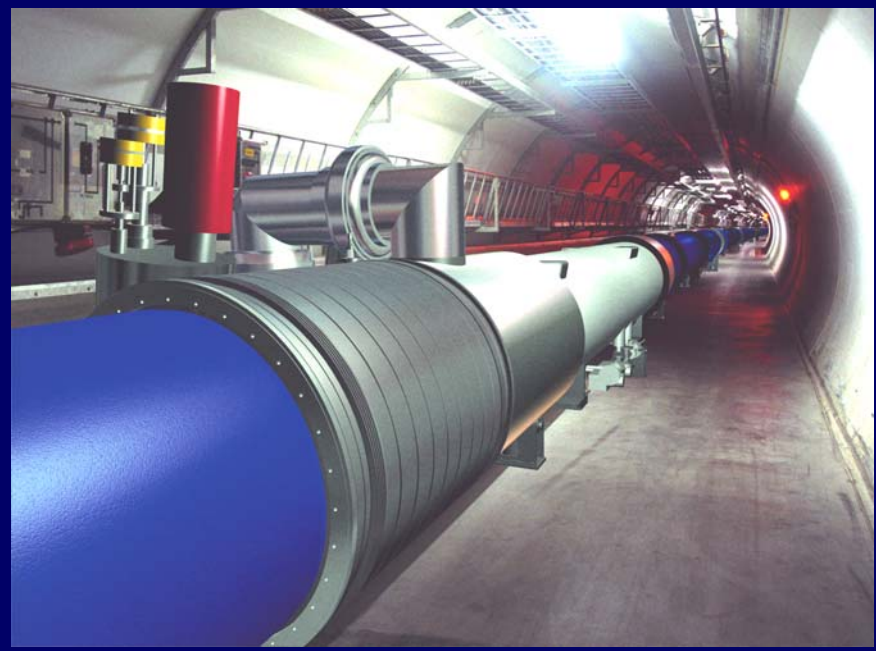
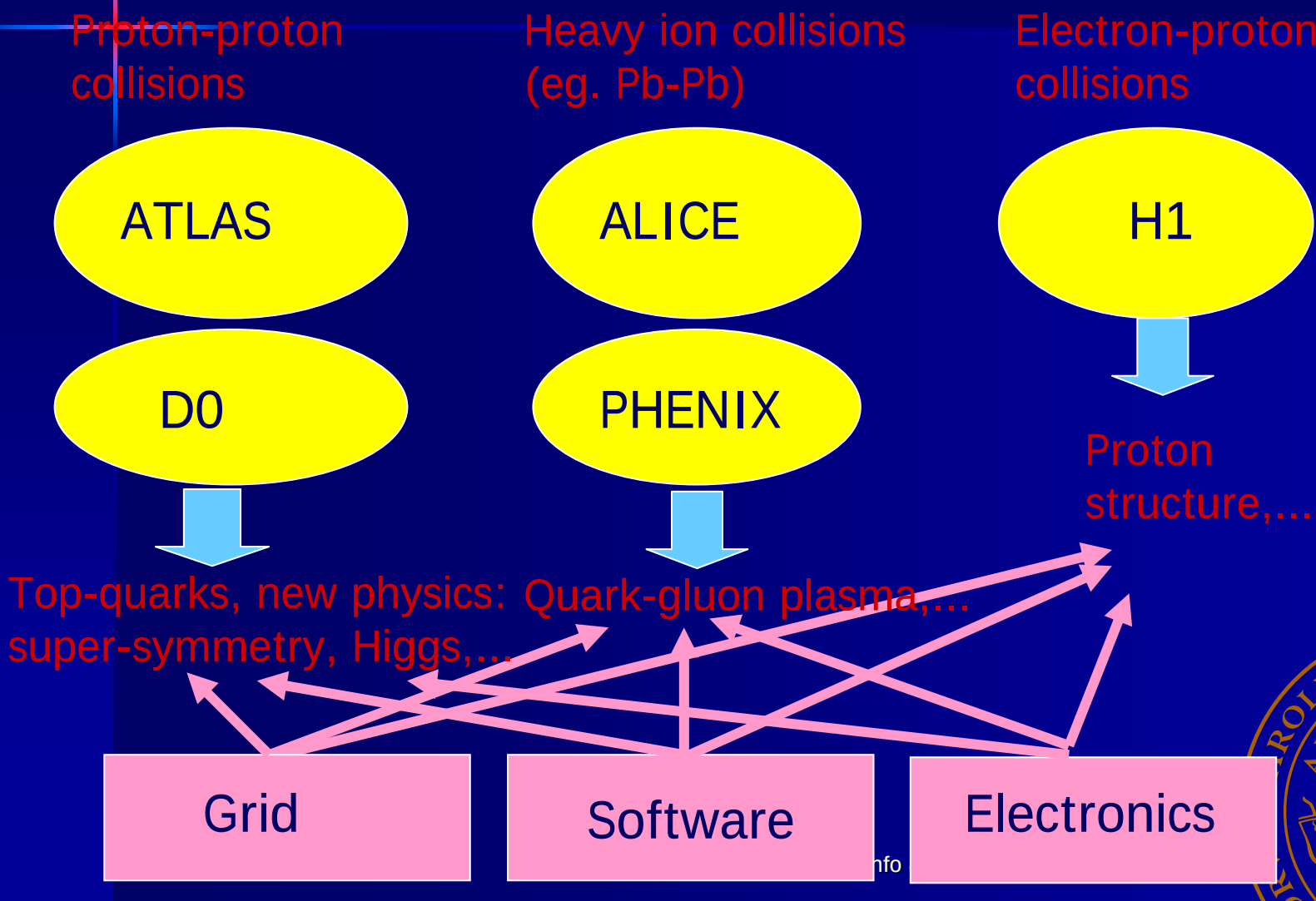
Research presentations – experimental high energy physics



