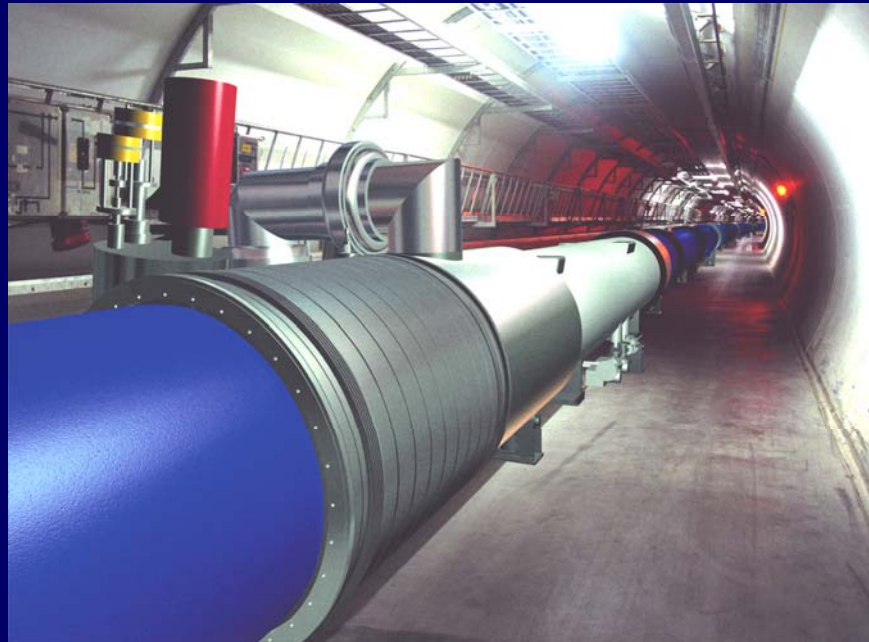


Experimental high energy physics



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6 December 2006

Division for Experimental High Energy Physics

Proton-proton collisions

Heavy ion collisions (eg. Pb-Pb)

Electron-proton collisions

ATLAS

ALICE

H1

New physics: super-symmetry, Higgs,...

Proton structure,...

CP-violation

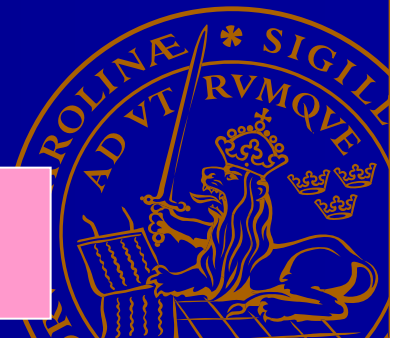
Quark-gluon plasma,...

Grid

Software

Electronics

06



Researchers and projects

■ ATLAS

- P. Eerola, V. Hedberg, G. Jarlskog (emeritus), S. Seidel (visitor), O. Smirnova, T. Åkesson.
- MSc student C. Laaksometsä.

■ Grid (distributed data handling)

- P. Eerola, J. Jönemo, B. Kónya, O. Smirnova.

■ ALICE

- P. Christiansen, H.-Å. Gustafsson, A. Oskarsson, I. Otterlund (emeritus), E. Stenlund.
- MSc student Ph. Gros.

■ PHENIX

- P. Christiansen, H.-Å. Gustafsson, A. Oskarsson, E. Stenlund.
- PhD students S. Rosendahl, E. Haslum.

■ H1

- L. Jönsson.
- PhD students M. Hansson, A. Knutsson, S. Osman.

■ ILC

- V. Hedberg, L. Jönsson, A. Oskarsson.

■ Lund-HEP graduate school

- PhD students N. Boelaert, A. Dobrin, J. Groth-Jensen, W.-N. Ji.



- *ATLAS experiment at the Large Hadron Collider, LHC*

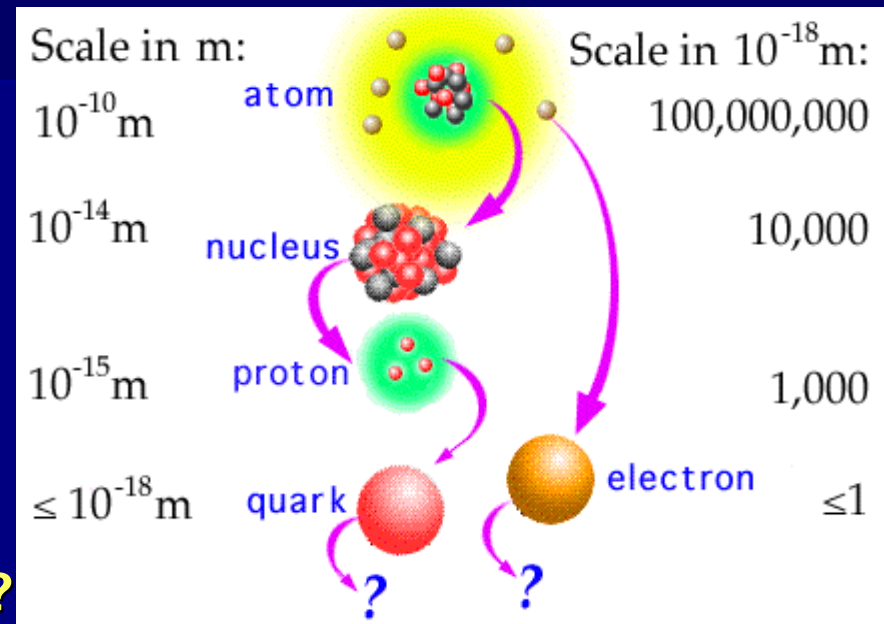


Why do we need yet a bigger accelerator?

We know that there are 6+6 quarks and leptons and how they interact, but...

THERE ARE MANY IMPORTANT OPEN QUESTIONS:

- What is the origin of particle masses? Is it the Higgs particle?
- Why does the Universe consist of matter, and not matter+ antimatter?
- Few % of Universe is known matter, and 25% Dark Matter – is it made of supersymmetric particles?

