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Matériel EWK pour la discussion “perspectives 2011”

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cnrs dépasser les frontières

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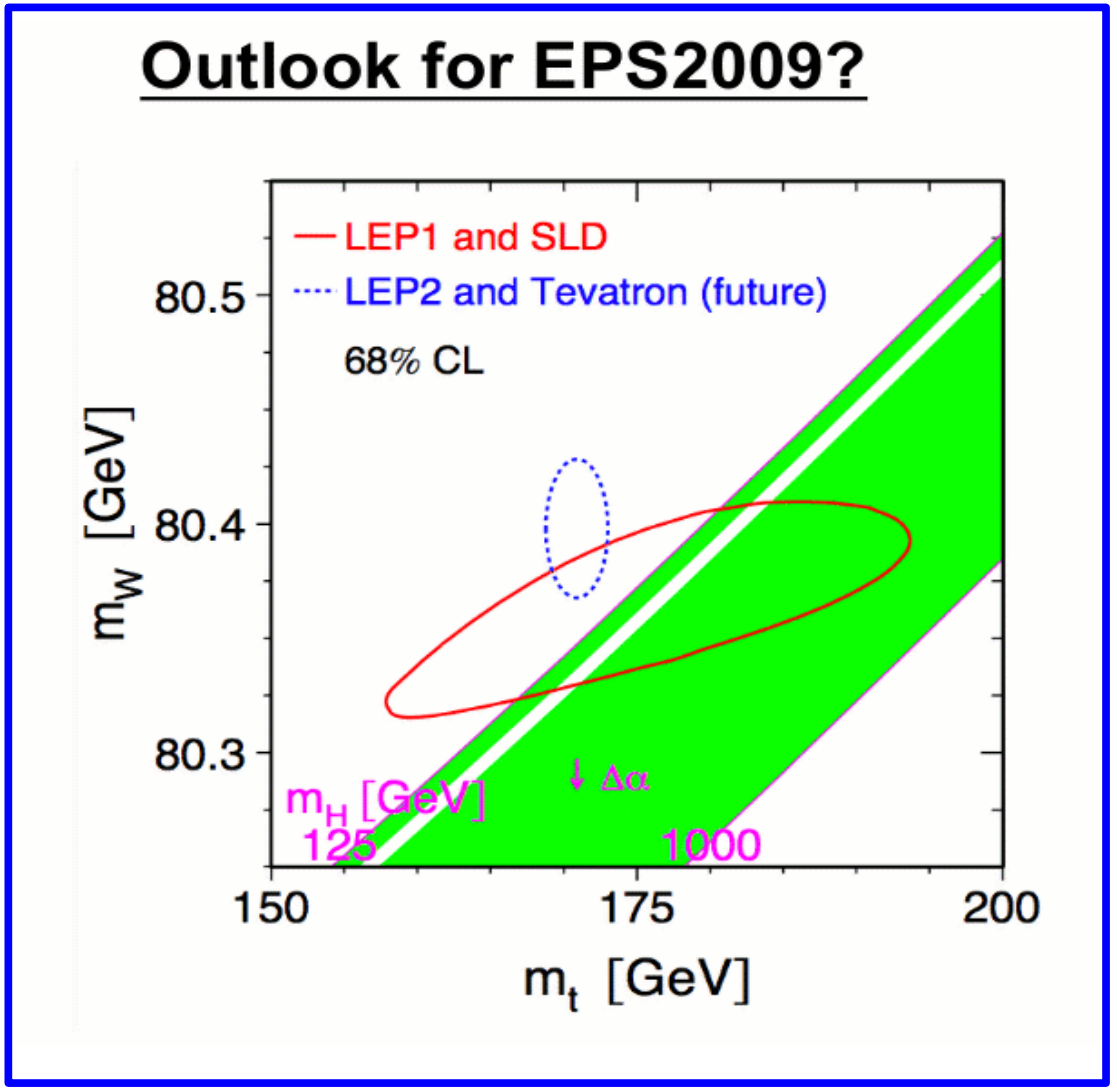
Institut National de Physique Nucléaire et de Physique des Particules

Secret hopes



... as shown by Terry Wyatt at the EPS 2007 conference.