Paula Eerola, paula.eerola [at] hep.lu.se, 046-222 7695
FYS225/FKF050, 8 Feb 2005

Division for experimental high enegy 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.

CERN- projects

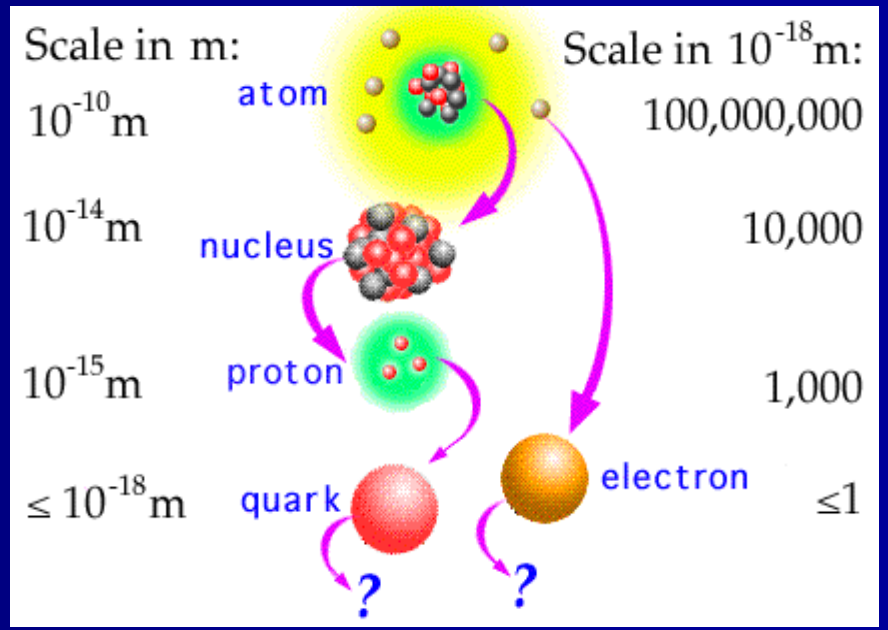
- *ATLAS and other projects*

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

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

there are OPEN QUESTIONS:

