Riding the Wave or Paradigm Shift?

EXASCALE COMPUTERS TO TRAIN FOUNDATIONAL MODELS

THOMAS LIPPERT

DECEMBER 4, 2024 | JSC END OF YEAR COLLOQUIUM

JÜLICH Forschungszentrum
JÜLICH SUPERCOMPUTING CENTRE

Program

11.00-11.10 h ***Thomas Lippert***
Welcome on Board

11.10-11.30 h ***Thomas Lippert***
Riding the Wave?

11.30-11.50 h ***Alexander Strube***
→

11.50-12.10 h ***Georgia Psychou***
Setting Sail

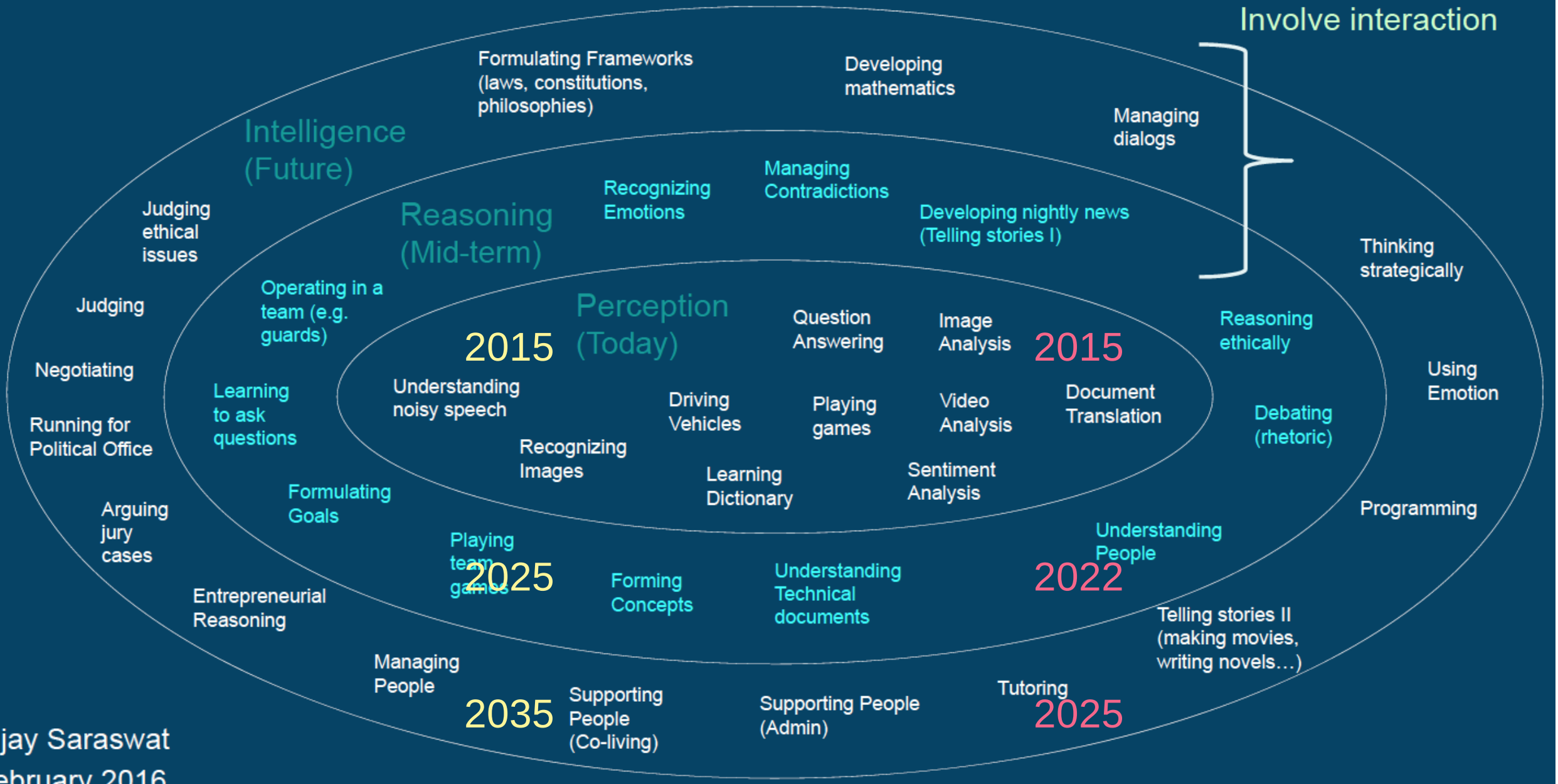
12.10-12.30 h ***David Rabanus***
Into the Cold

