ODISSEE:
Using AI to cope with data deluge from SKAO and CERN HL-LHC

Damien Gratadour, CNRS



ODISSEE
Online Data Intensive Solutions
for Science in the Exabytes Era

The project in figures

14
Partners and 2 associated partners

7
Countries

9.5M
Million € funding

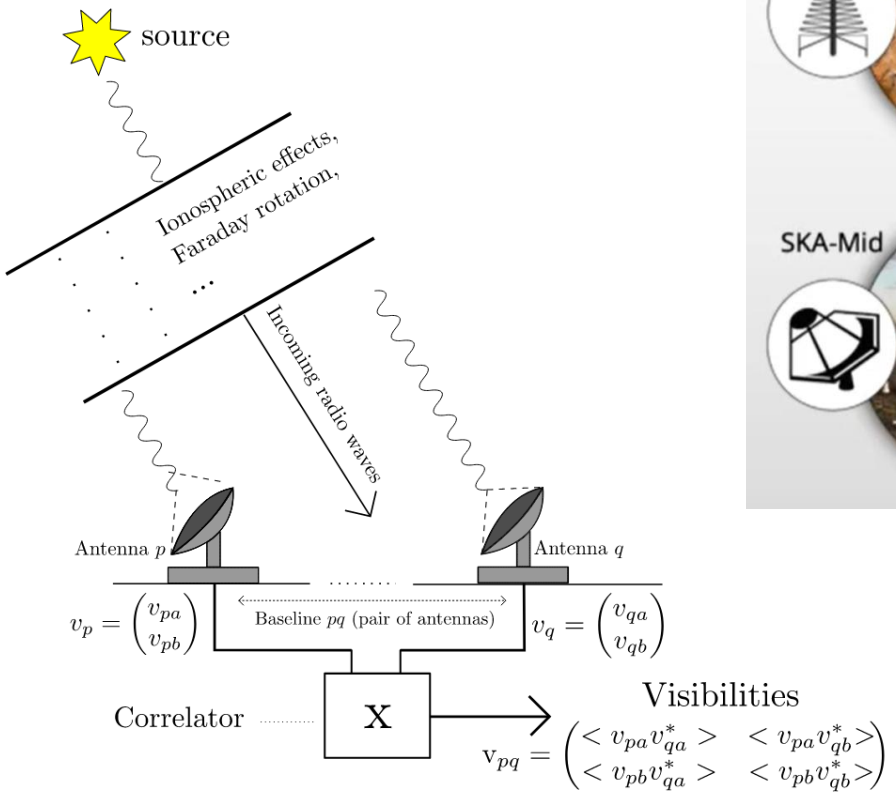
36
Months

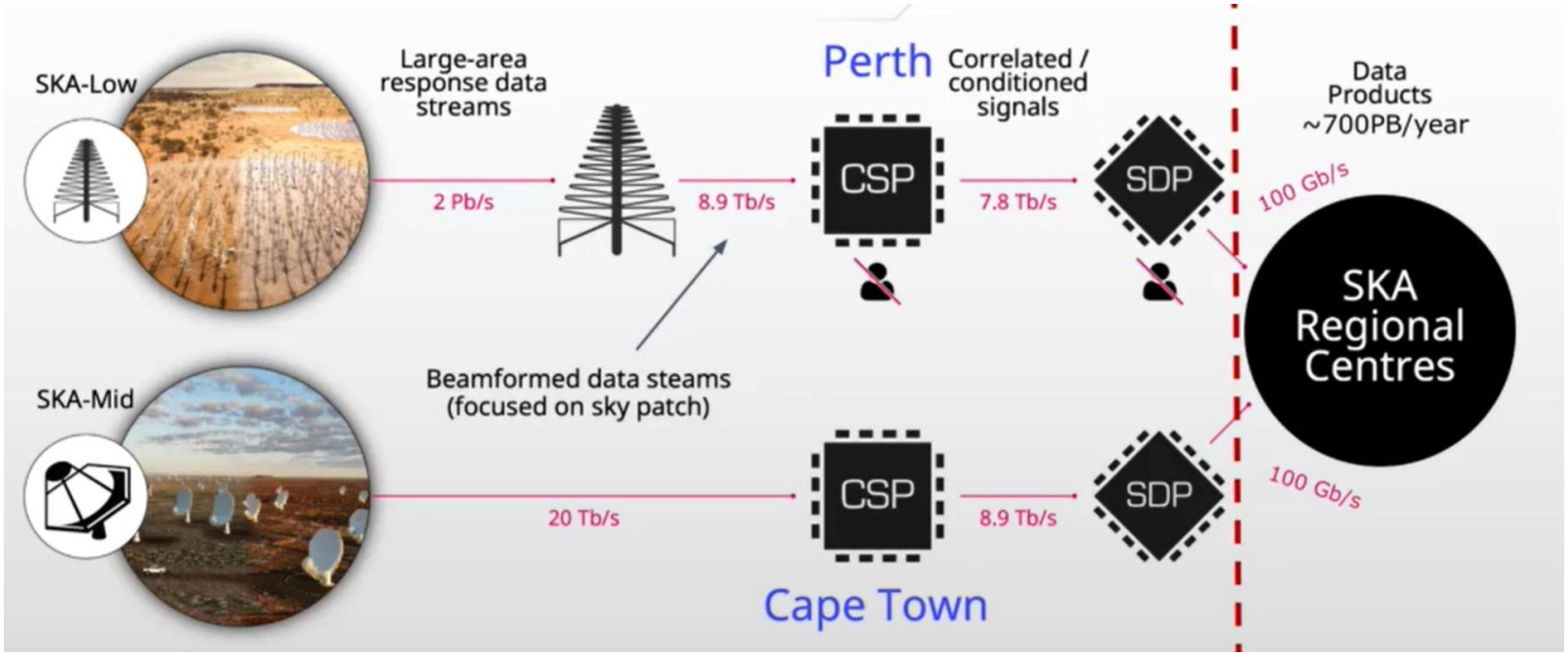
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cnrs
CERN openlab
ASTRON Netherlands Institute for Radio Astronomy
BSC Barcelona Supercomputing Center Centro Nacional de Supercomputación
simula
GENCI Le calcul intensif au service de la connaissance
ear energy aware runtime
SIPEARL
NEXTSILICON
SKAO
Inria
slices RI
SURF
EPFL
CSCS Centro Svizzero di Calcolo Scientifico Swiss National Supercomputing Centre
ETH zürich
Neovia Innovation

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Use-cases overview (I)

