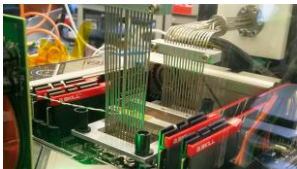


Physics Data Processing

Accelerating 'time to science' through computing and collaboration

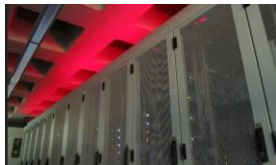
Algorithmic design patterns and software

- efficient software for (GPU) accelerators, new algorithms, high-performance processors
- data and processing pipelines



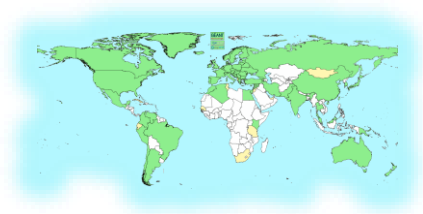
Infrastructure, network & systems co-design R&D

- co-design & development
- experimental technologies
- research *on* IT infrastructure
- building 'research IT facilities'



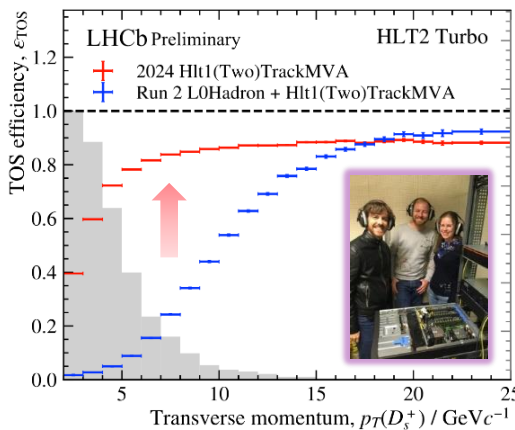
Infrastructure for trusted collaboration

- managing the complexity of collaboration mechanisms
- securing the infrastructure of our open science 'clouds'



Pushing computing boundaries, some examples

From single GPU demo to **500 node LHCb HLT1** makes tracking info directly available for classification



Now we get much higher efficiency (blue → red points) for e.g. $D(s) \rightarrow KK\pi$ charm physics

Nikhef Data Processing Facility in our federated Dutch e-Infrastructure: WLCG Dutch Tier 1, Auger, KM3NeT gravitational waves ... but also e.g. WeNMR structural biochemistry



Image sources: EOSC EU Node <https://open-science-cloud.ec.europa.eu/>; IGWN utilisation from OSG GRACIA <https://gracc.opensciencegrid.org/> and <https://edu.nl/tr79b>; LHCb HLT1: Roel Aaij (Nikhef), Daniel Campora (Nikhef & UM), Dorothea vom Bruch (LPNHE), photo: LPNHE; Run3 to Run2 comparison: <https://bfence.cern.ch/alc/public/figure/details/3837>; EOSC AAI Architecture: publications office of the European Union; AARC blueprint: <https://aarc-community.org/>; DNI: <https://www.nikhef.nl/pdp/doc/stats/>

Providing Security and Risk Management for the **European Open Science Cloud** “EU Node” core services (procured EC service, delivered with **EGI**)

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Manage your Research Workflows



Exchange with your Peers

and next-gen trust & identity for LSRLs with **AARC TREE** and **eduGAIN** security



Core Hours by Facility

IGWN GravWav jobs in 2024 (Q1-Q3)

unit: core-hours **total**



Dutch federated infrastructure both at Nikhef and SURF

INFN-T1	5 Mil
NIKHEF-ELPROD	4 Mil
UKI-SCOTGRID-GLASGOW	3 Mil
ComputeCanada - Cedar	3 Mil
PIC	3 Mil
MWT2 ATLAS UC	3 Mil
Albert Einstein Institute	3 Mil
SURFsara	2 Mil

PDP: accelerating ‘time to science’ through computing and collaboration

Nikhef

Our science data flows ... are somebody else's DDoS attack

Bandwidth for the HL-LHC, WLCG, and the trigger data streams can also 'exercise' our Dutch national critical infrastructure

The collage consists of three overlapping images. The top image is a screenshot of the Betalingsdienst website, showing a headline 'Ik heb een DDoS aanslag op mijn netwerk ontvangen - wat nu?' (I received a DDoS attack on my network - what now?). The bottom-left image is a screenshot of the Anti-DDoS-Coalitie website, displaying a list of member logos including NLIX, nederlandsche vereniging van banken, kpn, kadaster, SURF, POLITIE, SIDN, and others. The bottom-right image is a close-up of a presentation slide showing two large green semi-circular gauges labeled 'Bandbreedte' and 'Pakketjes' with values 'Tb/s' and 'Gp/s' respectively.

Image sources: [betalingsdienst.nl](https://www.betalingsdienst.nl), [rws.nl](https://www.rws.nl), [werkentegennederland.nl](https://www.werkentegennederland.nl), <https://www.nomoreddos.org/deelnemers/>

Jumping over our computing boundaries

Efficient and accelerated computing

- **accelerators**, such as GPU- and hybrid-computing
 - *extending its scope to last trigger stage, to off-line processing and to analysis*
- more **machine learning**, for tracking and physics event classification
- **efficient architectures**: ARM systems (with our SURF Experimental Platform)
- exploration of **quantum computing**, for future gains in algorithmic complexity

Networking, both physical link and collaborative networks

- network bandwidths **over 800 Gbps to CERN**, and to more destinations
- evolving and **aligning global collaboration** technologies (unified tokens): authentication & authorization for WLCG, Gravitational Waves, SKA, DUNE, ... and the European Open Science Cloud

Open Science at scale, with data for today's and tomorrow's science

- new forms of service delivery with **Analysis Facilities** and 'data lakes'
- **practical Open Science** for data-intensive systems (with 4TU.RD/TU Delft)
 - with a new Institutional Data Repository using Djehuty open source software, **linked to our local analysis facility**, adding re-usable science software

LLM service: <https://plofkip.nikhef.nl/chat>, services: kb.nikhef.nl/ct, AmpereOne SURF ETP ARM experimental platform pauperbak.nikhef.nl; scatter plot shows compute time per event estimated for ATLAS at the HL-LHC with the current processing model (from: FASTER ENW-XL); Djehuty open source Data repository: archive.nikhef.nl, data.4tu.nl, Catharina Vaendel (Nikhef) and Roel Jansen et al. (TU Delft).