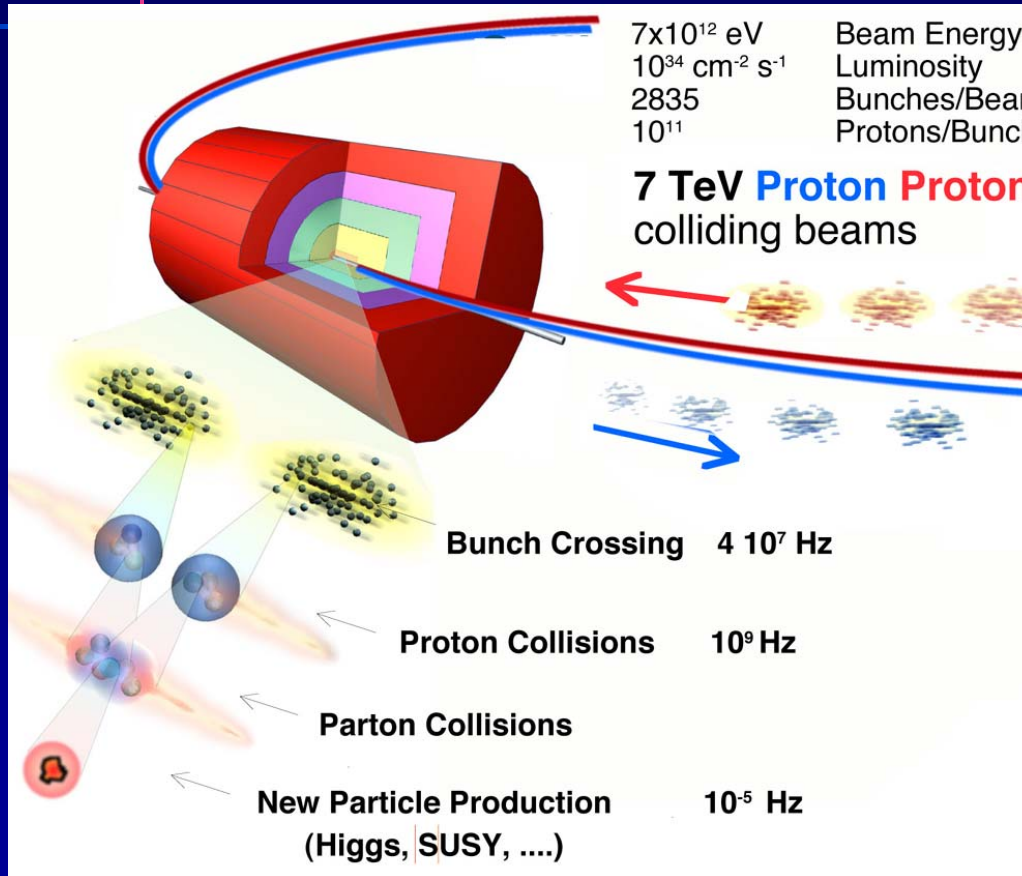


- Can we unify all 4 fundamental forces within one single theory?
- Can we unify gravity and quantum mechanics?



The Large Hadron Collider, LHC

pp collisions at $\sqrt{s} = 14$ TeV,
bunch crossing rate = 40
MHz



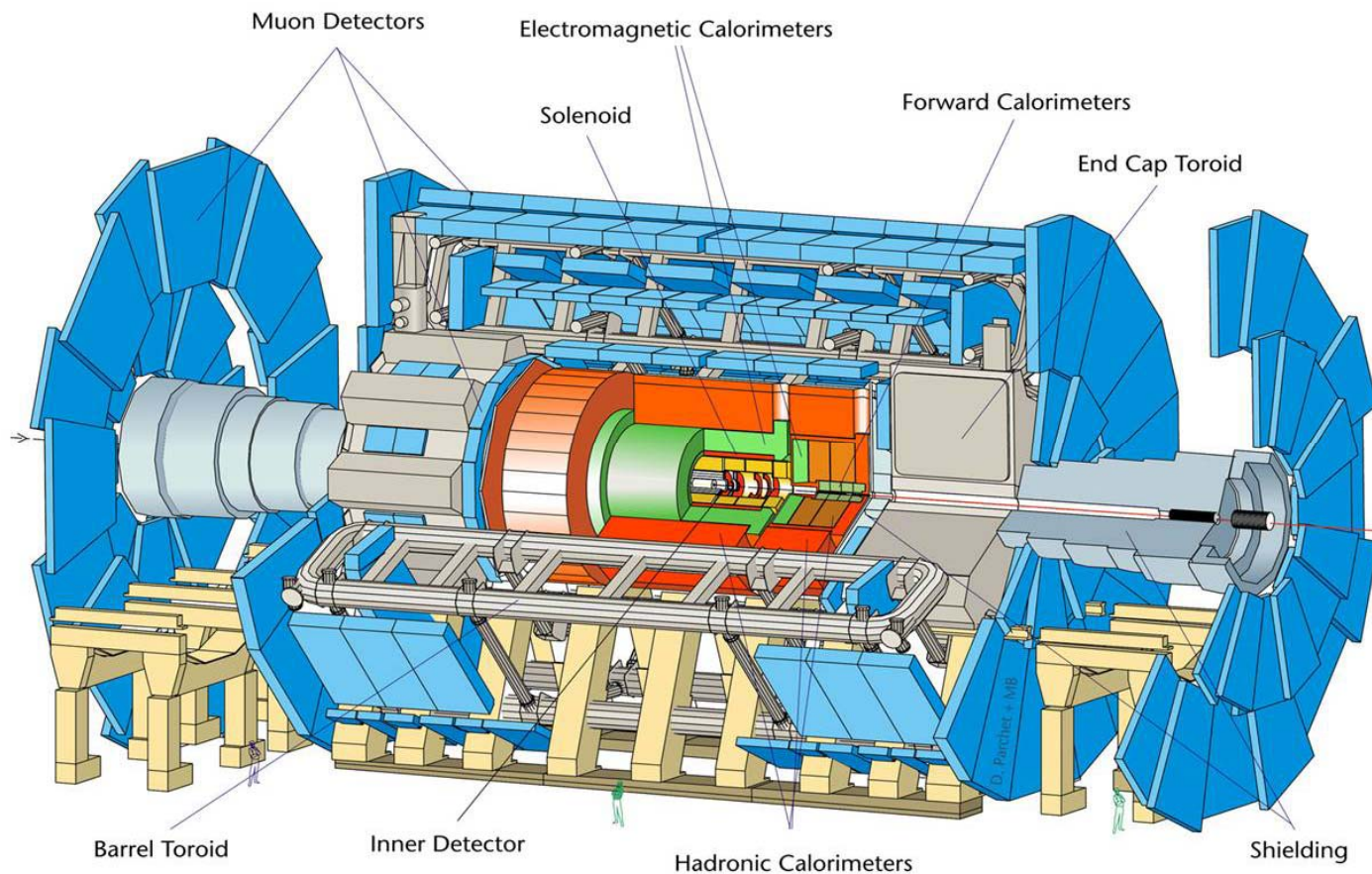
To find out:

- The mass problem – Higgs?
- The Dark Matter of the Universe – supersymmetric particles?
- Matter vs Antimatter – CP violation?