- **Radio-astronomy**

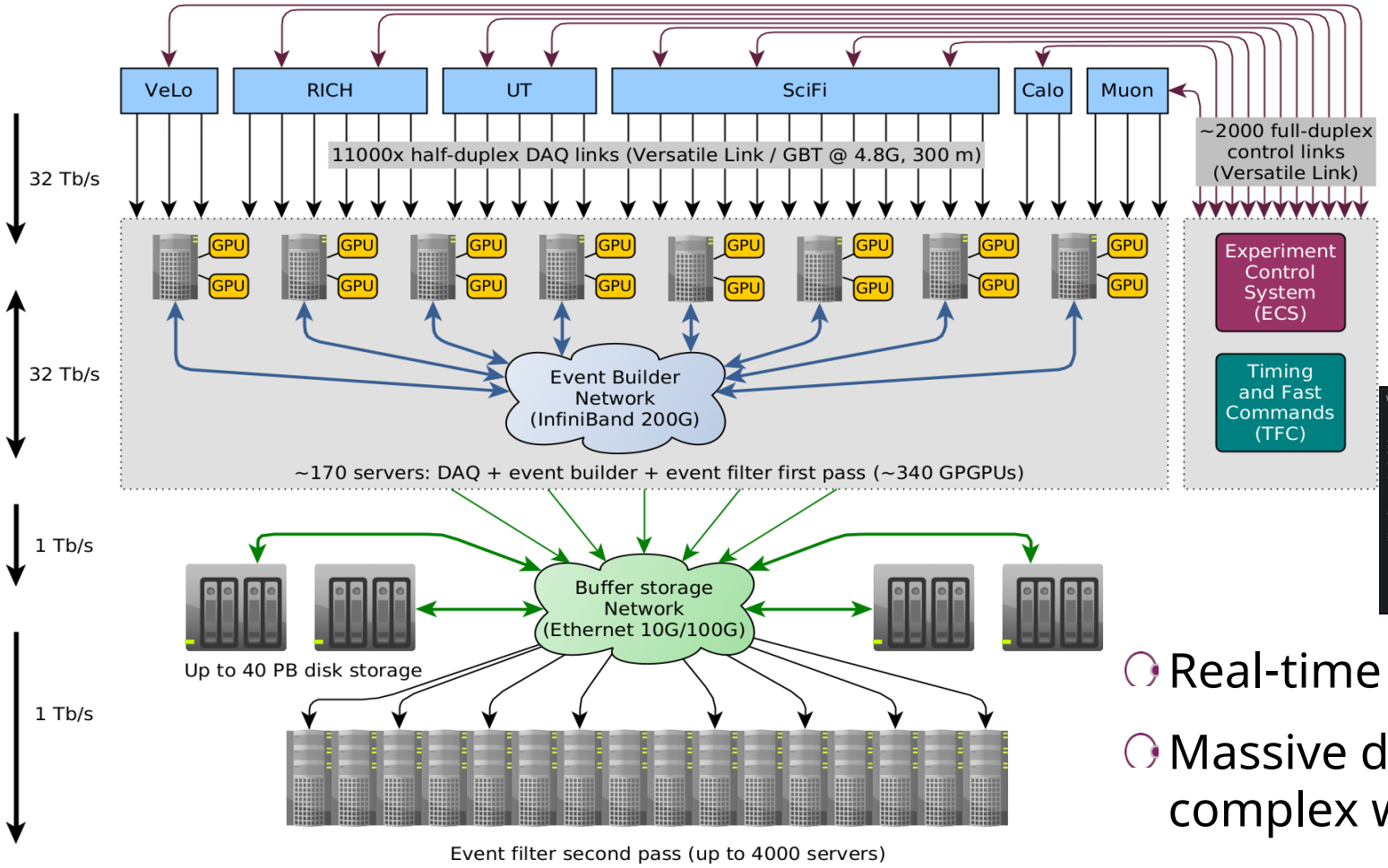


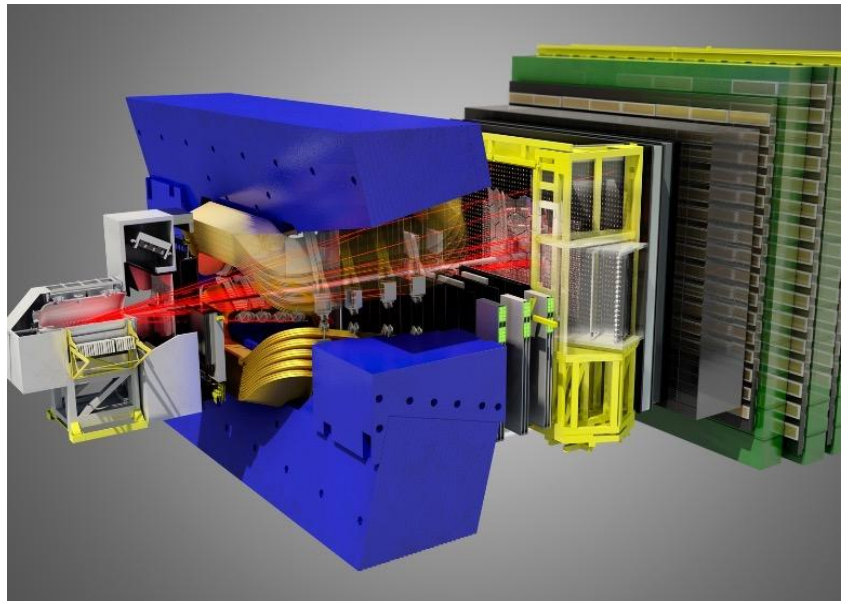


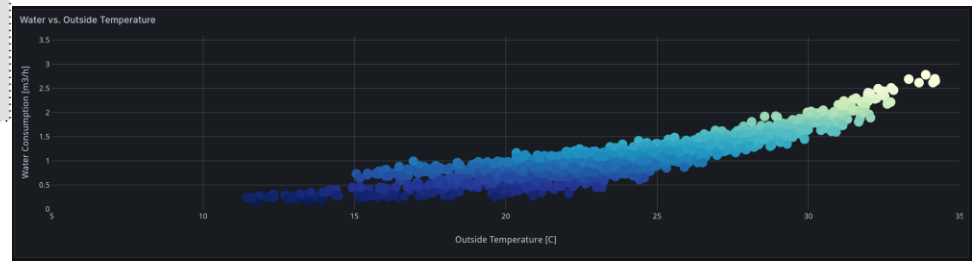
- Batch processing with deadline constraints
- Complex data processing with scalability issues

Use-cases overview (II)

High Energy Physics

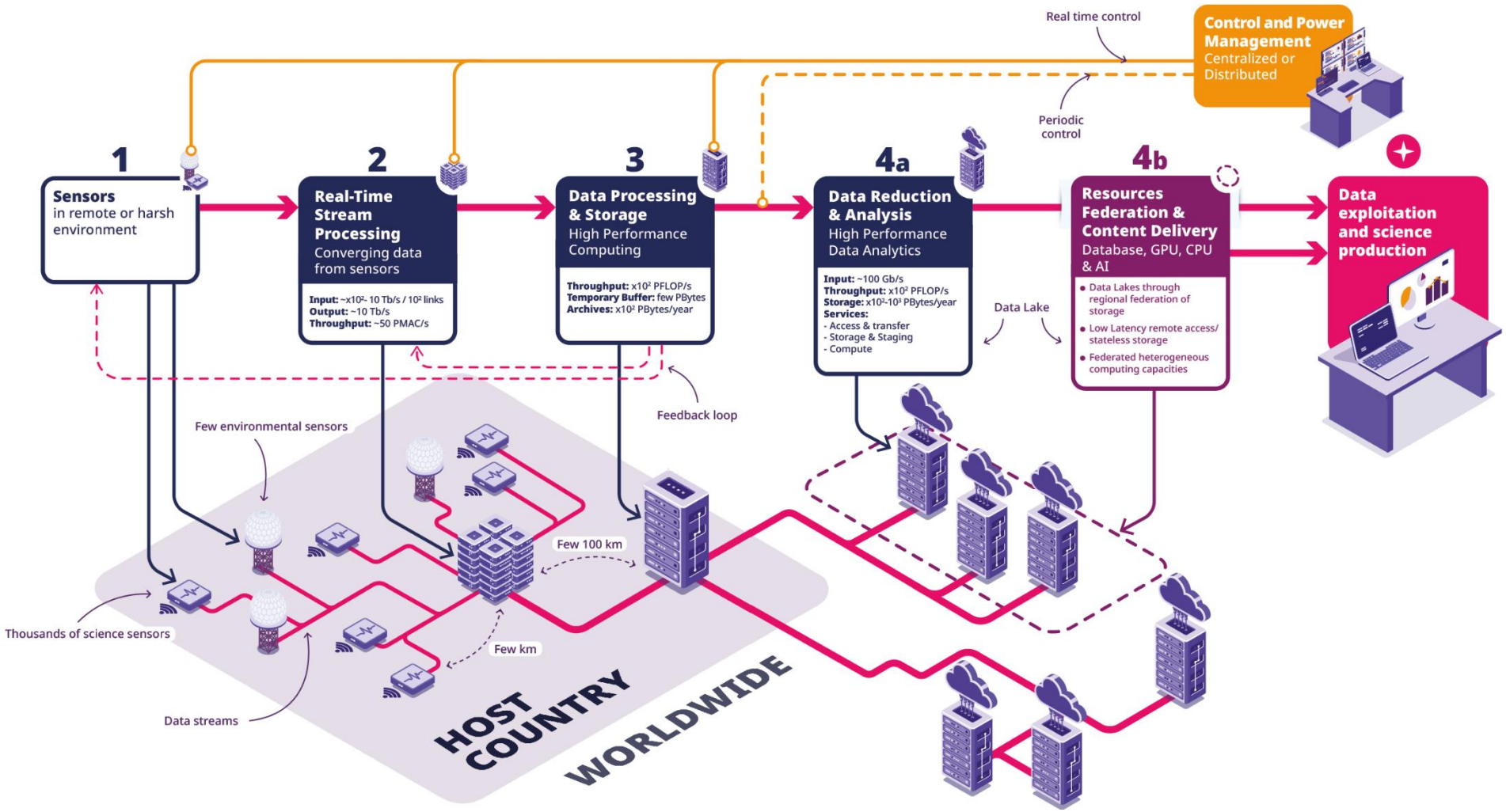






- Real-time classification for triggering
- Massive data volumes + need for more complex workflows (new physics)

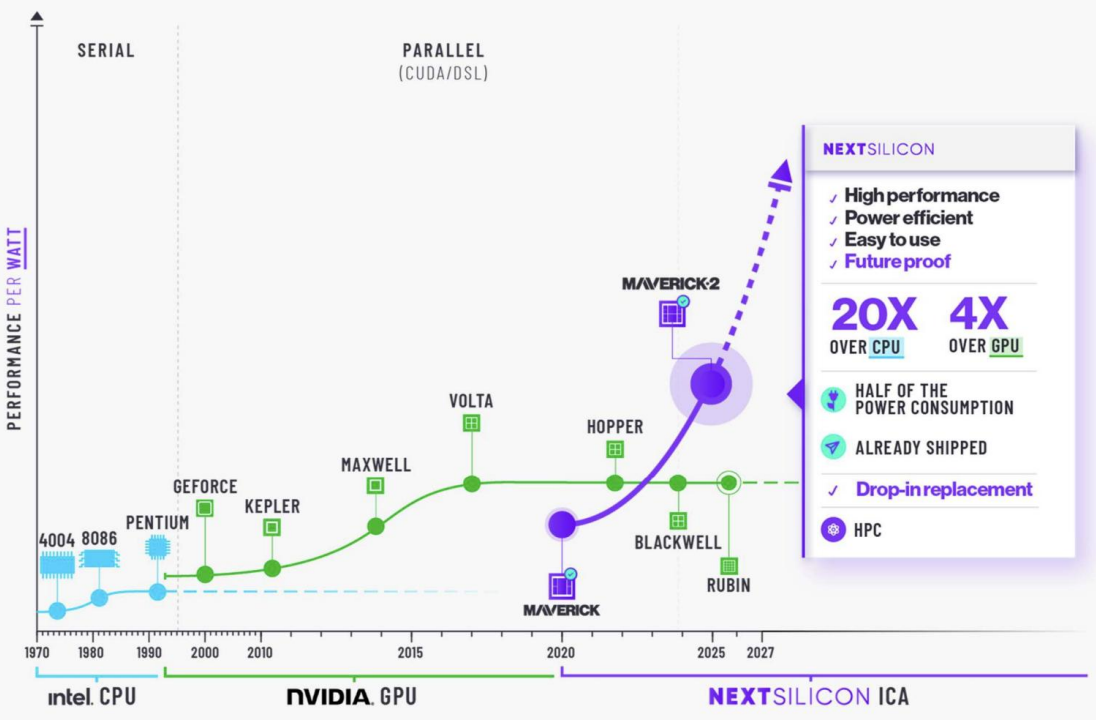
Key Objective: Address multiple challenges across the continuum



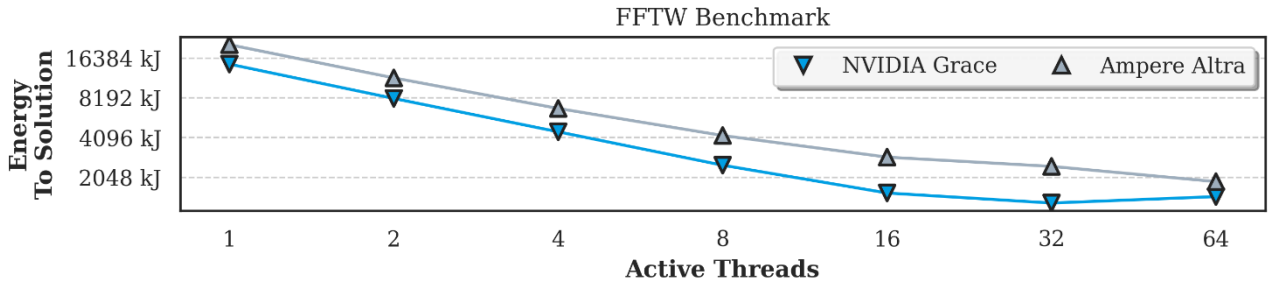
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PoC hardware demonstrations

