

# IDAF: Interdisciplinary Data Analysis Facility

Dr. Yves Kemp, DESY IT  
CDCS opening symposium  
Hamburg, 28.4.2022

# DESY research divisions ... In a nutshell (those in Hamburg)



## Accelerators »

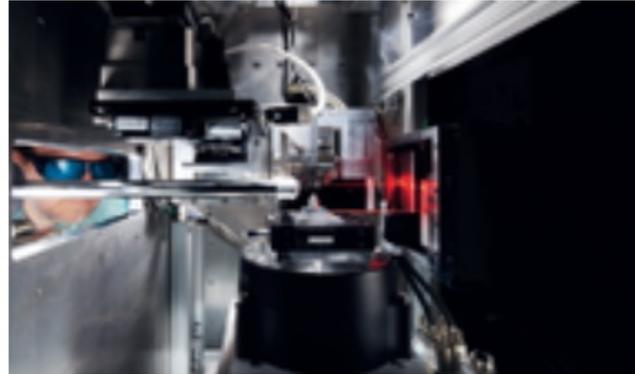
Running / Operating:

- Petra III, FLASH, XFEL, ...

Planning:

- Petra IV

General Accelerator R&D



## Photon science »

Petra III, FLASH, EXFEL,  
CFEL, CSSB, EMBL, HZG

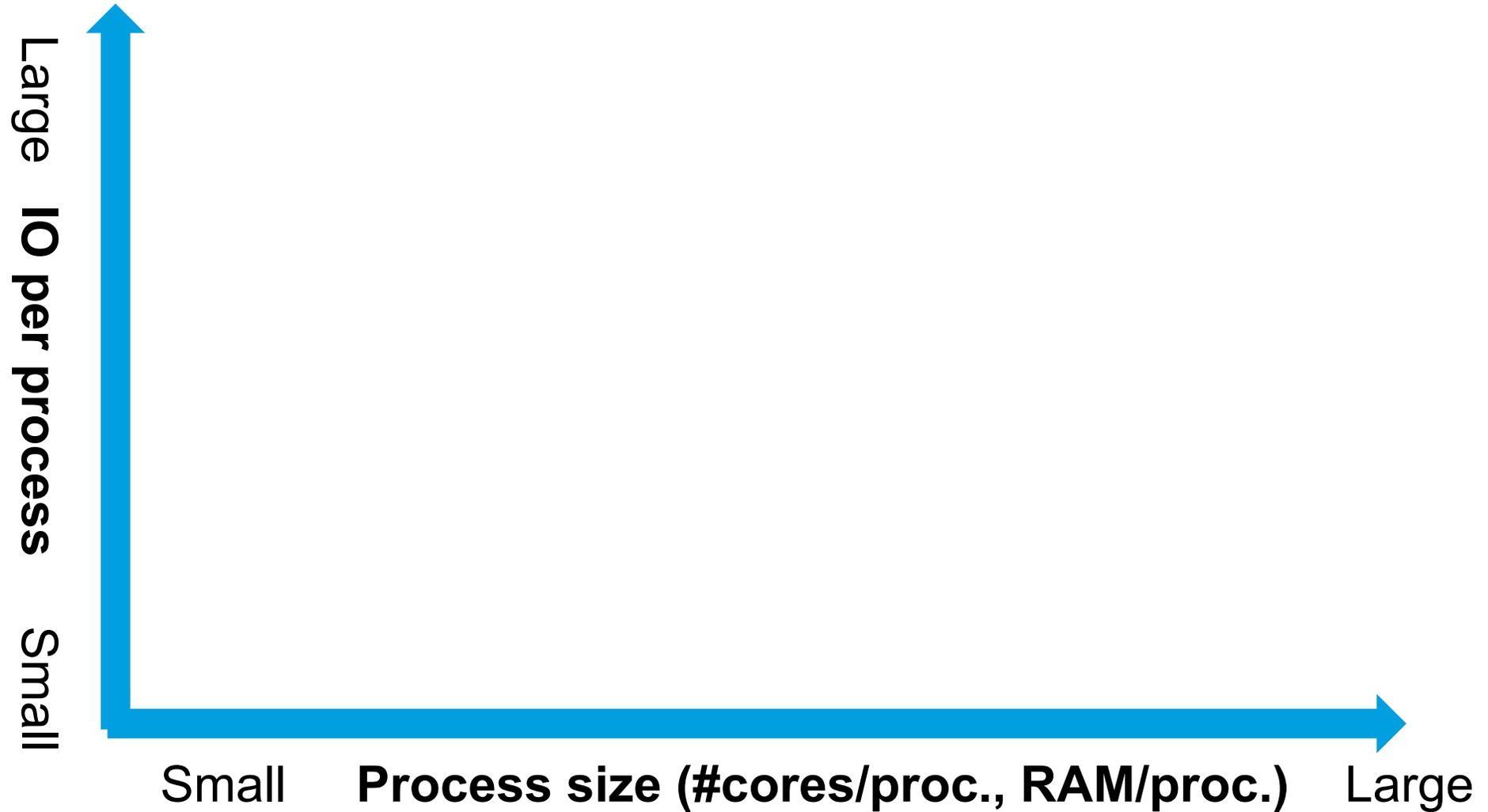


## Particle physics »

- LHC, HL-LHC
- Belle II
- ILC, ALPS, ....
- Theory division

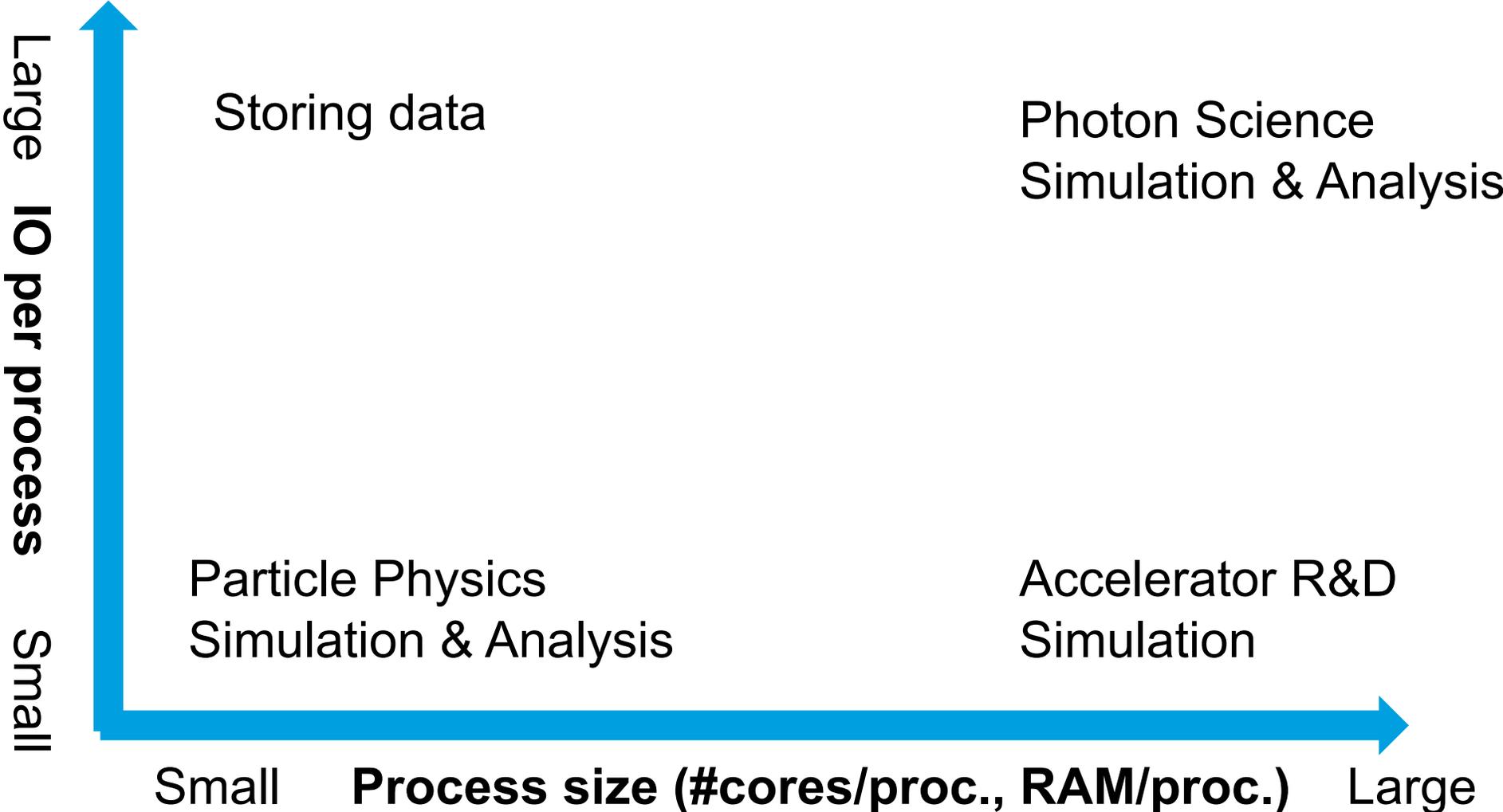
# Computational requirements: Job size vs IO needs