Start 2007: pilot run at 900 GeV. First physics run 2008 at 14 TeV.



The ATLAS experiment



<http://atlasexperiment.org/>

6 December 2006

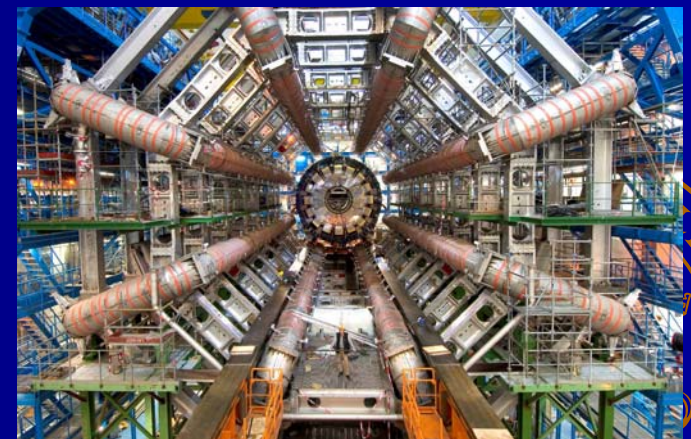


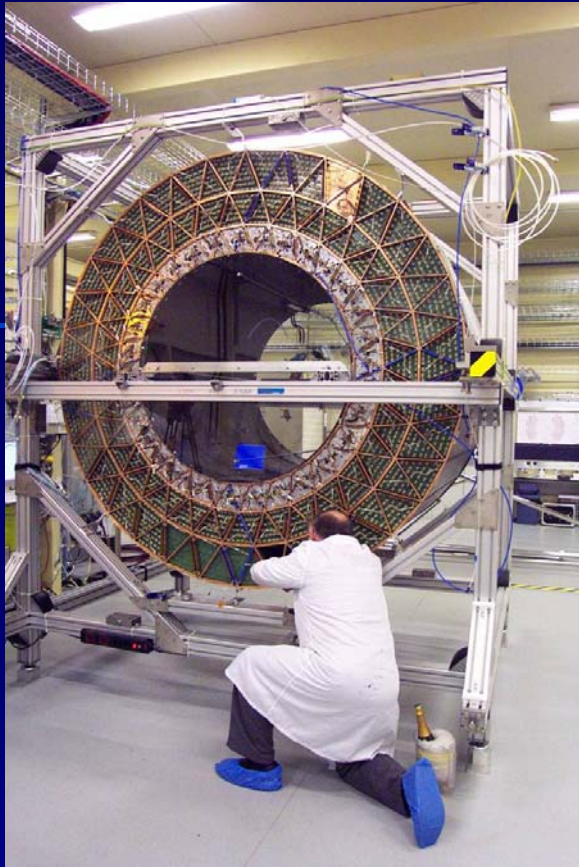


ATLAS installation

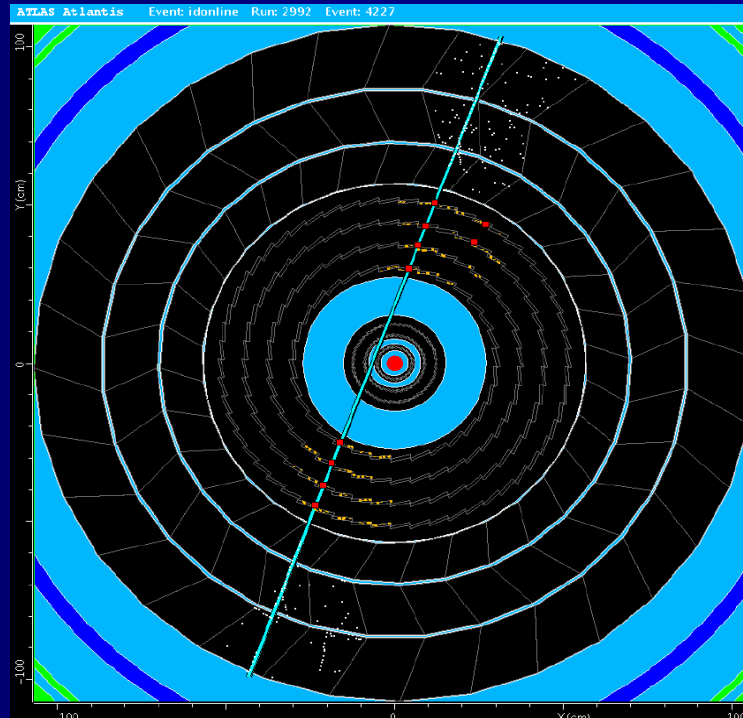


Toroid magnets



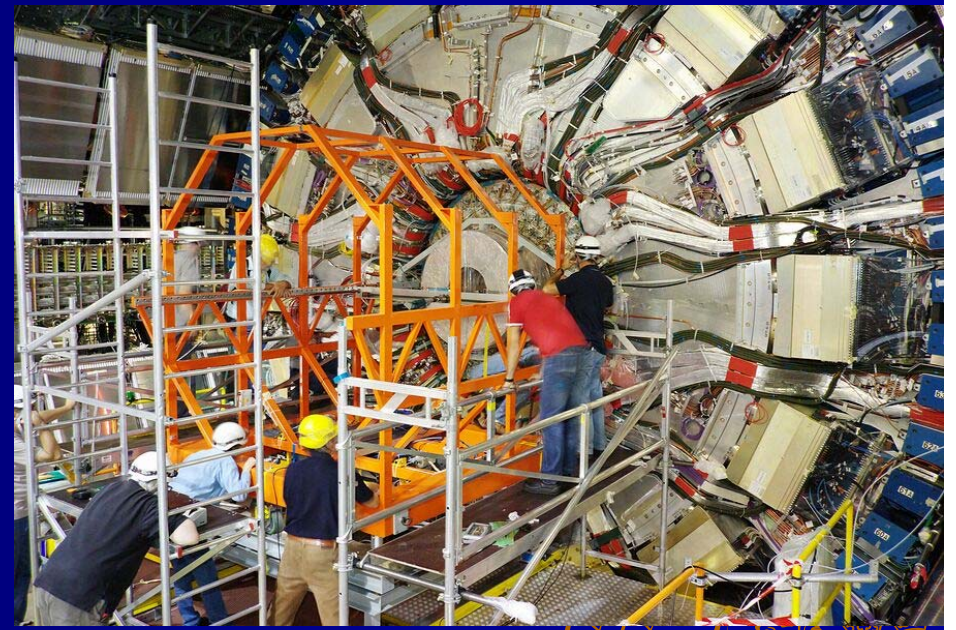