First DØ Run II measurement of the W boson mass (preliminary)

1 fb^{-1} of data
using central electrons ($|\eta|<1.05$)

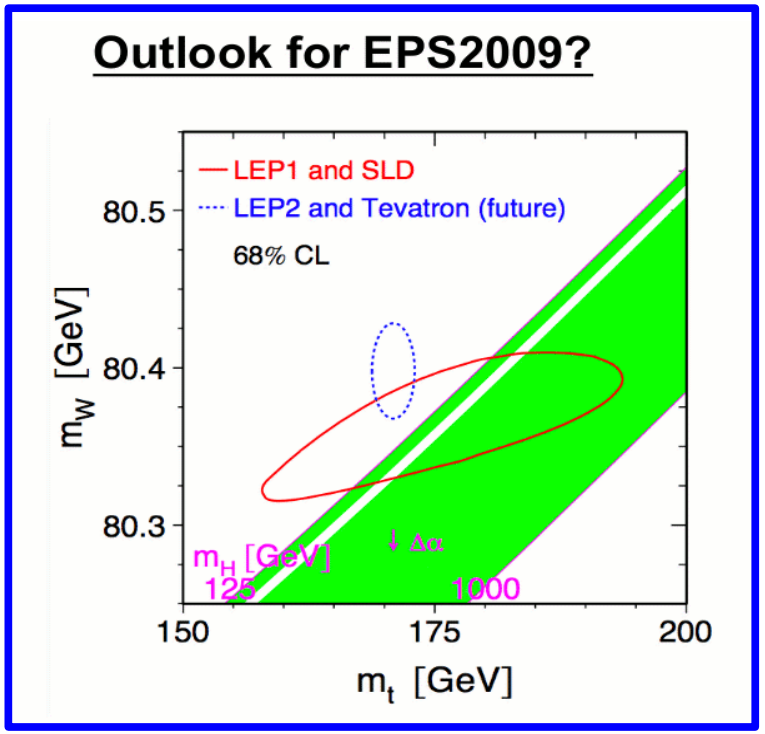
~ 500k W events
~ 19k Z events

Summary of uncertainties

systematic uncertainties

Source	$\sigma(m_W)$ MeV m_T	$\sigma(m_W)$ MeV p_T^e	$\sigma(m_W)$ MeV $\not\!\!E_T$
Experimental			
Electron Energy Scale	34	34	34
Electron Energy Resolution Model	2	2	3
Electron Energy Nonlinearity	4	6	7
W and Z Electron energy loss differences (material)	4	4	4
Recoil Model	6	12	20
Electron Efficiencies	5	6	5
Backgrounds	2	5	4
Experimental Total	35	37	41
W production and decay model			
PDF	9	11	14
QED	7	7	9
Boson p_T	2	5	2
W model Total	12	14	17
Total	37	40	44
statistical	23	27	23
total	44	48	50

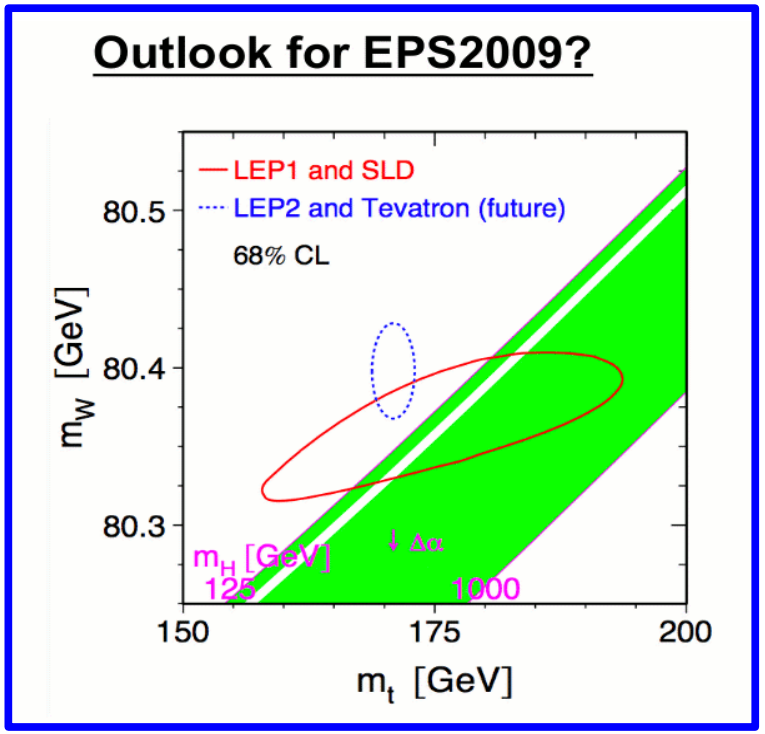
Back to Terry's hopes



... as shown at the EPS 2007 conference.

