

# US-ATLAS Nov 2001

Ian Hinchliffe LBNL

November 29, 2001



# Physics activities

- Recent activities off Project
- Recent activities on Project
- Immediate Future – Critical path items for DC
- Future activities



# Physics activities

- Lund Workshop (14/100 talks by US people)  
First major exposure of Athena to “user community”
- Impact of staging
- Impact of detector changes  
Bigger gaps in Muon system  
Fully insertable Pixels
- Thoughts about an upgrade  
Study of physics impact of energy and or luminosity upgrades  
Requested by CERN Director General



# Lund Feedback – Main points

Code is not available outside LBNL, BNL and CERN

Need for same geometry in Simulation and reconstruction **In process**

Unclear distinction between developer and production releases

Concerns about bookkeeping

Complaints about mailing lists and information flow

Unstable environment (SRT/CMT) **transition completed**

Tutorials are broken **Being fixed**

Need for event skipping/filtering

Pile up support is needed **being worked on**

No user documentation on how to use Objy for output **being worked on**



# Upgrade Studies

Physics studies carried out in Summer 2000 and 2001 in response to request from CERN management.

Joint studies with CMS (plus theorists in 2001)

Addressed physics impact of Luminosity and energy upgrades. 28TeV and 10 times design luminosity.

Most activity focused on luminosity upgrade as this is less demanding for the machine and less costly

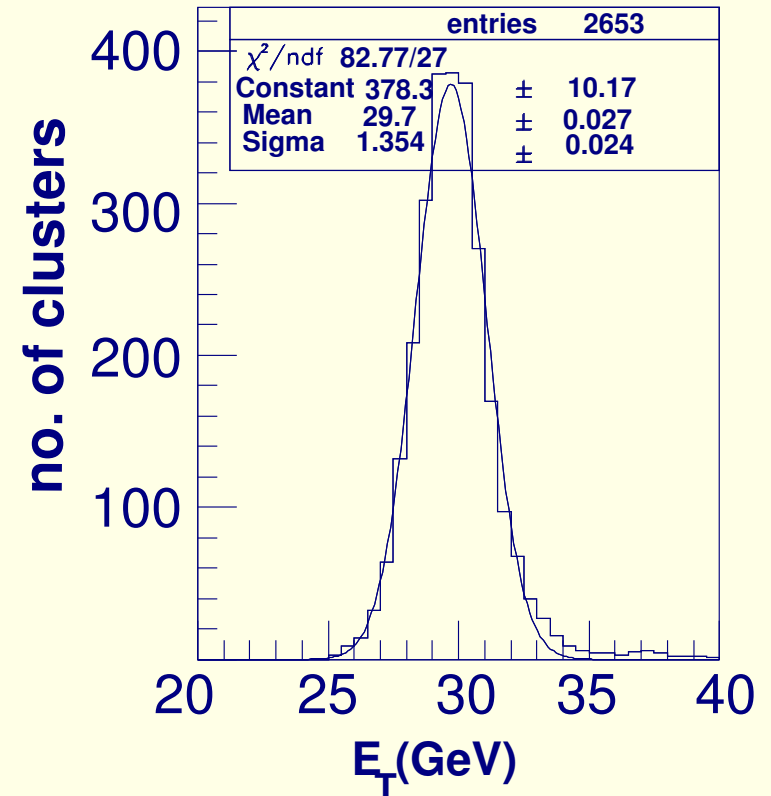
Ultimate Luminosity of  $2.3 \times 10^{34}$  could be achieved by current design but only in two experiments (ATLAS+CMS)



# Detector Performance

Luminosity is much more demanding

LAr calorimeter performance degrades  
30 GeV electrons  $\frac{\sigma}{E} \sim 2.5\%$  at  $10^{34}$   
 $\rightarrow \frac{\sigma}{E} \sim 3.6\%$  at  $10^{35}$



## b-tagging

Rejection factors against u-jets  
for 50% b-tagging efficiency

$P_T(\text{GeV})$	$10^{34}$	$10^{35}$
25-40	33	3.7
45-60	140	23
60-100	190	27
100-200	300	113
200-350	90	42

