



Roadmap ICT netwerk & informatie event

LHC UPGRADE & *THE DATA INFRASTRUCTURE*

David Groep
Nikhef
April 2019

NIKHEF – THE NATIONAL INSTITUTE FOR SUBATOMIC PHYSICS

The mission of the National Institute for Subatomic Physics Nikhef is to study the interactions and structure of all elementary particles and fields at the smallest distance scale and the highest attainable energy.

Two complementary approaches are followed:

- Accelerator-based particle physics – Studying interactions in particle collision processes at particle accelerators, in particular at CERN;
- Astroparticle physics – Studying interactions of particles and radiation emanating from the Universe.

Nikhef coordinates and leads the Dutch experimental activities in these fields. The research at Nikhef relies on the development of innovative technologies.

The knowledge and technology transfer to third parties, i.e., industry, civil society and general public, is an integral part of Nikhef's mission.

Vaste wetenschappelijke staf	80
Promovendi en postdocs	125
Technische en engineering staf	75
Ondersteunende staf	25

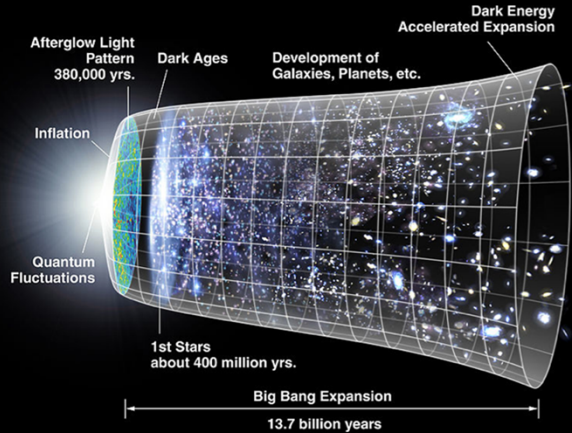
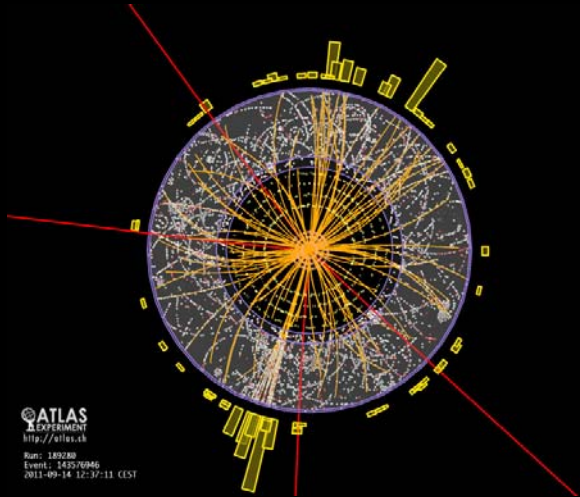
LHC Upgrade and the Data Infrastructure



COMPLEMENTARY PROGRAMMES

LHC increased luminosity –
can we see beyond the standard model?

Astroparticle physics –
gravitational waves, neutrinos,
cosmics rays and search for dark matter