Are such expectations reasonable ?

Back to Terry's hopes



... as shown at the EPS 2007 conference.

Are such expectations reasonable ?

Yes ! And you can read it in detail in the following article.

When the authors of

"Measurement of the W Boson Mass at the Tevatron"
Ashutosh V. Kotwal , Jan Stark
Annual Review of Nuclear and Particle Science, November 2008

`http://arjournals.annualreviews.org/toc/nucl/forthcoming`

wrote that 25 MeV per experiment are around the corner, and that a final combined error of 15 MeV is realistic, they really meant it.

Extrapolation to 4 fb^{-1}

Extrapolation from 1 fb^{-1} to 4 fb^{-1} is not that difficult; leading systematics are really just a reflection of the cruel lack of $Z \rightarrow e^+ e^-$ events:

In 1 fb^{-1}, we have just

18k $Z \rightarrow e^+ e^-$ events

to calibrate our

485k $W \rightarrow e \nu$ events.

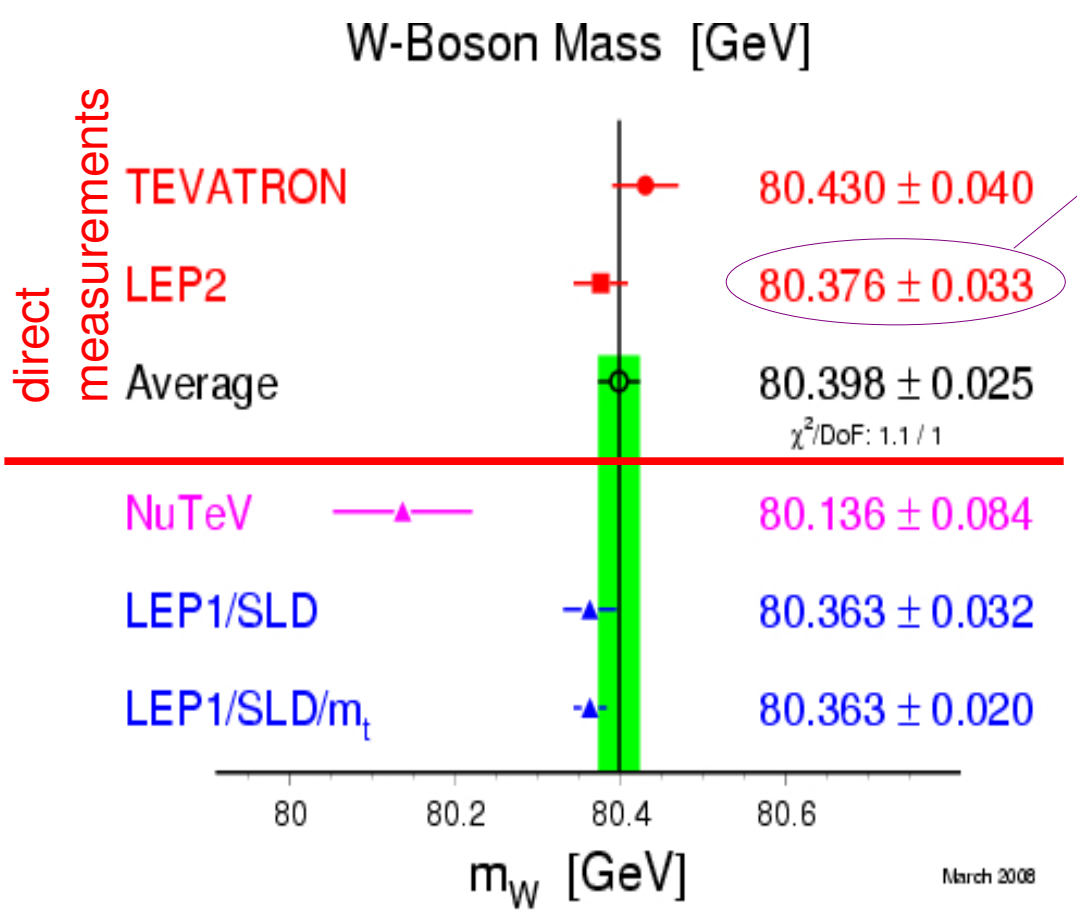
That is a problem and the solution is straightforward: **add more data**.