*e/jet* separation: 40GeV  $E_T$

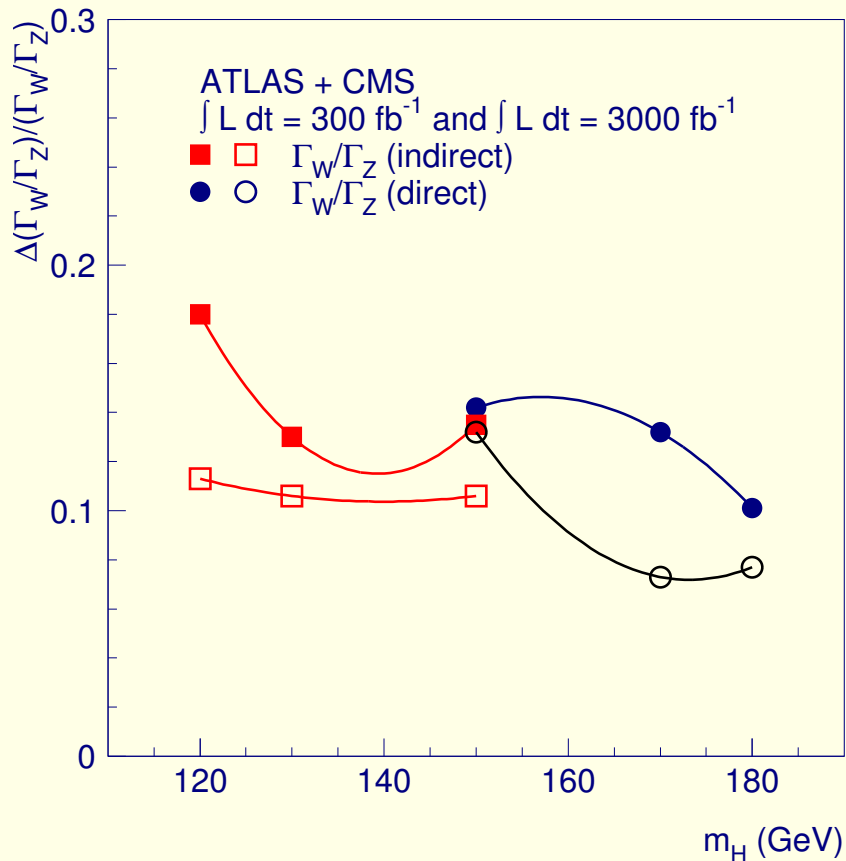
	Electron effic.	Jet Rejection
$10^{34}$	81%	$10600 \pm 2200$
$10^{35}$	78%	$6800 \pm 1130$

