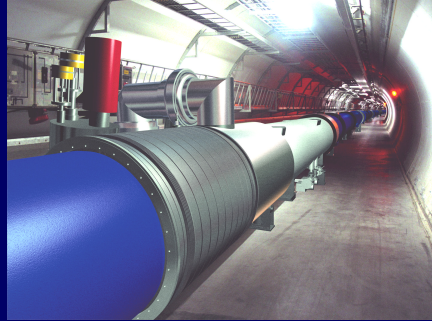
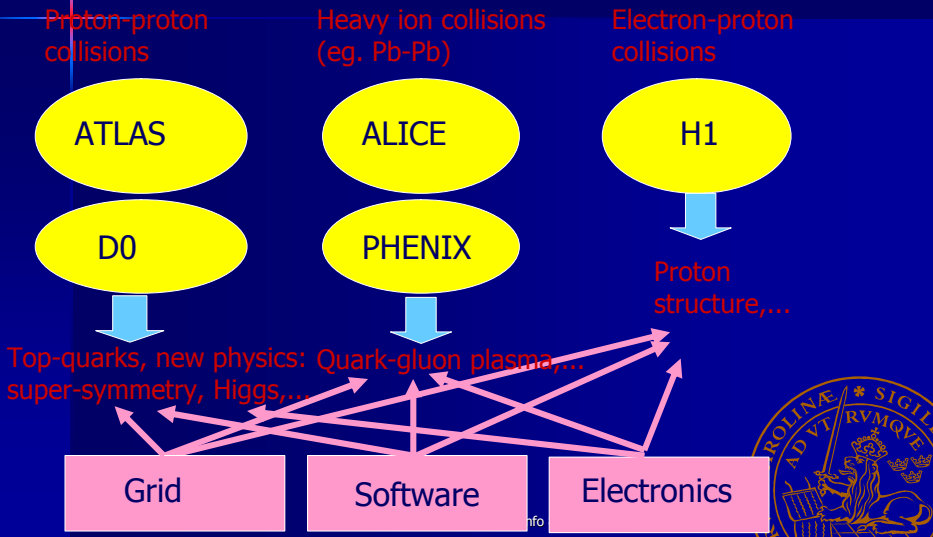


# Research presentations – experimental high energy physics



Paula Eerola, [paula.eerola@hep.lu.se](mailto:paula.eerola@hep.lu.se), 046-222 7695  
FYS225/FKF050, 8 Feb 2005

## Division for experimental high energy physics – house B, 3. floor



# Researchers and projects

- ATLAS, D0
  - P. Eerola, V. Hedberg, G. Jarlskog (emeritus), O. Smirnova, T. Åkesson.
- Grid (distributed data handling)
  - P. Eerola, B. Kónya, O. Smirnova
- ALICE
  - H.-Å. Gustafsson, A. Oskarsson, I. Otterlund, E. Stenlund.
- PHENIX
  - H.-Å. Gustafsson, A. Oskarsson, E. Stenlund.
  - PhD students S. Rosendahl, E. Haslum.
- H1
  - L. Jönsson.
  - PhD students M. Hansson, A. Knutsson, S. Osman.

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## CERN- projects

- ATLAS and other projects

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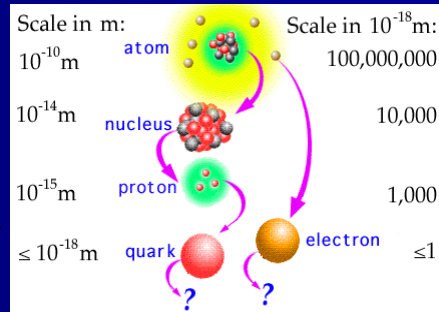


# Why do we need yet a bigger accelerator? Particles...

We know that there are quarks and leptons, but...

there are OPEN QUESTIONS:

- How do particles obtain masses? Through the Higgs mechanism?
- Why does the Universe consist of almost exclusively of matter, not antimatter? → CP violation
- The Dark Matter in the Universe – Supersymmetric particles?



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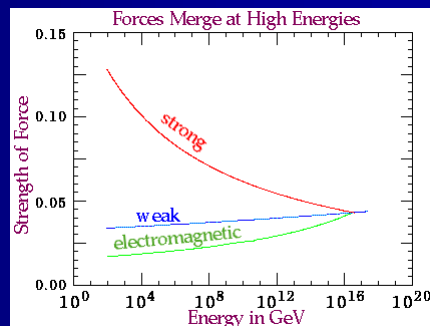
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## ...and forces

We know that there are four forces, but...

- Can we unify all the 4 forces into one theory?
- Can we unify gravity and quantum mechanics?

