

CERN

Chances, opportunities, challenges

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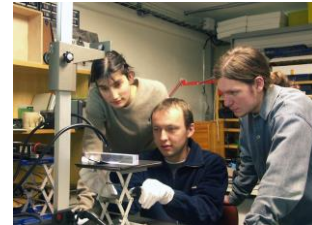
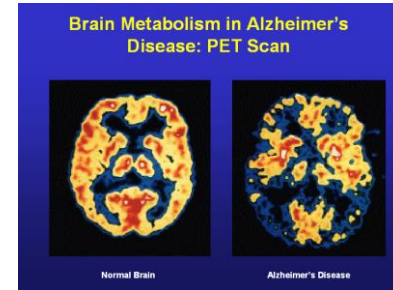
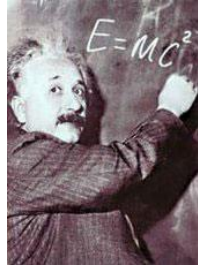
ICE-DIP is a European Industrial Doctorate project funded by the European Community's 7th Frameworkprogramme Marie Curie Actions under grant PITN-GA-2012-316596

- △ Introduction to CERN
- △ The Large Hadron Collider (LHC)
- △ Big Data at CERN
- △ Career Opportunities

Organisation Européenne pour la Recherche Nucléaire

Introduction to CERN

- △ **Push forward the frontiers of knowledge**
The secrets of the Big Bang ...what was the matter like within the first moments of the Universe's existence?
- △ **Develop new technologies for accelerators and detectors**
Information technology - the Web and the GRID
Medicine - diagnosis and therapy
- △ **Train scientists and engineers of tomorrow**
- △ **Unite people from different countries and cultures**



What is CERN?



CERN in numbers

Member states

Founded by 12 European states in 1954

Today: 21 members

Poland since 1991

Budget

2013 total expenses:

1246.5 million CHF

People involved

Staff members: 2512 (December 2012)

Fellows: 540

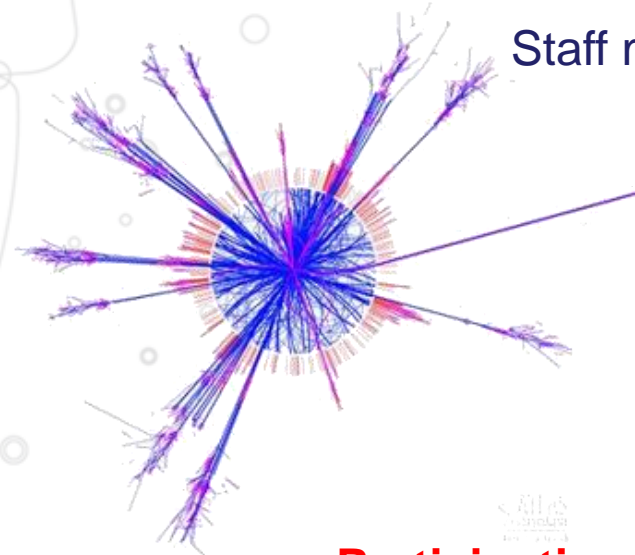
Paid associates: 372

Students: 315

Apprentices: 24

Users: 11008 (April 2013)