# Measurements of Higgs Couplings

Luminosity upgrade improves precision by up to a factor of two

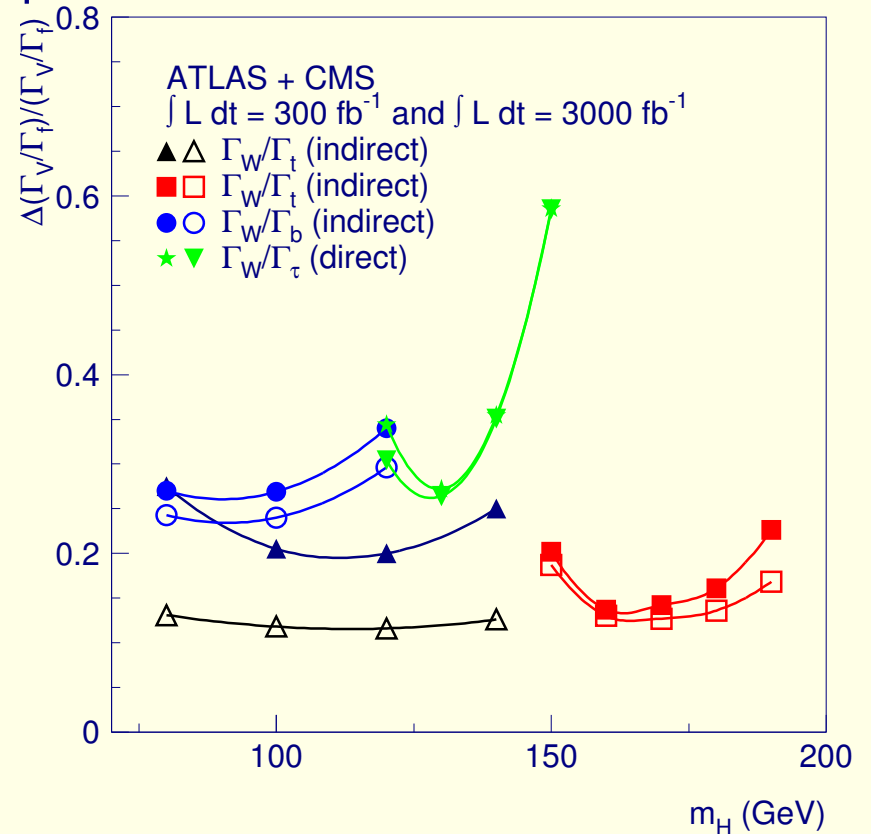
## Boson couplings

Measured from  $\gamma\gamma$ ,  $WW$  and  $ZZ$  decays



## Fermion couplings

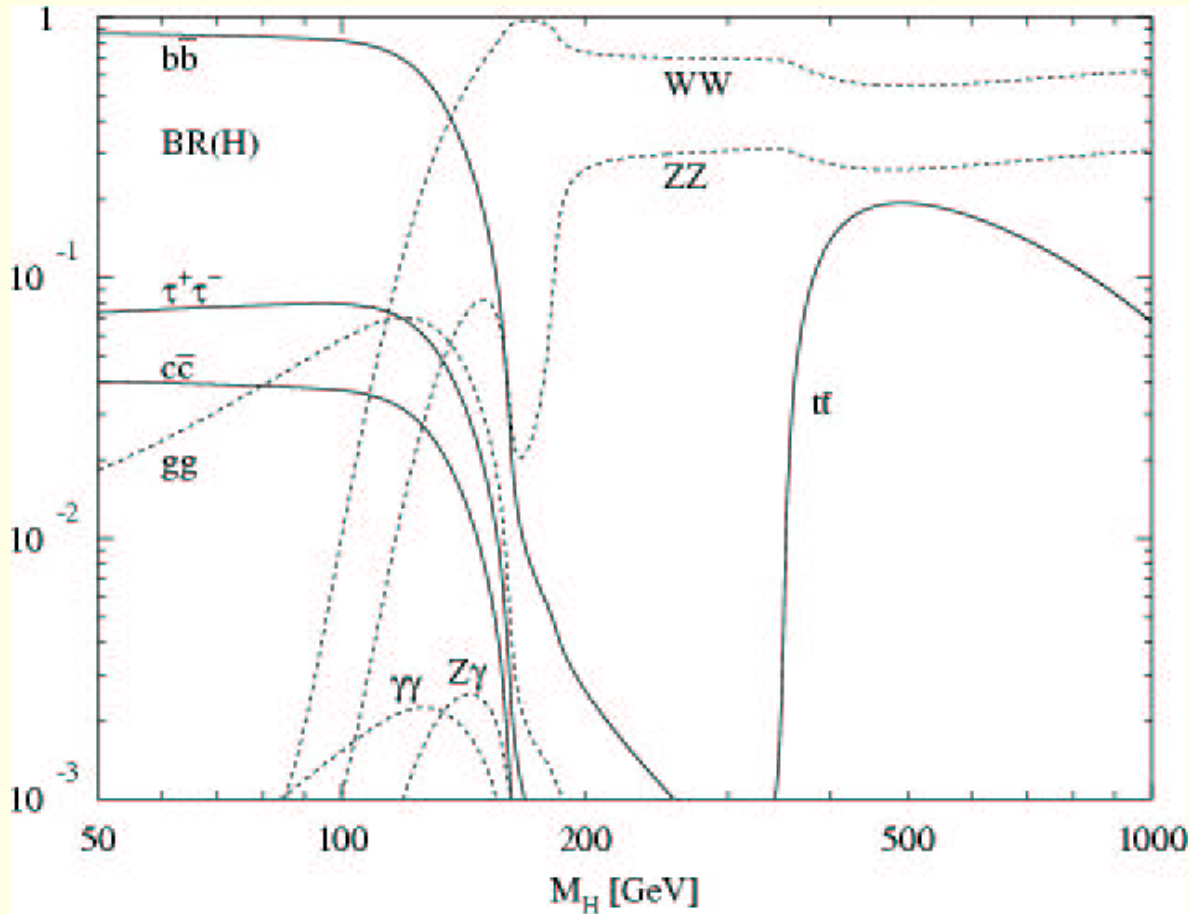
Inferred from  $\gamma\gamma$  and  $WW$  final states and comparison of  $WH$ ,  $t\bar{t}H$  and  $H$  production





