

The Linear Collider Roadmap



IWLC2010

CERN

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CERN

Topics

- A look back
- What 's new since Beijing
- What can we expect from LHC and Tevatron
- What can you expect from CERN
- What do we expect from you
- The next years

A look back

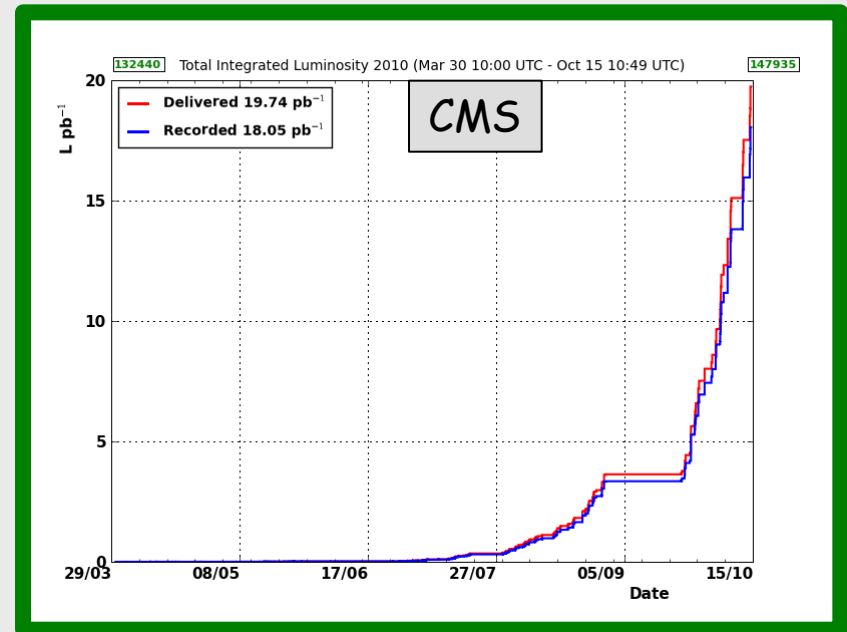
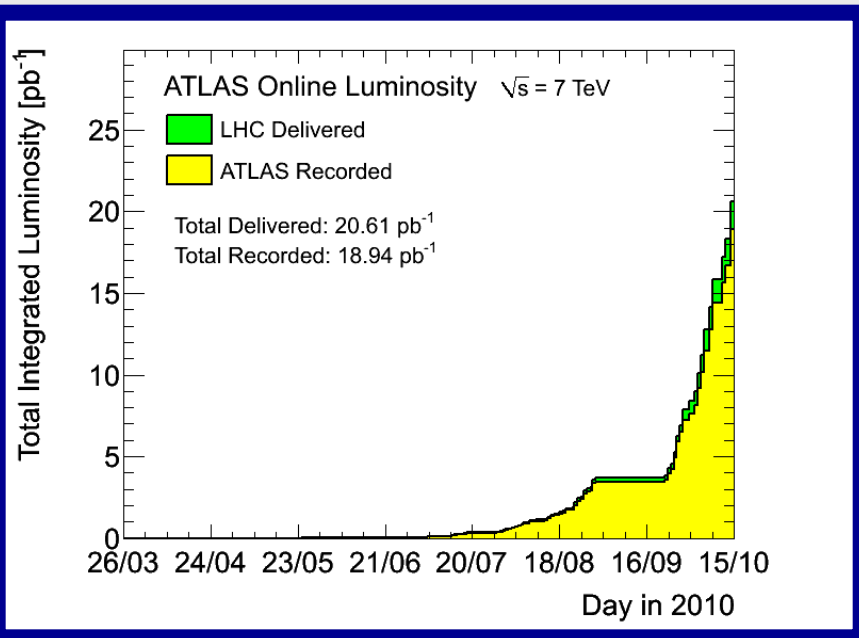
Summary RDH in Beijing, March 26, 2010

- By year 2013, **experimental results** will be dictating the agenda of the field.
- Early discoveries will greatly accelerate the case for the construction of the next facilities (Linear Collider, ν -factory, SLHC...)
- No time to idle: a lot of work has to be done in the meantime

What's new since Beijing

- LHC machine has started March 30 with steadily increasing performance at 7 TeV cms energy