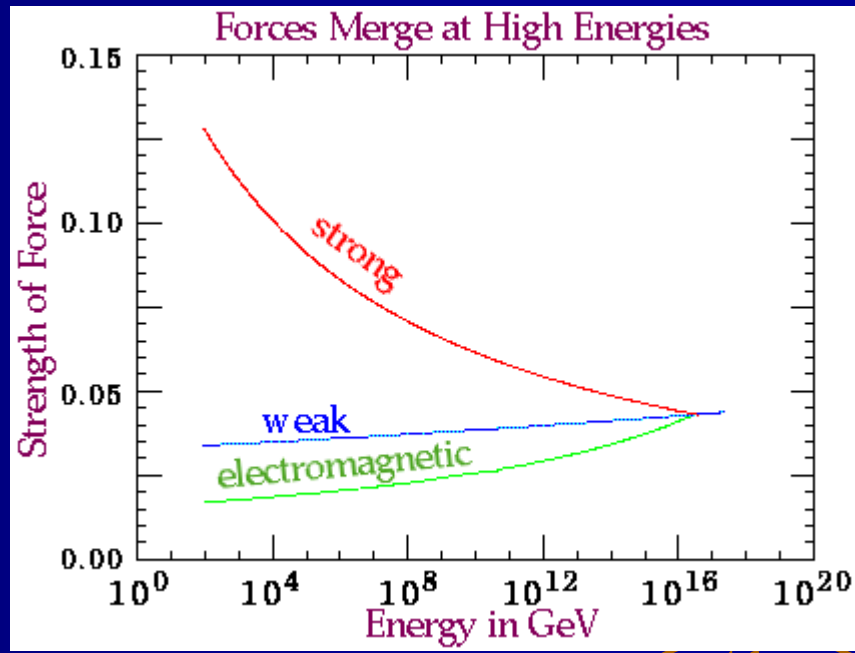
- How do particles obtain masses? Through the Higgs mechanism?
- Why does the Universe consist of almost exclusively of matter, not antimatter?→ CP violation
- The Dark Matter in the Universe – Supersymmetric particles?