Very very coarse



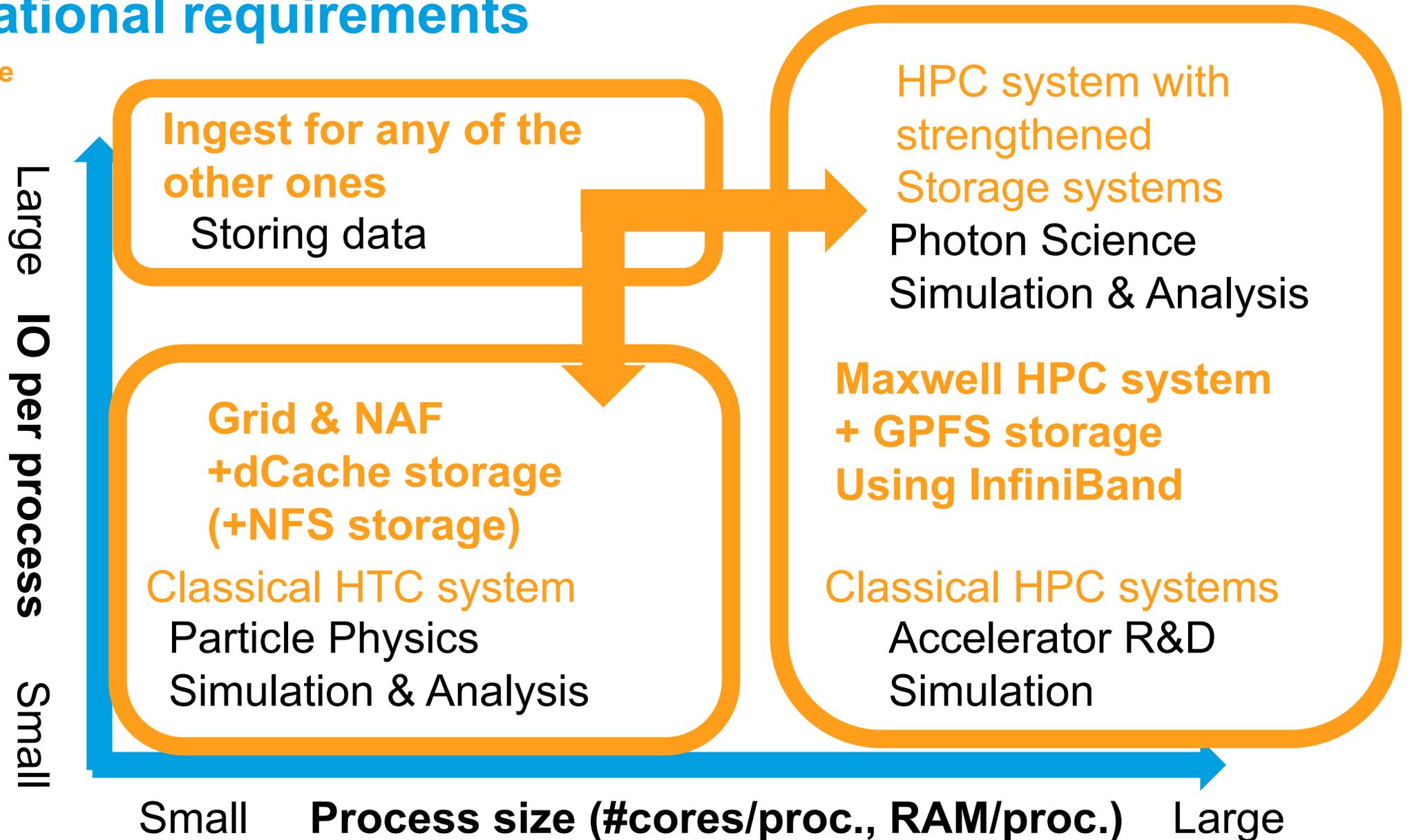
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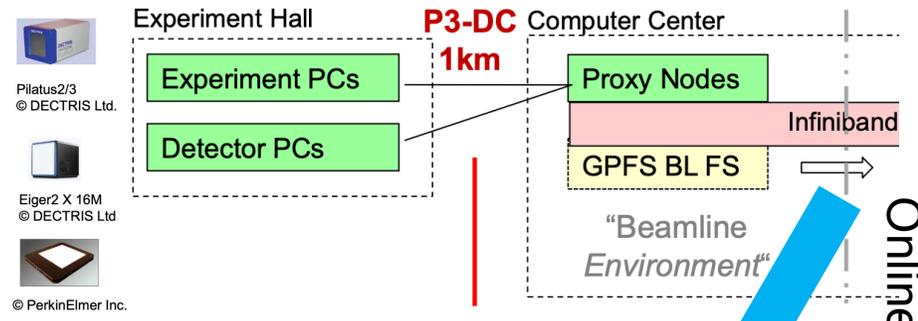


# Computational requirements

Very very coarse



# The Setup for Photon Science



Pilatus2/3  
© DECTRIS Ltd.