$H \rightarrow Z\gamma$  is with  $Z \rightarrow \mu\mu$  or  $Z \rightarrow e^+e^-$  is visible

BR



ATLAS+CMS  $600\text{fb}^{-1}$   $3\sigma$ ;  $6000\text{fb}^{-1}$   $11\sigma$



# Higgs self coupling??

Preliminary particle level study of  $HH$  final states which contains a contribution from  $\lambda_{HHHH}$  Very hard to measure anywhere: linear collider folks claim 20% precision.

Event rates for  $6000\text{fb}^{-1}$ , both total rates and rates from  $WW$  fusion studied

Process	$M_H = 120$	$M_H = 140$	$M_H = 170$
$HH \rightarrow 4b$	6000	1000	0.5
$HH \rightarrow 2bl\nu\nu$	500	650	5
$HH \rightarrow 4l4\nu$	10	90	235
$qqHH \rightarrow qq4b$	380	70	0
$qqHH \rightarrow qq4b$	30	40	1
$qqHH \rightarrow qq4b$	0.5	6	15
$t\bar{t}H \rightarrow 6bl\nu jj$	15	2	0

b-tagging efficiency is vital (50% assumed)

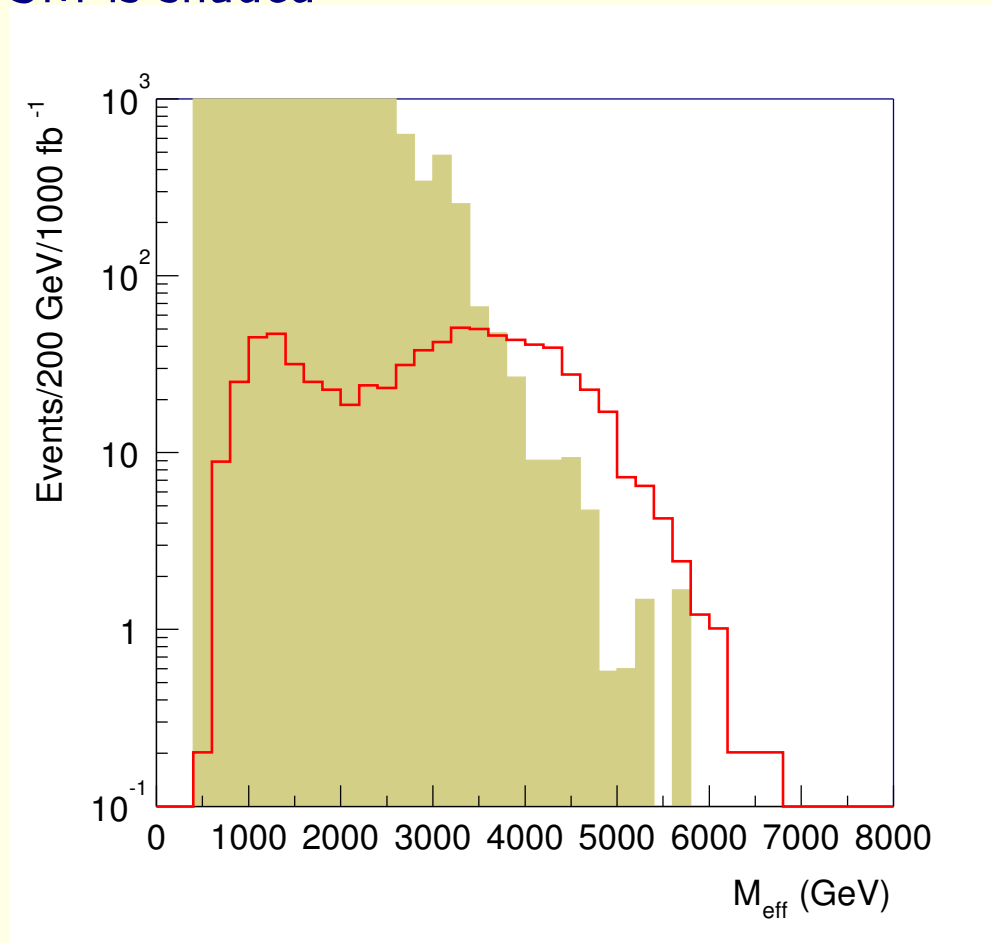
Only a few backgrounds estimated: jet rejection at least 40 is needed