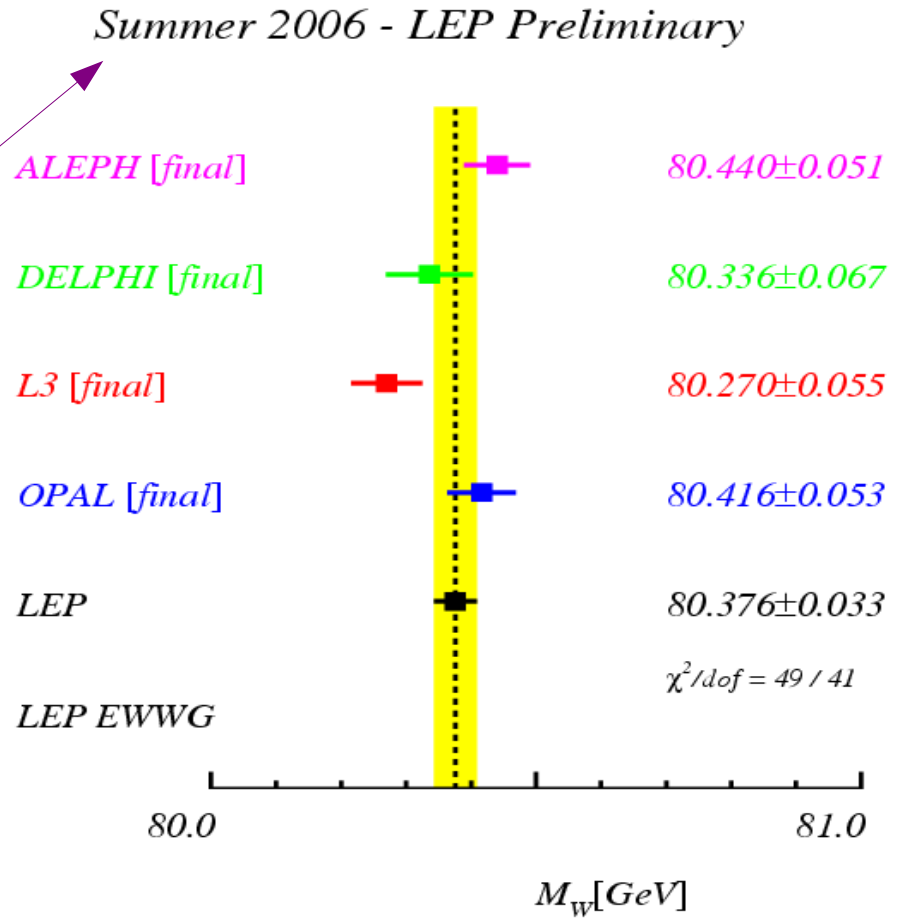
At least in the case of DØ, all Run II – specific issues are addressed in the first round of analysis. Specifically, the first 1 fb^{-1} already contain very high inst. luminosities. Can simply add more data, with small losses due to a possible veto on the highest lumi events.

source	M_t	$ElecP_t$
W stat	12	14
e resp	17	17
e linea.	4	3
e resol	2	2
had tune	3	6
bkgd	2	2
efficiencies	5	6
pdf	9 ?	11 ?
$P_t W$	2	5
QED	8	10
W width	<5	<5
Total	26	29

Backup Slides

Current precision





The current world average is still dominated by the final LEP2 results.