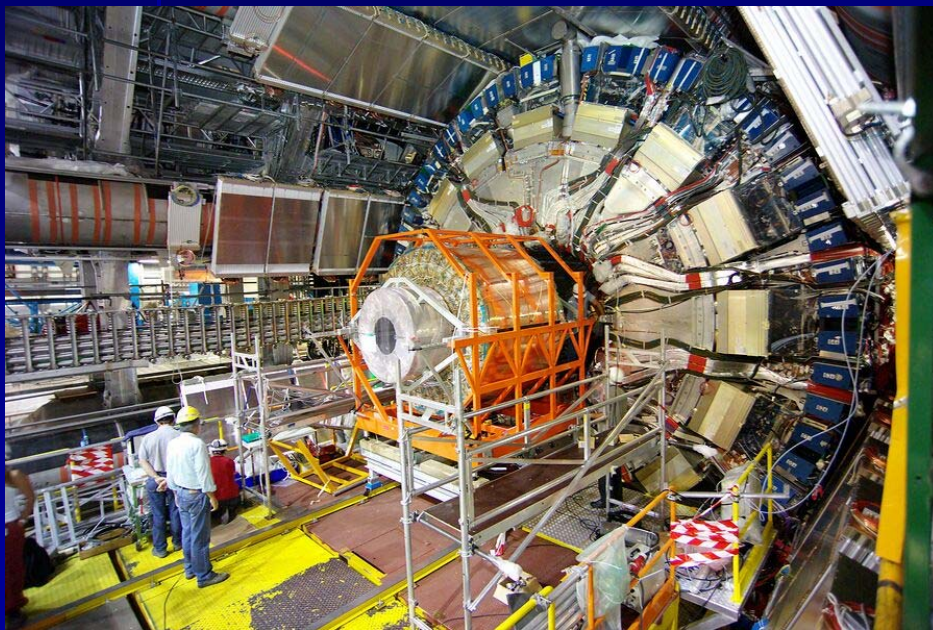
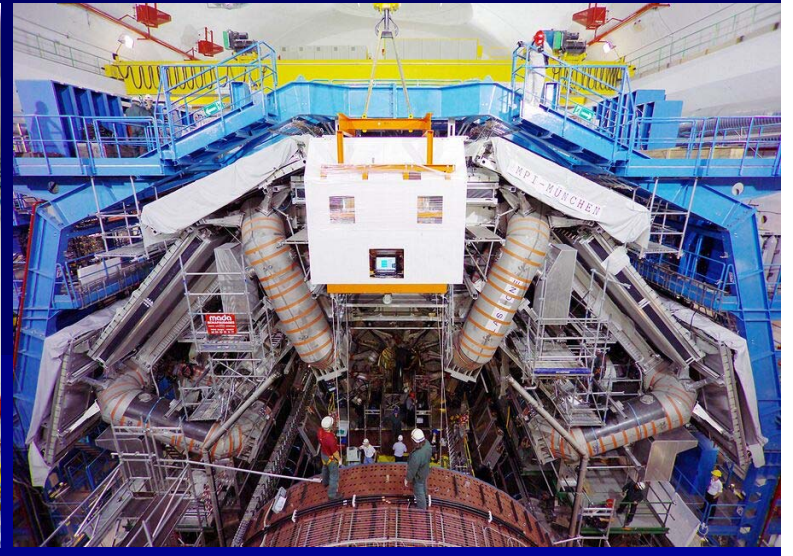


ATLAS Transition Radiation Tracker (TRT), electronics and design partly in Lund



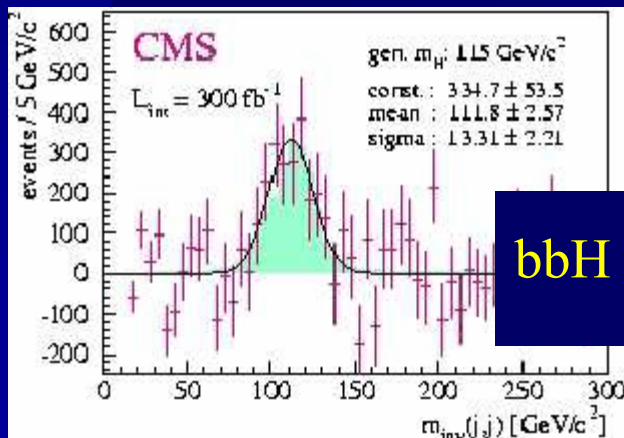
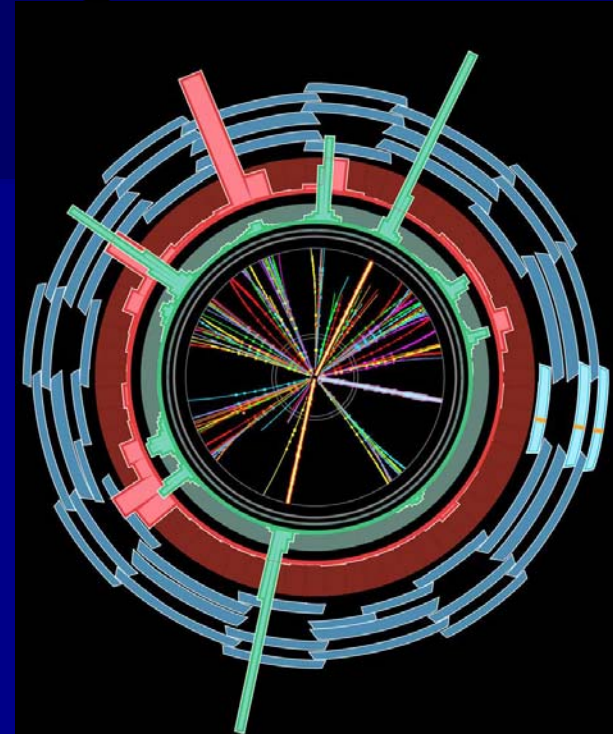
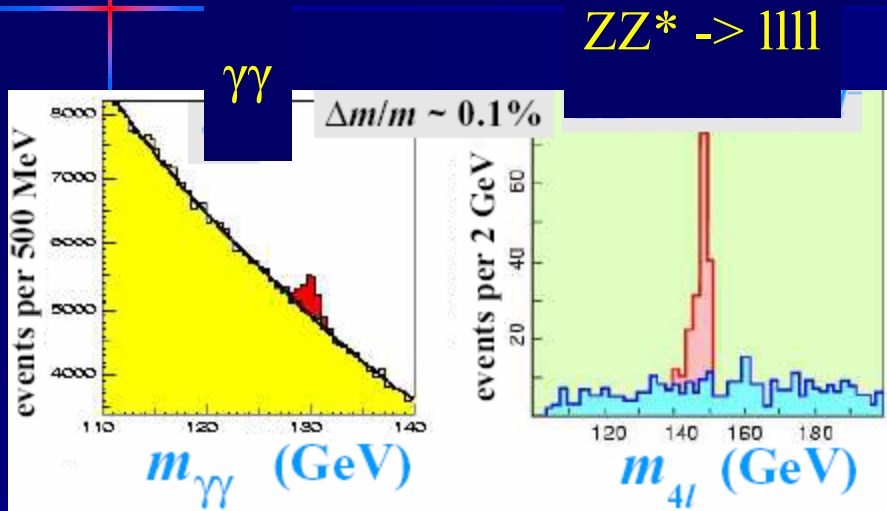
Cosmic muon recorded in ATLAS