12.30-12.50 h ***Salem El Sayed***
Against all Odds

12.50-13.00 h ***Thomas Lippert***
Last Words

13.00-15.00 h ***Get-together with poster session***

Cognitive Task Landscape



Vijay Saraswat
February 2016

FOUNDATION MODELS

Since ChatGPT …

- Pre-trained on massive datasets for various tasks
- Transformative for scientific research and industrial applications

PARADIGM SHIFT IN HIGH-PERFORMANCE COMPUTING ?

- Foundation models demand massive computational resources
- HPC evolving to support AI training (alongside traditional simulations?)
- Challenges include energy and data sovereignty

HIGHLIGHT LAION

8B Image data set in Europa

JJ

Stable Diffusion 1.5,
trained on JUWELS
using the LAION-5B data set

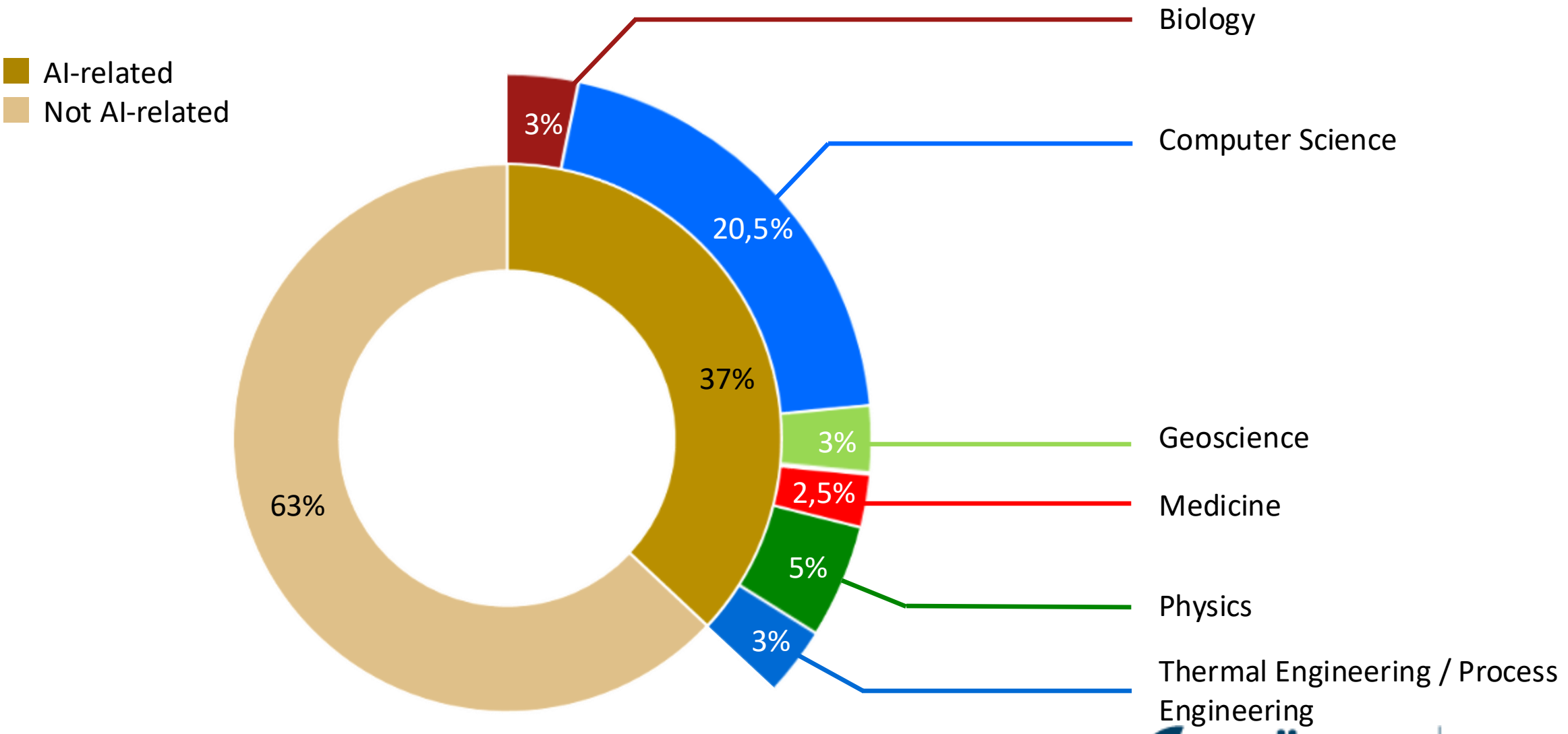
Prompt:

“Painting by Picasso‘s hand a cubistic elephant”

Outstanding NeurIPS 2022 award

JUWELS – STILL RANK 33 IN TOP500 11/2024

Resource Shares* of GCS/NIC, ESM, and VSR Projects



*) allocated resource shares (>1%) based on EFLOP on JUWELS (Cluster+Booster) and JURECA-DC (CPU+GPU)

SUPERCOMPUTING: GERMANY AND EU

A developing country?

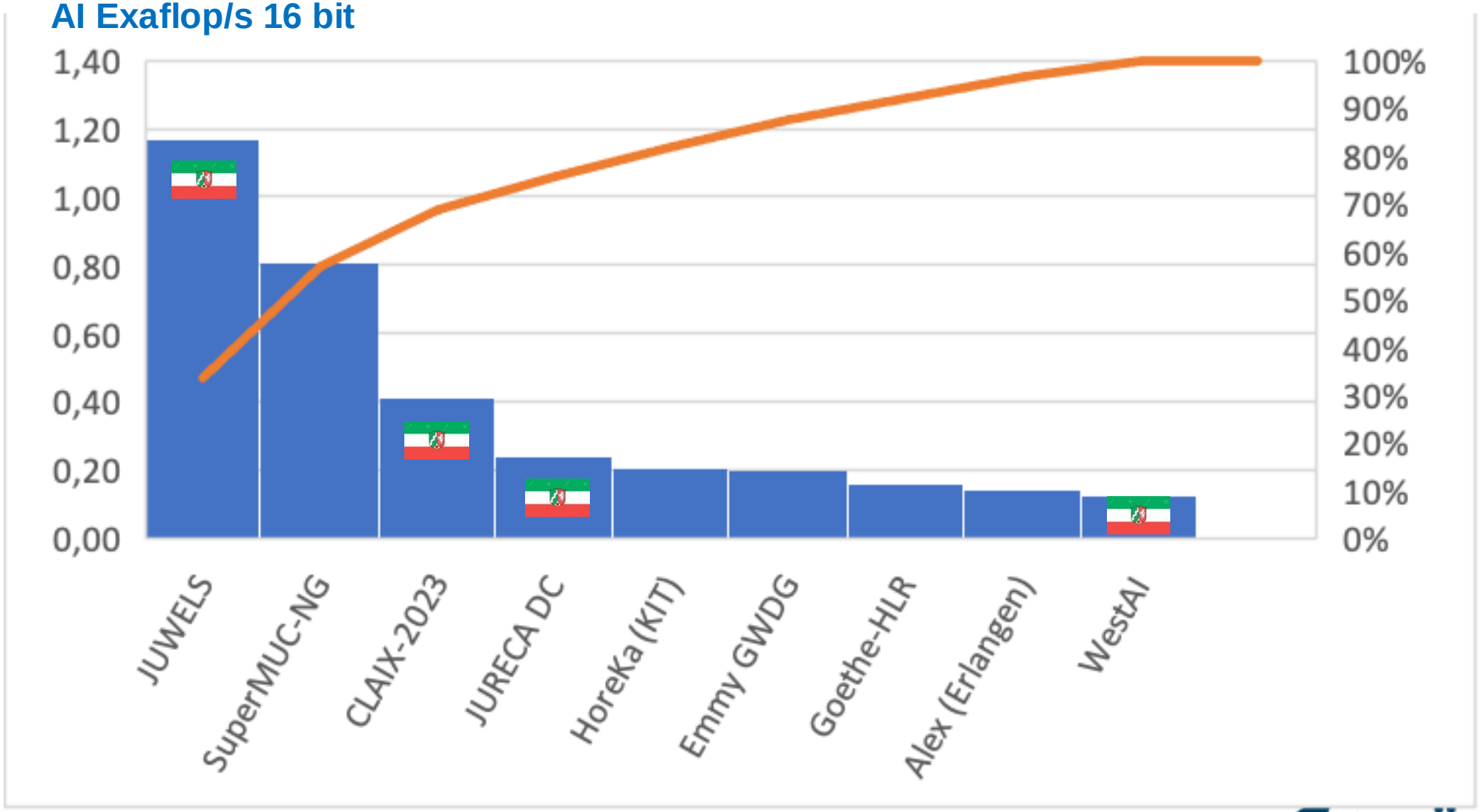
- Germany lacks hyperscaler-level AI infrastructure
- JUWELS most capable system for AI in Germany
- Europe catching up through EuroHPC JU and national engagement
- Key for Germany and Europe to secure scientific and technological leadership