- Multiple hardware solutions are being tested with energy profiling as a KPI



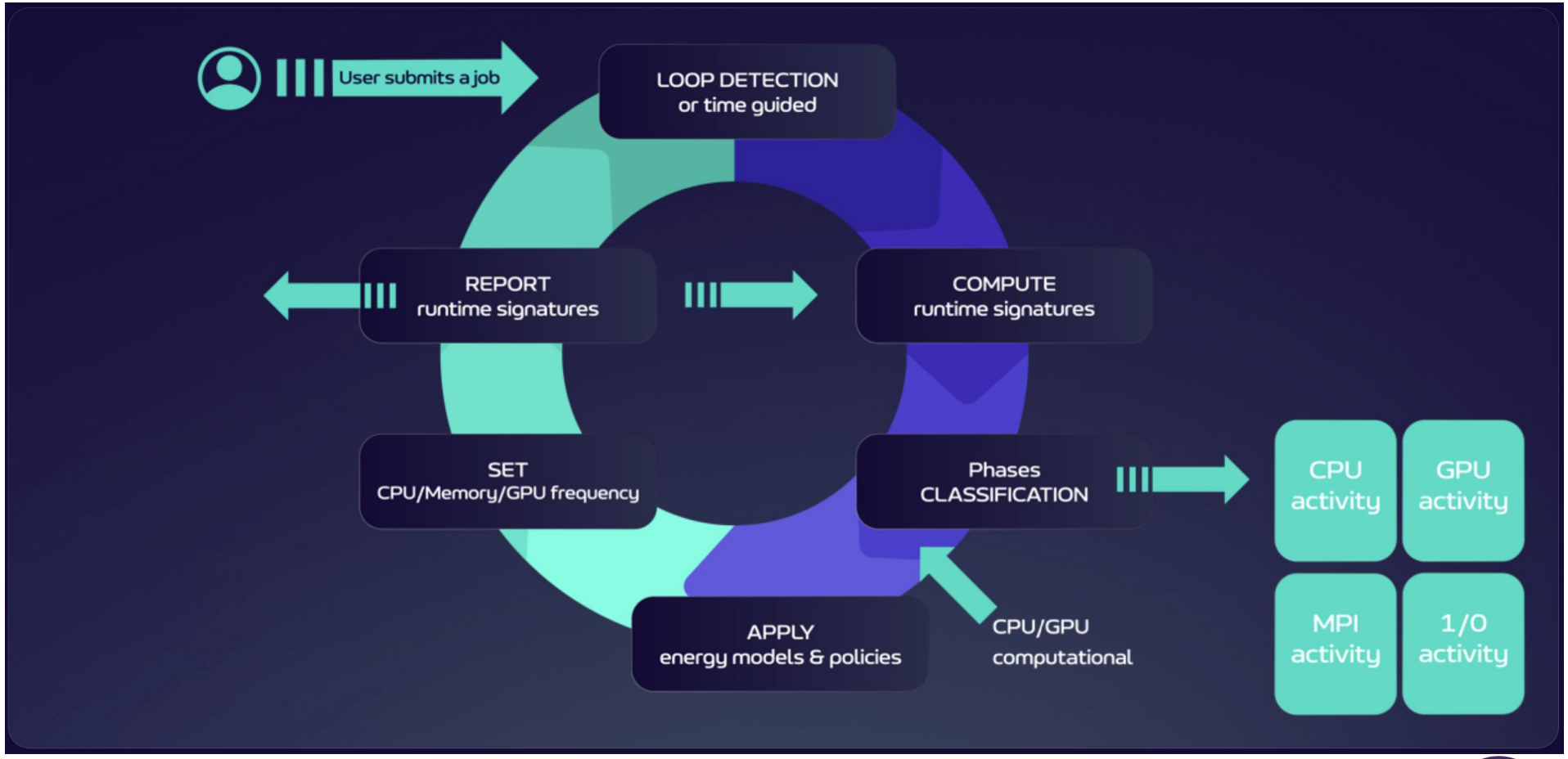




PoC hardware demonstrations

energy aware runtime
More Performance per Watt

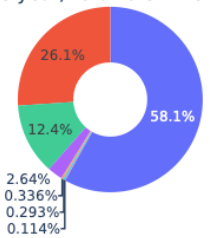
- Using a EU solution for energy monitoring and optimization



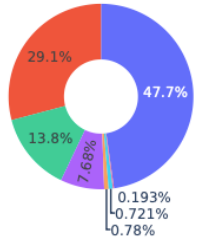
Assessment of sustainability goals

- Financial + environmental impact
- Human capital & capacity building
- Anomaly detection + predictive maintenance strategy