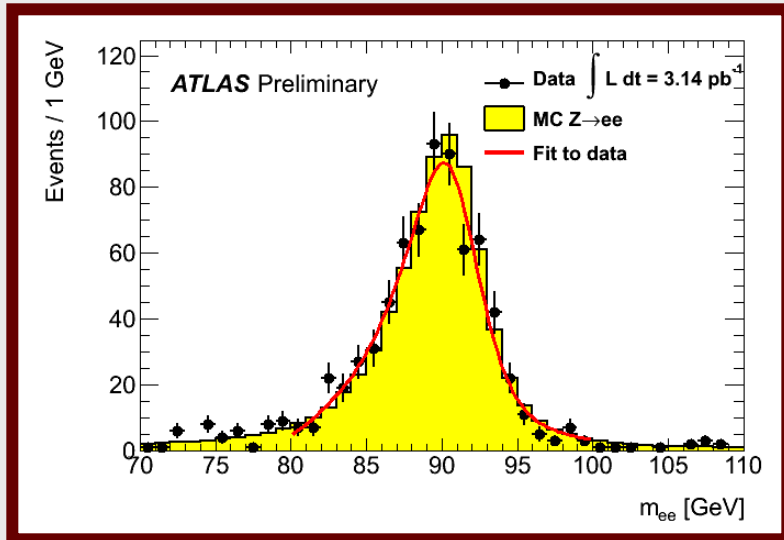
Peak lumi today: $\sim 1.5 \times 10^{32} / \text{cm}^2 / \text{s}$
deliv. integr. lumi today: $\sim 24 / \text{pb}$



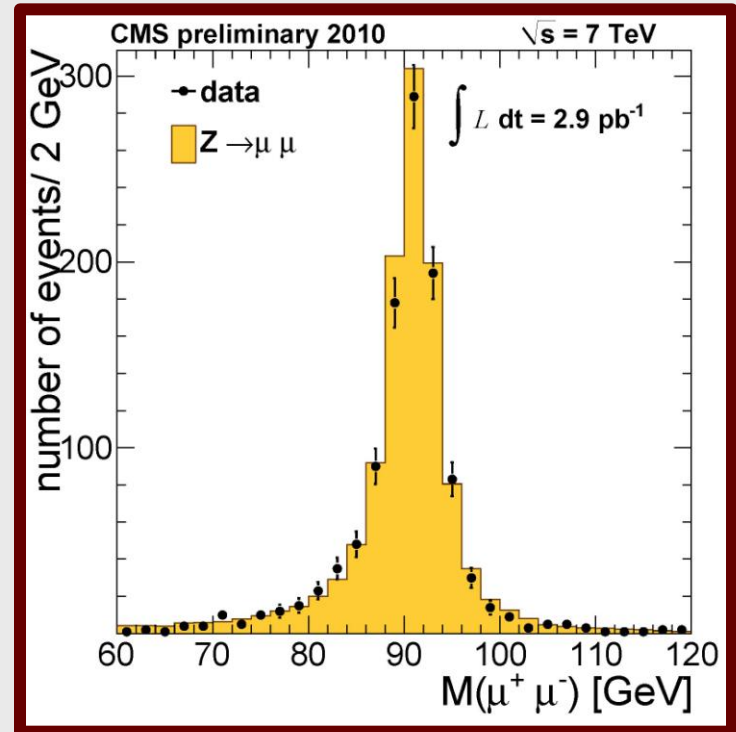
Data sample doubling time:
 $\sim 6-10$ days over last weeks

