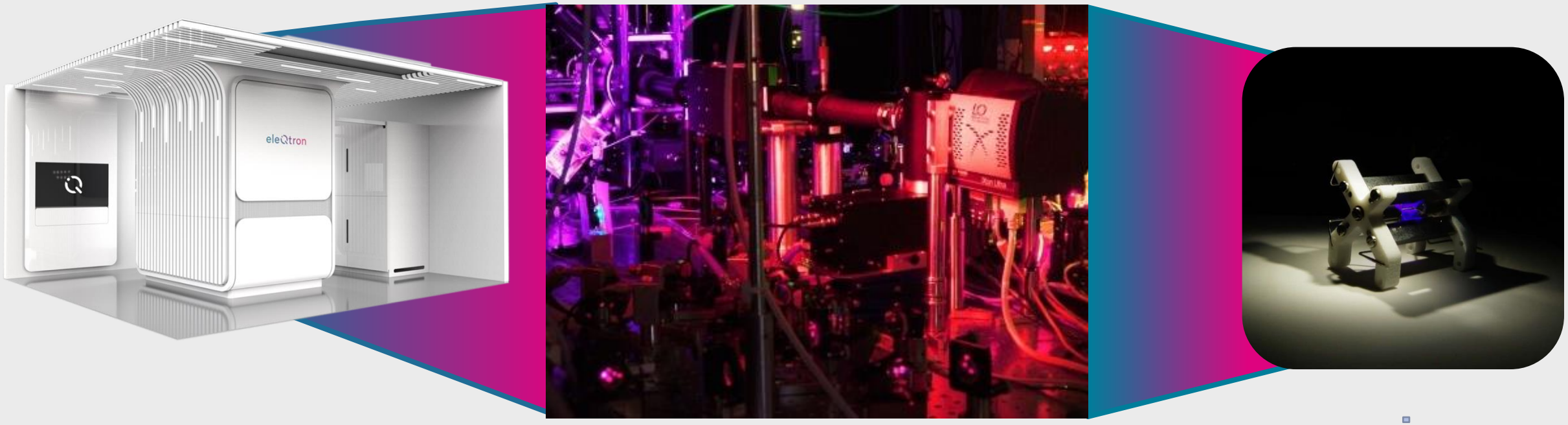
eleQtron

Quantum Processing Unit

Linear ion trap

Quantum Register

20-30 trapped ion qubits



SILICON-CMOS

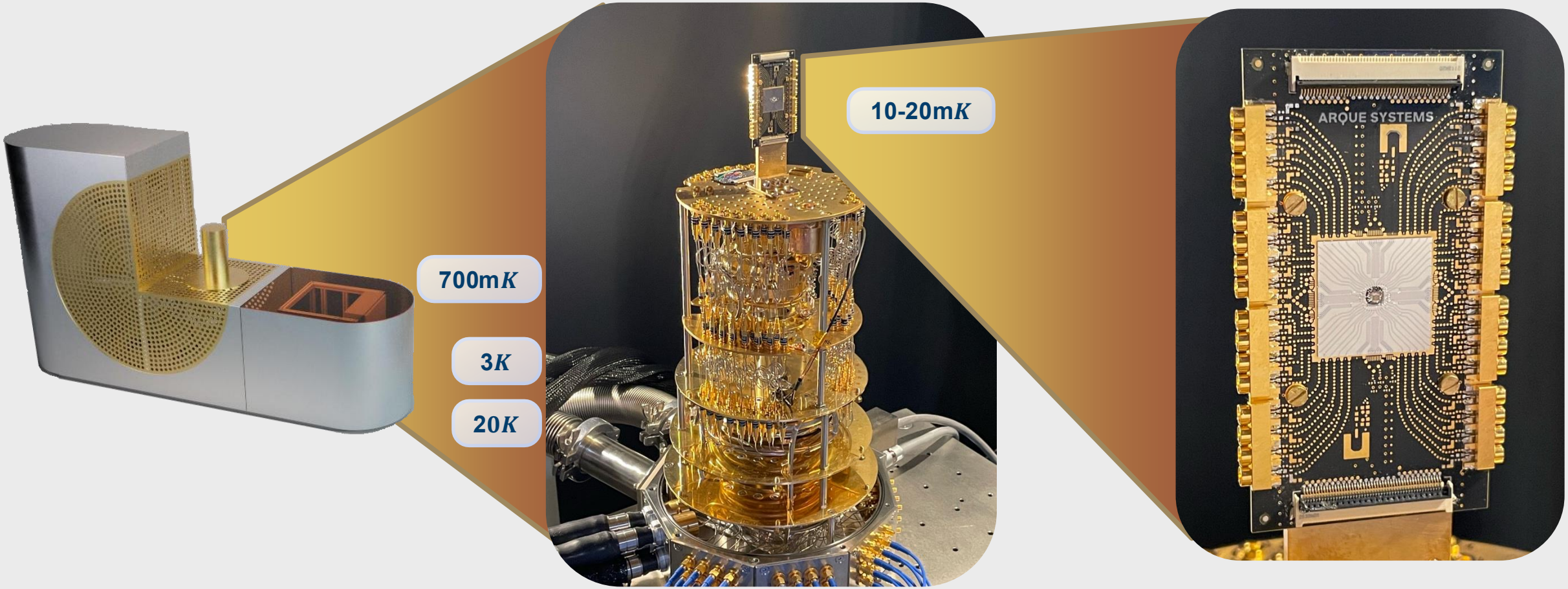
Unternehmen	Phys. Qubits	Log. Qubits	Wichtige Roadmap-Ziele	Zeitrahmen	Bemerkung
Intel 	12 Tunnel Falls	–	Scaling auf 300mm Cryo-CMOS Integration	2026+	
Diraq 	8	–	1 Mio. Qubits pro Chip	2031	
SQC 	10 Phosphor-Donor	–	High Fidelity (99,99% 2Q)	2026+	Weltrekord-Fidelity
Quantum Motion 	2 – 4	–	Full-Stack System am UK NQCC	2026+	Fokus auf Cryo-CMOS
Equal1 	6 Bell-1	–	Integrierte Cryo-CMOS	2026+	Rack-mountable
Quobly 	n/a	–	100 phys. Qubits auf Consumer-Logic-Prozess	2027	STMicroelectronics Partner
ARQUE 	5	–	Skalierbare Architektur	2026+	Shuttling

ARQUE SYSTEMS

Cooling system

Quantum Processing Unit

5 electron-spin qubits



PHOTONIC QUANTUM PROCESSORS

Unternehmen	Phys. Modes	Log. Qubits	Wichtige Roadmap-Ziele	Zeitrahmen	Bemerkung