time: 466.9 node-year, Total idle time: 164.3 node-year

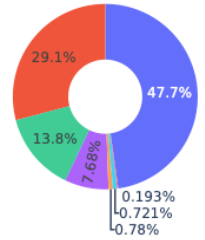


energy usage: 367469.4 kWh = 137.4 household yearly elect consumption

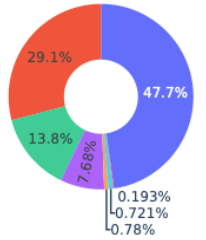


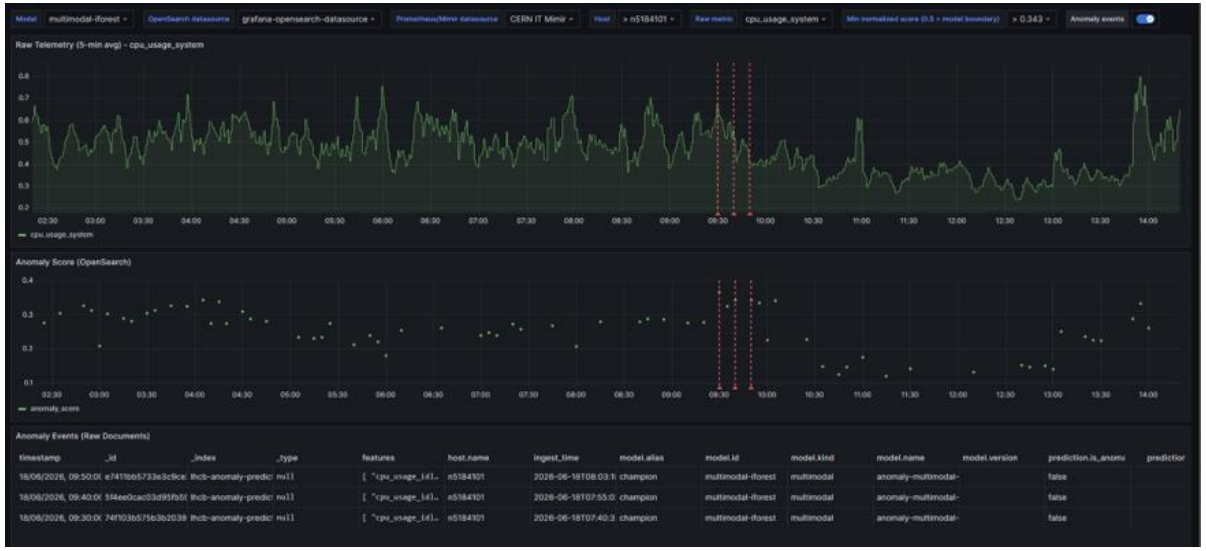


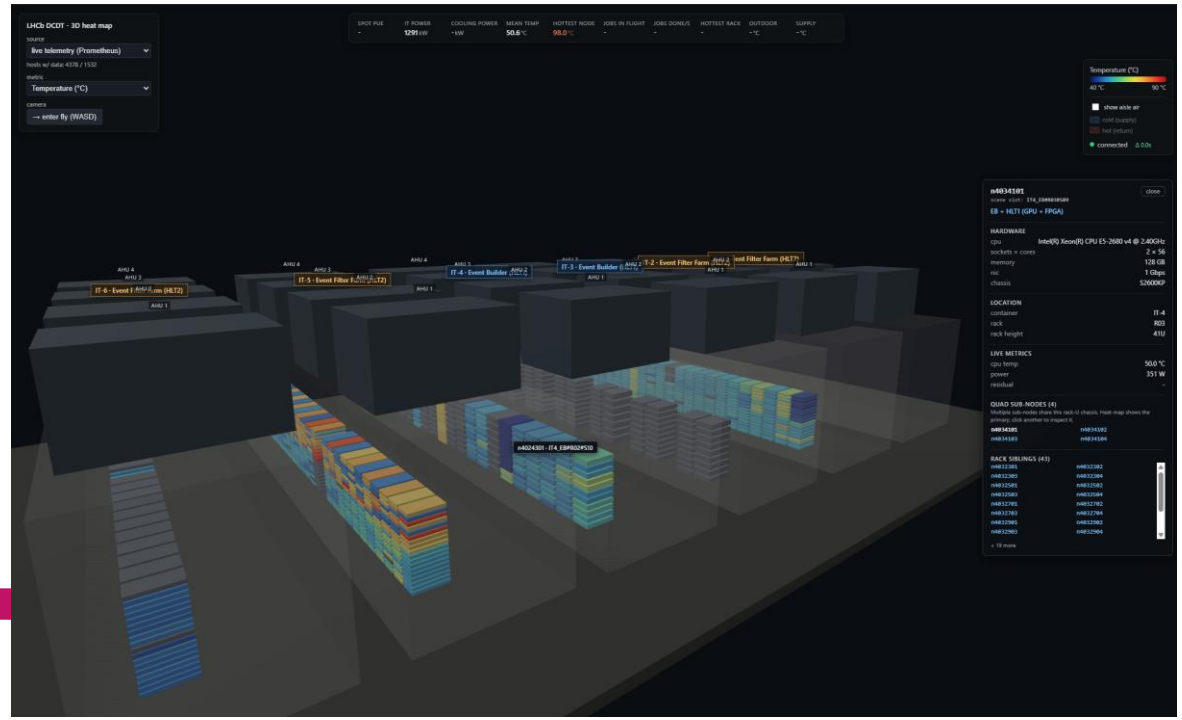
financial cost: 110240.8 Euro



CO2 emission: 99216.7 Kg







Radio-interferometric imaging

Overall workflow

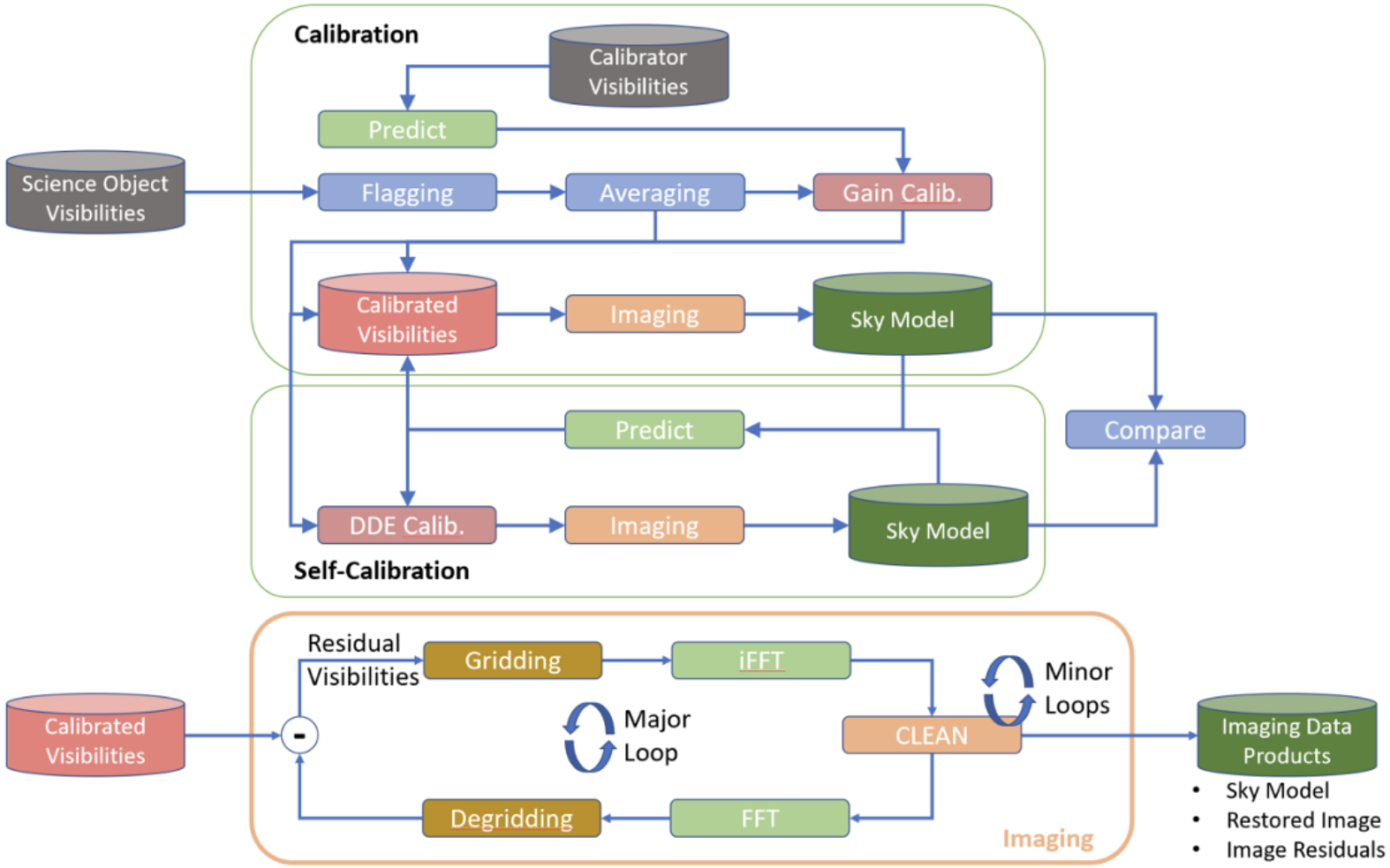


Figure 3 Typical full calibration + imaging pipeline for radio-interferometers. The imaging module within the full pipeline is detailed on the bottom part.

Radio-interferometric imaging

- **Simplified self-contained streaming experiment**

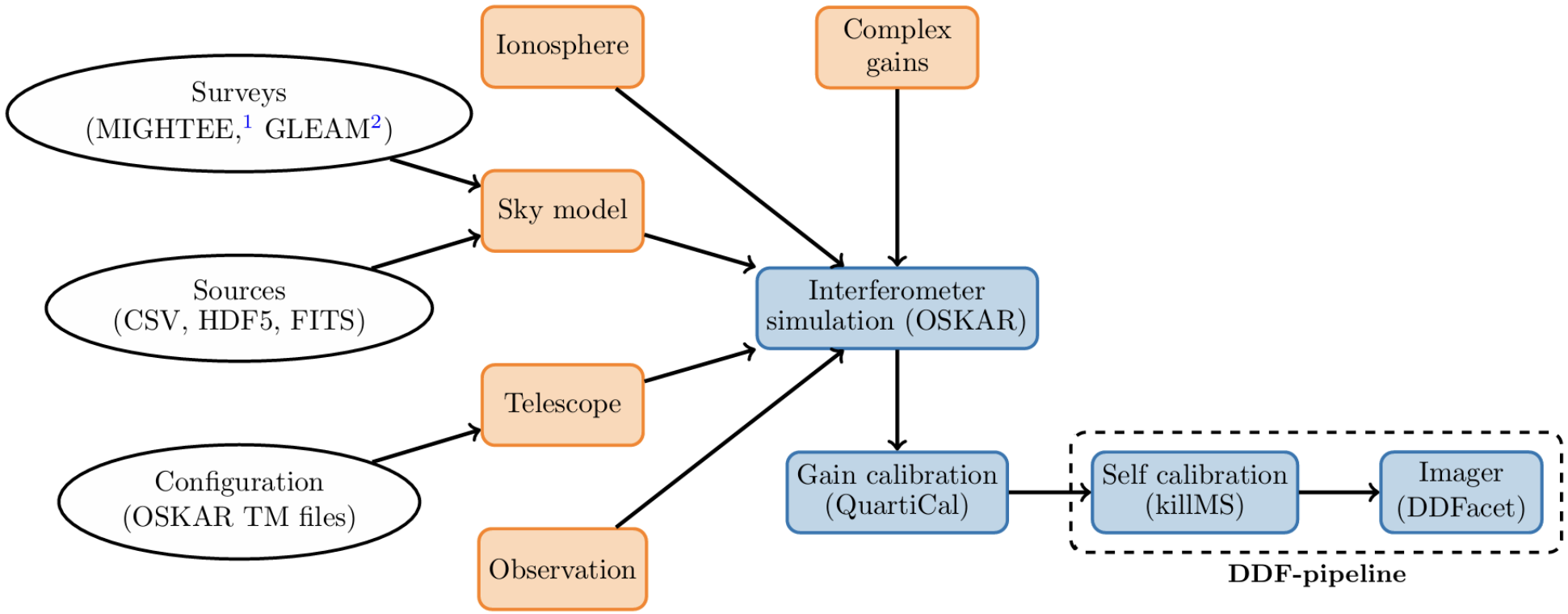


Figure 1: Workflow.