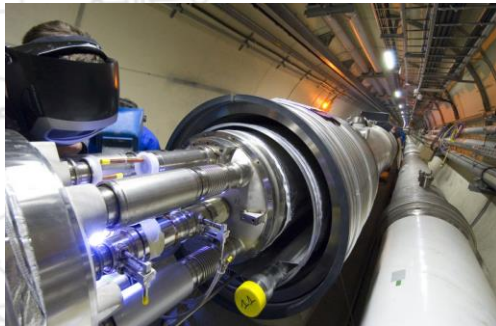
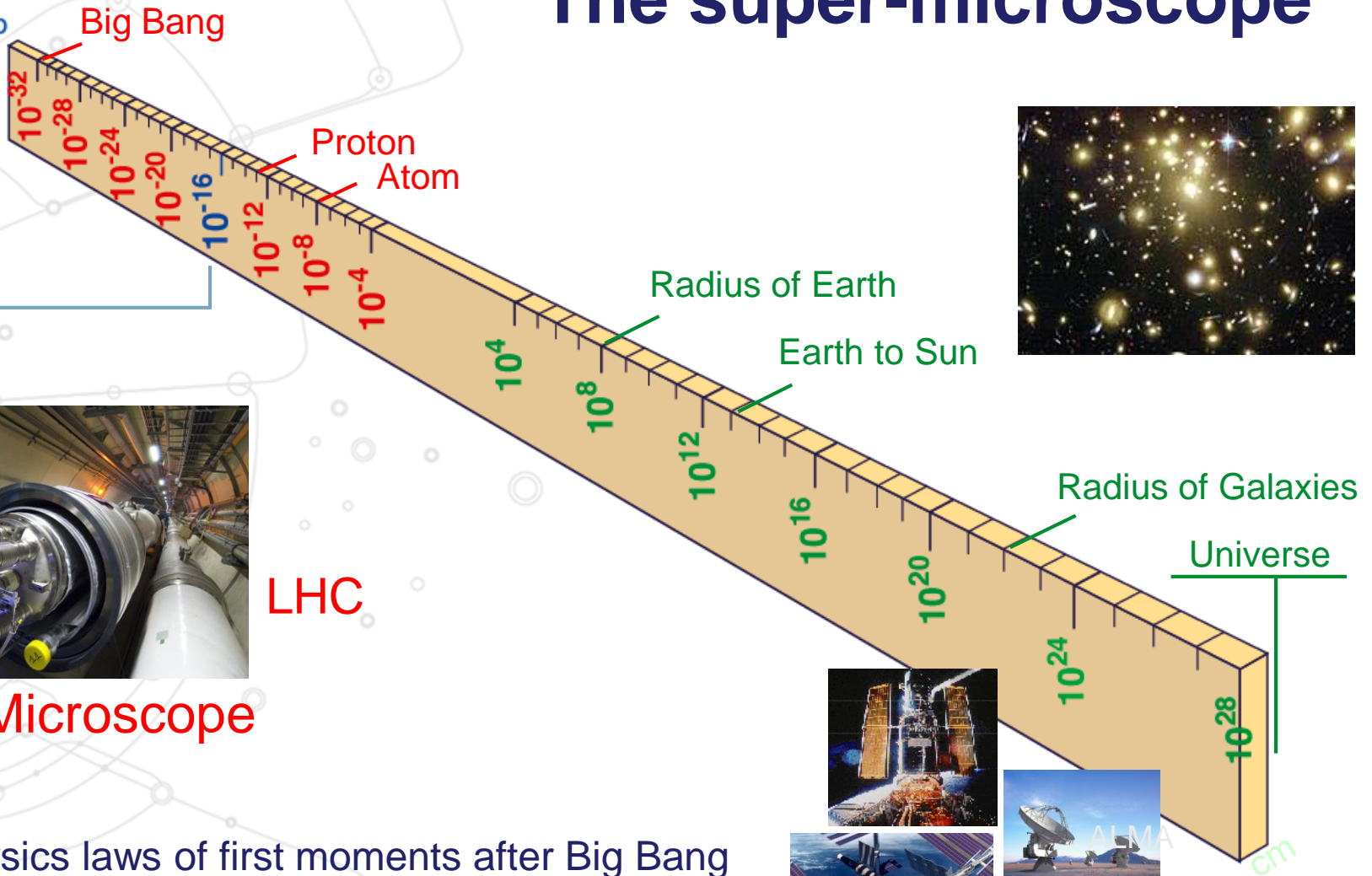
Participating institutes and universities: 641



Large Hadron Collider

The LHC

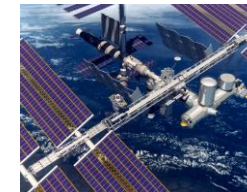
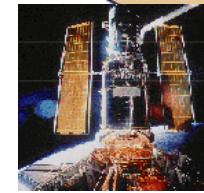
The super-microscope