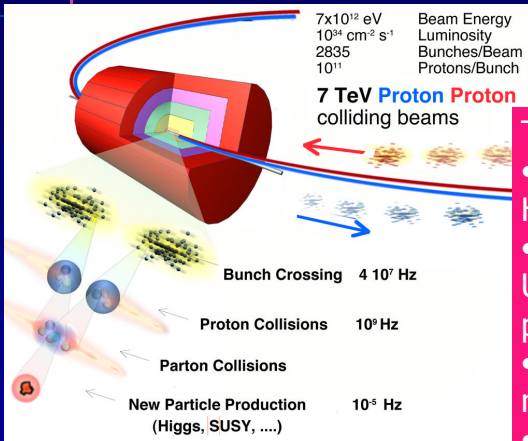


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# The Large Hadron Collider, LHC



To find out:

- The mass problem – Higgs?
- The Dark Matter of the Universe – supersymmetric particles?
- How was the Universe a moment after BIG BANG?
- Matter vs Antimatter?

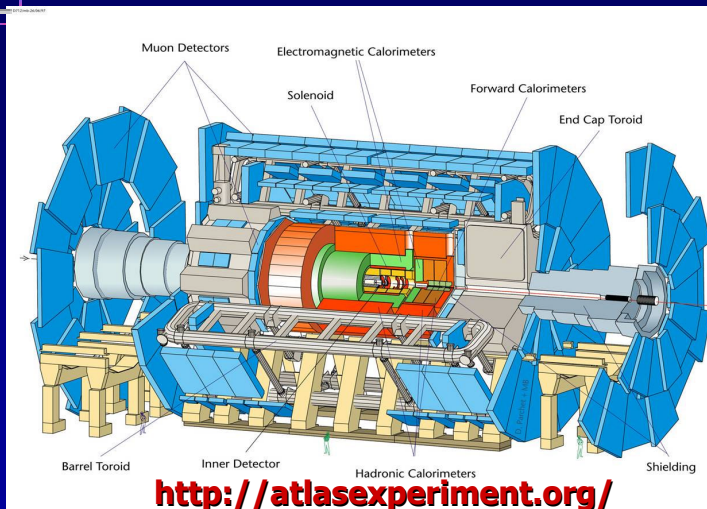
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Start 2007

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## The detector Sweden is involved in - ATLAS



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# ...and ALICE

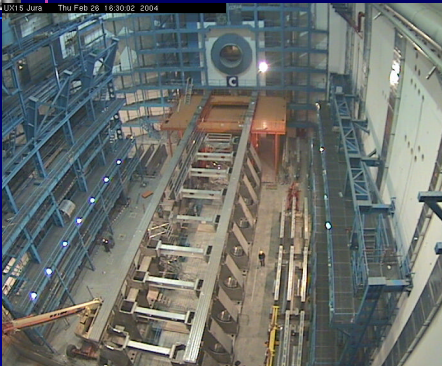


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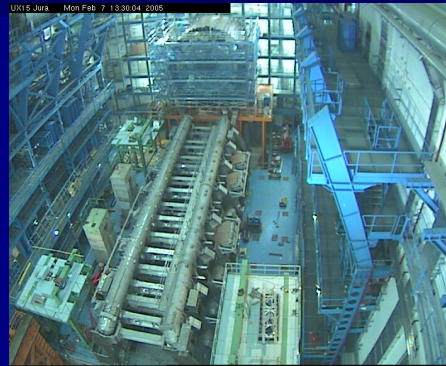
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# ATLAS experiment now...



Thu 26 Feb 2004 16:30



Mon 07 Feb 2005 13:30

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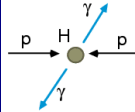
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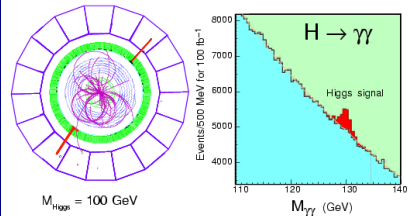
# Higgs physics

- Why do particles have a mass?
- The Higgs mechanism (or something similar) is required to generate particle masses
- BUT Higgs particle has not been found yet!
- Present tests: Higgs must be heavier than 115 GeV
- LHC: Higgs can be found if mass is 115-1000 GeV

## Higgs to 2 photons ( $M_H < 140$ GeV)



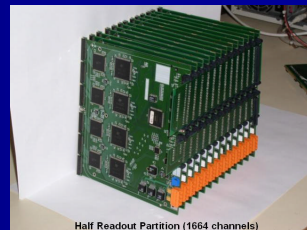
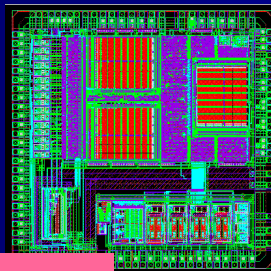
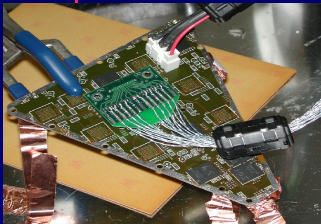
$H^0 \rightarrow \gamma\gamma$  is the most promising channel if  $M_H$  is in the range 80 – 140 GeV. The high performance PbWO<sub>4</sub> crystal electromagnetic calorimeter in CMS has been optimized for this search. The  $\gamma\gamma$  mass resolution at  $M_{H\gamma\gamma} \sim 100$  GeV is better than 1%, resulting in a S/B of  $\approx 1/20$ .