What's new since Beijing

- Experiments are performing very well



EM energy scale known to 1-3%
Resolution approaching MC value



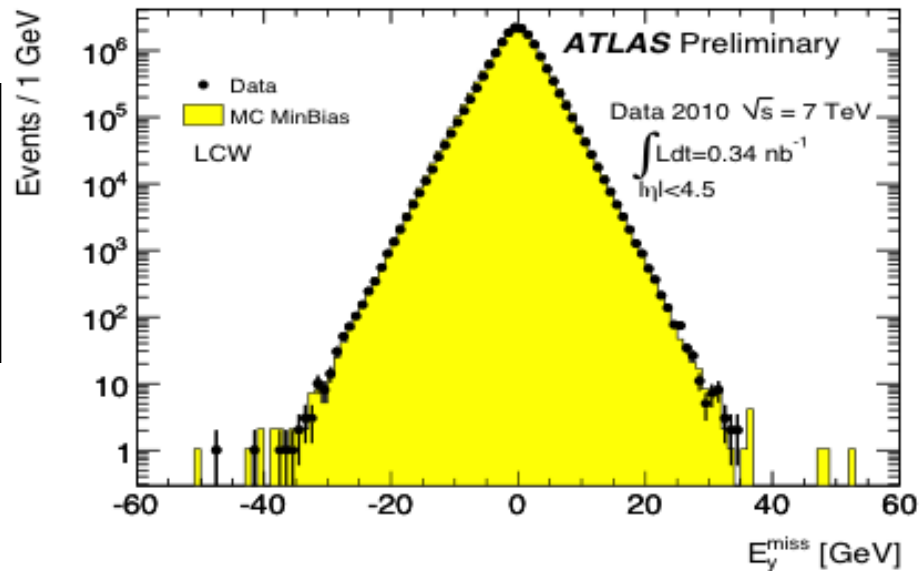
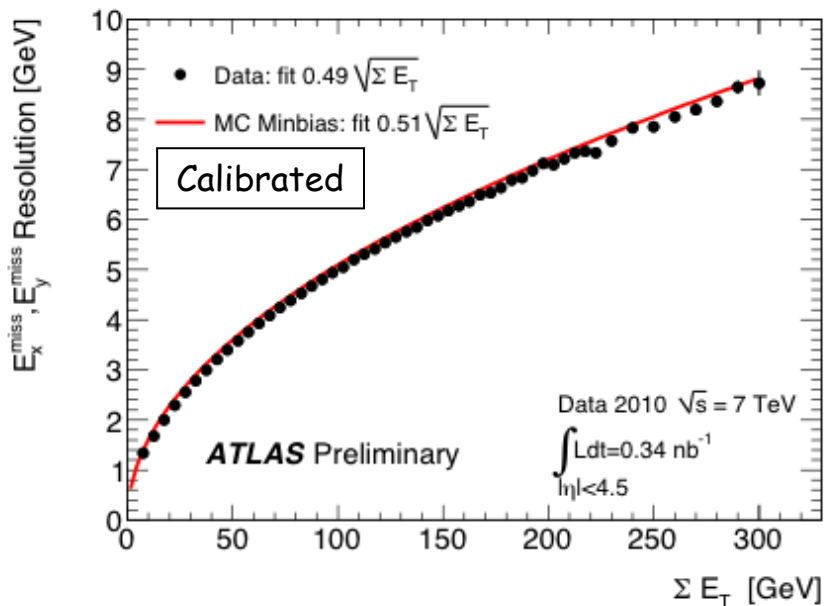
Muon scale known to $\sim 1\%$ (or better) in Z-region
Resolution approaching MC value

Missing transverse energy

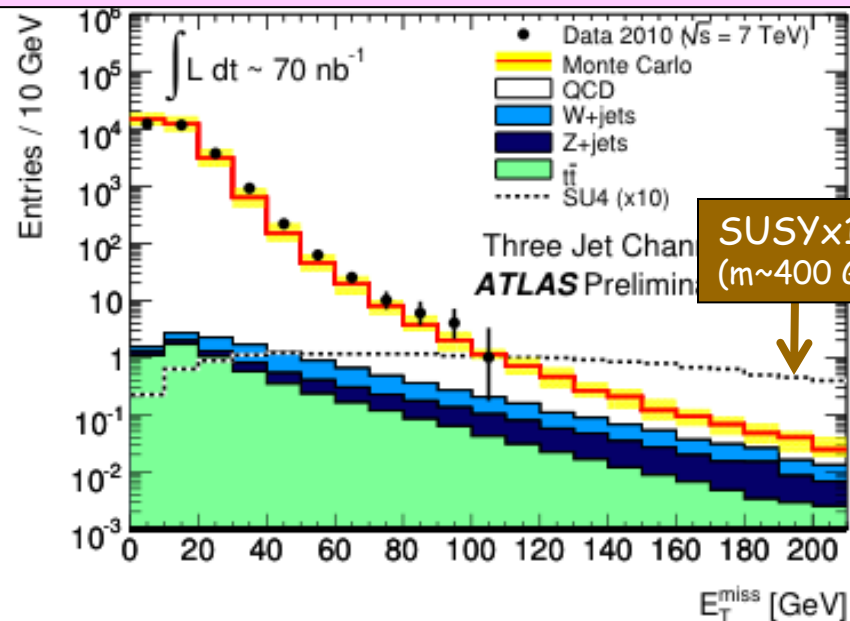
- Sensitive to calorimeter performance (noise, coherent noise, dead cells, mis-calibrations, cracks, etc.), and non-collision backgrounds
- Fundamental for searches (Higgs, SUSY, ..)