Some physics highlights:

1. Higgs physics



- The Higgs mechanism (or something similar) is required to generate particle masses
- Present tests: Higgs must be heavier than 115 GeV
- LHC: Higgs can be found if mass is 115-1000 GeV

2. Supersymmetry (SUSY)

SPIN $\frac{1}{2}$
FERMIONS

Quarks	u	c	t
	d	s	b
Leptons	ν_e	ν_μ	ν_τ
	e	μ	τ
	I	II	III

The Generations of Matter

SUSY

SPIN 0
BOSONS

\tilde{u}	\tilde{c}	\tilde{t}
\tilde{d}	\tilde{s}	\tilde{b}
$\tilde{\nu}_e$	$\tilde{\nu}_\mu$	$\tilde{\nu}_\tau$
\tilde{e}	$\tilde{\mu}$	$\tilde{\tau}$
I	II	III

The Generations of Smatter

- The Standard Model requires fine-tuning to keep masses at a low scale \rightarrow SUSY eliminates nearly all the fine-tuning

- SUSY provides an excellent candidate for dark matter: the spin- $\frac{1}{2}$ partner to the photon which is the lightest SUSY particle and is cosmologically stable



SUSY makes forces to unify at high energies

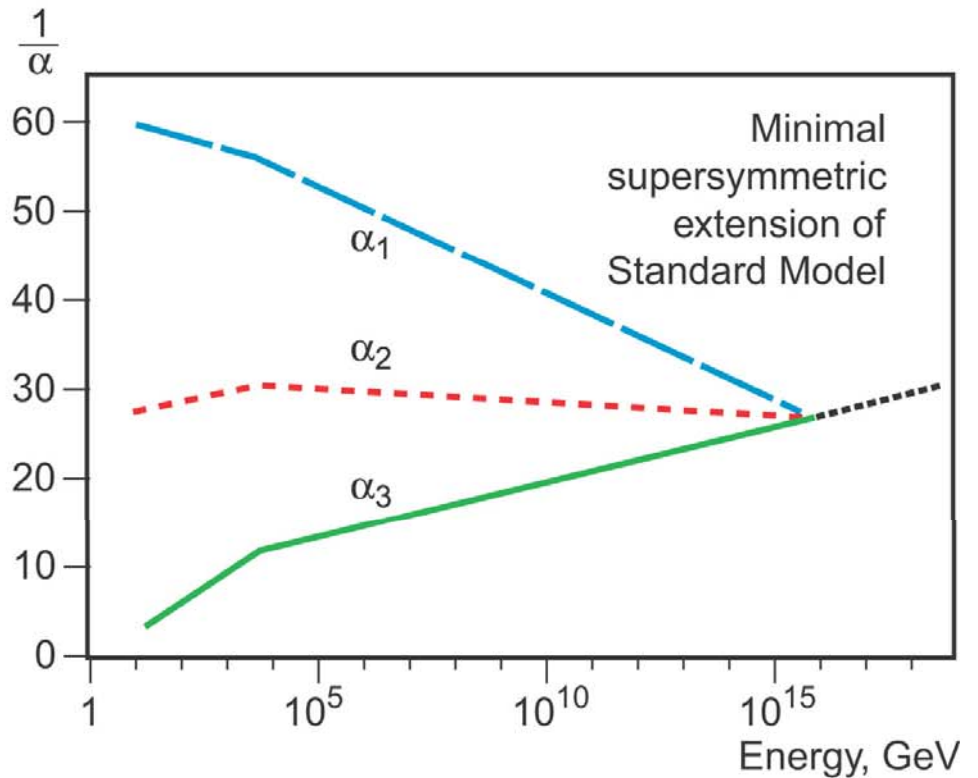
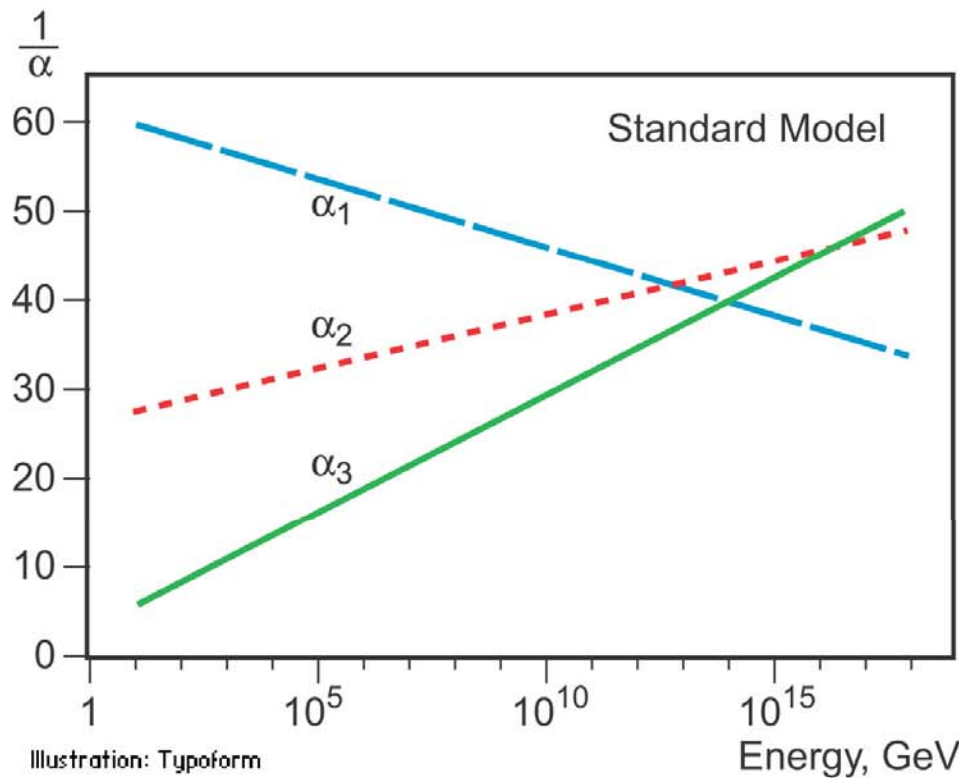