NIKHEF AT THE LHC

ATLAS

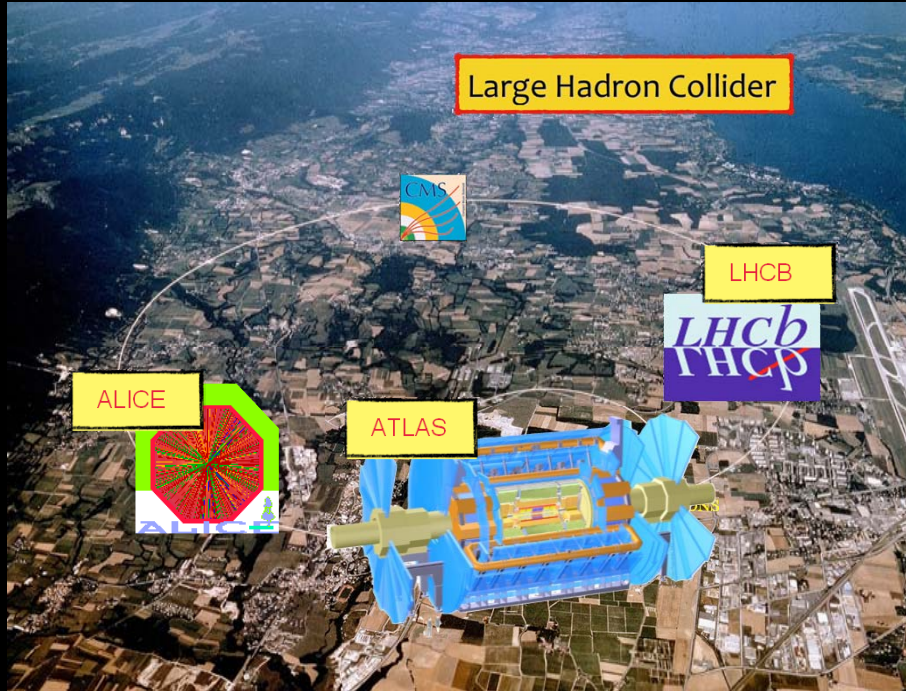
- Higgs physics
- Beyond the standard model