Radio-interferometric imaging

Large scale simulations deployments

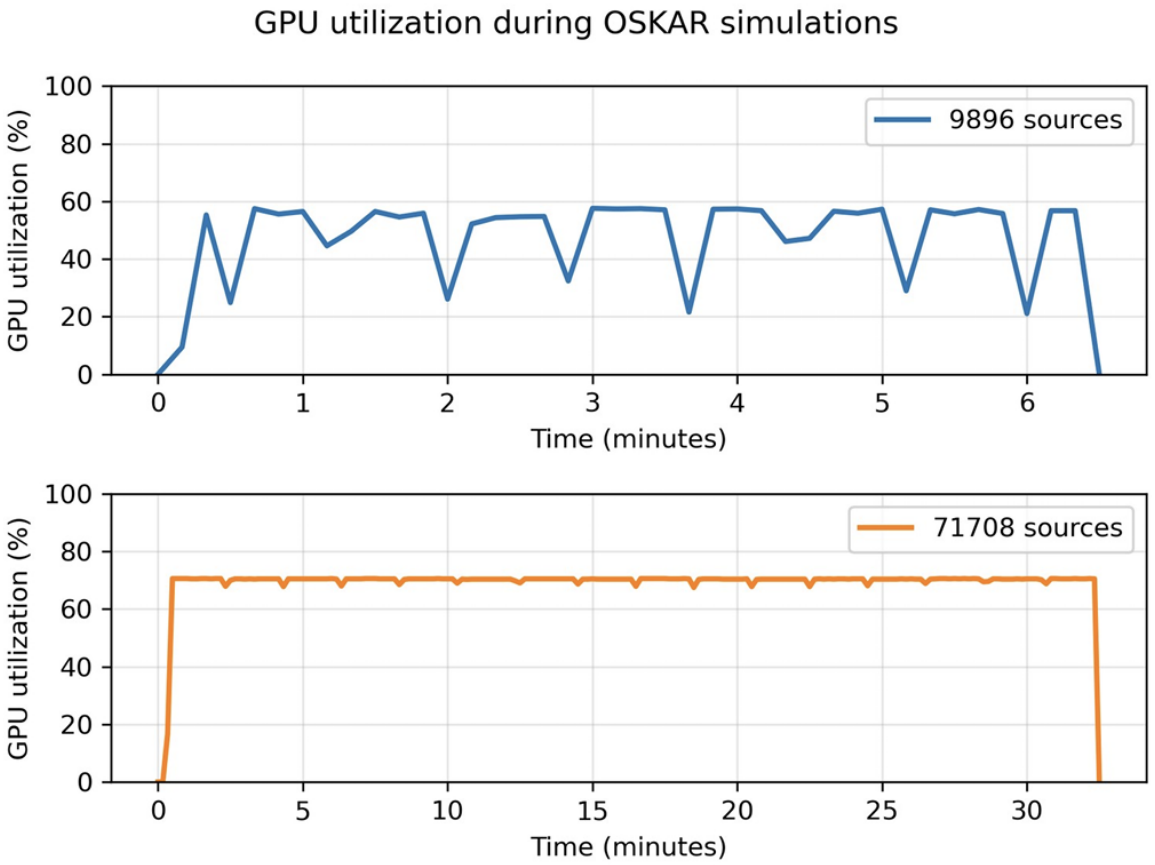
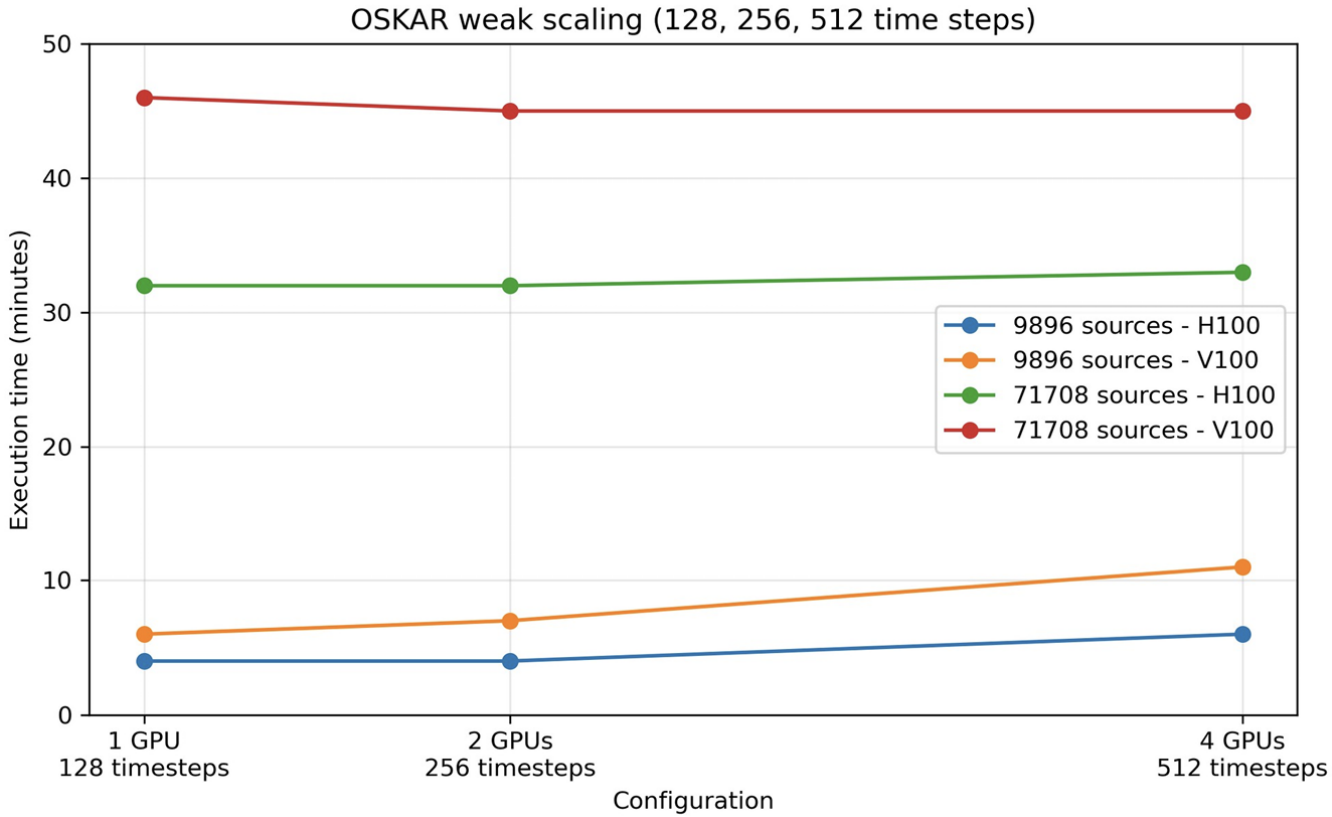


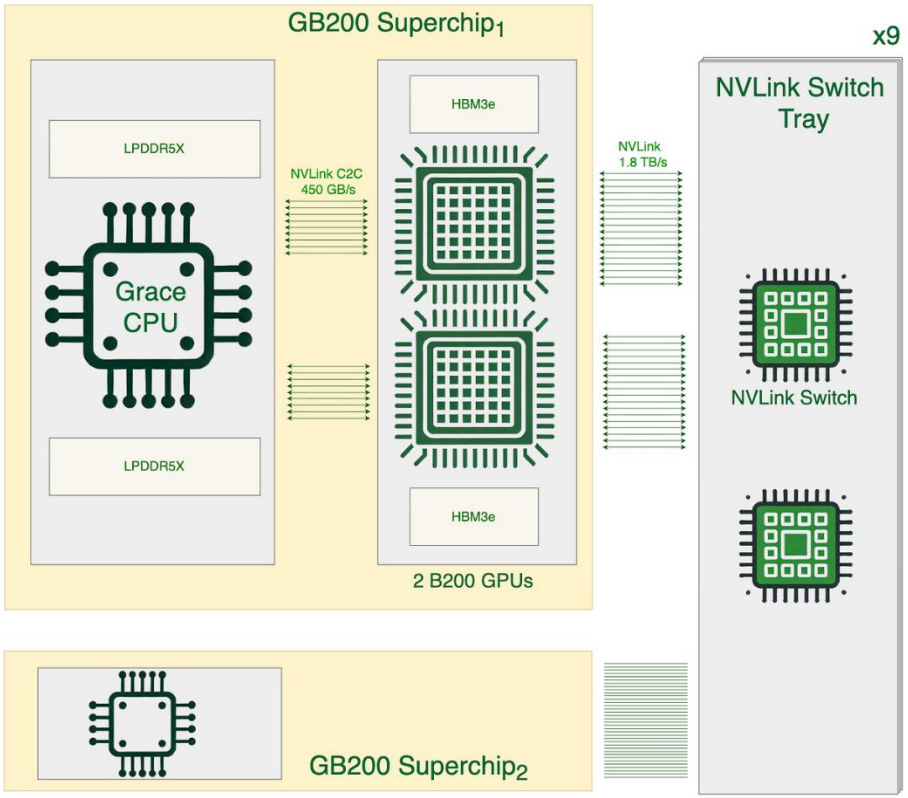
Figure 10 OSKAR H100 GPU utilisation



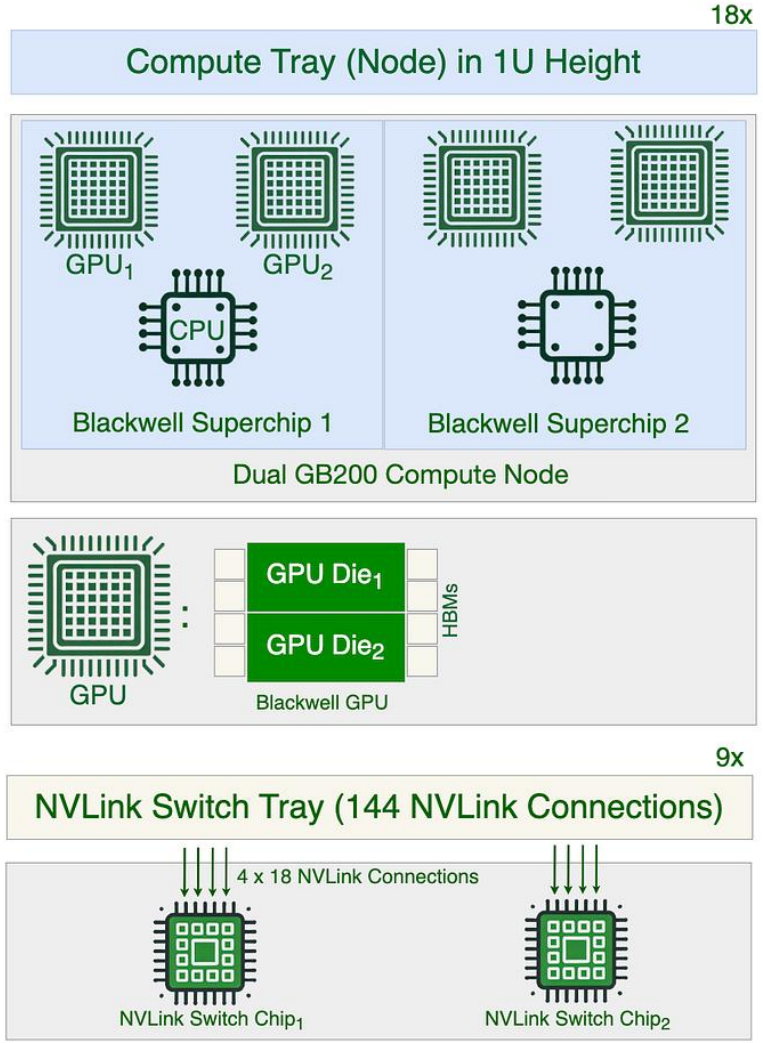
2 scenes with 9k and 71k sources and various numbers of frequency channels