LHC

Super-Microscope

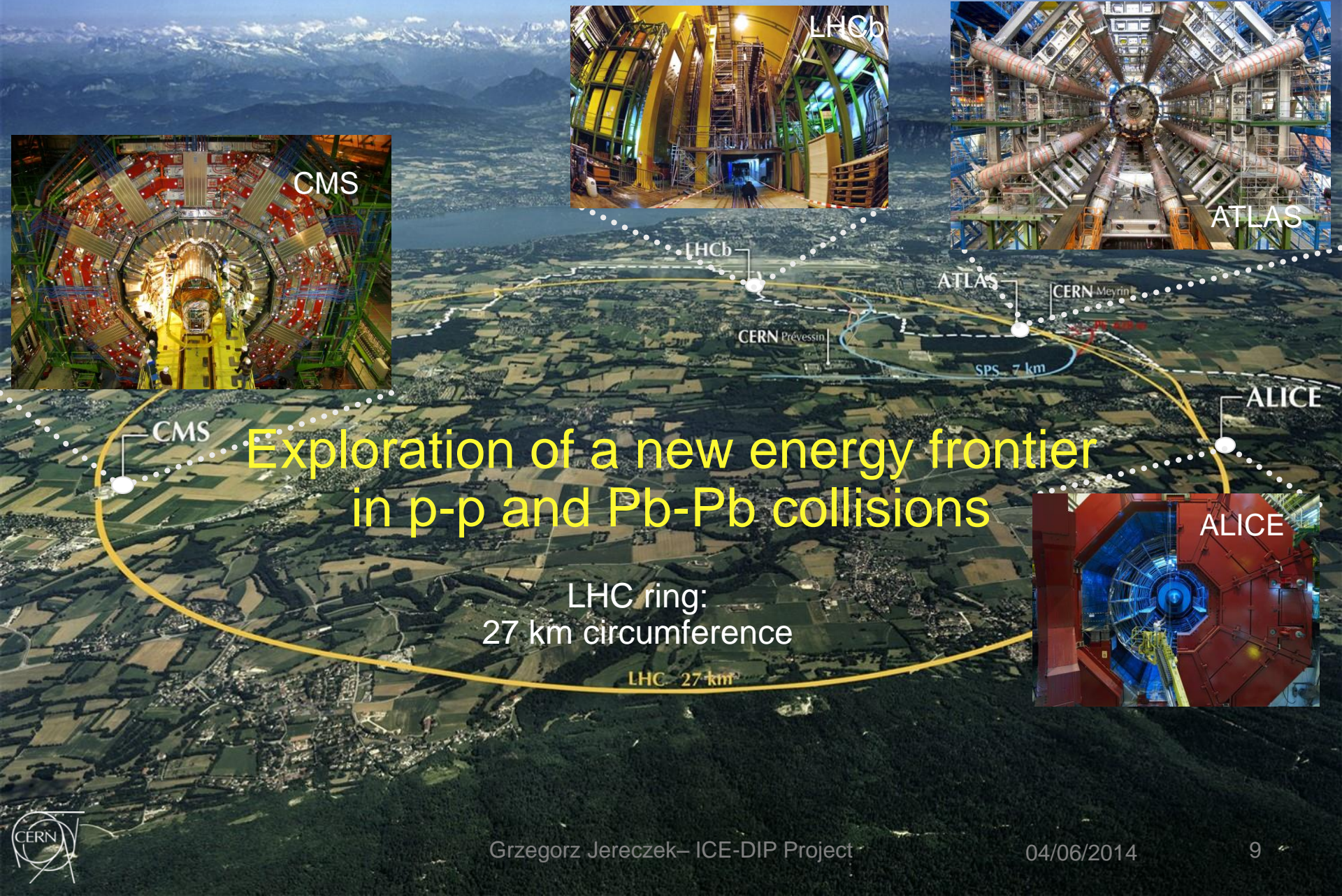
Study physics laws of first moments after Big Bang
 increasing Symbiosis between Particle Physics,
 Astrophysics and Cosmology