LHCb

- rare decays
- matter vs anti-matter

Alice

- quark-gluon plasma
- matter phase transitions



ASTRO-PARTICLE PHYSICS

KM3NET

- neutrino telescope

Virgo/LIGO, towards the Einstein Telescope

- gravitational waves

Auger

- ultra-high energy cosmic rays

Xenon

- search for dark matter

PIERRE AUGER - COSMIC RAYS



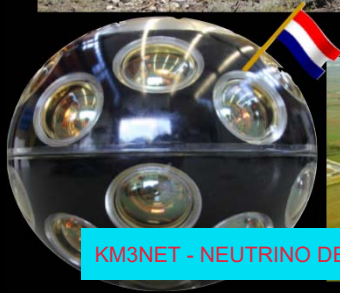
XENON1T - DARK MATTER



ADV VIRGO - GRAVITATIONAL WAVES

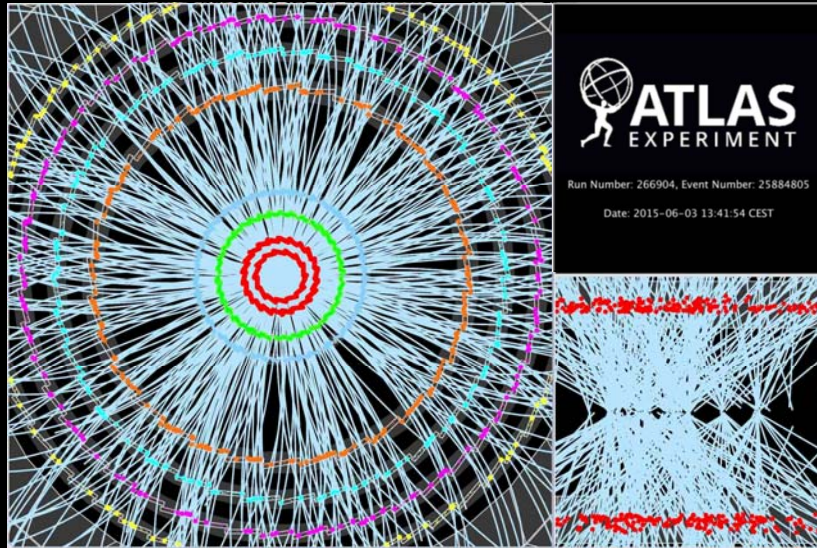


KM3NET - NEUTRINO DETECTION



COMPUTING: FOR THE LHC AND MORE

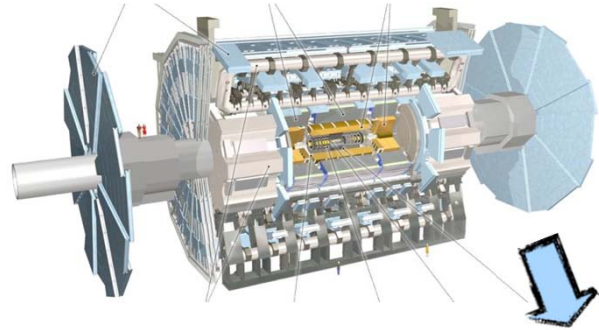
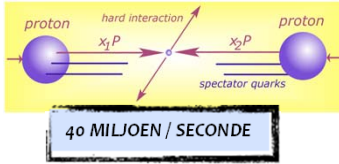
~ 10 seconds to compute a *single event* at ATLAS for 'jets' containing ~30 collisions



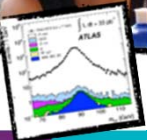
DISPLAY OF A PROTON-PROTON COLLISION EVENT RECORDED BY ATLAS ON 3 JUNE 2015, WITH THE FIRST LHC STABLE BEAMS AT A COLLISION ENERGY OF 13 TEV

EVENT PROCESSING TIME: V19.0.1.1 AS PER JOVAN MITREVSKI AND 2015 J. PHYS.: CONF. SER. 664 072034 (CHEP2015)

DATA FLOW AT THE LHC



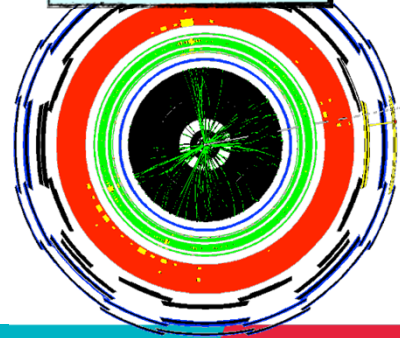
ANALYSIS OF RESULTS BY
STAFF AND PHD STUDENTS



DATA DISTRIBUTION IN
THE NATIONAL AND GLOBAL
E-INFRASTRUCTURES



FILTERING AT SOURCE SELECTS
~ 600 HZ, SO ~ 1 GB/S DATA

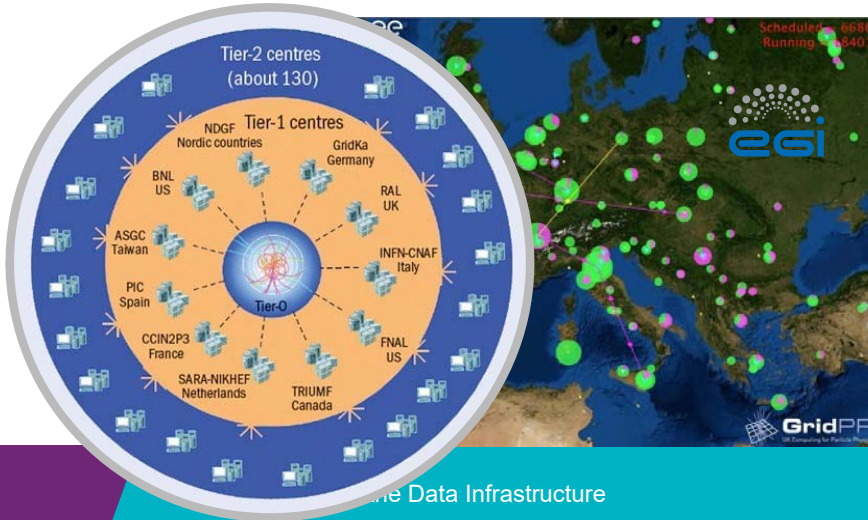


COMPUTING – THE NETHERLANDS TIER-1

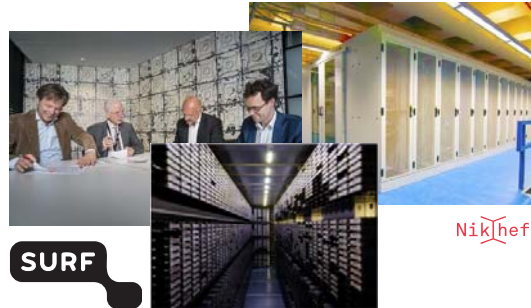
for the ‘Worldwide LHC Computing Grid (WLCG)’