Calibrated E_T^{miss} from minimum-bias events

Measured over \sim full calorimeter coverage (360° in φ , $|\eta| < 4.5$, $\sim 200\text{k}$ cells)



E_T^{miss} spectrum from SUSY searches: events with ≥ 3 high- p_T jets, $p_T(j_1) > 70$ GeV



What can we expect from LHC

Plans for near future:

- ❑ Run pp until beginning of November, then switch to heavy ions
- ❑ 6 December: start year-end technical stop
- ❑ Resume data taking mid February 2011, continue through 2011
- ❑ Shutdown 2012 to prepare for 13-14 TeV

What **energy** in 2011 ?

Base planning: 7 TeV

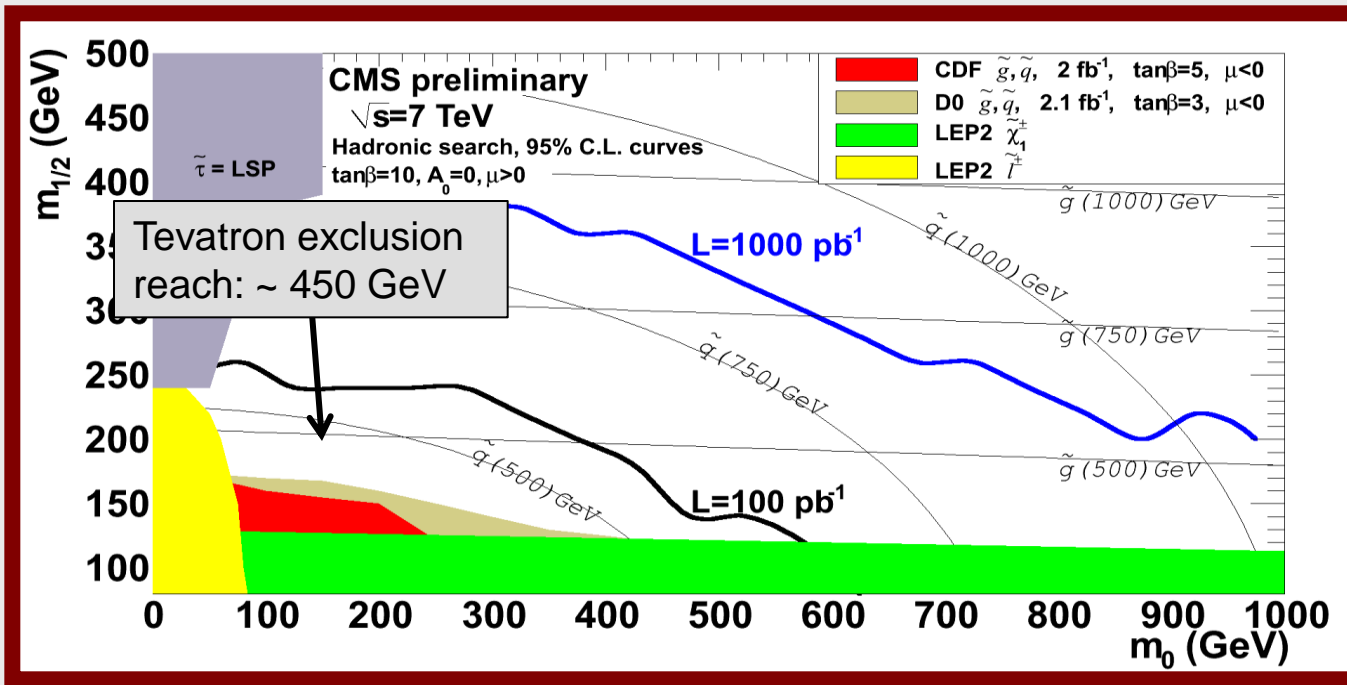
The possibility of running at $\sqrt{s} \sim 8$ TeV will be discussed at the yearly machine retreat in Chamonix end of January, based on confidence gained with machine operation and absence of beam-induced quenches

What **luminosity** in 2011 ?

