



VRIJE  
UNIVERSITEIT  
BRUSSEL

# HEP COMPUTING IN BELGIUM

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# GRID IN BELGIUM

2003-2017

- GRID started in 2003 in Belgium
- Regrouped 6 grid enabled Grid Clusters  
VUB/ULB - UCL - Leuven - Gent - Cétic - Vliz
- In 2012 most clusters chose to become non-grid clusters
- Decision driven by regional funding (VSC and CÉCI)  
VSC: Vlaams Supercomputing Centrum (2007)  
CÉCI: Consortium des Équipements de Calcul Intensif (2010)
- After 2012, only 2 grid clusters remained

# BELGIAN GRID CLUSTERS

2017

2 separately managed grid clusters mainly used for CMS

- One hosted in ULB-VUB Computing center and one at UCL
- Providing
  - ~ 8000 job slots
  - ~ 5PB of mass storage
- Infrastructure is diverse
  - Scaling with LHC luminosity
    - Bought over different years
  - Usually, the cheapest solution is chosen
    - Except for critical services like main file servers

## ICECUBE + SOLID

### Integration in Brussels grid cluster

Until 2015, IceCube had its own cluster

- ~1000 cores
- ~200TB mass storage
- Not grid enabled

In 2016 they integrated in the ULB/VUB grid cluster

- Can now also integrate grid jobs
- Better support for the users
- Better use of available resources

Since 2016 ULB/VUB is also hosting the Solid Collaboration

- And acts as T1 and T2 for the Solid collaboration

## MADGRAPH, NA62 AND COSMOLOGY AT UCL

### Madgraph

- 500 cores with web interface (no grid)

### NA62

- 430 cores and 350TB (grid)

### Cosmology

- 300 job slots and 25TB

CMS tier2, MadGraph and NA62 are now fully integrated with a general purpose cluster at UCL

- Job queues priorities are enforced
- Part of the work load is therefore outsource to the university team