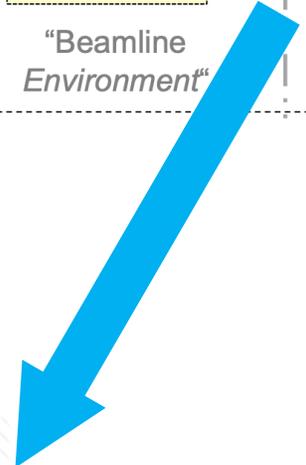
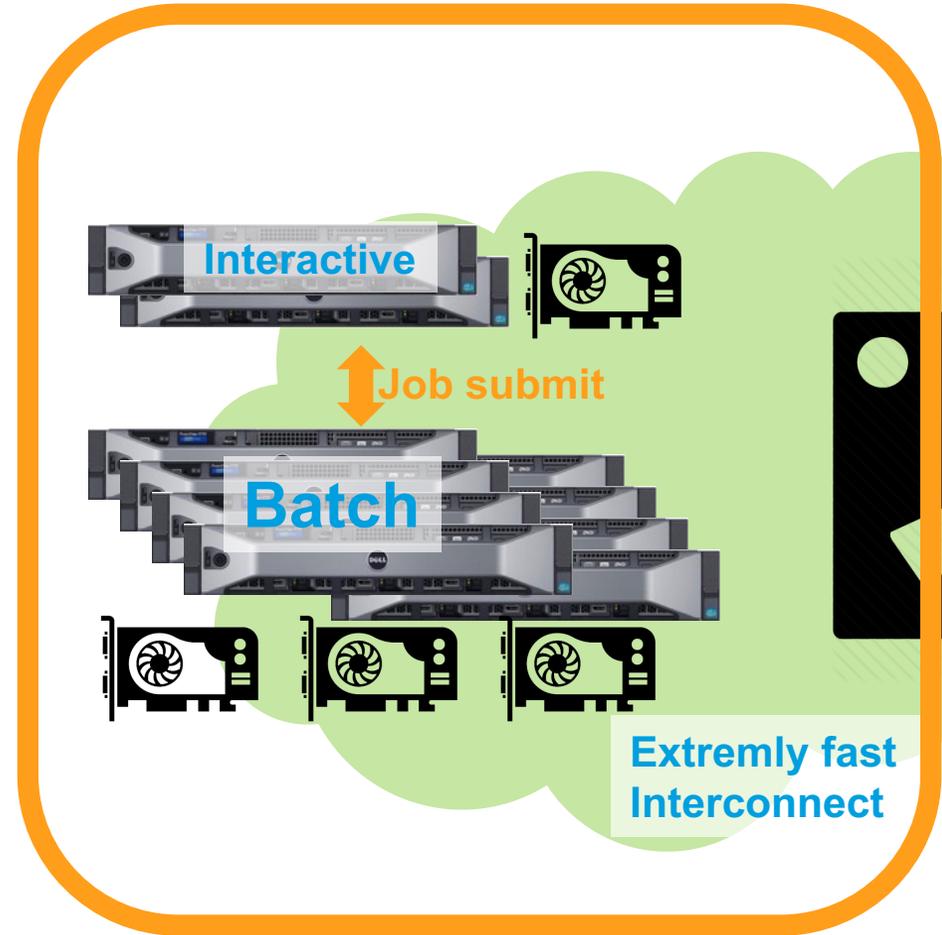
Eiger2 X 16M  
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## Maxwell

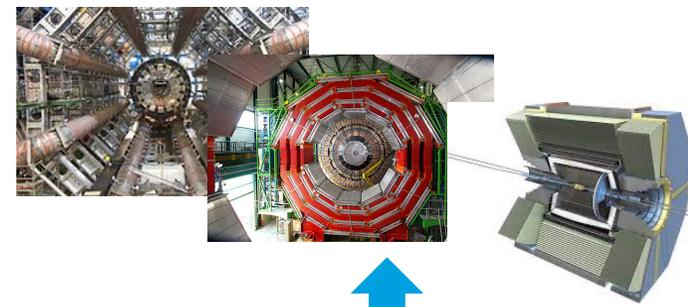


ssh /  
FastX /  
Jupyter



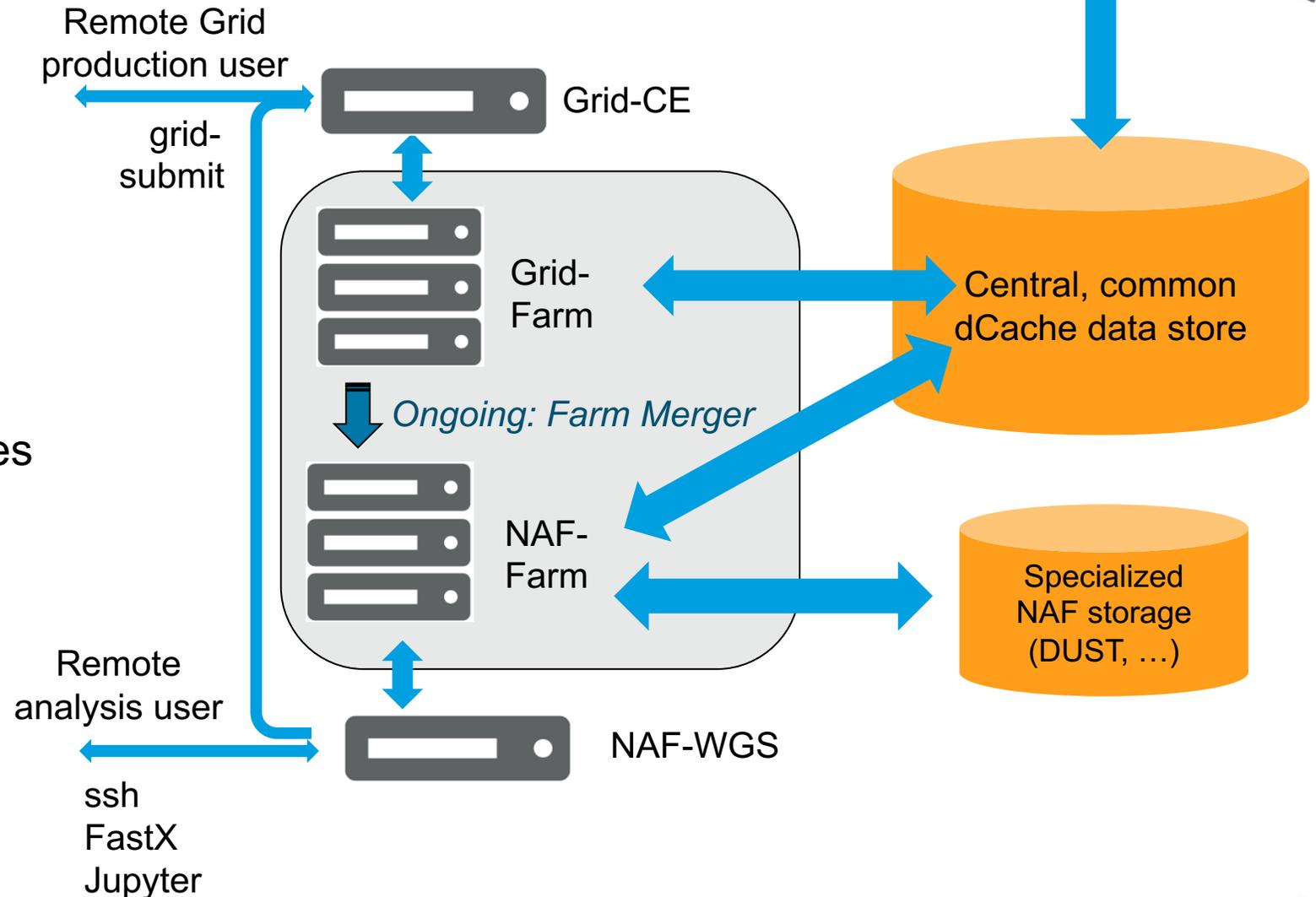
Online P-III: André Rothkirch talk yesterday