operations per second.

Rank	Country	# of computers in TOP500 ranking	Maximum performance (TFlops)
1	US	172	6,475,559
2	Japan	34	940,710
3	Italy	13	837,788
4	Switzerland	5	473,517
5	Germany	41	405,341
6	Finland	3	391,388
7	China	63	319,062
8	France	24	298,086
9	Spain	3	221,873
10	S. Korea	13	213,091
11	Taiwan	7	103,541
12	Netherlands	10	98,364
13	Saudi Arabia	7	96,036

SUPERCOMPUTERS SUITABLE AS AI-TRAINERS IN D – 2024

AI Exaflop/s 16 bit



Enter

JUPITER

The Arrival of Exascale in Europe

ParTec MODULAR SUPERCOMPUTING

EVIDEN

fz-juelich.de/jupiter | #exa_jupiter

EuroHPC Joint Undertaking

Federal Ministry of Education and Research

Ministry of Culture and Science of the State of North Rhine-Westphalia

GCS Gauss Centre for Supercomputing

JEDI

JUPITER EXASCALE DEVELOPMENT INSTRUMENT

JEDI

Rank	TOP500 Rank	System	Cores	Rmax (PFlop/s)	Power (kW)	Energy Efficiency (GFlops/watts)
1	222	**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.

JETI

Jupiter Exascale Transition Instrument

Rank 18

83 PF/s

Rank 6 in Green500

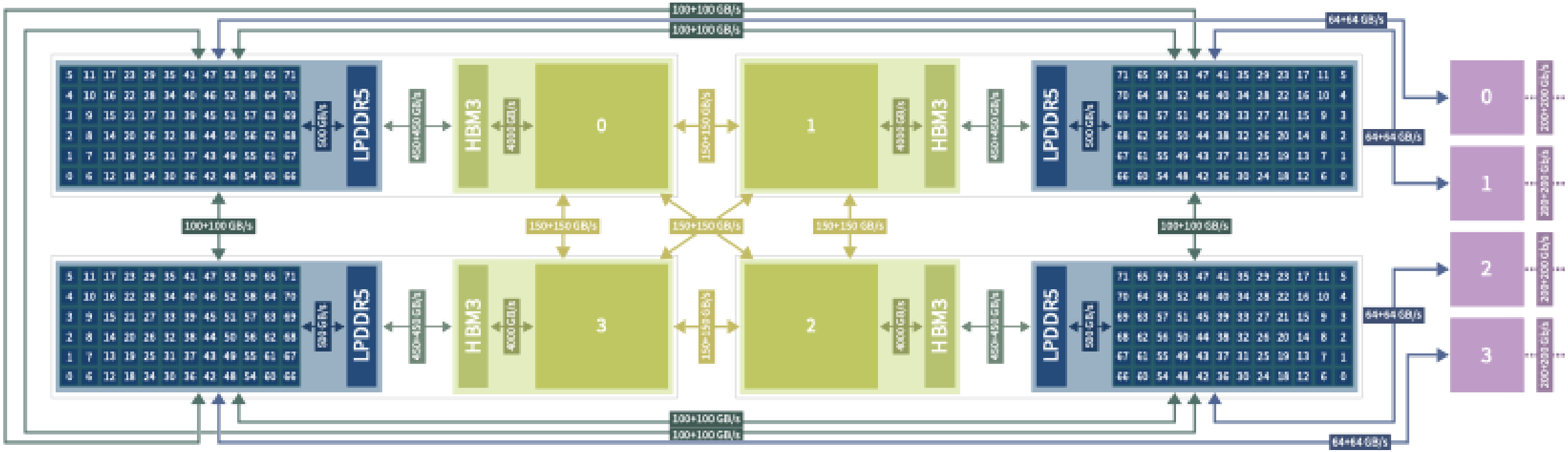
JUPITER: EUROPE'S FIRST EXASCALE SYSTEM

A Paradigm Shift in Itself – Germany will be on rank wto in total power worldwide

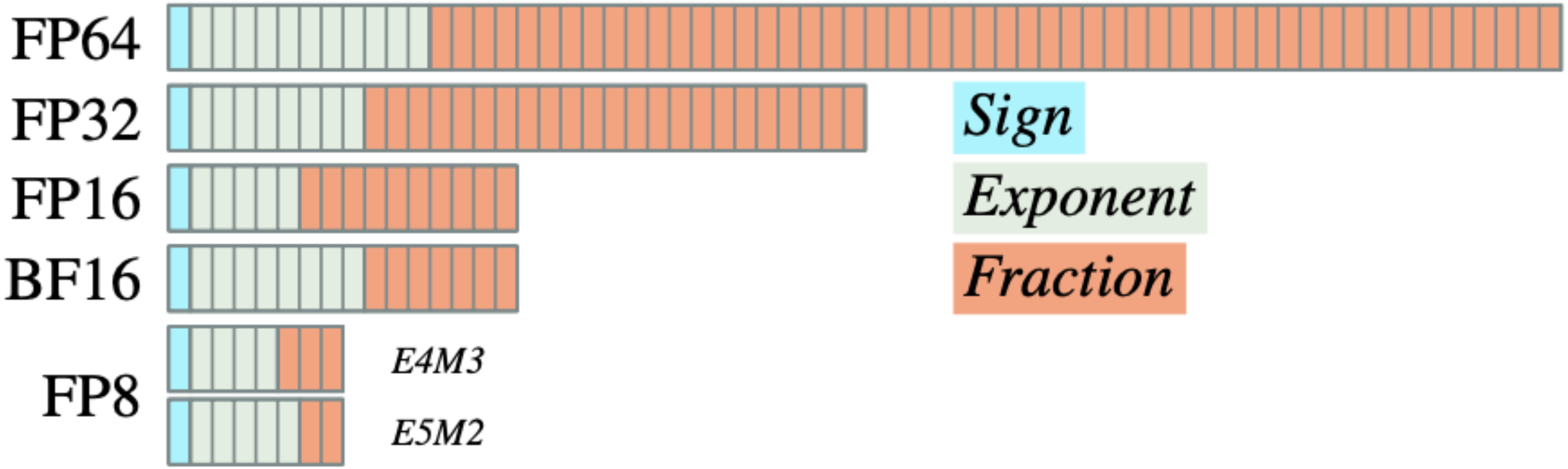
- Balances compute, network, and energy efficiency for versatile apps
- Designed to address the AI training and simulation gap
- Capable of 40 to 80 AI exaFLOP/s at 8 bit