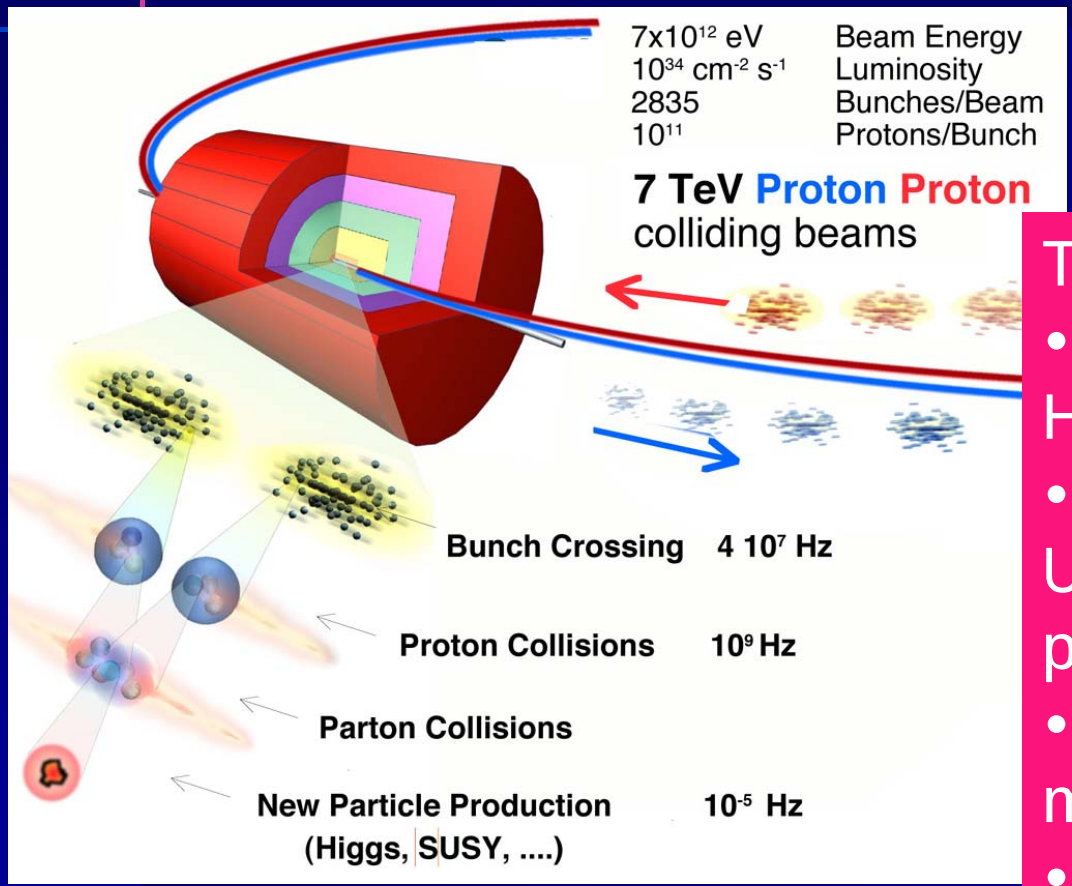
...and forces

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?