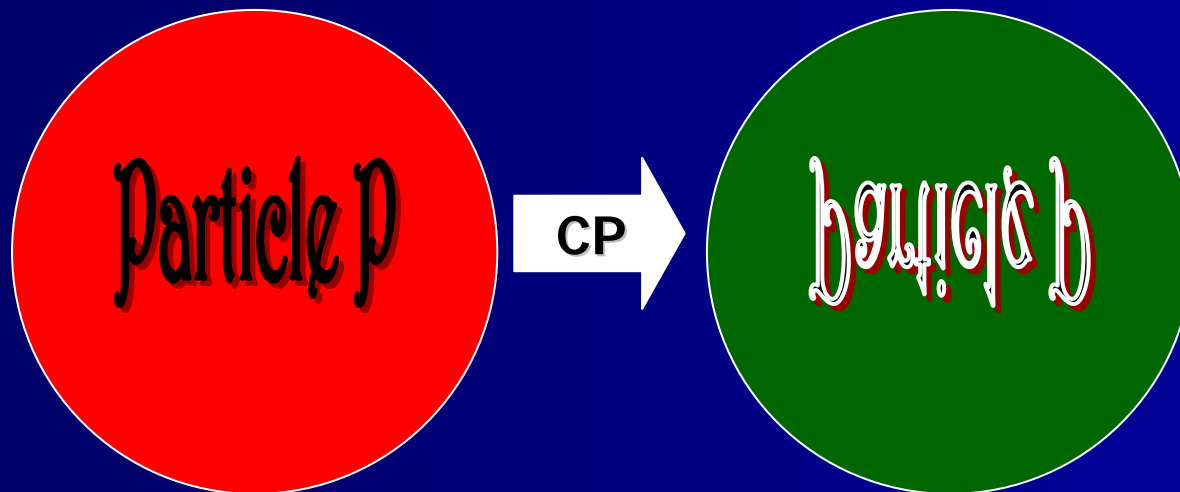
Illustration: Typoform



3. B-physics at LHC

C: **particle-antiparticle** symmetry

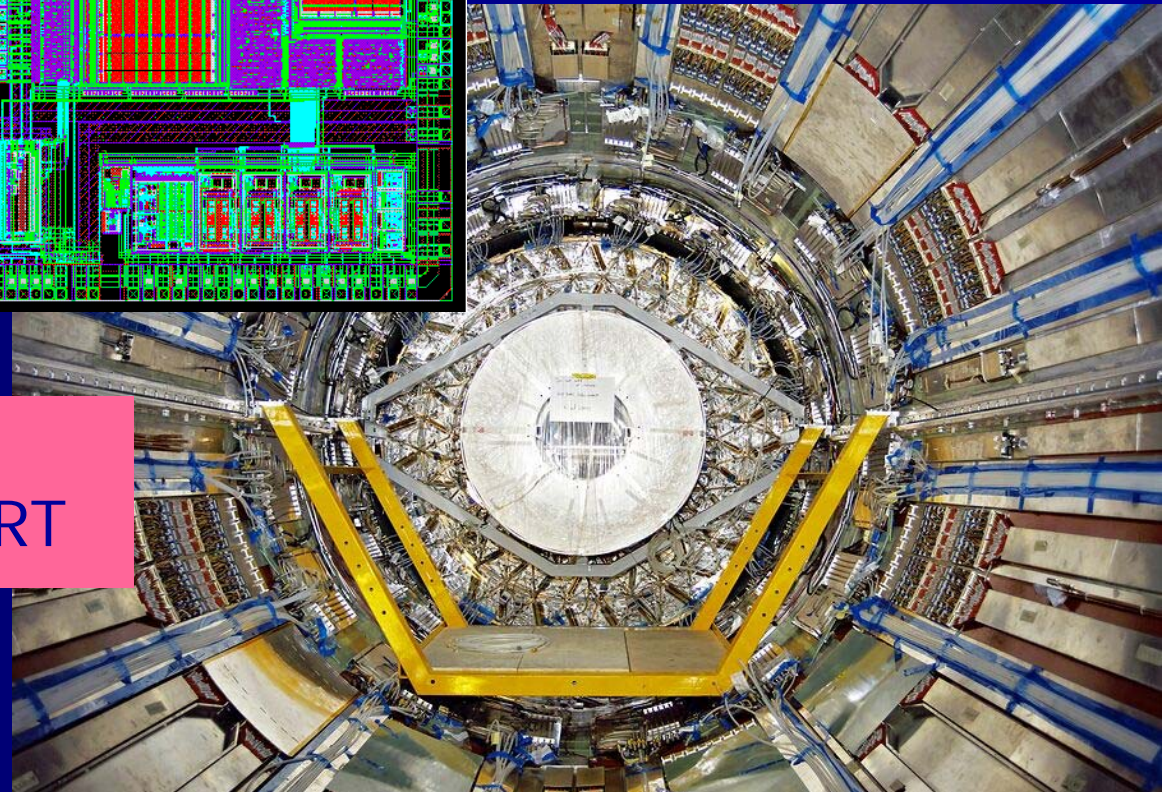
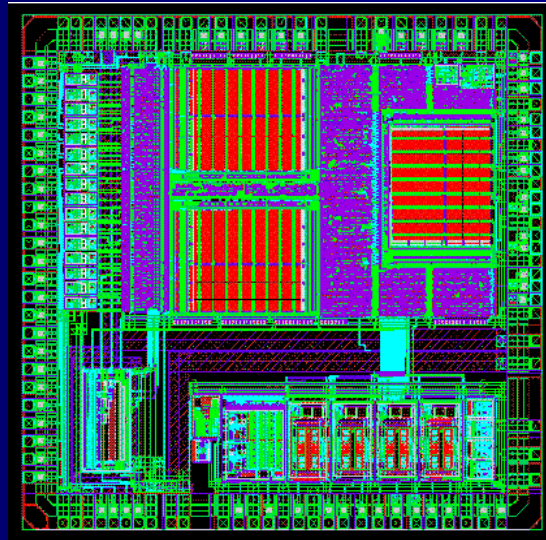
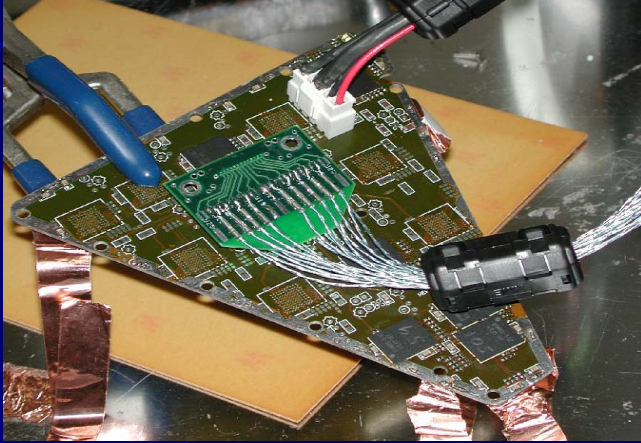
P: mirror symmetry