One of our target testbeds

- **Dalia supercomputer: NVIDIA GB200 NVL72**







Radio-interferometric imaging

- **Overall imaging workflow deployment on Jean Zay (CPU only)**

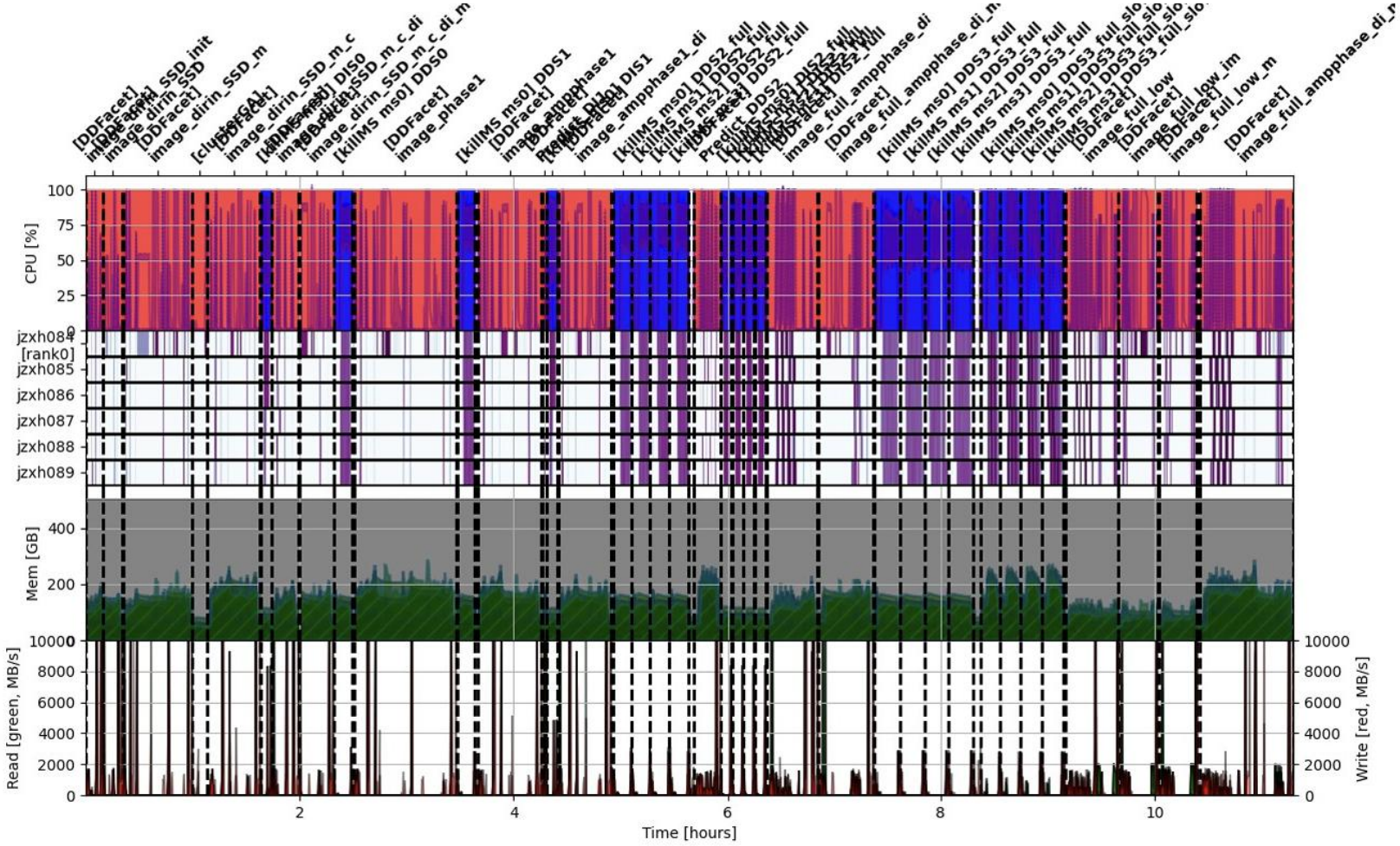
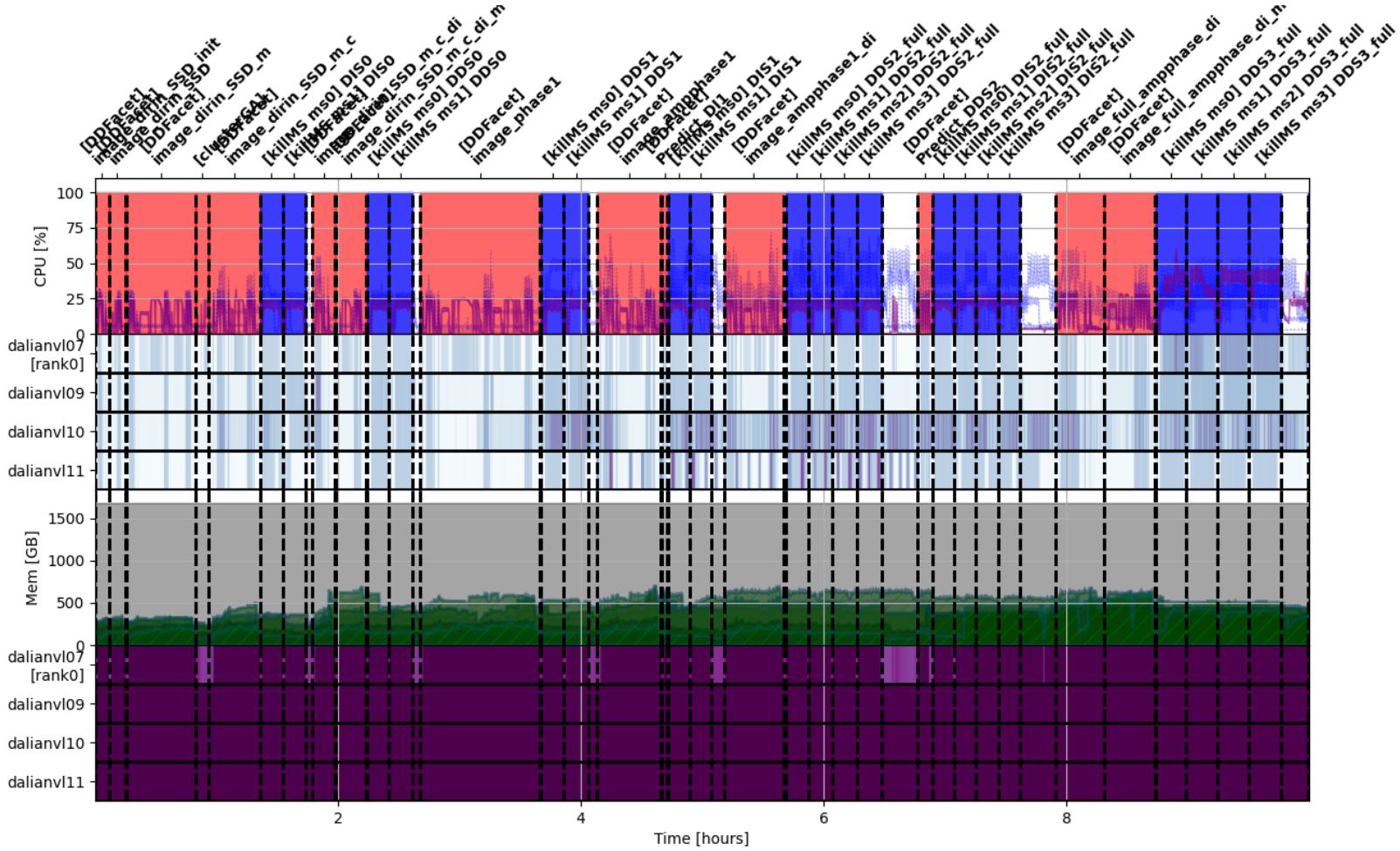


Figure 21 Execution profile of DDF-pipeline on 6 nodes of Jean Zay on a LoTSS dataset of 24 MS file representing 8h of observation with LOFAR.

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Radio-interferometric imaging

Overall imaging workflow deployment on Dalia (CPU only)