The Large Hadron Collider, LHC

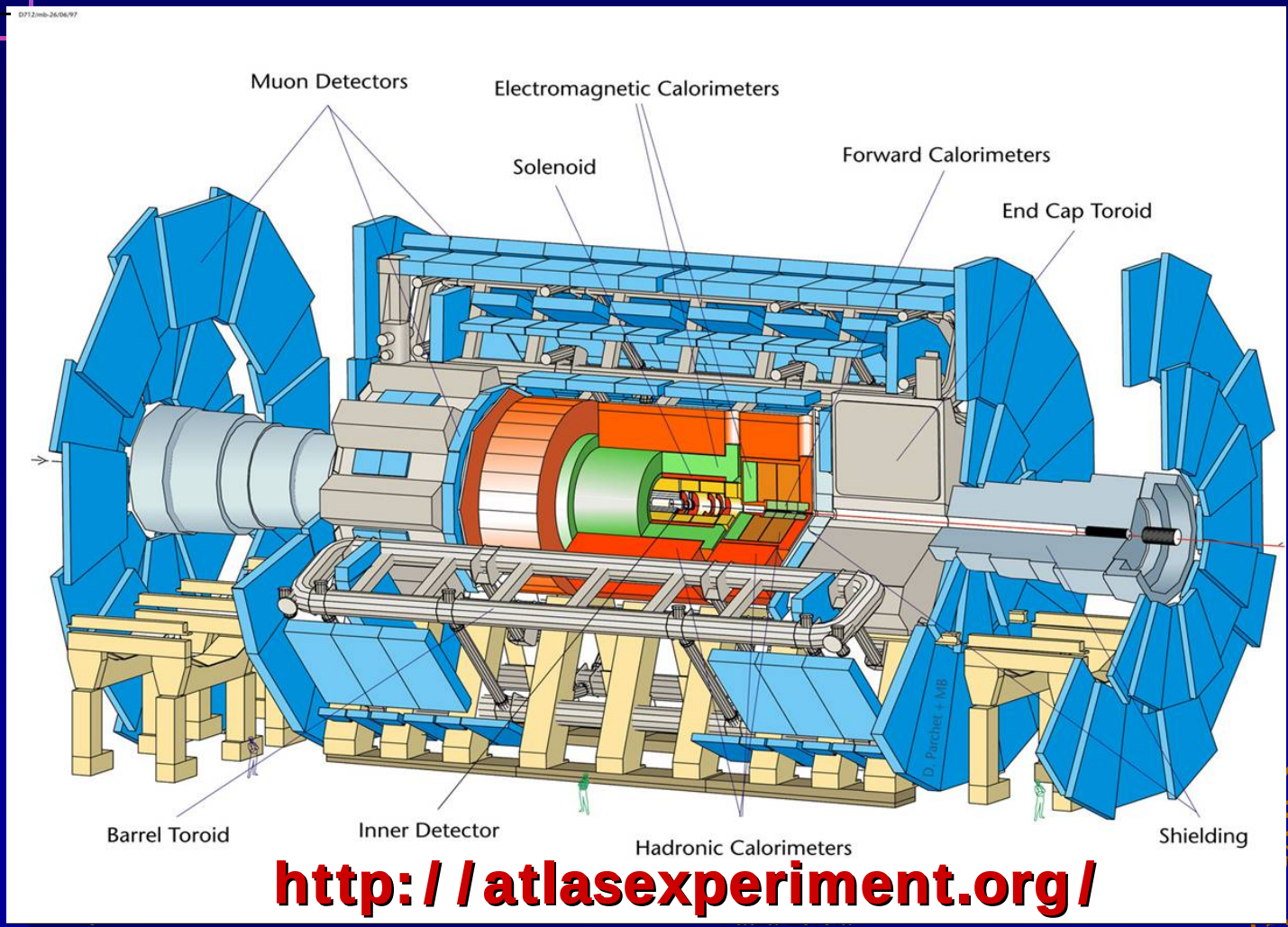


To find out:

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

Start 2007

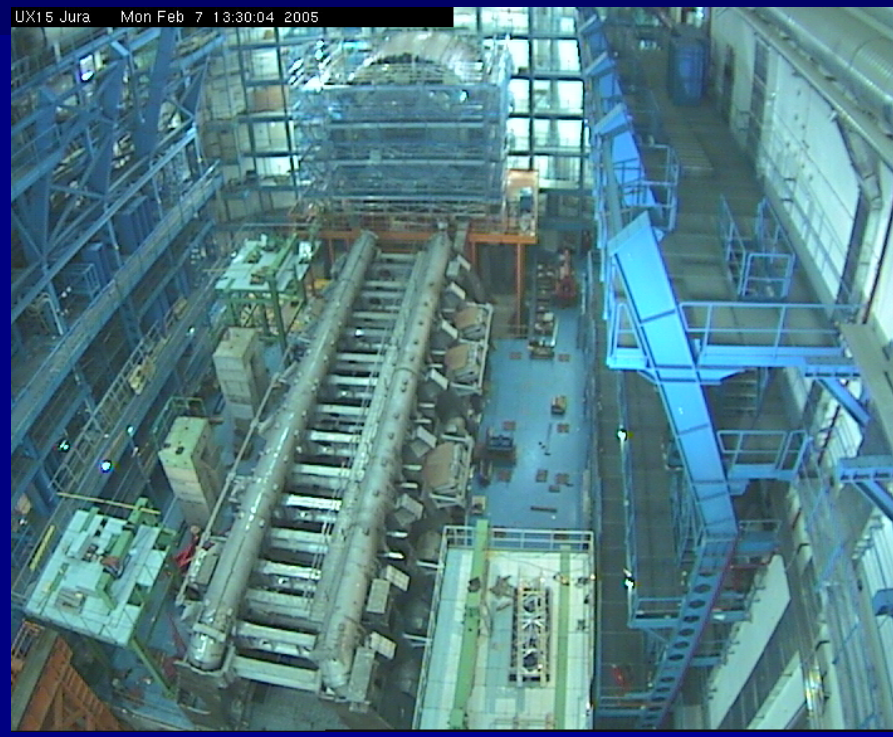
The detector Sweden is involved in - ATLAS



http://atlasexperiment.org/

...and ALICE

ATLAS experiment now...