AMS



New era in fundamental science



CMS

LHCb

ATLAS

CMS

Exploration of a new energy frontier
in p-p and Pb-Pb collisions

ALICE

ALICE

LHC ring:
27 km circumference

LHC 27 km

SPS 7 km

CERN Prévessin

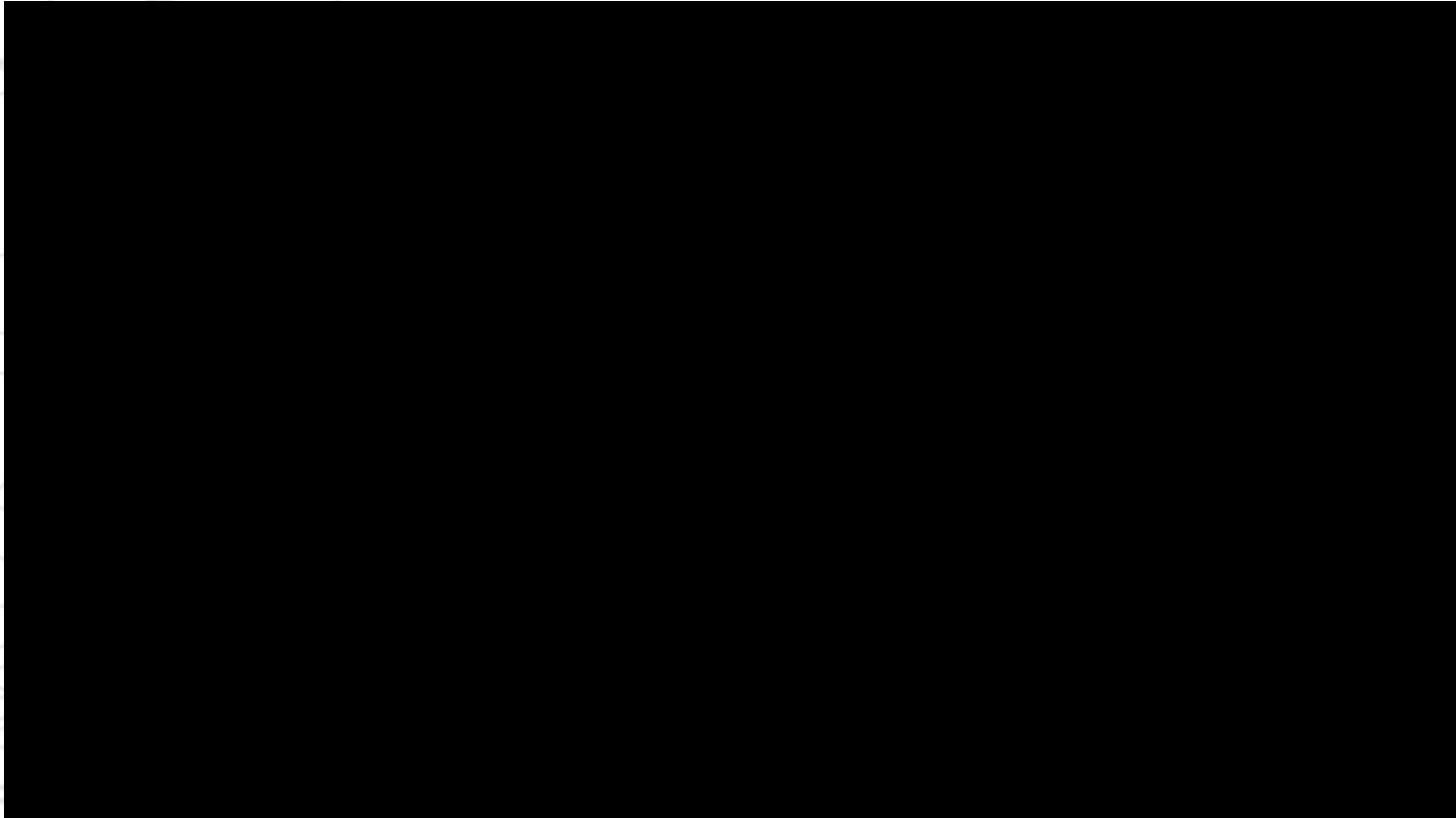
CERN Meyrin

ATLAS

LHCb



Principles of operation



Challenges

Accelerating cavities

Bunches of charged particles

99.9999991% of the speed of light

Dipole magnets

Guiding protons

High magnetic fields

Superconductors cooled down to **1.9K**

12 000 amperes

Vacuum

Prolong life of the beam

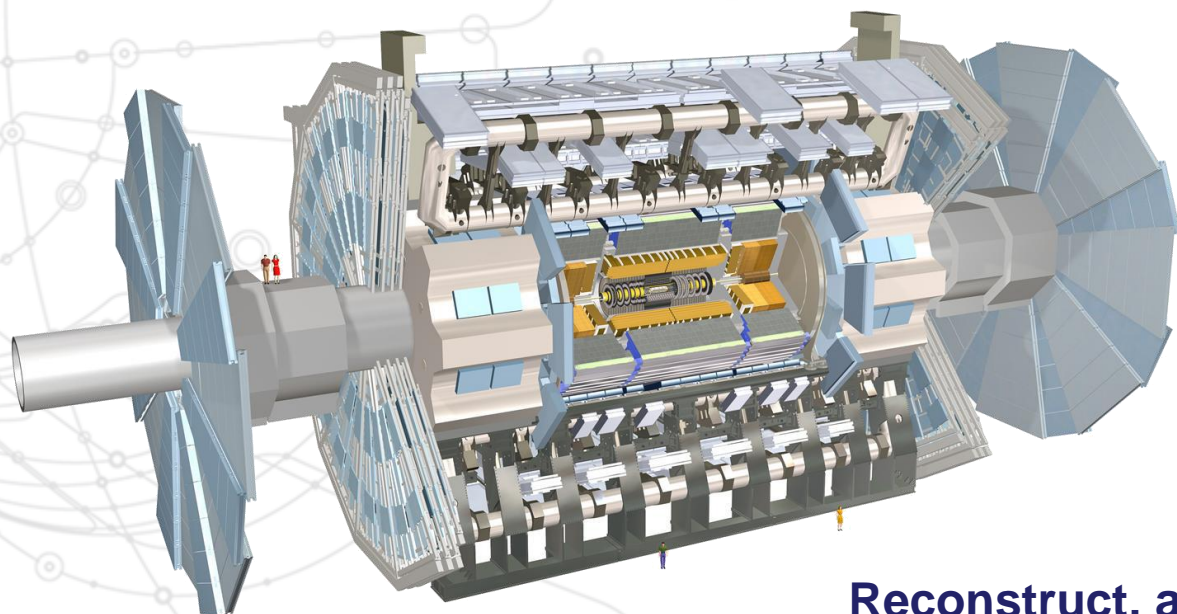
Emptier than interplanetary space



Detectors

Huge “cameras”

Taking “pictures” of the collisions each **25 ns**
 $\sim 10^7$ channels
400 Tb/s of data assuming binary channels



Challenge of data acquisition

Reconstruct, analyse and select extremely complex events in **real time**

Data acquisition and processing

Big Data at CERN

Big Data at ATLAS

If all data was recorded...:

- △ **100 000 CDs per second...**
- △ This stack would be 150 m high...
- △ And would reach the moon and back twice a year

Trigger and data acquisition systems reduce the total amount of data.

320 Mbytes per second were recorded during run 1:

- △ **27 CDs per minute...**

Data processing

Online processing

- Acquire the data from the detector
- Select interesting events and reduce the rates
- Custom electronics
- Farms of commodity PC's
- Fraction of events saved to permanent storage

Offline processing

- Event reconstruction, simulation and analysis
- Worldwide LHC Computing Grid (WLCG)