# NETWORKING

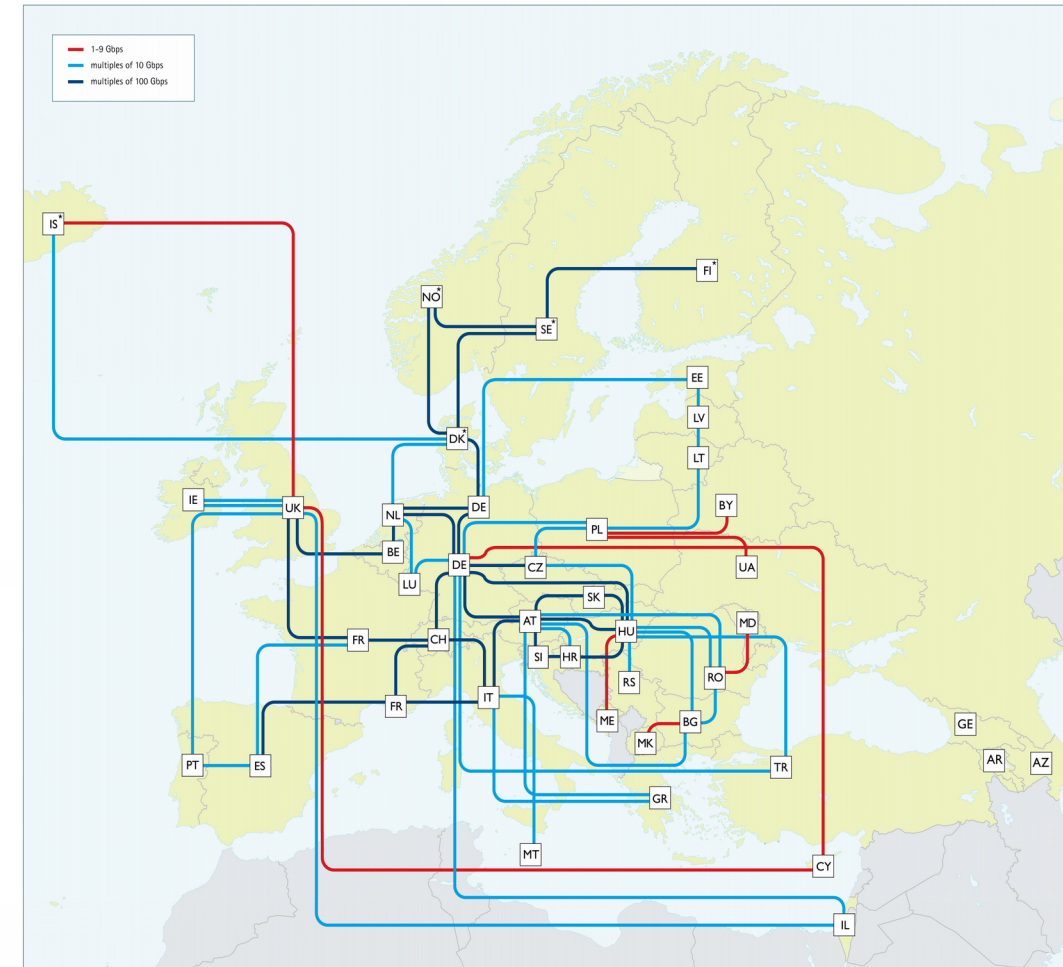
## GEANT

Both sites are interconnected to the GEANT network via a 10Gb/s link

- Link provided through Belnet

*Belnet is the Belgian national research network that provides high-bandwidth internet connection and services to Belgian universities, colleges, schools, research centers, and government departments.*

GEANT's pan-European research and education network interconnects Europe's National Research and Education Networks (NRENs). Together we connect over 50 million users at 10,000 institutions across Europe.



GEANT's pan-European network is funded by the GEANT Project (GN4-1). This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 691567. The map shows topology as at October 2015. The GN4-1 partners are listed below.

**BELNET** →



## FUNDING

Funding is provided by

- Fonds Voor Wetenschappelijk onderzoek (FWO)
  - In Flanders
- Fonds de la Recherche Scientifique (FNRS)
  - In Federation Wallonie-Bruxelles

Per year ~200k€ is invested in the purchase of infrastructure

- Electricity, cooling, and hosting is provided so far by the hosting universities

## FUNDING

ULB/VUB site is also partially funded by

- VSC
- Belspo
  - Was Federal Public Planning Service Science Policy, now is regionalized
  - So far, BelSpo was paying the Belgian contribution to EGI

Therefore the site is open to all researchers in Belgium that want to use the Grid.



## PEOPLE

Hiring IT people for the long term is not easy

- We have many contracts that are renewed regularly
- UCL:
  - 1.5 FTE
    - 3 persons: 25% + 25% + 100%
    - Only the two 25% persons are permanent
- ULB/VUB:
  - 3.5 FTE
    - 1 FTE IceCube, 2.5 FTE CMS
    - Of those, only 1 FTE is permanent

## PERFORMANCE

### Sizeable and reliable contribution

Belgian grid sites maintain high availability and reliability as measured by EGI

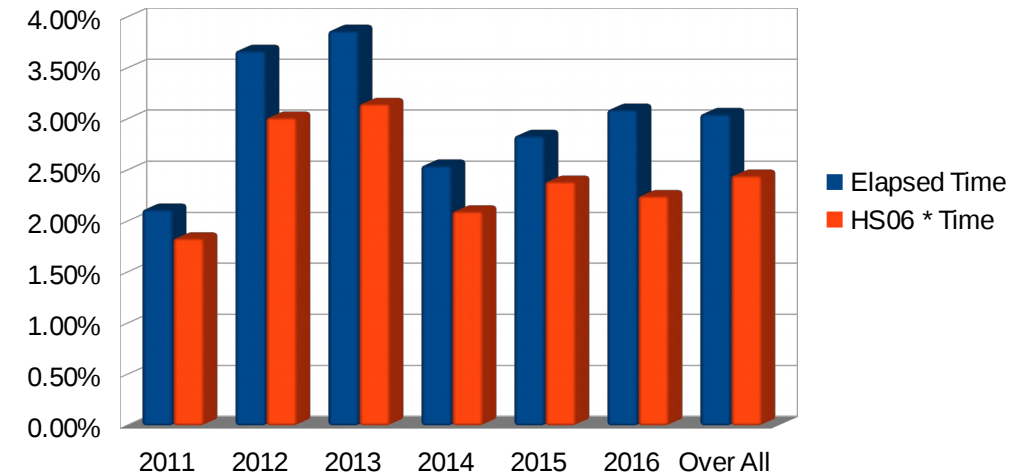
- ~95% last year
- ~91% all time (since 2009)