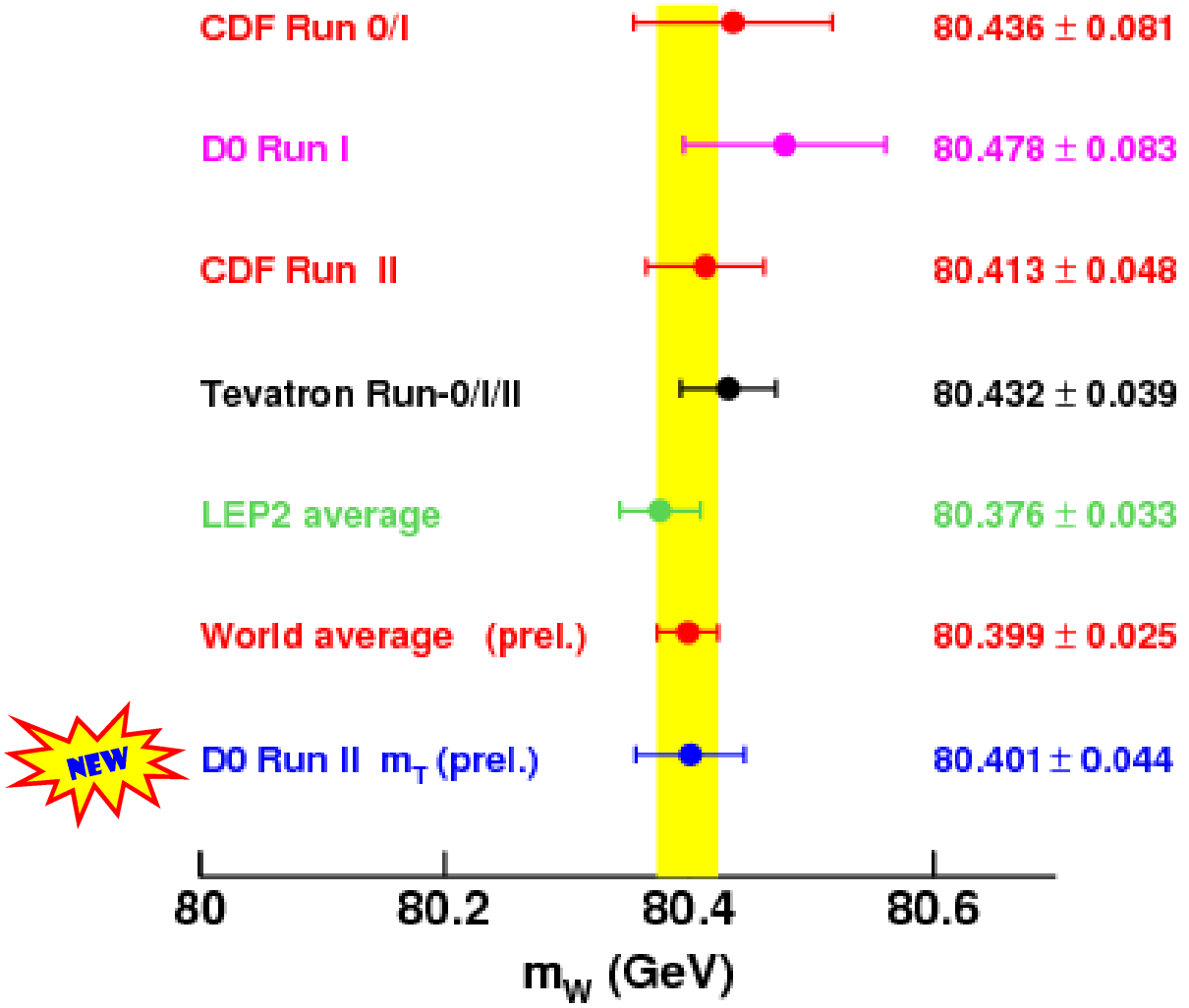
The Tevatron average is driven by a recent Run II measurement from CDF (200 pb^{-1}), but the analysis of the Tevatron Run II data is really just starting ...

CDF Run II (200 pb^{-1}):

m(W) = 80.413 ± 0.048 GeV

Phys.Rev.Lett.99:151801 (2007)
Phys.Rev.D77:112001 (2008)