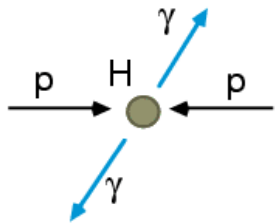
Thu 26 Feb 2004 16:30

Mon 07 Feb 2005 13:30

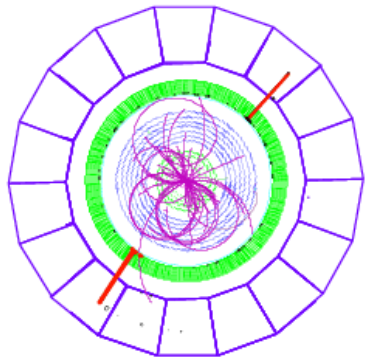
Higgs physics

- 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

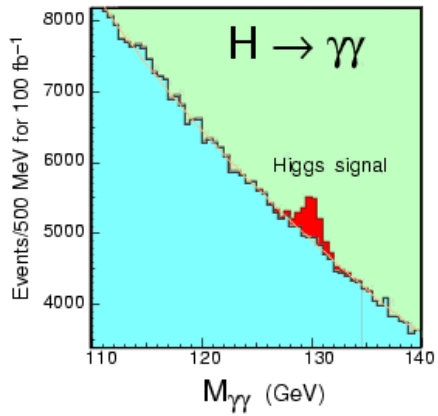
Higgs to 2 photons ($M_H < 140$ GeV)



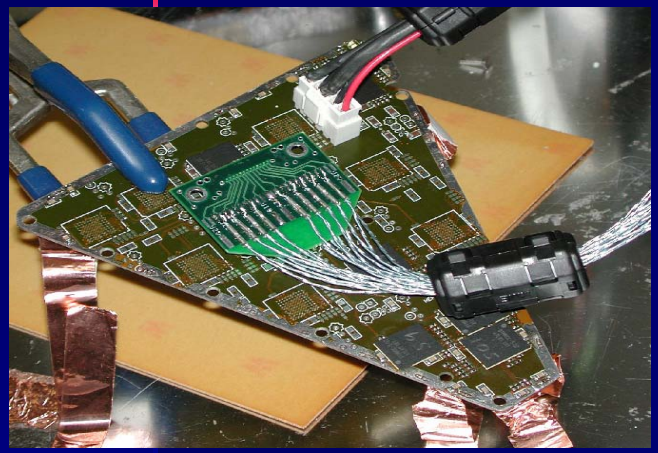
$H^0 \rightarrow \gamma\gamma$ is the most promising channel if M_H is in the range 80 – 140 GeV. The high performance $PbWO_4$ crystal electromagnetic calorimeter in CMS has been optimized for this search. The $\gamma\gamma$ mass resolution at $M_{\gamma\gamma} \sim 100$ GeV is better than 1%, resulting in a S/B of ≈1/20