# GRID & NAF: The big detailed picture

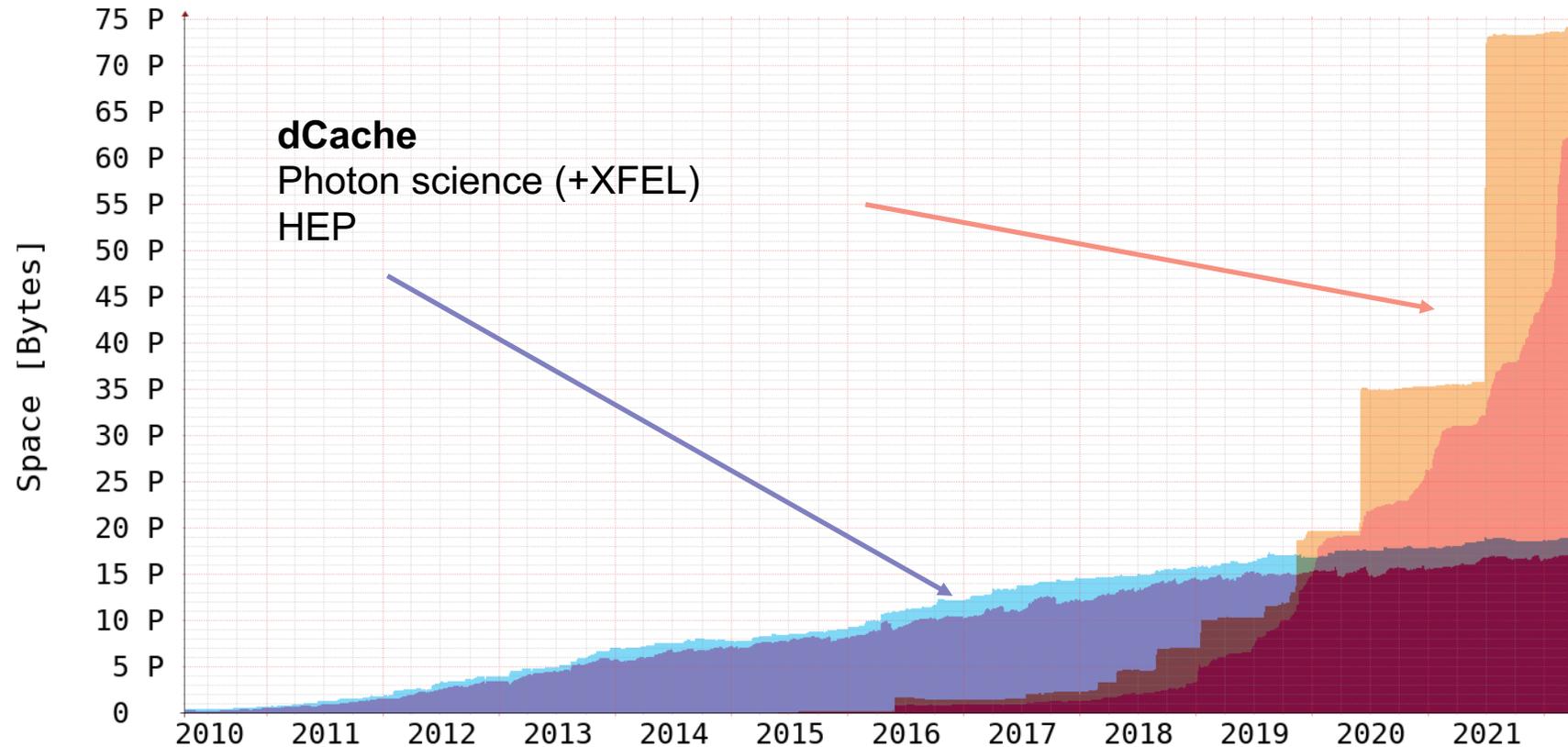


**Grid:** Serves worldwide HEP community through Grid protocols  
**NAF:** Serves national HEP community through interactive protocols