- ❑ **Original goal:** deliver $1 \text{ fb}^{-1} \rightarrow$ requires running at $1\text{-}2 \times 10^{32}$
- ❑ Because of excellent machine quality, control and protection system (zero beam-induced magnet quench) \rightarrow good prospects for going beyond 1 fb^{-1} :
 - machine aperture much better than expected ($\sim 13\sigma$ instead of 8σ)
 \rightarrow can reduce β^* to 2m (perhaps lower ...) \rightarrow gain > 1.7 in luminosity
 - transverse emittance better than nominal (~ 2 instead of $3.7 \mu\text{m rad}$)
 - number of bunches could be increased by 2-3 (75-50 ns bunch spacing)
 - move from commissioning to physics mode \rightarrow increase physics data taking time

What can we expect from LHC

SUSY



LHC discovery reach for \tilde{q}, \tilde{g} pair production, 1 experiment

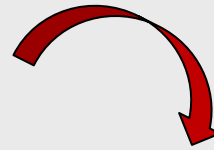
M (TeV)	1 fb ⁻¹	2 fb ⁻¹	5 fb ⁻¹
$\sqrt{s}=7$ TeV	0.7	0.8	1
$\sqrt{s}=8$ TeV	0.8	0.9	1.1

What can we expect from LHC and Tevatron

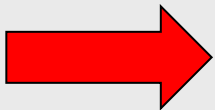
Higgs

- Assume continued excellent performance of Tevatron and continued excellent progress of LHC machine ($\geq 1/\text{fb}$ in 2011) and experiments

expected mass ranges




- 95% cl exclusion between 114 and ~600 GeV
- 3σ evidence between ~125 and ~500 GeV



Keep flexibility concerning shutdown 2012

What can we expect from LHC and Tevatron

- LHC will have results on masses of SUSY particles (squarks, gluinos) up to/beyond around 800 GeV by end of 2011
 - LHC and Tevatron together will have results on Higgs mass exclusion or even possible allowed mass range up to around 500 GeV by end 2011
-  2012 could be a decisive year concerning LC (in time with update of European strategy)

What can you expect from CERN

- CERN as laboratory at the energy frontier
- Budget constraints: Less *increase* for LC studies at CERN but (new) collaborators etc will help out
- Newly appointed LC studies leader to drive and promote a Linear Collider
- Active role in defining LC governance
- Preparations to bid for hosting the LC but also to participate in LC project elsewhere

CERN Opening

- CERN is prepared to play its role in particle physics at the energy frontier
- Geographical Enlargement/Opening
 - full and associate membership independent of geographical location
- Participation in Global Projects
 - coordinate broad European participation in a future global accelerator project hosted elsewhere

What do we expect from you

- Prepare the case for a LC for first consideration
2012: *ILC TDR(s), CLIC CDR*
- Assess the implications of the **emerging physics scenario** from LHC/Tevatron to the Linear Collider (make use of ILC/CLIC)
- Realistic costing
- Prepare mechanism to arrive at site decision
- Prepare governance proposals for the final project
 - for the time after the T(C)DRs

Sergio B. will assess your progress in his concluding remarks

Governance

- Final Project \equiv Global Project
- Global Project \equiv Treaty Organisation (≥ 30 years)
- Need to bridge time between 2011 (CLIC CDR), 2012 (ILC TDR) and the final project with a different arrangement:
 - Continuation of CLIC collaboration
 - Multi-National Laboratory Model for ILC

The next years

Important steps in the coming years

- CDR for CLIC 2011
- TDR for ILC 2012
- ICFA Seminar at CERN 3-6 October 2011
use this occasion to
 - layout exciting future prospects in particle physics
 - synchronize regional strategies/roadmaps
- Update of European strategy for particle physics
start: EPS 2011, finalize Sept. 2012
- IEEE 2012 special event to promote LC

And beyond ??



Next decades

Road beyond Standard Model

through synergy of

hadron - hadron colliders (LHC, HE-LHC ?)

LHC results will guide the way at the energy frontier

lepton - lepton colliders (e+e- LC ?)

In summary

Exciting years ahead of us

We will need

- Preparedness
- Flexibility
- Visionary global policies