Searching for extremely rare phenomena
One Higgs event every 3 hours

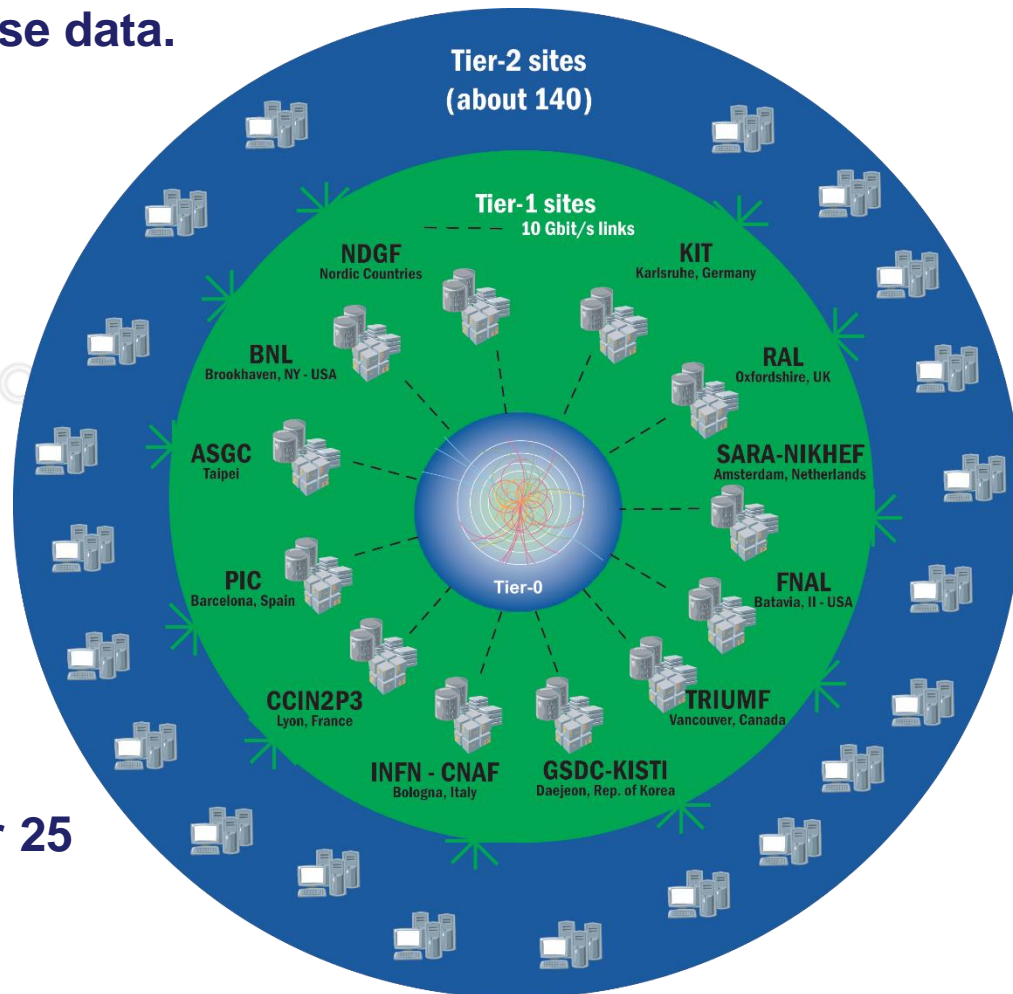


Worldwide LHC Computing Grid

A vast global network of data centres that continuously transmit, store, process and analyse data.

- △ 157 computing centers
- △ 40 countries
- △ 200 petabytes of disk storage
- △ 300 000 processing cores
- △ 70 petabytes of data accumulated at CERN

The LHC experiments produce over 25 petabytes of data per year.



<http://jobs.web.cern.ch>

What options do you have?

Career Opportunities

Student programmes

- △ **Technical Student Programme**
Applied Physics, Engineering or Computing
Technical training period or final project
4 to 12 months
- △ **CERN openlab Student Programme**
Computer Science, Mathematics, Engineering or Physics
Advanced IT projects
2 months in summer
- △ **Administrative Student Programme**
- △ **Summer Student Programme**
Physics, Engineering or Computing
8 to 13 weeks



Opportunities for graduates

- △ **Fellowship Programmes**
Physics, Applied Science, Computing or Engineering
24 months (Marie Curie – 36 months)
- △ **Technician Training Experience (TTE)**
Mechanics, Electro-mechanics, Electricity or Electronics
1 to 2 years
- △ **VIA (Volontaires Internationaux en Administration)**
Applied Science, Computing, Engineering or Administration
Contract from 6 to 24 months