Comparison to previous results

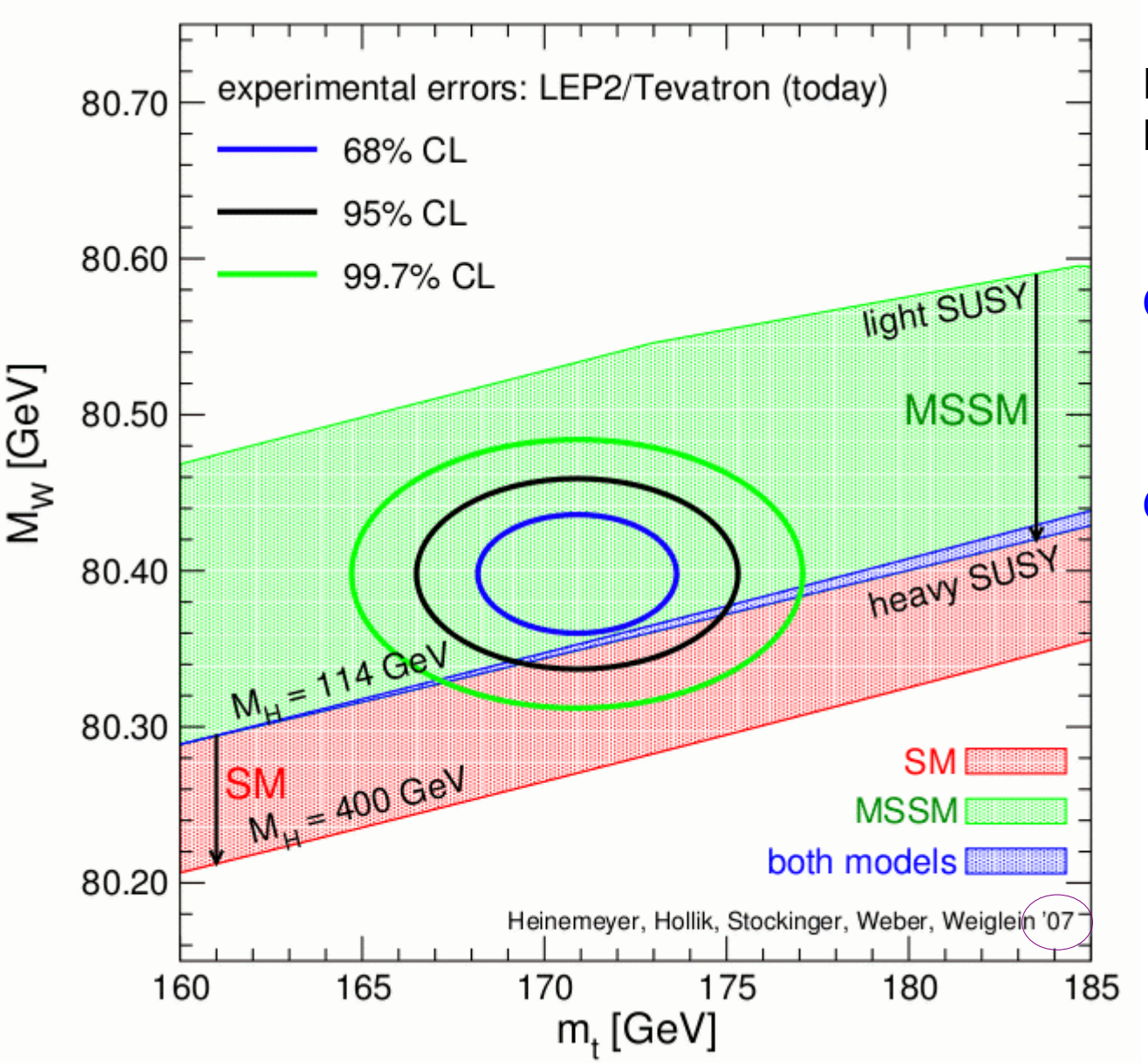


The new result from DØ is the single most precise measurement of the W boson mass to date.

So far, we quote our m_T result as the main result. Will combine results from the three observables; expect ~ 10 % improvement in total error over m_T alone.

The new result is in good agreement with previous measurements.

Motivation



For equal contribution to the Higgs mass uncertainty need:

$$\Delta M_W \approx 0.006 \; \Delta M_t \; .$$

Current Tevatron average:

$$\Delta M_t = 1.3 \text{ GeV}$$

$$\Rightarrow \text{would need:} \quad \Delta M_W = 8 \text{ MeV}$$

Currently have: $\Delta M_W = 25$ MeV

At this point, i.e. after all the precise top mass measurements from the Tevatron, the limiting factor here is ΔM_W, not ΔM_t .

This figure does not use the latest value of the top mass, but as I just said, that's not a major limitation.