Nikhef

Roadmap ICT netwerk & informatie event

LHC UPGRADE &
THE DATA INFRASTRUCTURE

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Nikhef
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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.

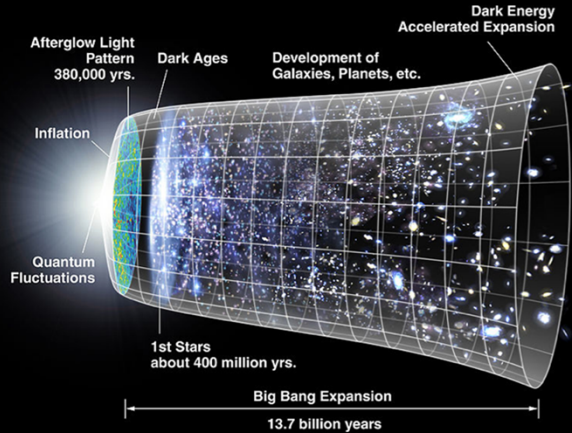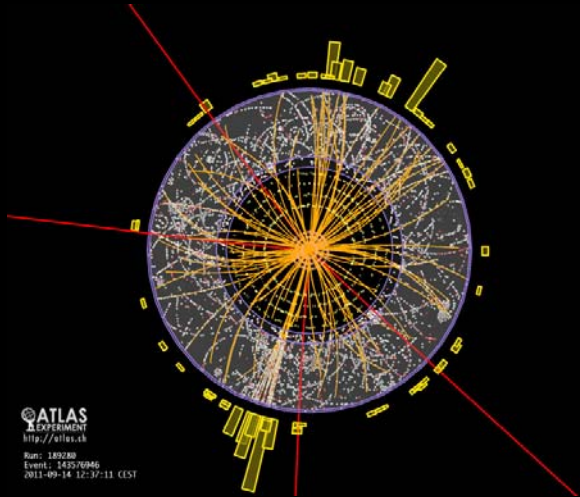|	
Vaste wetenschappelijke staf	80
Promovendi en postdocs	125
Technische en engineering staf	75
Ondersteunende staf	25

COMPLEMENTARY PROGRAMMES

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

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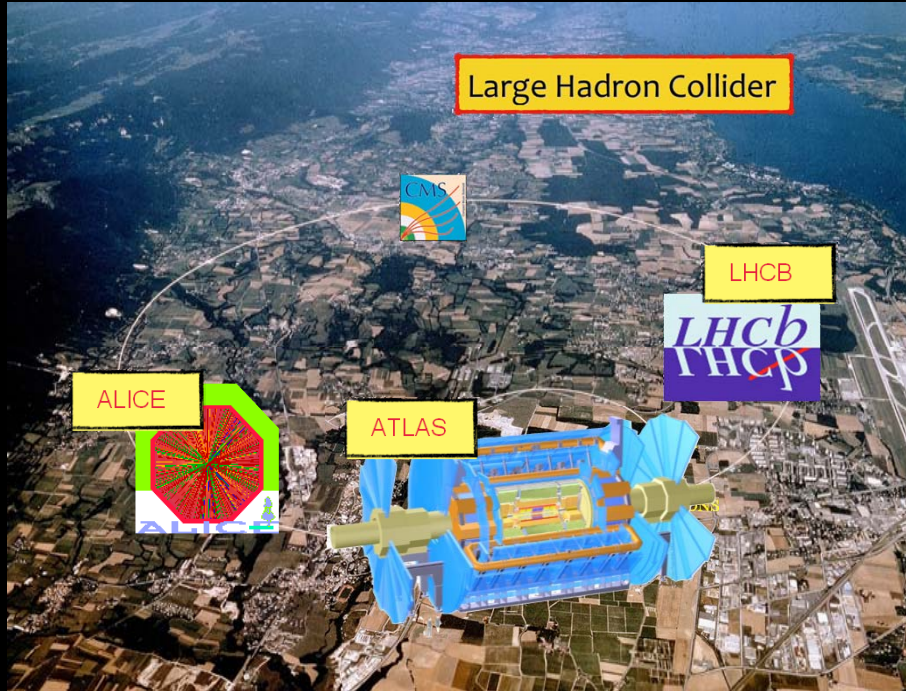cosmics rays and search for dark matter