Marie Curie Actions

Research Fellowship Programme

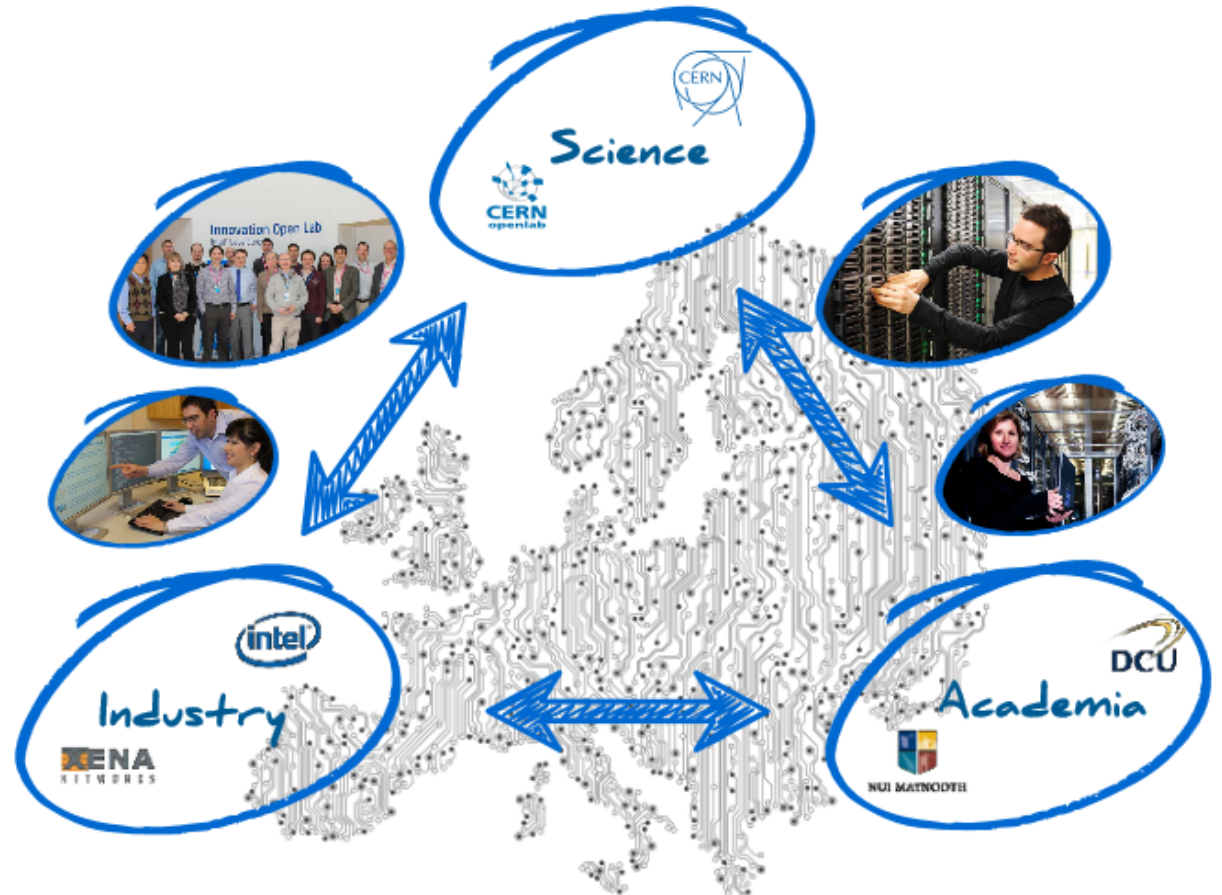
- △ Fellowships are awarded by the European Commission
- △ Stimulate the training and mobility of researchers within the European Union
- △ All disciplines
- △ Industrial doctorates
- △ Early Stage and Experienced Researchers
- △ Contracts up to 3 years
- △ Up to 12 months at CERN
- △ Generous training allowance



Training young researchers
across Europe

ICE-DIP 2013-2017: The Intel-CERN European Doctorate Industrial Program

» A public-private partnership to research solutions for next generation data acquisition networks, offering research training to five Early Stage Researchers in ICT