Quandela 	12–24 Modes Belenos / Canopus Ziel 48+	–	Modular Scaling 10+ LQB Demonstrator	2026 2028+	Single-Photons Quantum Dots
Xanadu 	216 Modes Borealis / Aurora	–	bis 100.000 PQB / 500 LQB Quantum Data Center	2029 2030	d = 15
QuiX 	8–20 Modes	–	Logical Qubits + Loss-Tolerance	2026+	Integrierbare phot. Prozessoren
ORCA 	90 Modes PT-Serie	–	Prakt. Anwendungen	2026+	Near-term apps / Quantum Memory
PsiQuantum 	Nicht öffentlich	–	Utility-scale FT System 1 Mio. PQB	2027 2029+	No NISQ phase not transparent

NV-CENTERS

Unternehmen	Phys. Qubits	Log. Qubits	Wichtige Roadmap-Ziele	Zeitrahmen	Bemerkung
XeedQ 	6 XQ1 BabyDiamond	–	Skalierbares 32 PQB System	2026	Raumtemperatur mobil
SaxonQ 	2 x 5	–	SXQ128 (16 x 8 PQB) SXQ512 (64 x 8 PQB)	2026 2027	Raumtemperatur mobil
Quantum Brilliance 	2 + 2	–	25–100 Qubits Portable / Edge-Systeme	2026–2027+ 2030	Raumtemperatur mobil