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

Large Hadron Collider

CMS

LHCB

ALICE

ATLAS

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ASTRO-PARTICLE PHYSICS

KM3NET
- neutrino telescope

Virgo/LIGO, towards the Einstein Telescope
- gravitational waves

Auger
- ultra-high energy cosmic rays
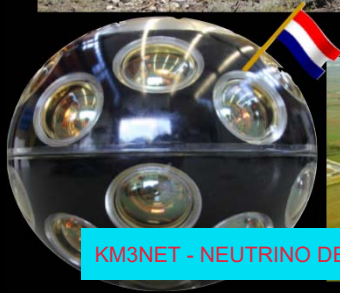
Xenon
- search for dark matter

PIERRE AUGER - COSMIC RAYS

XENON1T - DARK MATTER

ADV VIRGO - GRAVITATIONAL WAVES

KM3NET - NEUTRINO DETECTION

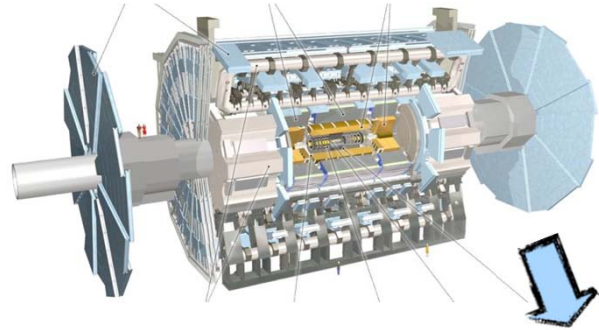Nikhef

COMPUTING: FOR THE LHC AND MORE

~ 10 seconds to a compute a single event at ATLAS for 'jets' containing ~30 colllisions
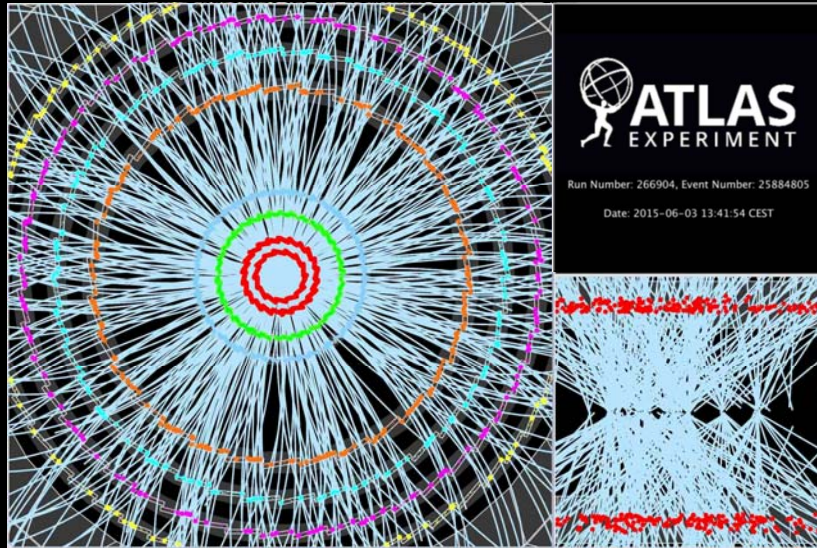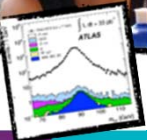
DATA FLOW AT THE LHC
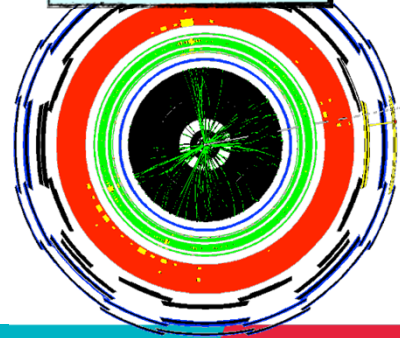