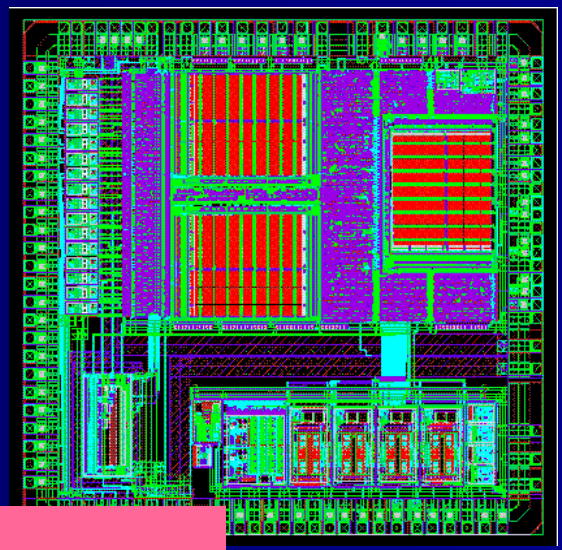


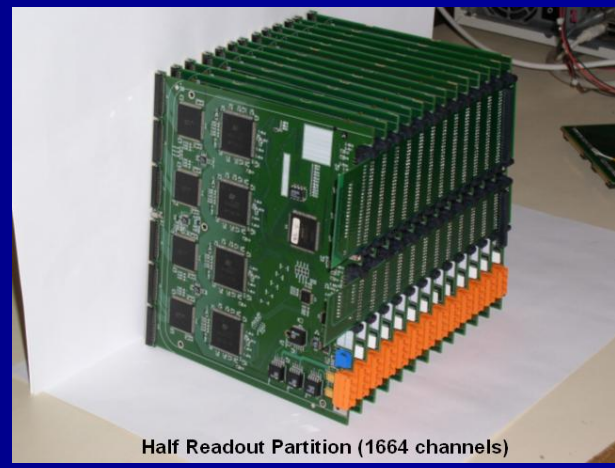
M_{Higgs} = 100 GeV



Detector parts being built in Lund







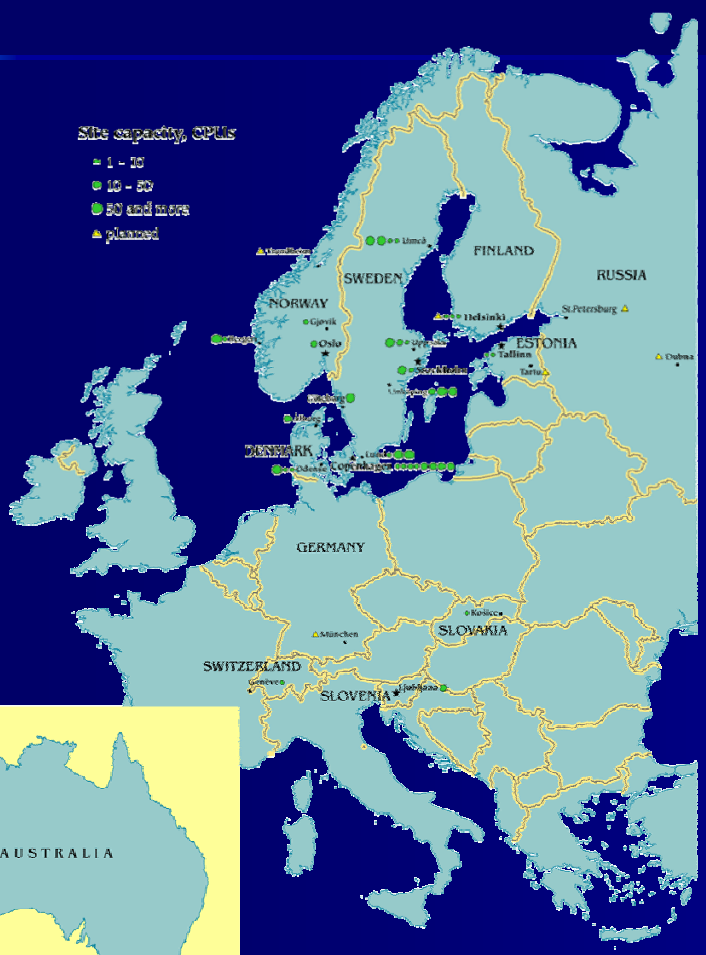
- Tracking detector electronics for ATLAS TRT