the *Dutch National e-Infrastructure* provides the NL Tier-1 *as a service* to WLCG

→ the LHC NL Tier-1 is *jointly operated* by the DNI partners, and coordinated by SURF



but this did not just happen by chance



STRONGER TOGETHER – BIG GRID



BiG Grid (2005, 2007-2012)

from data processing 'project' to
a national e-Infrastructure

- all in this together: Nikhef, NWO, NBIC
- solve common challenges
- invest in both hardware and peopleware

BiG Grid Mission:

To realise a national 'world class' ICT infrastructure for scientific research such as particle physics, life sciences and other sciences, including a variety of hardware facilities to enable e-Science.

Dutch National e-Infrastructure (2013-) coordinated by SURF

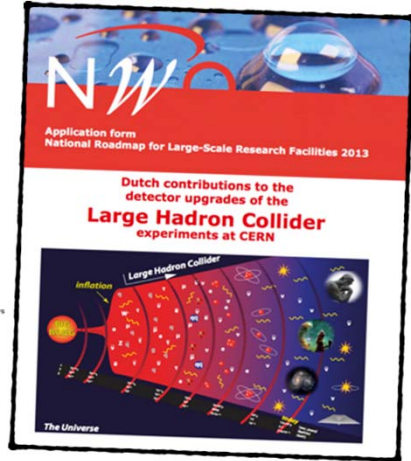
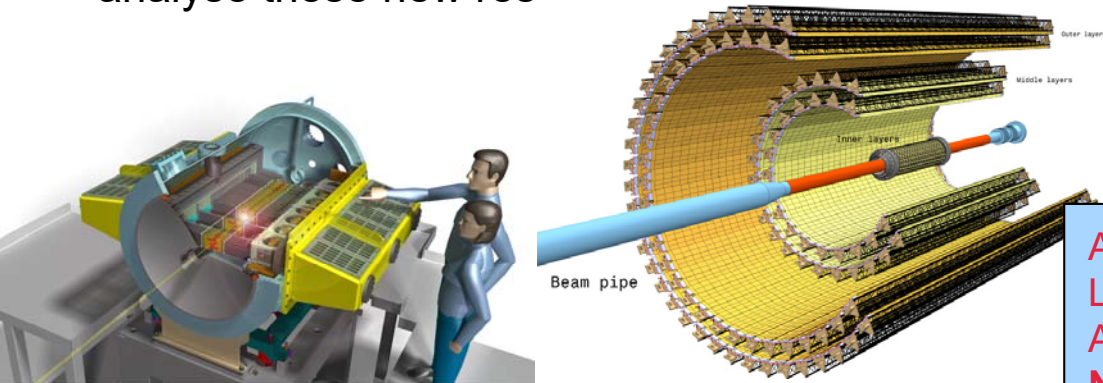
- national collaboration brings great results
- ensure continuation of BiG Grid success
- more effective and cost-efficient,
and of ensured quality



THE LHC DETECTOR UPGRADES ROADMAP (2014)

National roadmap 2014: invest ~15.2M€ in

- upgrade of the LHC detectors for new discovery potential
- enable the computing infrastructure to analyse these new results



ATLAS:	5.2 M€
LHCb	4.0 M€
ALICE	2.3 M€
NL-Tier1	3.7 M€
(for 5 years)	