40 MILJOEN / SECONDE
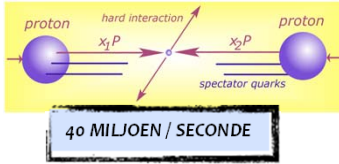
ANALYSIS OF RESULTS BY STAFF AND PHD STUDENTS

DATA DISTRIBUTION IN THE NATIONAL AND GLOBAL E-INFRASTRUCTURES

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

proton   hard interaction   proton
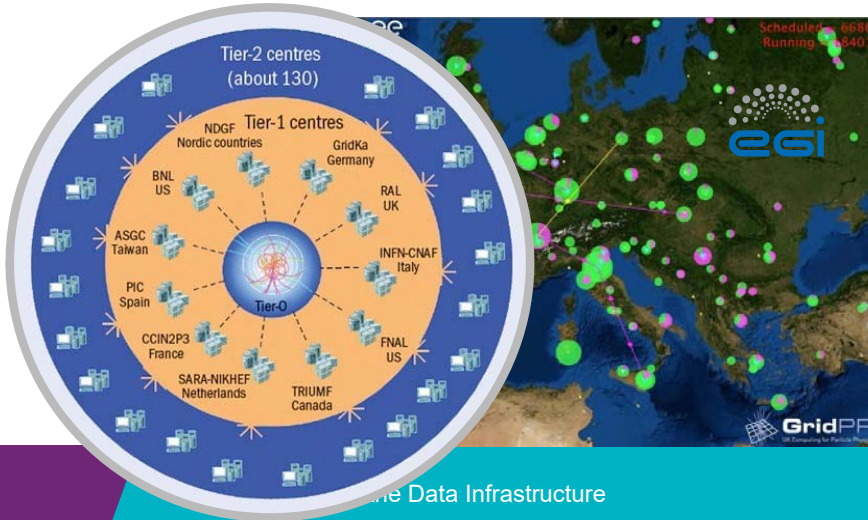$x_1 P$ $x_2 P$
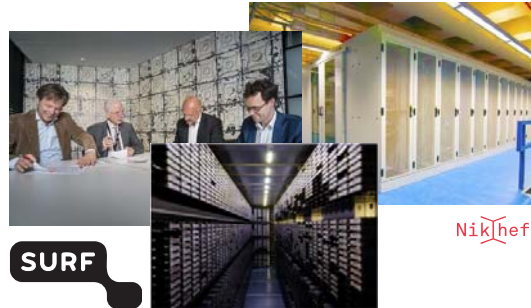spectator quarks

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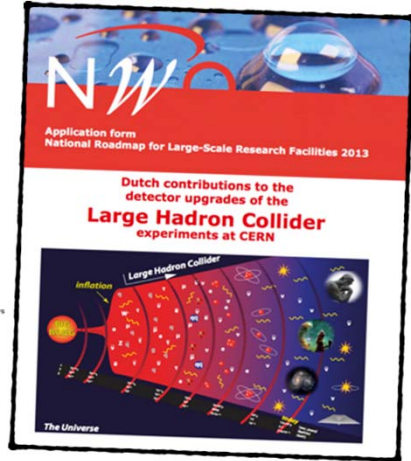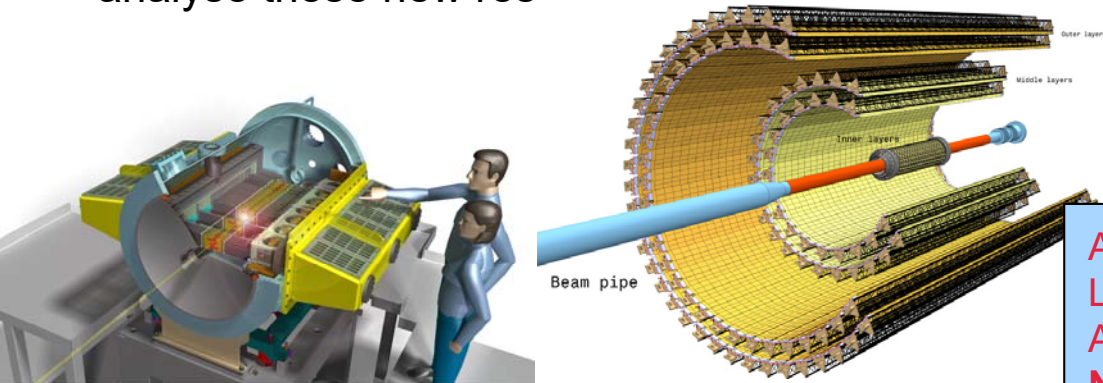
ATLAS:	5.2 M€
LHCb	4.0 M€
ALICE	2.3 M€
NL-Tier1	**3.7 M€**
(for 5 years)	