- ... and for ALICE

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

Current NorduGrid status



Grid Monitor

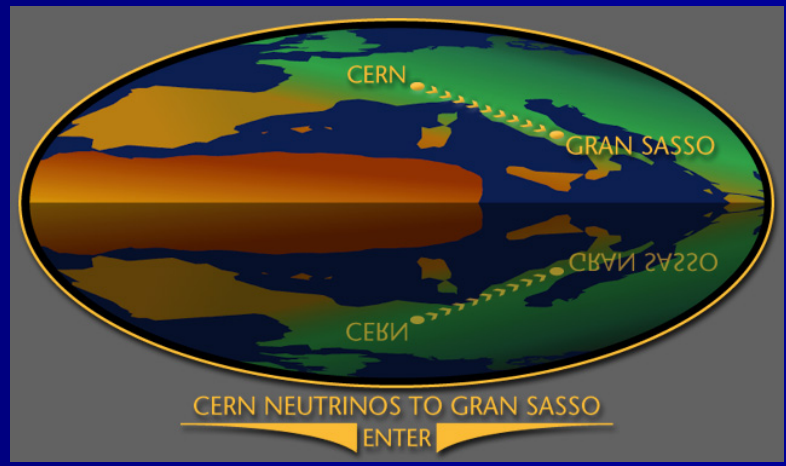
2004-05-06 CEST 02:15:09

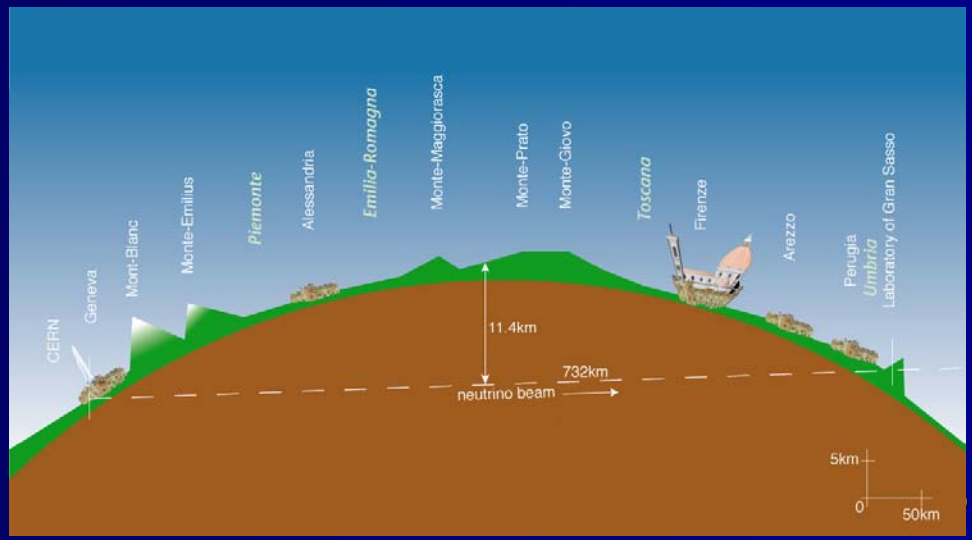
Processes: Grid Local

	Site	CPUs	Load (processes: Grid+local)	Queueing
Australia	ATLAS (UniMelb)	30	0+0	0
Denmark	DistLab (DIKU)	9	0+0	0
	Benedict (AAU/DCGC)	32	0+0	0
	Horseshoe (DCSC/SDU)	561	0+497	40
	NBI GRID	4	3+0	0
	HEPAX1	1	0+0	0
	Morpheus	18	0+0	0
	Theory (DCSC/KU)	104	0+49	1
	VCR (VideoRecorder)	1	1+0	0
Estonia	CMS on CERN Linux	1	0+0	0
	CMS test cluster	1	1+0	0
Finland	CSC Kirppu	1	0+0	0
	Hirmu Cluster (HIP)	16	0+0	0
	Alpha (HIP)	1	0+0	0
Norway	Parallab IBM Cluster	58	0+58	65
	Bergen Grid Cluster	4	2+0	0
	Oslo Grid Cluster	36	0+0	0
	Gjovik Grid Cluster	2	0+0	0
Slovakia	UPJS GRID	1	0+0	0
Slovenia	SiGNET	42	0+10	0
Sweden	Bluesmoke (Swegrid,NS>	100	62+30	93
	Kosufy farm	66	30+0	0
	Grendel	14	0+0	5
	ISV	4	2+0	0
	Hagrid (SweGrid,Uppma>	94	0+0	0
	Hive (Swegrid, UNICC)	99	0+66	0
	Ingrid (SweGrid,HPC2N)	101	101+0	330
	Ingvar (NSC)	31	0+27	2
	Monolith (NSC)	394	0+344	222
	Quark Cluster	7	2+0	0
	Seth (HPC2N)	202	0+133	36
	Beppe (SweGrid PDC KT>	92	87+4	238
	Sigrid (SweGrid, Luna>	99	0+76	3
Switzerland	HIP CH	1	0+0	0
TOTAL	*34 sites*	*2227*	*291 + 1302*	

CERN has even other plans…

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





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 [at] 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!