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# Detector parts being built in Lund



■ Tracking detector electronics for ATLAS TRT

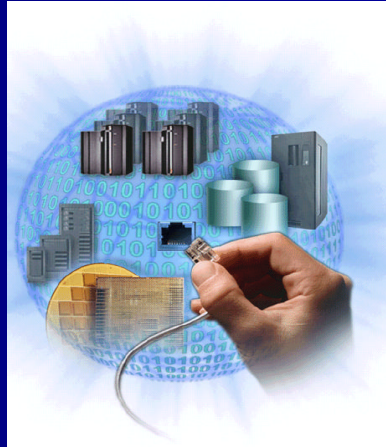
■ ... and for ALICE

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# About the Grid

- **WEB**: get **information** on any computer in the world
- **GRID**: get **CPU-resources**, **disk-resources**, **tape-resources** on any computer in the world
- Grid needs advanced software, **middleware**, which connects the computers together
- Grid is the future infrastructure of computing and data management



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# Current NorduGrid status



2004-05-06 CEST 02:18:09

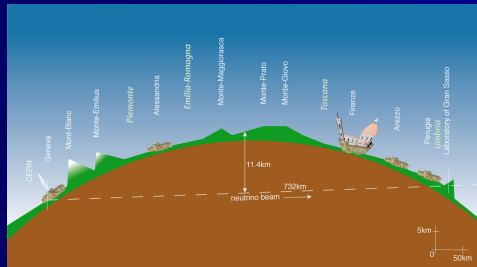
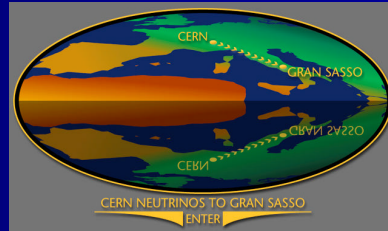
Processes: ■ Grid ■ Local

Site	CPU's	Load (processes: Grid+local)	Queueing
ATLAS (Orsted)	30	0/0	0
DiSLab (DIKU)	9	0/0	0
Benedict (AAU/DCGC)	32	0/0	0
Horseshoe (DCSC/SU)	551	0/407	40
NBI GRID	4	3/0	0
HEP AXI	1	0/0	0
Morphos	18	0/0	0
Theory (DCSC/KU)	104	0/0	1
VCR (VideoRecorder)	1	1/0	0
CMS on CERH Linux	1	0/0	0
CMS test cluster	1	1/0	0
CSC Kirppu	1	0/0	0
Hirwa Cluster (HEP)	16	0/0	0
Alpha (HEP)	1	0/0	0
Paralab IBM Cluster	58	0/58	65
Bergen Grid Cluster	4	2/0	0
Oslo Grid Cluster	36	0/0	0
Gjovik Grid Cluster	1	0/0	0
UP7S GRID	1	0/0	0
SIGNET	42	0/10	0
Bluesmoke (SweGrid, NS>)	100	0/230	93
Kosovs farm	66	0/0	0
Grandel	14	0/0	5
ISV	4	0/1	0
Haagrid (SweGrid, Hppma>)	94	0/0	0
Hive (SweGrid, UNICC)	99	0/0	0
Engrid (SweGrid, HPC2H)	101	101/0	330
Ingvar (NSC)	31	0/27	2
Monolith (NSC)	394	0/344	222
Quark Cluster	7	2/0	0
Seth (HPC2H)	202	0/153	36
Beppe (SweGrid PDC KY>)	92	0/74	238
SigrM (SweGrid, Luna>)	99	0/26	3
HEP CH	1	0/0	0
<b>TOTAL</b>	<b>34 sites</b>	<b>2227 291 + 1302</b>	

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# CERN has even other plans...

- ... like sending neutrinos to Italy... to observe neutrino oscillations



2005



## What do we do here in Lund?

<http://www.hep.lu.se/>

- Who? ATLAS/Grid-group has 5 physicists and 2 engineers.
- Physics studies with ATLAS:
  - CP-violation, B-physics
  - Supersymmetry and other "new physics"
- Software development: GRID
- ATLAS detector construction: Transition Radiation Tracker (TRT)
- Possibilities for diploma works
  - Physics simulations about CP-violation, supersymmetry,...
  - Grid-development and interface between physics and Grid
  - ATLAS detector: analysis of TRT test beam data, TRT module installation and testing
  - Muon lab

Diploma works: contact us! [Paula.eerola@hep.lu.se](mailto:Paula.eerola@hep.lu.se), 046-222 7695



# Courses and summer courses

- "Introduction to Particle Physics FYS225 (5p)", Jan-Mar. See <http://www.hep.lu.se/staff/eerola/fys225.html>
- CERN Summer Student programme: see <http://public.web.cern.ch/Public/>
  - 3 months summer course at CERN, incl. Research and lectures. Full salary, travels are reimbursed!
  - Ca 130 best students from CERN member states
  - Requirements: 3 years of studies
  - Next deadline: end of January 2006
- More info: contact us!