COMPUTING IS PART OF THE INFRASTRUCTURE

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)

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
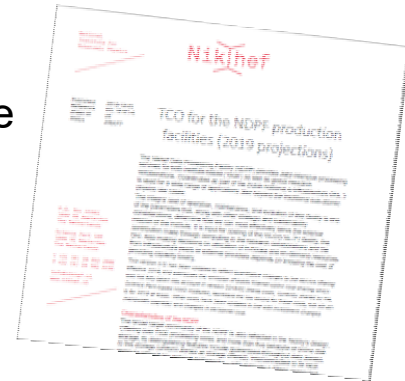
Services in the DNI

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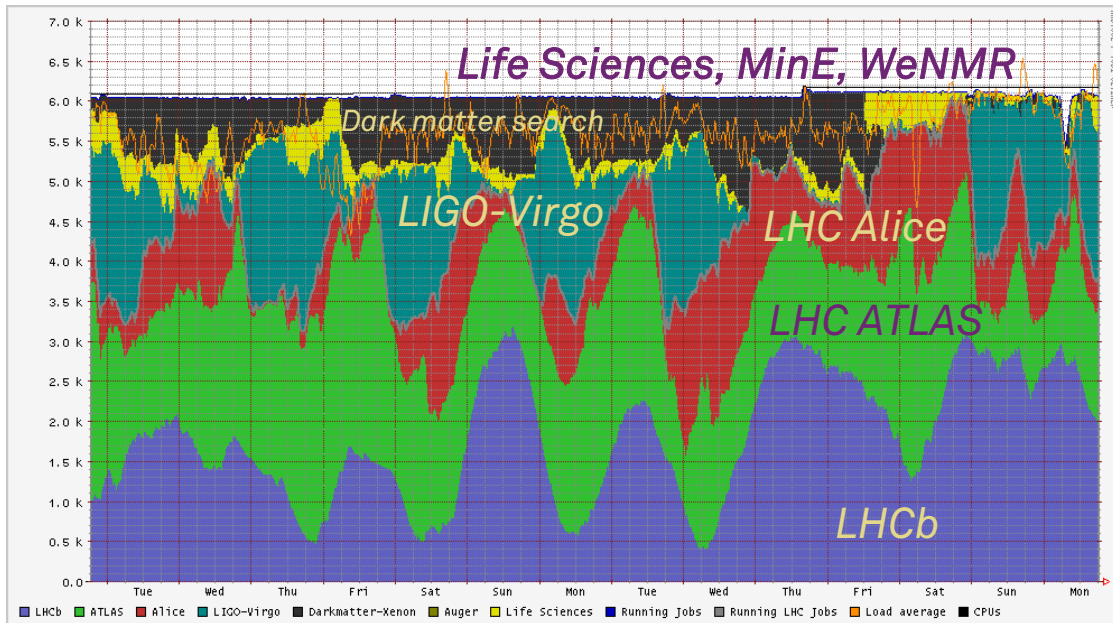
JOINT INFRASTRUCTURE: A UTILIZED SERVICE IS A COST-EFFECTIVE SERVICE

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

TCO for the NDPF production facilities (2019 projections)

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Questions?

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