High-precision CP-violation measurements by comparing decays of B- and anti-B-mesons (e.g. $B_d \rightarrow J/\psi K^0_S \dots$)

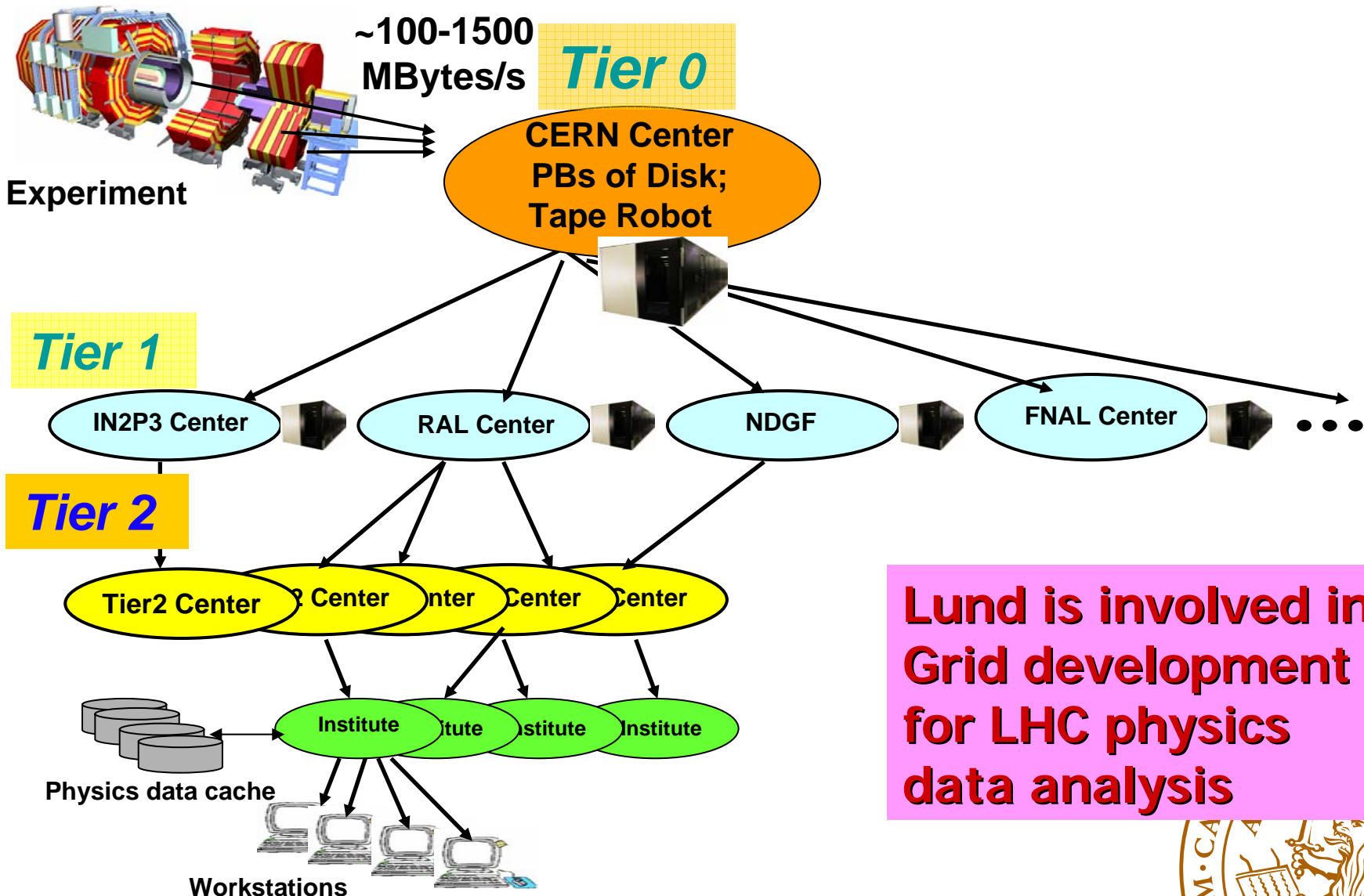


Detector parts built in Lund

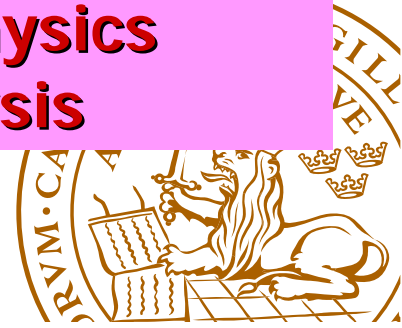


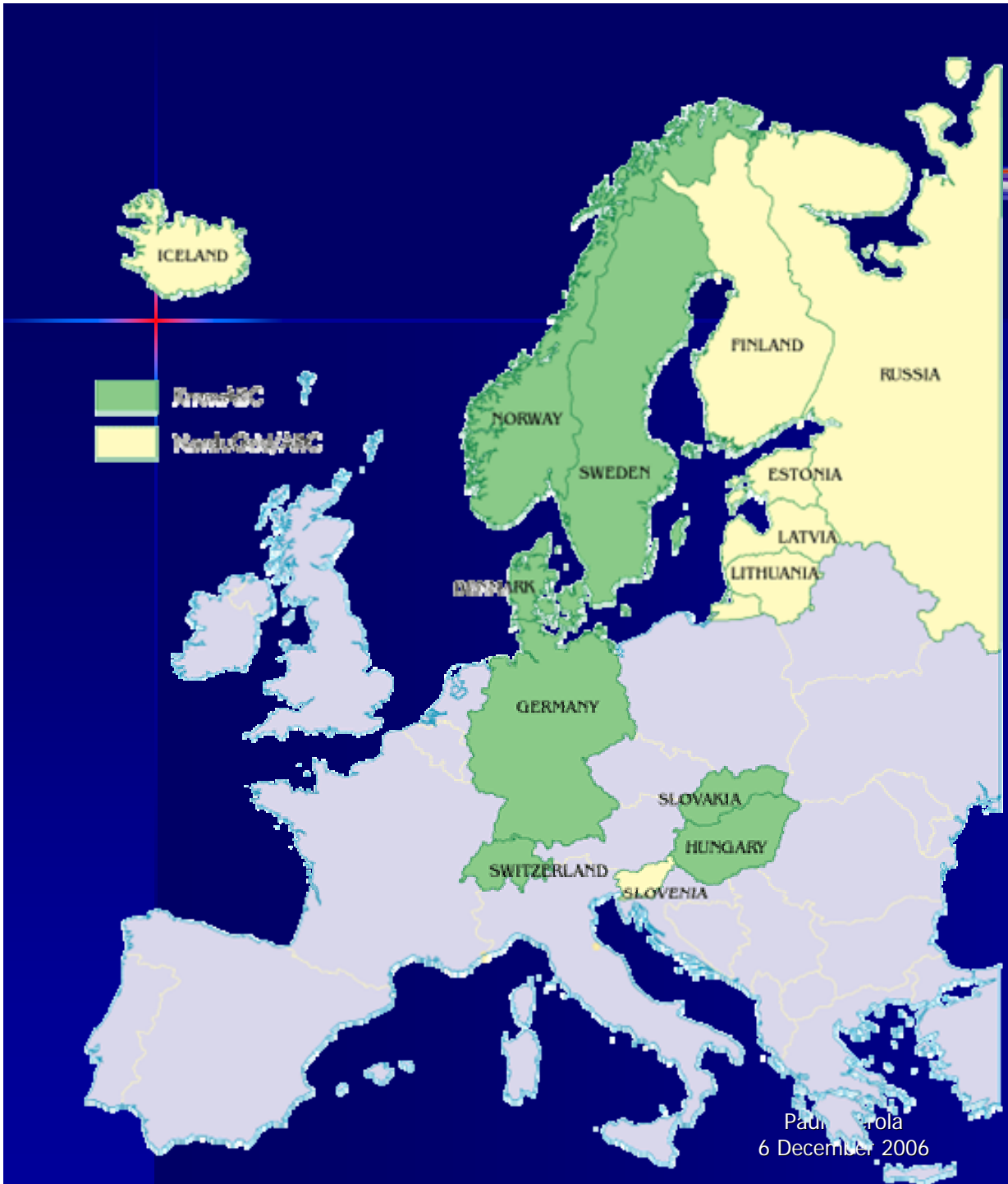
- Tracking detector electronics for ATLAS TRT

Grid: distributed processing of data



Lund is involved in Grid development for LHC physics data analysis





KnowARC

Paula Perola
6 December 2006



Courses and summer courses

- "Introduction to Particle Physics" FYS225 (5p):
next time VT07 January-March (LP3)
- "Modern subatomic physics" FYS246 (5p): next
time VT07 March-May (LP4)
- CERN Summer Student programme
<http://humanresources.web.cern.ch/HumanResources/external/recruitment/students/summer/summ.asp>
deadline 31 January 2007
- DESY Summer Student programme
<http://www.desy.de/summerstudents/>
deadline 31 January 2007



The Summer Student Programme: How to Apply

We are now accepting applications for the 2007 programme.

All applications should be electronic and submitted using our e-recruitment system ERT (<http://ert.cern.ch>) by clicking [here](#) or on the image below:



The deadline for applications and all supporting documents to reach CERN is:

31 January 2007

A complete application should consist of:

- 1) the fully completed electronic application form;
- 2) curriculum vitae;
- 3) any additional academic information (such as list of subjects studied and marks or grades obtained); and
- 4) two 'reports on candidate' forms.

Important: candidates will receive an e-mail with an html link to the "report on candidate" form to forward to their referees ONLY AFTER their application has been received and checked by our service.