- 24,000 NVIDIA GH200 superchips with high interconnect bandwidth.
- DragonFly+ topology for scalability.
- Storage includes 29 PB NVMe systems, 310 PB HDDs and +700 PB tape capacity

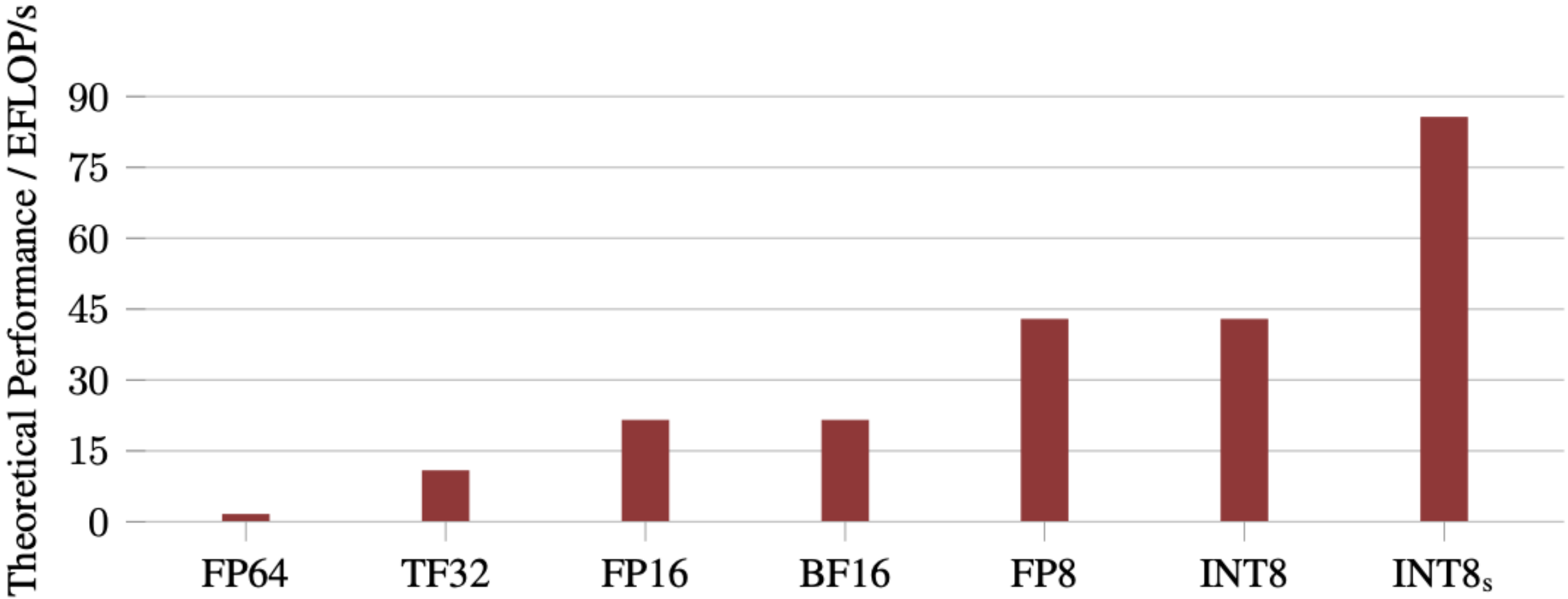
JUPITER BOOSTER COMPUTE NODE DESIGN



ENCODING OF PRECISION



AI PERFORMANCE



JUPITER

Installation in progress

- **Logistic containers: September**
- **Energy containers: Begin October**
- **Data Centre: Mid October**
- **HPC-Systems: Mid December**
- **Begin of operation: End of Jan.**
  - JUREAP on JUPITER starts
- **April: Full system**
- **May: LINPACK**
- **June: Begin of full operation**
  - KI Competition
  - 1st regular call

A PARADIGM SHIFT – NOT RIDING THE WAVE

A blissful, pleasant, and relaxing Christmas break to you and your families…

2025

2024

EU PEX

2023

HPC|QS

EuroHPC

SEA Projects

2022

2021

FP7 - H2020

DEEP Projects

2020

2011

…and a Happy and Healthy New Year!