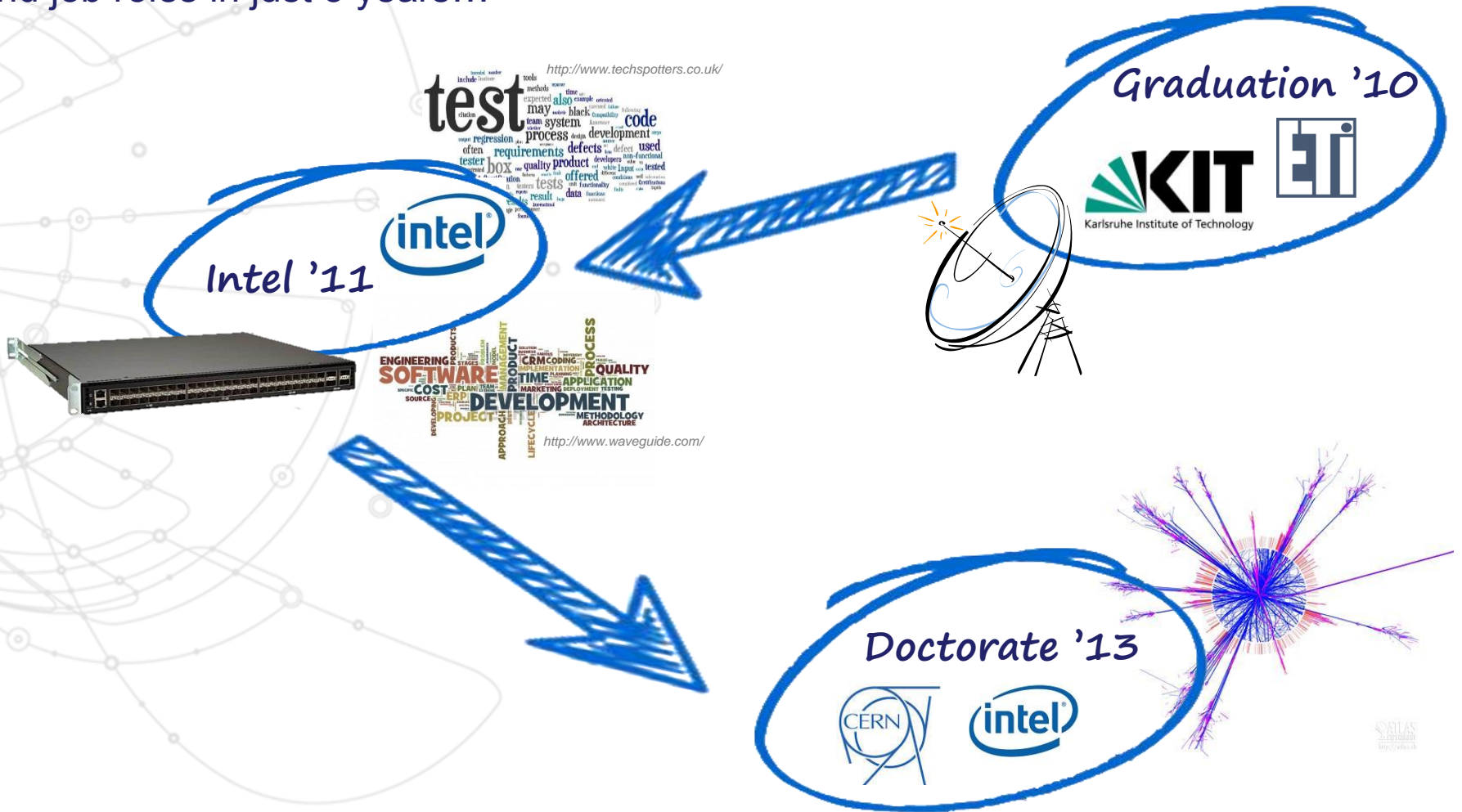


Research topics:

- ▶ Silicon photonics systems
- ▶ Next generation data acquisition networks
- ▶ High speed configurable logic
- ▶ Computing solutions for high performance data filtering

Don't be afraid of change

I moved through different fields of work and job roles in just 3 years...



Questions?