Klein und einfach zu betreiben, geeignet für Universitätsgruppen

Sehr gut für hands-on Lehre und Training geeignet

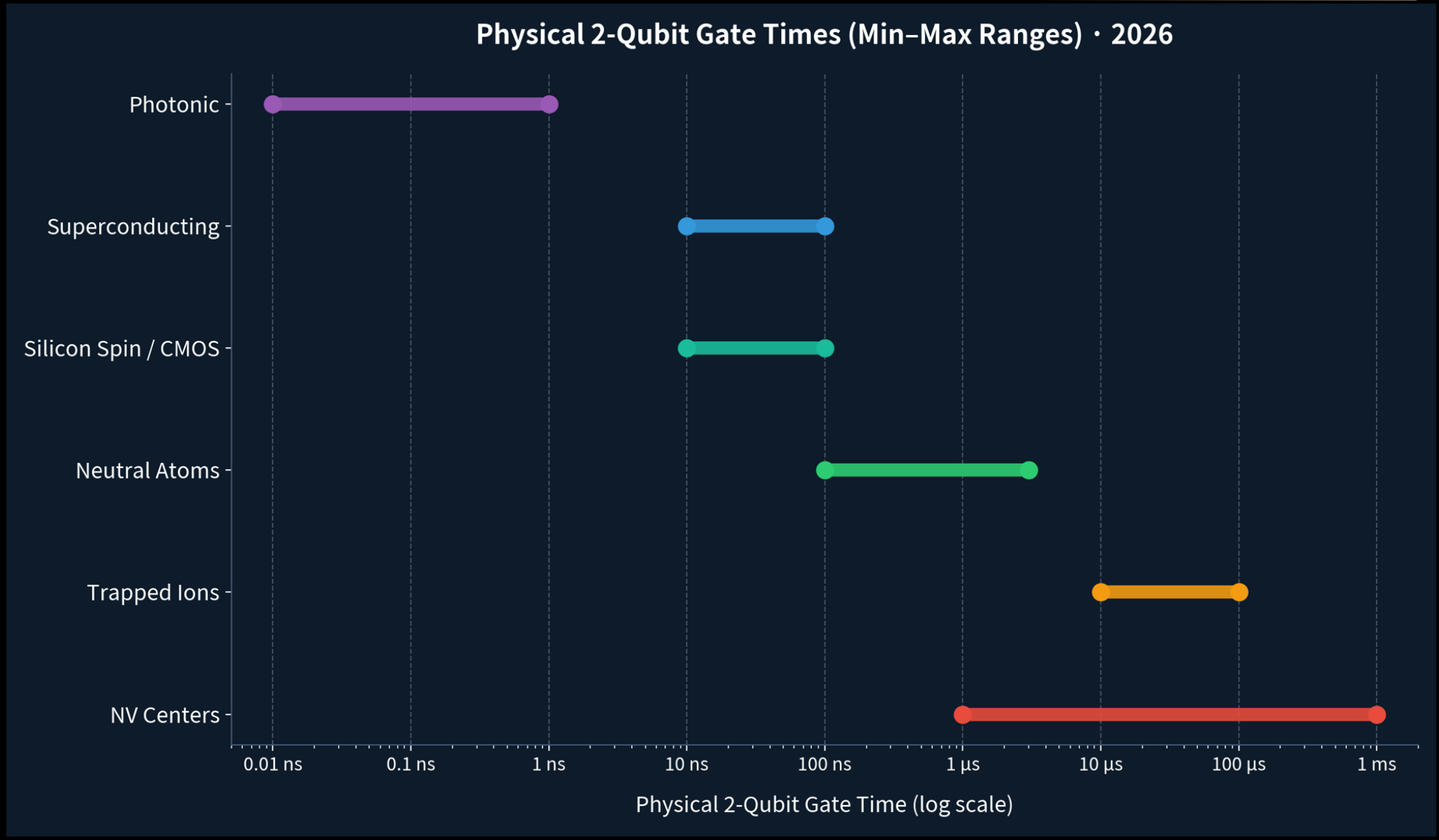
BABY DIAMOND

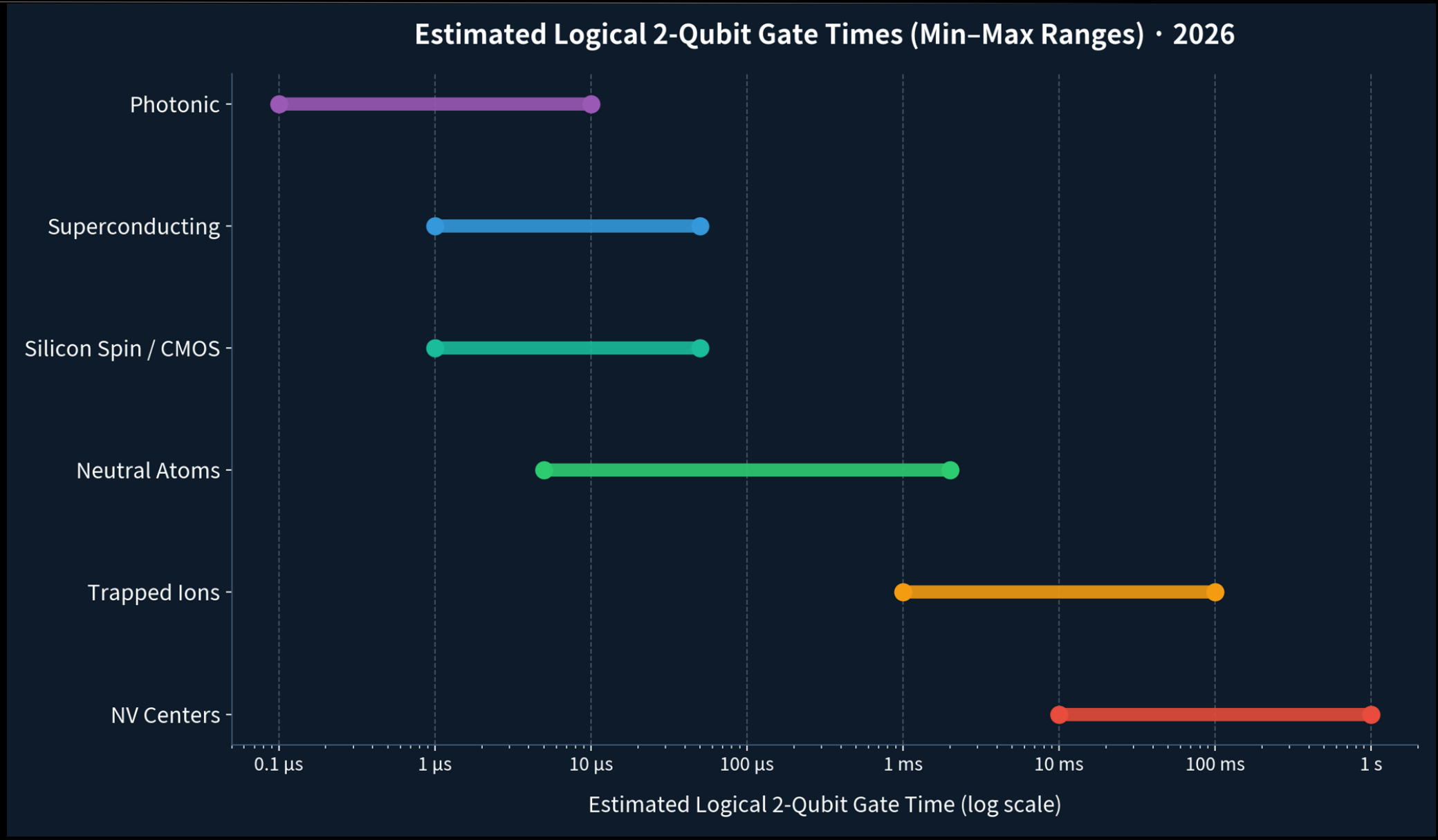
NHR Workshop on Practical Quantum Computing 2026