Radio-interferometric imaging

Optimizing imaging components on GPUs

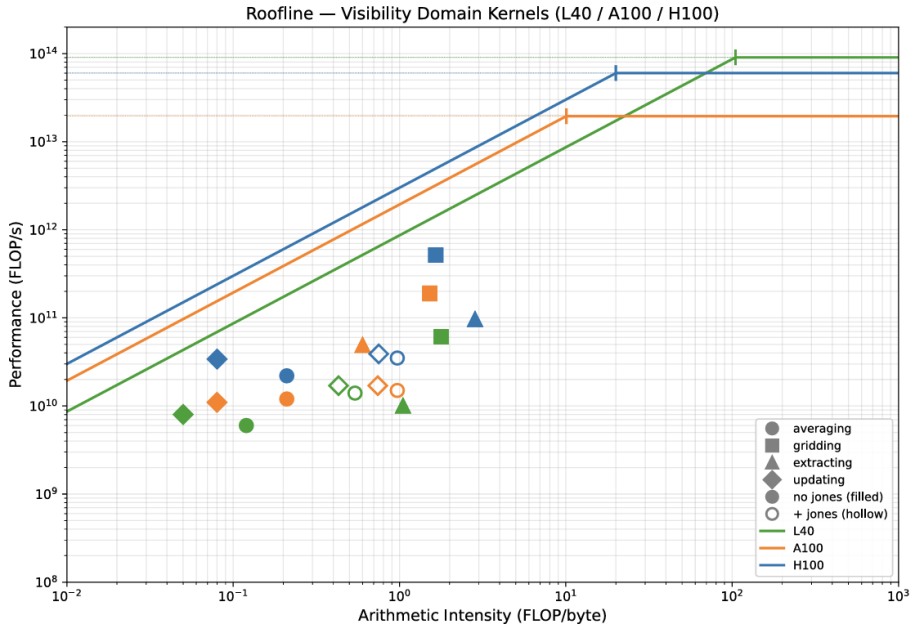
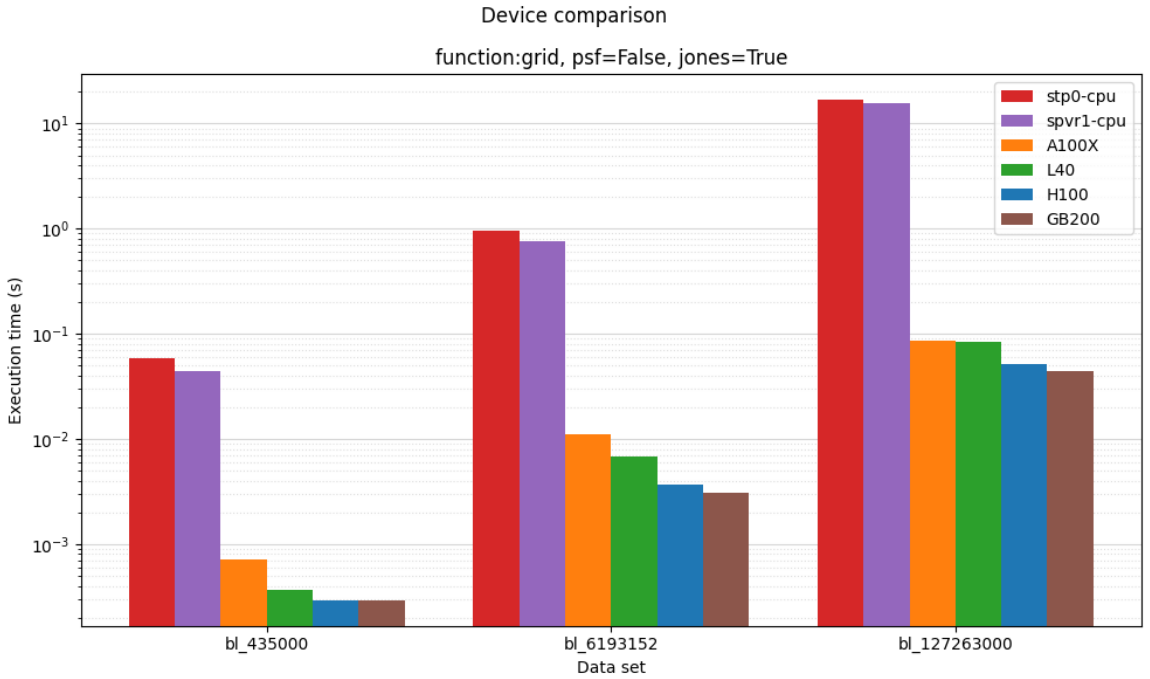
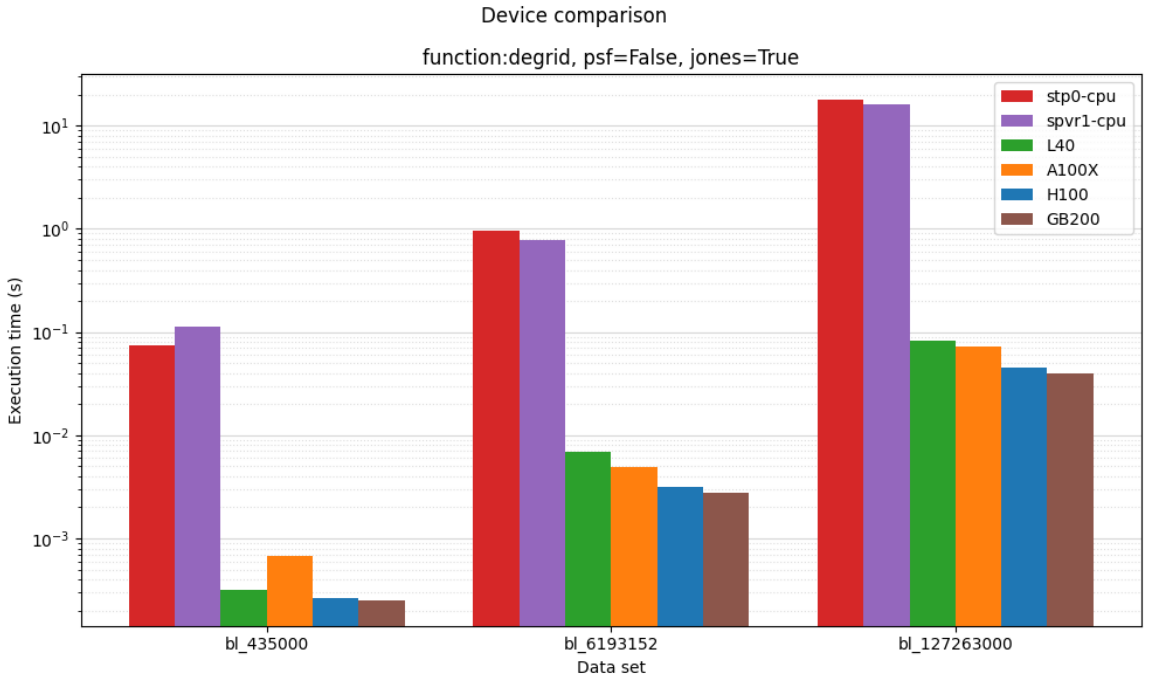


Figure 5. Roofline model of the kernels of gridding and degridding: averaging (circle), gridding (square) extracting (triangle) and updating (diamond) on L40(green), A100X (orange) and H100 (blue)





Radio-interferometric imaging

Optimizing imaging on GPUs

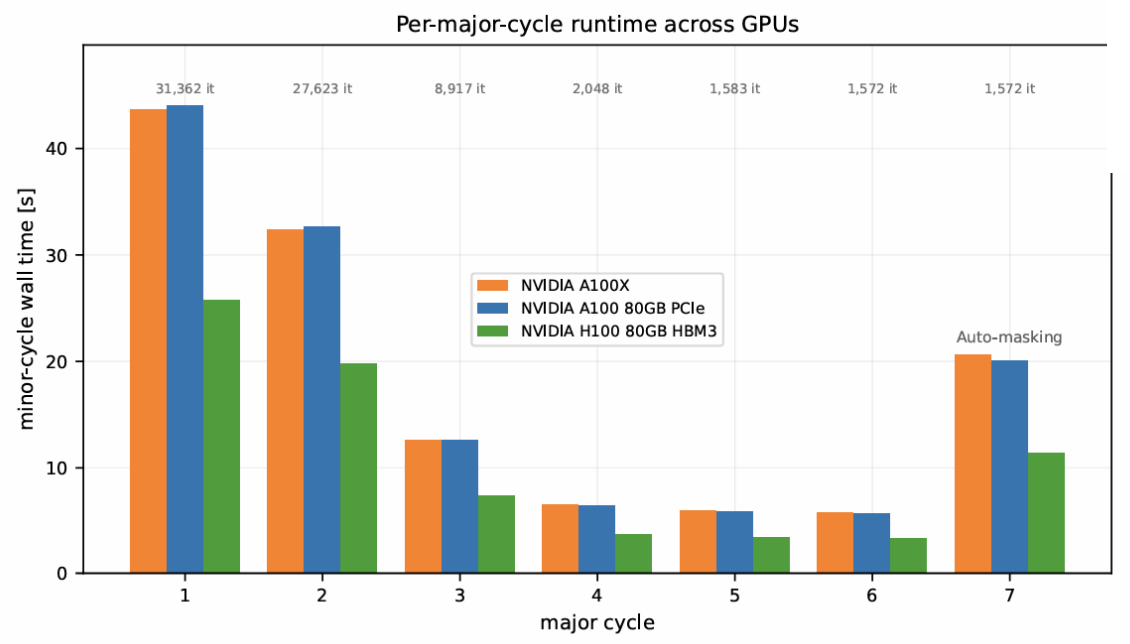


Figure 2. Per-major-cycle minor-loop wall time on the P282+00 field, grouped by major cycle with one bar per GPU. The minor-iteration count of each cycle is fixed by the data, so the spread is pure runtime: the H100 is the fastest at every cycle, and the A100 80GB PCIe and A100X run at nearly the same speed. The final cycle runs auto-masking (a full-image dilation/RMS/threshold pass), which costs more than its low iteration count alone would suggest.

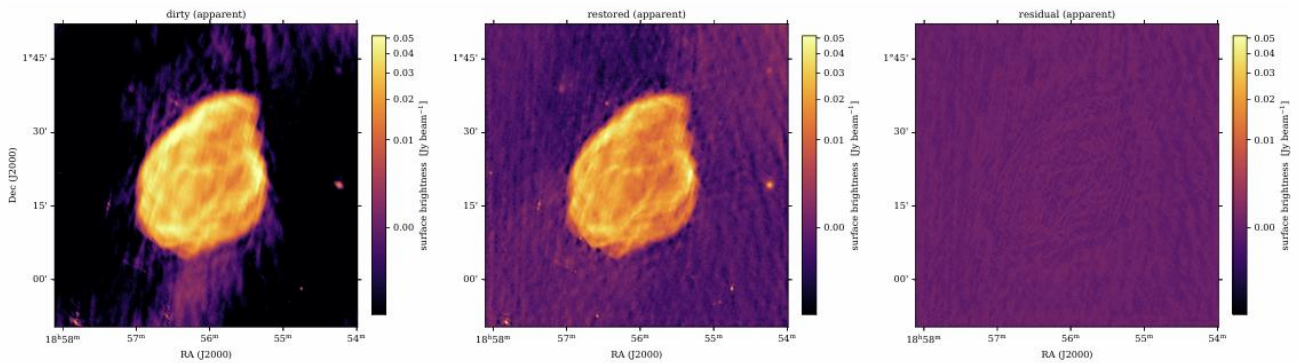
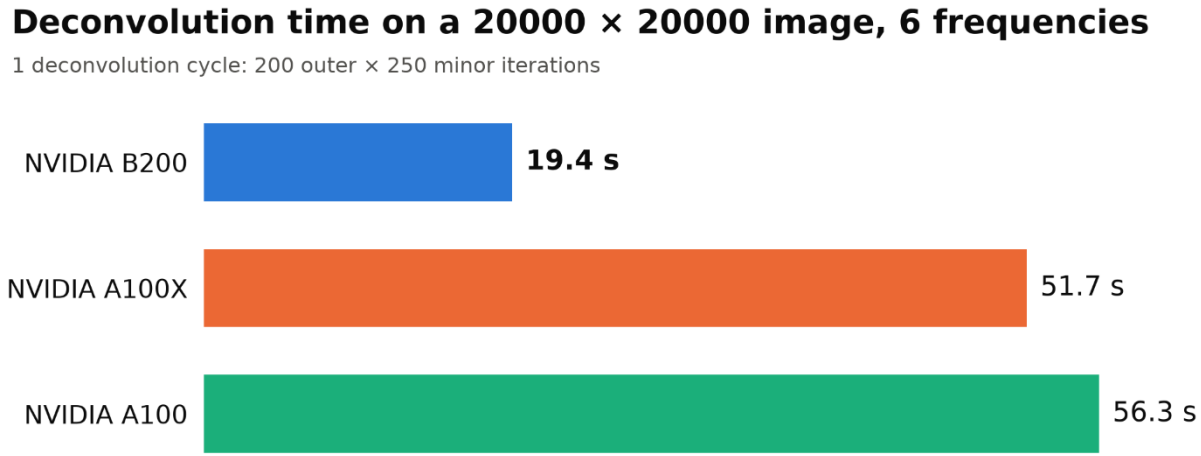


Figure 12. Deconvolution sequence on the P282+00 cut-out with tuned deconvolution parameters, on the apparent flux scale and a common color scale. Left: the dirty image, with the PSF sidelobe striping around the extended structure. Middle: the restored image, with the striping removed and the compact and extended emission recovered. Right: the residual image, dominated by noise.