COMPUTING IS PART OF THE INFRASTRUCTURE

National Roadmap for Large-Scale Research Facilities

Total costs of the Facility	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Construction (incl. 2014-2023)	130	240	450	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Operating costs (incl. 2014-2023)	500	1,000	1,500	2,000	2,500	3,000	3,500	4,000	4,500	5,000	5,500
Researcher support (incl. 2014-2023)	100	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Other (incl. 2014-2023)	500	1,500	2,000	2,500	3,000	3,500	4,000	4,500	5,000	5,500	6,000
Total (incl. 2014-2023)	1,230	2,740	3,950	6,500	7,500	8,500	9,500	10,500	11,500	12,500	13,500

General information
Research proposal
Timeline
Decision/Signature

Requested computing investment
6 M€ for 10 years (2014 - 2023)

- CPU
- Storage
- Networking equipment

Commission reduced computing term to 5 years (and only 3,7 M€) – but then: “We’ll be back”

Our own contribution:

- Operations personnel (~ 4 fte/yr)
- Housing (Nikhef datacenter)



Professor Pieter Leijnse
Director
Nikhef
Science Park 105
NL - 1098 XG Amsterdam
The Netherlands

Date: 19 September 2013
To: SURF
From: SURF
Subject: Request for the Dutch Research proposal on the LHC experiments

Dear Professor Leijnse,

I am writing to bring you up to date on the status of the Dutch Roadmap for Large Scale Research Facilities. The very first version of the Roadmap was published in 2011. In relation with the LHC experiments, SURF will be heavily involved in contributing to the implementation of the LHC experiments, in order to ensure a smooth and successful start of the experiments. In addition, SURF will be heavily involved in contributing to the implementation of the LHC experiments, in order to ensure a smooth and successful start of the experiments.

The unprecedented computing and data requirements of the LHC experiments have been a driving force for the construction of the e-infrastructure in the past decade. They have served us well, but the future from 2014 until 2017. The Netherlands' Tier 1 services provided to the LHC experiments, in order to ensure a smooth and successful start of the experiments, in order to ensure a smooth and successful start of the experiments.

SURF has integrated BBO Grid in the national e-infrastructure, which is also an important part of the Roadmap for the construction of the e-infrastructure. We very much welcome the interest expressed in your proposal to fund the implementation of the LHC experiments. SURF will be heavily involved in contributing to the implementation of the LHC experiments, in order to ensure a smooth and successful start of the experiments.

“National government should encourage and fund the national e-infrastructure Roadmap (e-Infra). National government should encourage and fund the national e-infrastructure Roadmap (e-Infra). National government should encourage and fund the national e-infrastructure Roadmap (e-Infra).”

We therefore already include the proposal to be funded.

Yours sincerely,
Prof. W.B.G. Leijnse
Executive Director

Mailing address: Mailing address: Mailing address: Mailing address:
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www.surf.nl, www.surf.nl, www.surf.nl, www.surf.nl

COMPUTING IS ALL IN THE NATIONAL E-INFRASTRUCTURE – COORDINATED BY SURF

The NL/Tier-1 is a joint venture of Nikhef and SURFsara, serving the three LHC experiments in which Nikhef participates (ATLAS, LHCb, and ALICE), and is fully integrated into the Dutch e-infrastructure, operated by the SURF foundation and partners, one of which is Nikhef.

SURFsara is the national computer centre and the flagship partner of the national e-infrastructure. The NL/Tier-1 profits from excellent high-speed optical links provided by notably SURFnet. Being the best-connected Tier-1 centre, it plays an important role in the WLCG high-bandwidth network connectivity between several other Tier-1s and CERN.

Expansion of the NL/Tier-1 to keep pace with the computing needs of the upgraded LHC facility depends on our success in securing new funding. In the new e-infrastructure model, it will be exclusively our own funding that provides the adequate compute and data capacity.