Access protocol is just one/few boxes large compute behind, as well as storage infrastructure and access is (mostly) identical



# Facts and figures



- Executive Summary:
  - Maxwell + Grid + NAF
  - dCache + GPFS + BeeGFS
  - ~60.000 CPU cores, ~320 GPUs
  - ~150 PB data on disk
  - ~2.700 server (compute, storage, management)
  - ~ 0.5 Megawatt

GPFS increase: See e.g. André Rothkirch talk yesterday

**Unified Compute Infrastructure**

**a.k.a.**

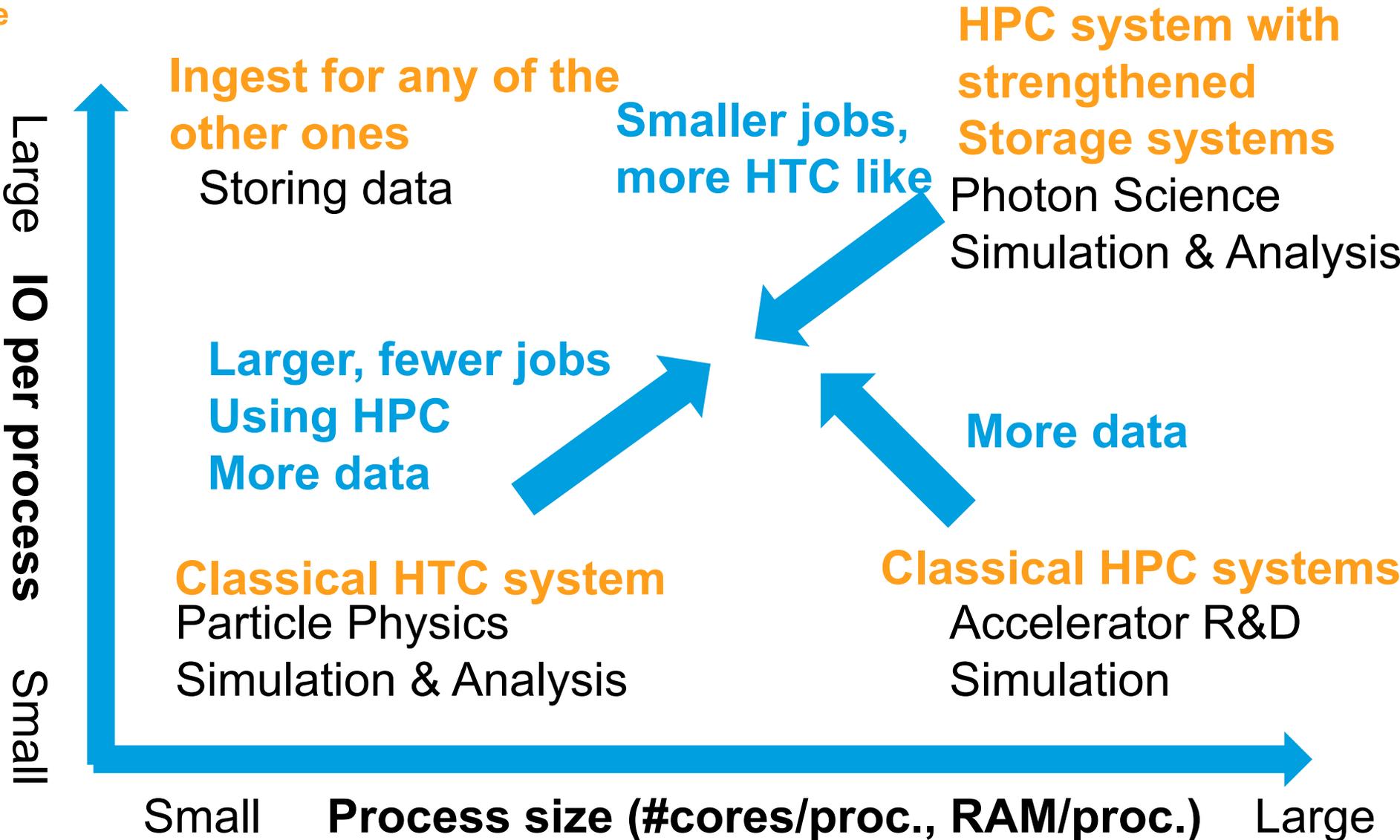
**Interdisciplinary Data  
Analysis Facility IDAF**

# Motivations for a change: User views

- Data deluge:
  - in Photon Science
  - Upcoming: Particle accelerator operation
- Changes in job profiles:
  - Particle physics: Single-core → Multi-core
  - Particle physics: Usage of HPC systems
  - Photon science: Not all processes need large resources
  - Photon science: Need for online analysis (and reduction)
  - Particle accelerator operations: Doing Big Data & Machine Learning
- Changes in hardware needs
  - All relevant communities now employ computational accelerators (GPUs)