# SUSY

$$M_{\tilde{g}} = 2.4 \text{ TeV}$$

SM is shaded

Mass reach extends by 30% to 3.5 TeV for gluinos in case of luminosity upgrade  
More detailed measurements become possible Note that energy upgrade is more powerful



# Critical Items for Data Challenges

DC0 (December 01) and DC1 (February - June 02)

Issues for physics Generation– WP1– I.H.

DC0 is  $Z + jet$  (leptonic Z decays only), mainly pythia (ready to go)

Some Isajet and Herwig for comparison

DC1 Jets for HLT/TDR; some “interesting physics” for improved physics studies and testing of analysis model.

Will also use dedicated min-bias generator (phojet) for comparison.



# Project activities

## Organization

Goal is to integrate Generators so that

All generators present data in the same format to simulation

Parameters are set at runtime

Version switching must be possible

Actual Generators are maintained outside Atlas codebase

Interface packages are part of Athena

See WBS for complete structure



# External packages

Each generator exists as an external package

/afs/cern.ch/atlas/offline/external/

allows us to have version control

Linksets from External for ease of use

Pythia 6.129 and 6.157 Exist – Maintained by Stan Thompson

Pythia 7 Maintained by Maya Stavrianakou

Herwig 6.1 Exists – Maintained by I.H. (volunteer needed)

Isajet 7.44 - 7.51 Exist – Maintained by Jim Shank

Taoula/Photos vanilla/CLEO/ALEPH versions Exist – Maintained by I.H. (volunteer needed)

Stdhep 4.07 Maintained by I.H. (volunteer needed)

EvtGen – Maintained by Maria Smizarska

Others need to be there, in particular CompHep, Grace, MADGRAPH, vecbos

These tasks should be spread among many people



# Athena Interface

Interfaces to load events into common format (HepMC) that can be used downstream

Documentation in Generators/GeneratorModules/doc and <http://www-theory.lbl.gov/~ianh/monte/Generators/>

Information is presented as a collection of HepMC structures

HepMC is an ATLAS developed product, exported to CLHEP

One interface per Generator. Interfaces are my responsibility at present



# Status – Lund Release

Isajet 7.51, Pythia 6.157 supported

Herwig 6.1 available except for SUSY

Pythia 6.129 can be used by simple change (needs recompile, straightforward for Athena users, impossible with tar ball)

GENZ to HepMC converter available (Maria S.), enables old generators (Pythia 5.7) to feed common format.





# Current Activity

Fix problems reported by users of Lund release

Full support for Herwig 6.3 – Should be in 3.0.0

Restructure of Event store (Storegate) – **just done**

Tauola integrated (M. Dosil) – (Code exists – 2.5.0)

Move to CLHEP names for HepMC – **just done**

Integrate Genz reader so that data can be fed to ATLFAST – **just done**

Interface to feed events to G4 – **exists in private area, Leggett**



## Longer term

Integrate EvtGen – Dedicated B decay package, vital for B-physics group

Improve user interface for parameter querying and setting.

Parton packages, Comphep *etc* – Discussion with CMS (De Roeck) about this



# Conclusions

Dissapointing that CLHEP is moving slowly on HepMC, we are still using ATLAS version.

Just about managed to “stay above water”

Serious Manpower shortage for DC.

Search has started for support person supported by project

Take over Interface support

Help manage generation for DC

Should get software agreement once person is hired.