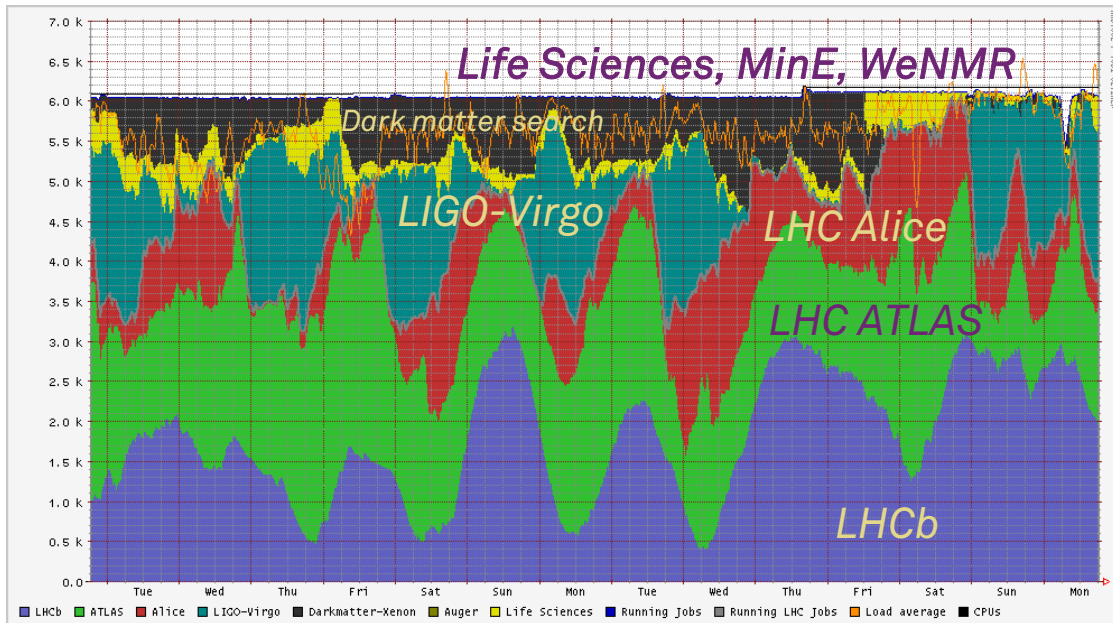
However, we will provide this capacity by participating in and through the national e-infrastructure, which allows us to benefit from economies of scale and profit from the joint operations and sharing of personnel. It allows us to focus on investments in capacity, while being assured of the long-term sustainable services by SURF and its subsidiaries.

Federation of resources across 'the DNI' very effective indeed

SERVICE-BASED APPROACH: EFFICIENT AND EFFECTIVE

Services in the DNI

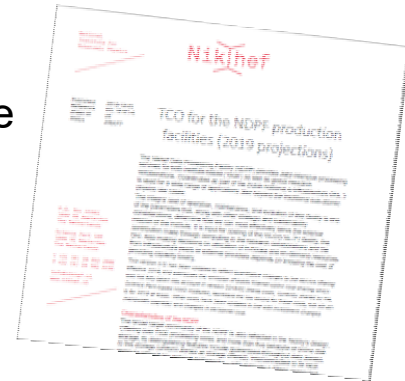
- compute in many operational sites (SURFsara, Nikhef, RUG-CIT)
- high-throughput storage at SURFsara and Nikhef,
- long-term storage at SURFsara,
- interconnected by SURFnet, and authentication by SURFcertificaten



JOINT INFRASTRUCTURE: A UTILIZED SERVICE IS A COST-EFFECTIVE SERVICE

Running the NL-T1 *service* is not 'free', also not on our national e-Infra

- the funding from the LHC Upgrade roadmap is invested via the 'DNI' Dutch National e-Infrastructure
- used to support all aspects of the service: compute, high-throughput storage, tape archive
- cost at all operational partners remarkably similar (if one is honest about total cost ...)
- with its high utilization DNI is far more efficient than public commercial clouds at our required service level



Questions?



Nikhef

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