# Computational requirements are changing

Very very coarse



# The IDAF: Consolidation of resources

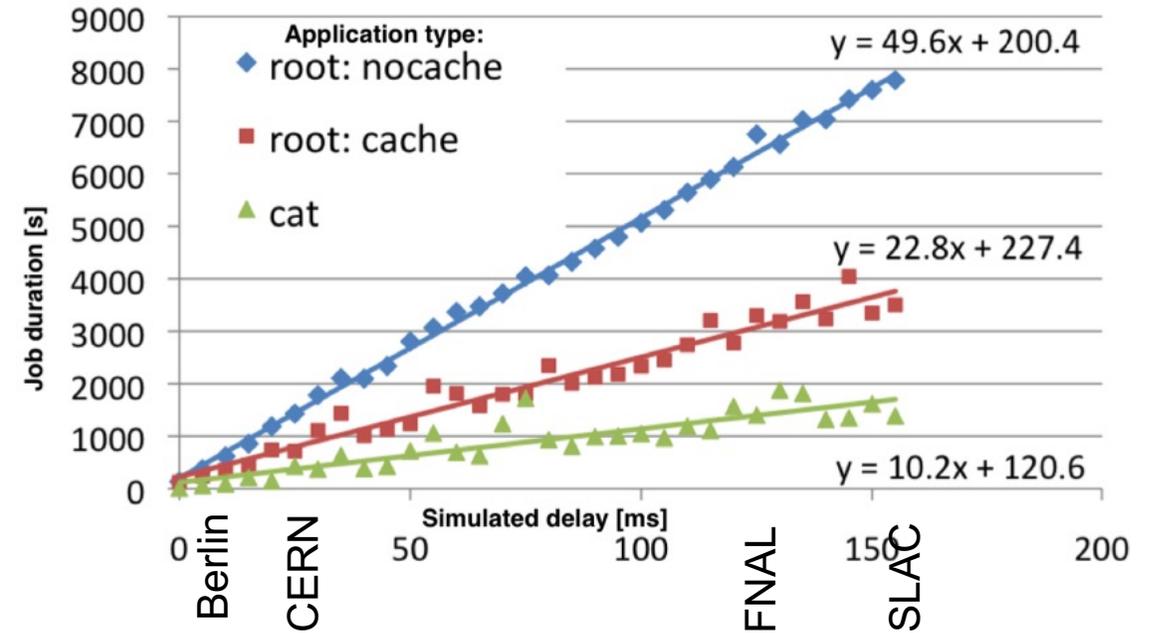
- IDAF:
  - Offering a consolidated access
  - to one resource set
  - via common interfaces
  - for an ever increasing number of communities
- Common interfaces:
  - Meta-schedulers, workflow engines and pipelines, portals, ...
  - Research topic e.g. in DMA, NFDI (PUNCH, DAPHNE), PaNOSC, ExPaNDS, EGI, ...

# Integration with external sites / storage

- External access is governed by bandwidth – **and latency!**
- Analysis is data centric
  - Perform analysis on local data is best / Data locality
  - Remote data access needs additional tools:



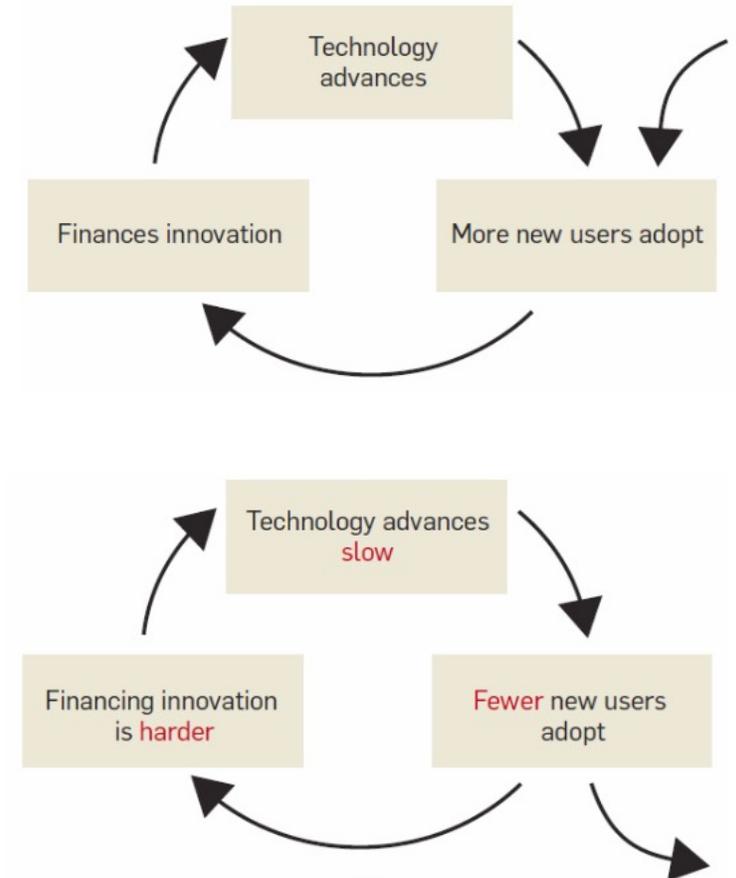
- **(transparent) data caches**
  - **Metadata services**
  - **Workflow engines**
  - **Access portals**
  - **FAIR principles, OpenScience**
- **Research topic, e.g. HIFIS, ARCHIVER, SciCat, PaNOSC portal**