### Grid sites pledge

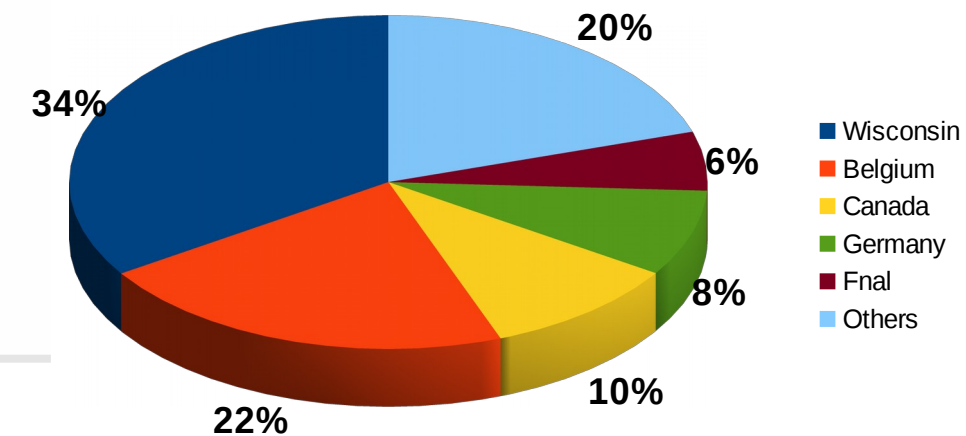
- ~4% of CPU needs of CMS
- ~6% of data needs of CMS
  - Consistent with the fraction of PhD students from Belgium in CMS

Contribution to IceCube is also sizeable

Relative Grid contribution of Belgian Sites to CMS



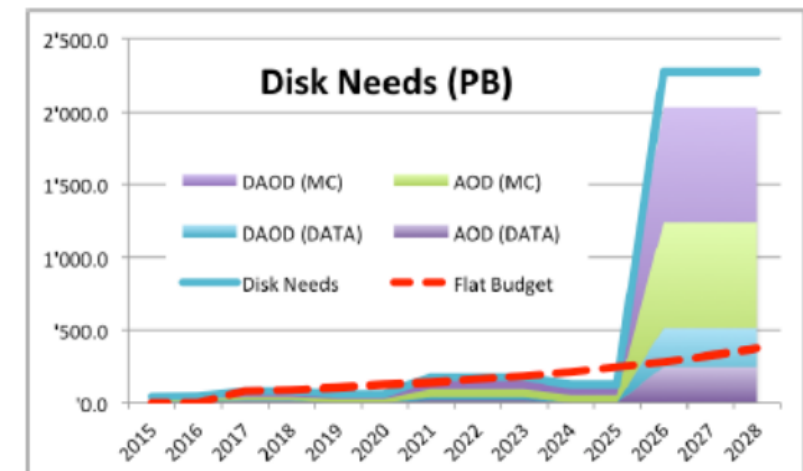
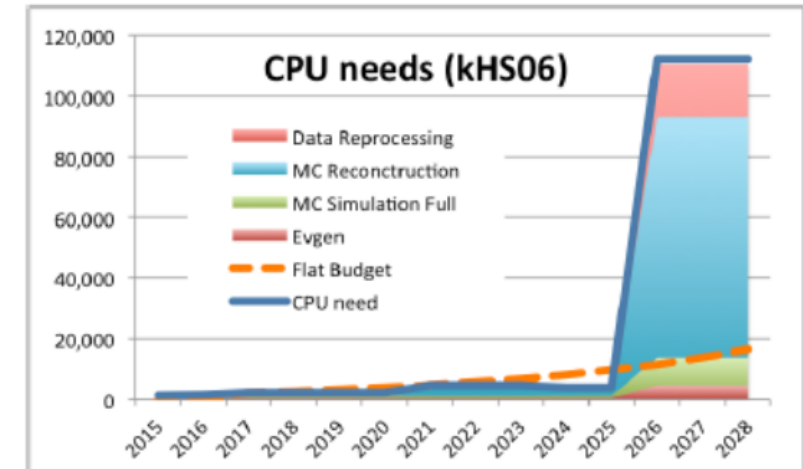
IceCube Simulation via the Grid, last 9 months



## PERSPECTIVES

- Until 2025, a constant yearly budget is needed and sufficient
- Grid membership fee must be maintained
  - So far paid by BelSpo
- HL-LHC needs (from 2025 onwards) are a concern
  - Optimization studies started, but needs are unlikely to be covered with constant yearly budget
- Highly-qualified IT staff is mandatory

## Initial studies on Computing for HL-LHC



THANKS