Only if you are unable to attach all supporting documents, such as academic records (list of subjects studied and grades obtained) to your electronic application, you may submit them on paper to the Recruitment Service which will be attached by us to the electronic application. These paper documents may be sent by ordinary post or fax. Please do not wait until the last moment! Our contact details are [here](#).

All applicants will receive an electronic notification of the result of their application by the end of March 2007.



home

DESY Summer Student Programme

Each summer DESY offers undergraduate students in physics or related natural science disciplines the possibility to participate in the research activities of the laboratory.

In **2007** the program takes place from **July 25 to September 18**. If you want to apply please refer to the [conditions](#).

Selected candidates join in the day-to-day work of research groups at the DESY Laboratory in Hamburg or Zeuthen (Berlin) and participate in one of these [activities](#).

While the work in the groups is the main activity, there will also be a series of lectures (given in English) related to the research done at DESY. Visits to the accelerators and experiments are also included in this programme.

If you are interested in our Summer Student Programme, please read the [how to apply](#) page.

Further information for the program at [Hamburg](#) and [Zeuthen](#)

An announcement poster (pdf-file) you find [here](#)

The web pages of the 2006 programme you find [here](#)

Group photos of summer students in Hamburg from last years : [1996](#), [1997](#), [1998](#), [1999](#), [2000](#), [2001](#), [2002](#), [2003](#), [2004](#), [2005](#), [2006](#)

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