

GRID for LHC Physics Analysis

Mattias Ellert

Department of Nuclear and Particle Physics
Uppsala Universitet

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Computing resources for LHC

- CERN IT
 - can't handle everything
- The computers at your university department
 - usually not very impressive
- Computing resources at academic computing centres
 - different systems, access methods, etc.

NorduGrid

- Computing and storage resources at university departments and computing centres in the Nordic countries (and beyond) have been connected to a grid using the ARC middleware developed by NorduGrid
- <http://www.nordugrid.org/>

What the Grid Offers

- Single sign-on to a heterogeneous distributed set of computing and storage resources
- Up-to-date information about available resources
- Automatic matchmaking (resource brokering)
- Job monitoring
- Input and output data movement

How does it work?



User



GIIS



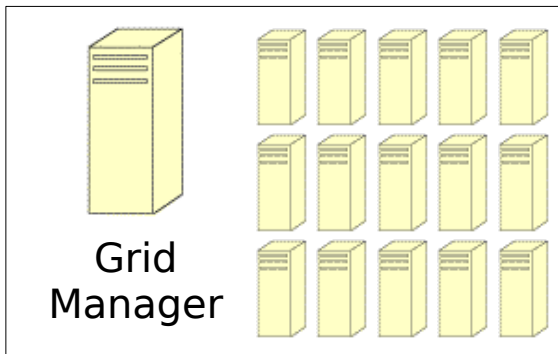
Storage Element



Storage Element

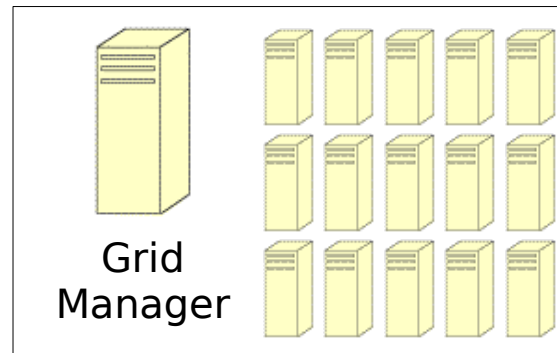


Replica Catalog



Grid
Manager

Cluster



Grid
Manager

Cluster

An online tutorial ...

- ... for running ATLAS analyses on ARC enabled resources can be found here:
<http://www.ift.uib.no/~mohn/NLHC/>
- Sending a simple computing job to a Grid is not that different from sending it to a batch system on a cluster
- Your job description must contain requirements for brokering and the location of the input data files

Computing intensive analyses

- ... like *e.g.* SUSY parameter scans, requiring Monte Carlo generation and simulation of signal and background samples for large sets of parameters can profit from the large computing resources available on the grid

A Real Example ...

- charged higgs \rightarrow chargino + neutralino
(Christian Hansen *et al.*)
- The masses and branching ratios depend on the MSSM parameters
- ~ 100 data points in the $m_A - \tan\beta$ plane
- For each data point: 10^5 signal events and $3 \cdot 10^7$ SUSY background events
- All events were simulated with HERWIG and processed with ATLFAST in NorduGrid

... with Published Results

Discovery potential for a charged Higgs boson decaying in the chargino-neutralino channel of the ATLAS detector at the LHC

C. Hansen^{†,1}, N. Gollub[†], K. Assamagan[‡], T. Ekelöf[†]

[†]*Uppsala University - Department of Radiation Sciences
Uppsala, SWEDEN*

[‡]*Brookhaven National Laboratory
Upton, NY 11973, USA*

Abstract

Charged Higgs boson production via the gluon-bottom quark mode, followed by its decay into a chargino and a neutralino has been investigated. Calculations are based on masses and couplings given by the Minimal Supersymmetric Standard Model (MSSM) for a specific choice of MSSM parameters. The signal signature is characterized by three hard leptons, a substantial transverse energy due to the decay of the neutralino and the chargino hard jets from the hadronic decay of the top quark. The possibility of discovery of the signal over the Standard Model (SM) and non-SM backgrounds was studied in the $\tan\beta$ vs. m_A plane. The existence of 5- σ confidence level regions for H^\pm discovery at integrated luminosities of 100 fb⁻¹ and 300 fb⁻¹ is demonstrated, which covers the intermediate region $4 \lesssim \tan\beta \lesssim 10$ where H^\pm decays to SM particles used for H^\pm discovery.

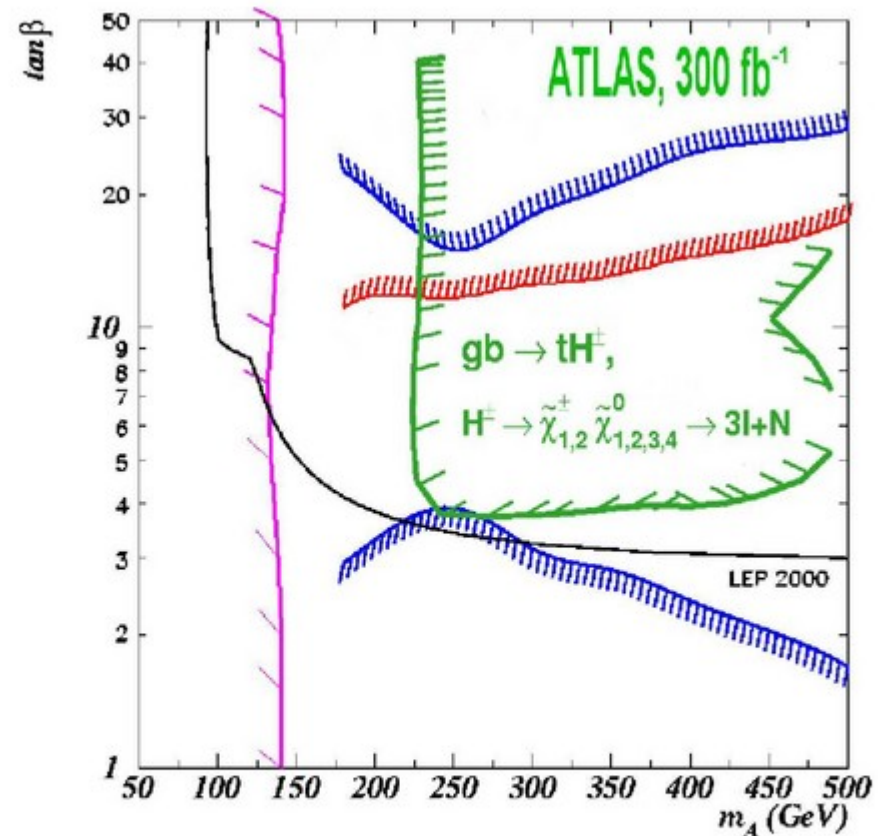


Figure 10: The 5- σ discovery contour for the $H^\pm \rightarrow \tilde{\chi}_{1,2}^\pm \tilde{\chi}_{1,2,3,4}^0 \rightarrow 3\ell + N$ channel for the parameter set defined in section 2 is shown in the $\tan\beta$ vs. m_A plane. The integrated luminosity is 300 fb⁻¹.

Nordic Grid Neighbourhood

- Network for promoting the use of Grid technologies in the Nordic and Baltic countries
- Organises workshops and conferences
- Next workshop will be in Uppsala 19-20 January: <http://www.grid.tsl.uu.se/NGN5/>

Summary

- Grid technologies make it possible for users to have access to many, geographically distributed, computing resources in a uniform way
- The available computing resources can be used in a more efficient way
- Analyses that require many specialised Monte Carlo samples, like *e.g.* SUSY parameter studies are particularly well suited for being carried out on the Grid