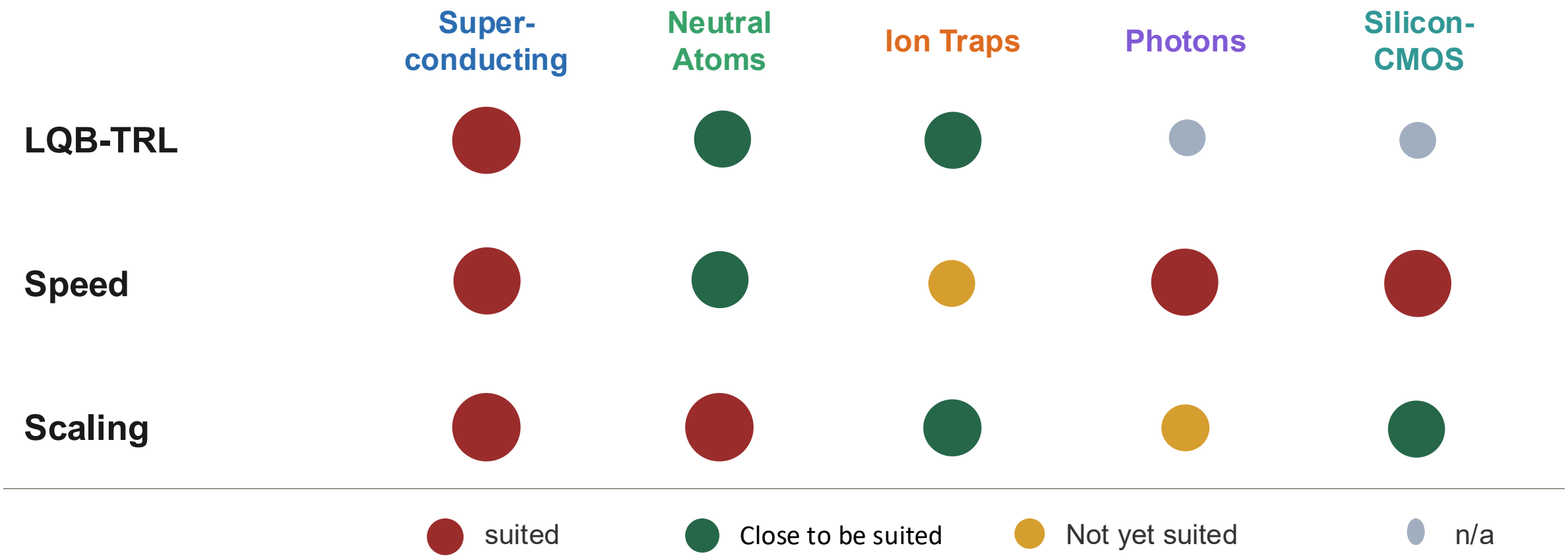





Physical 2-Qubit Gate Times (Min–Max Ranges) · 2026
Photonic
Superconducting
Silicon Spin / CMOS
Neutral Atoms
Trapped Ions
NV Centers
0.01 ns
0.1 ns
1 ns
10 ns
100 ns
1 µs
10 µs
100 µs
1 ms
Physical 2-Qubit Gate Time (log scale)

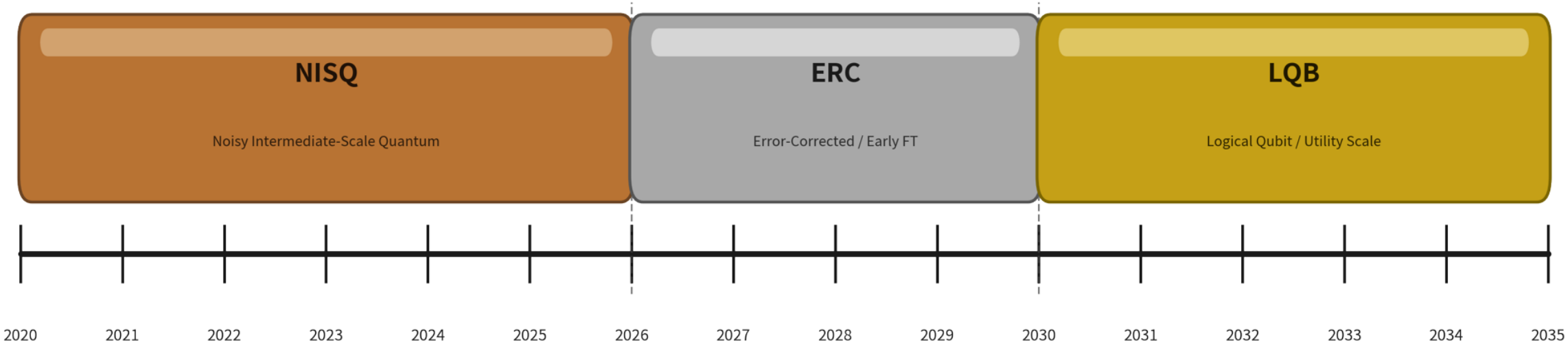

Estimated Logical 2-Qubit Gate Times (Min–Max Ranges) · 2026
Photonic
Superconducting
Silicon Spin / CMOS
Neutral Atoms
Trapped Ions
NV Centers
0.1 µs
1 µs
10 µs
100 µs
1 ms
10 ms
100 ms
1 s
Estimated Logical 2-Qubit Gate Time (log scale)