Experience with HEP analysis on mounted filesystems, *J.Phys.Conf.Ser.* 396 (2012) 042020

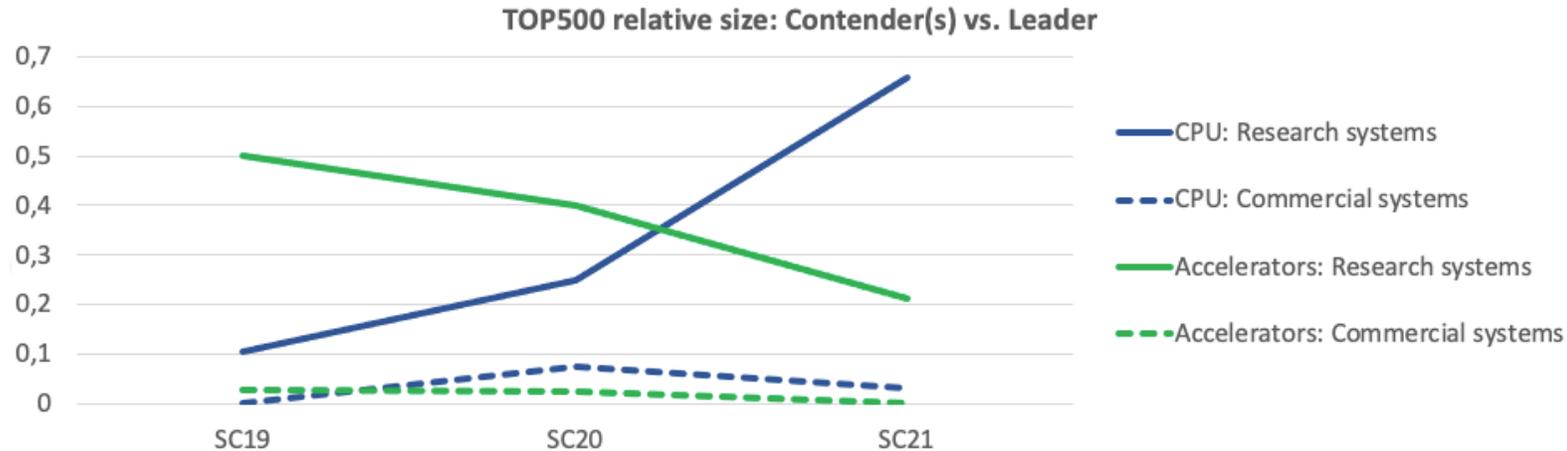
# Motivation for a change: Hardware evolution

- With the end of Moore's law and Dennard scaling, there is an economical motivation for leaving the path of universal processors
- Lots of interesting new architectures, products and companies emerge, esp. in the Machine Learning field
  - Leads to fragmentation of technology and hence resources
- As consequence: Consolidate clusters in order to manage technology fragmentation
- How well do we adopt specialised processors?
- How diverse are we?



N. Thompson, S. Spanuth,  
<https://doi.org/10.1145/3430936>

# Comparison Market leaders vs. competitors



Maxwell #installed systems april2022:

- Intel: 59%
- AMD: 22%
- NVIDIA: 19%
- Non-NVIDIA: 0%

- Maxwell goes with “research” trend: Intel → AMD
- Maxwell goes with “commercial” definition: Compute Accelerator = NVIDIA
- Experience shows: Monoculture & vendor-lock-in come with benefits ... and with costs:
  - Reduced innovation, unmotivated price increases, disruption danger, ...

Data source / raw data:  
Erich Strohmaier TOP500 BoF  
sessions at SC19, SC20, SC21

# Summary & Outlook & a Vision

**The IDAF is an excellent tool *for* research**

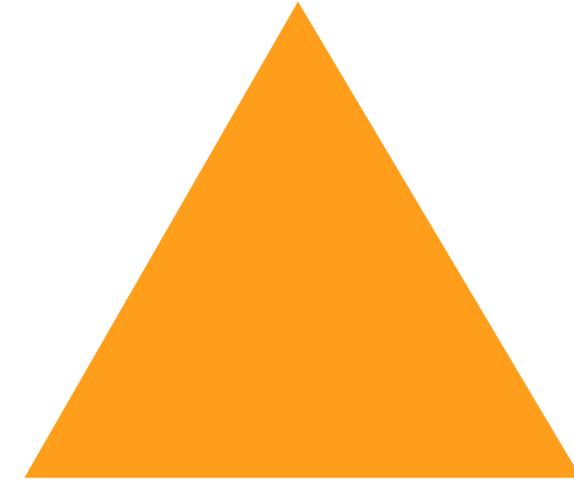
**The IDAF is an active area *of* research**

CDCS is a unique environment:

- Domain scientists have their domain knowledge
- Computer scientists have solid theoretical foundations
- IDAF systems architects have solid experience and contacts to industry

CDCS brings all three together, and creates an optimal environment, with efficient usage of these powerful yet expensive systems.

Domain scientists:  
Many different domains



Method scientists:  
System architects

Method scientists:  
Computer science