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Radio-interferometric imaging

- **New deconvolution with DNNS**

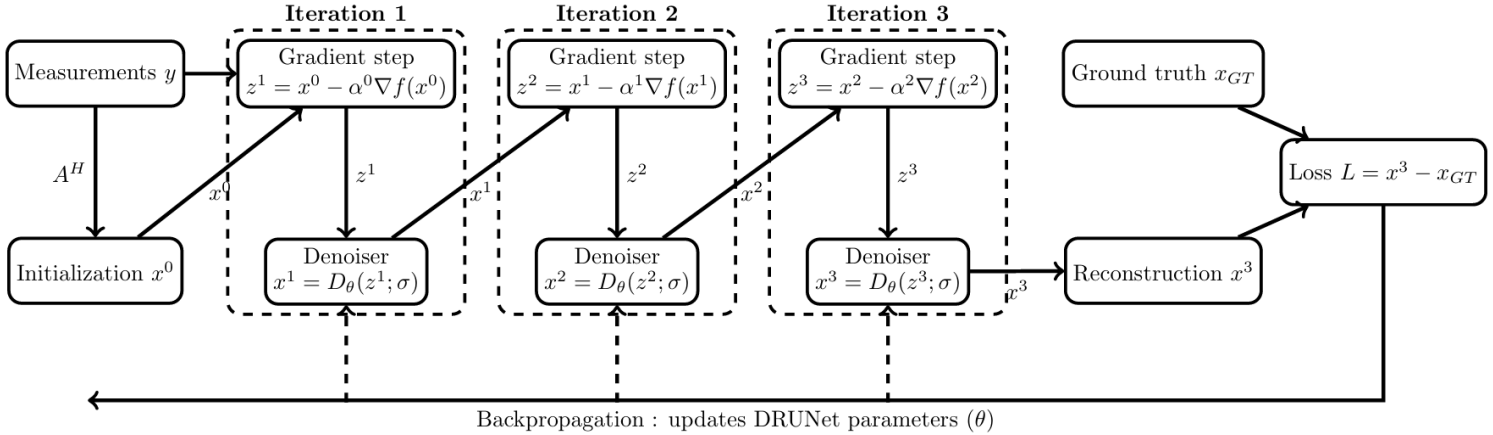
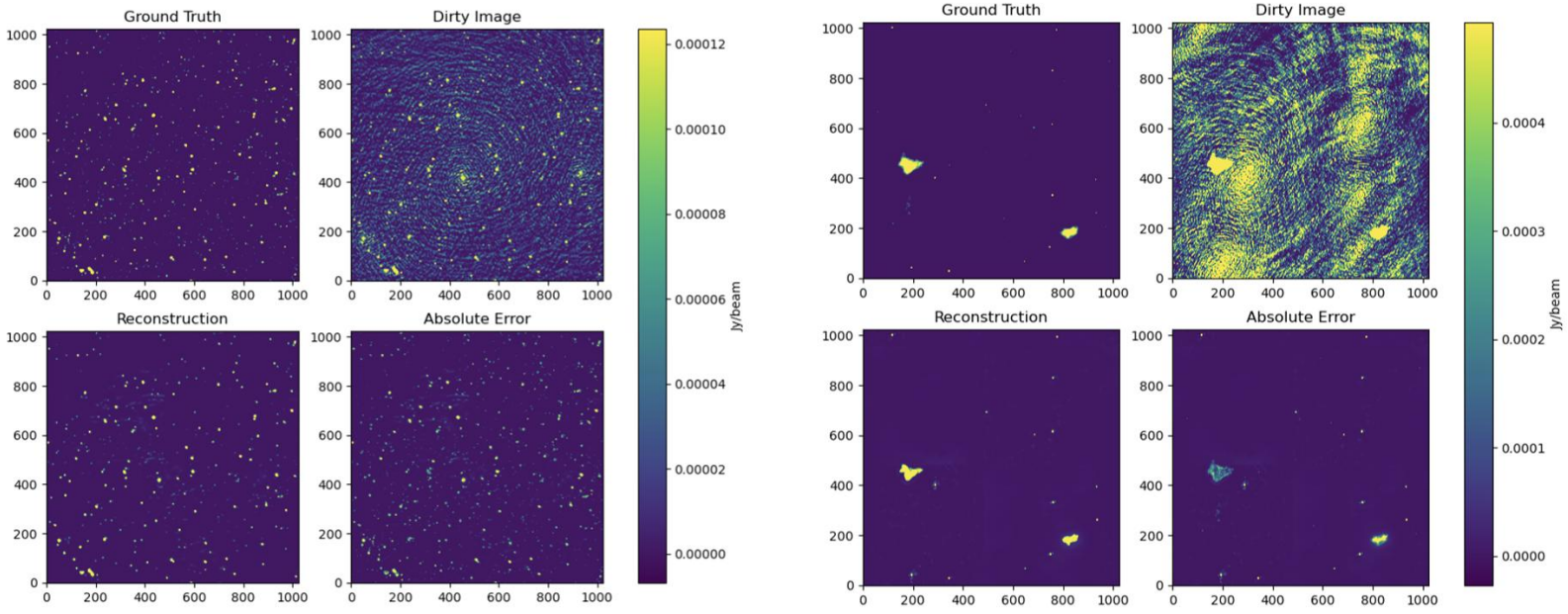


Figure 16: Unrolling.



(a) LoTSS data (b) Synthetic data

Figure 18: Unrolling results comparison on LoTSS and synthetic data.

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Following us …

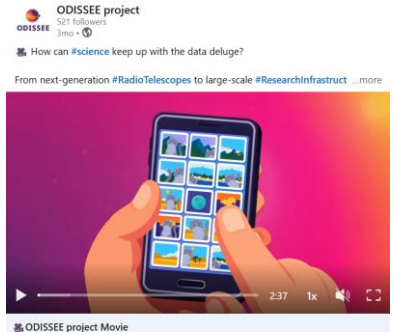
INTERVIEW WITH CHRIS BROEKEMA, SENIOR RESEARCHER IN HIGH-PERFORMANCE COMPUTING AT ASTRON

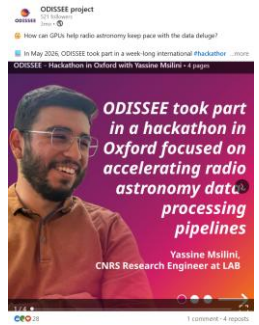
First ODISSEE hackathon, June 2026

Exploring sustainable computing for next-generation radio astronomy





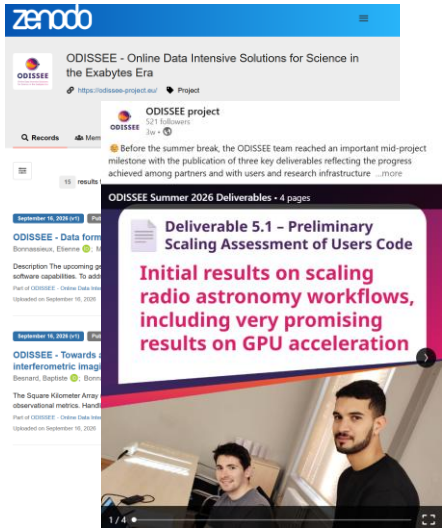


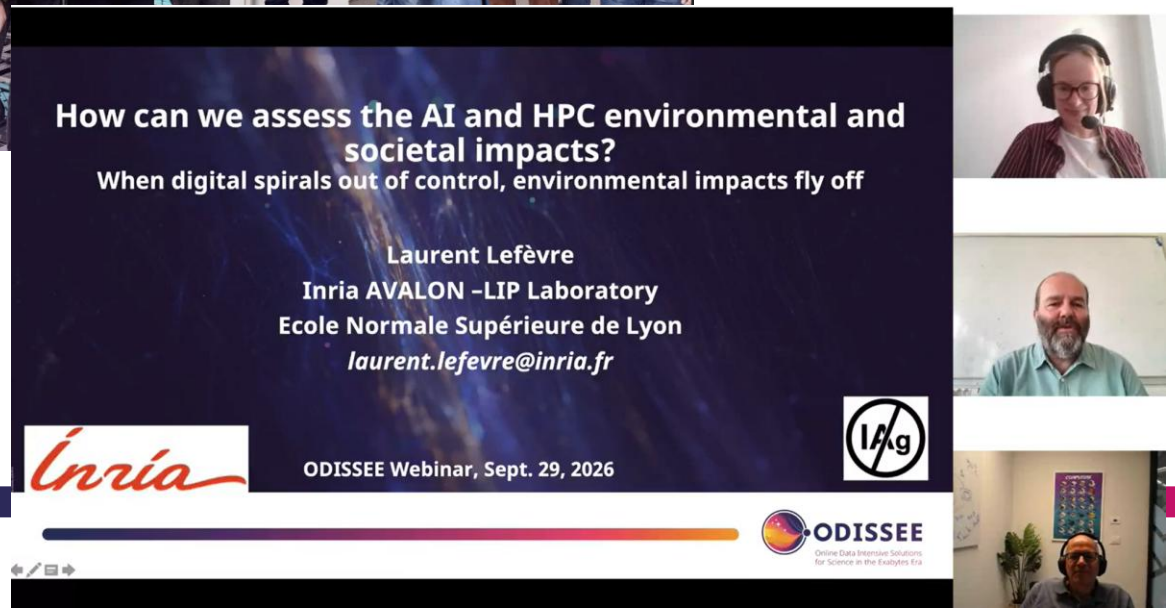




https://www.linkedin.com/company/106047693







https://odissee-project.eu/

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General project status

- First key demonstrations for both radio-astronomy and HEP at scale
- New AI-based reconstruction methods for both radio-astronomy imaging and HEP calorimetry
- Development a multi-tier energy monitoring framework
- EU technologies showcased through pilot experiments
- A production-level AI-based anomaly-detection system for CERN's LHCb data centre
- Quantified wasted energy in large-scale computing facilities including predictive models
- Accelerating developments through hackathons
- Skills gaps addressed through training focused on sustainability goals

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ODISSEE Project

Funded by the European Union