QUALIFICATION IN 2026 FOR PRACTICAL LOGIC QUBITS IN 2030



Supöerconducting qubits fulfill all three criteria for LQB in 2030

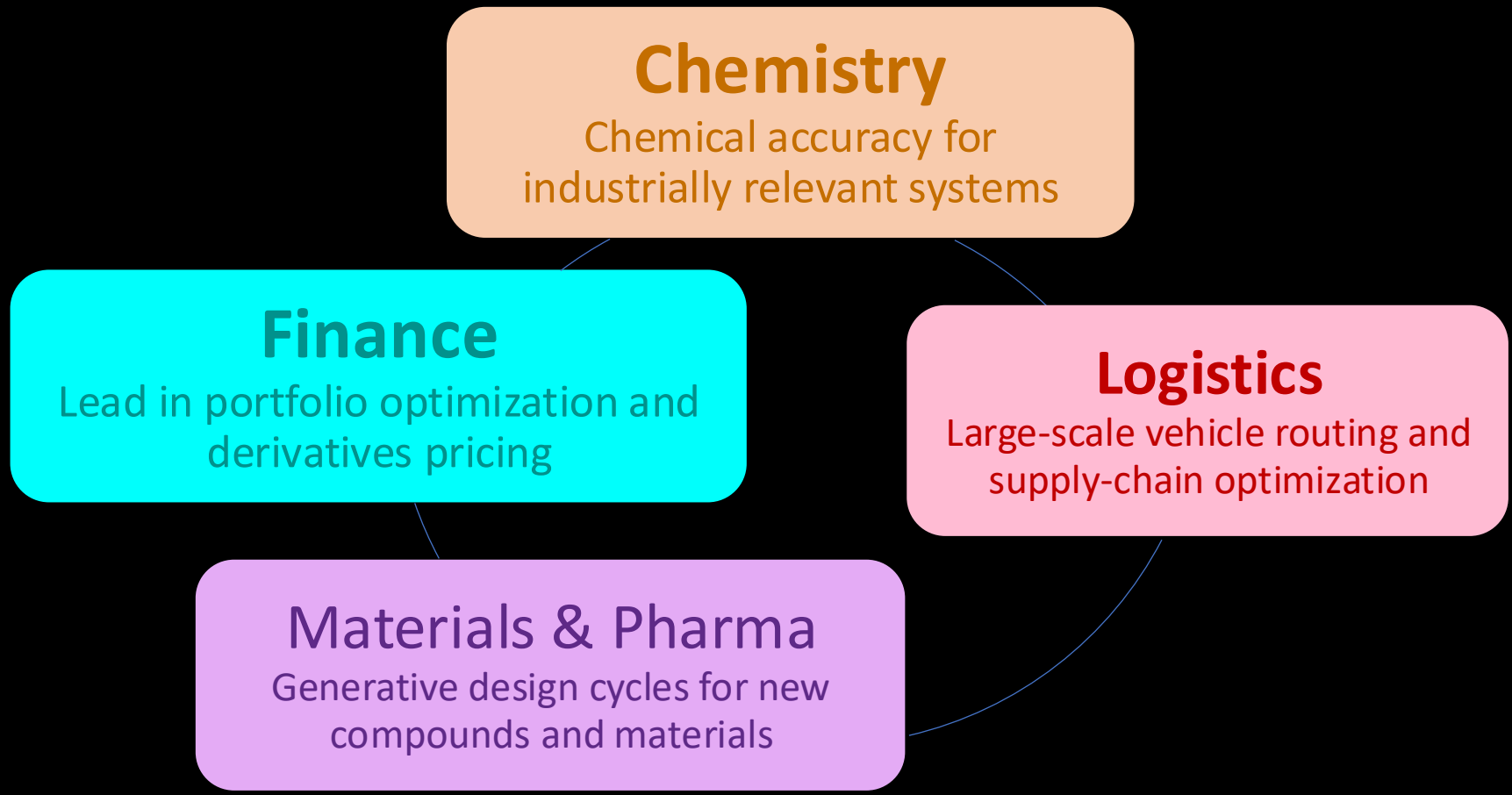
Why We Need Access to Systems with Over 50 Qubits



We need access **now** to systems with **more than 50 physical qubits** … otherwise we will lag behind during the **ERC-era** in developing applications for **LQBs** to create **real value**

LQB Era 2035 – What Can We Expect?

300 – 2,000 logical qubits with error rates ≤ 10^{-8} to 10^{-10}



I WOULD LIKE TO THANK ALL WHO HAVE HELPED MAKE JUPITER POSSIBLE