The LC physics case — in view of recent data at LHC, Tevatron and elsewhere

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DESY

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- LC physics case in light of the current experimental situation
- Summary of discussion on implications of 2011 experimental results for physics at future lepton colliders

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Higgs searches:

- Higgs searches at LHC and Tevatron have excluded (at least at 90% C.L.) the range of $140\ \mathrm{GeV} \lesssim M_{\mathrm{H_{SM}}} \lesssim 460\ \mathrm{GeV}$ for the SM Higgs, in agreement with the indirect constraints from electroweak precision data
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"Golden" production channel: $e^+e^- \to ZH$, $Z \to e^+e^-, \mu^+\mu^-$

As long as Higgs has a sizable coupling to gauge bosons it is guaranteed to be accessible in this channel

$\Rightarrow$ Will clarify whether something has been missed at the LHC

BSM searches

- Search for heavy resonances: limits of $\mathcal{O}(1 - 4\ \mathrm{TeV})$
- SUSY searches etc.: limits on coloured states of new physics (SUSY: only gluino and squarks of first two generations)

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$\Rightarrow$ Physics case for LC concerning search for

- colour-neutral states
- coloured states that are more difficult to access at LHC (SUSY: stop and sbottoms)

is essentially unchanged, unless very specific model assumptions are made (e.g. CMSSM)

Further experimental results

- Dark matter relic density: points to relatively low scale if interpreted as weakly interacting massive particle

- Top: measurement of the forward–backward asymmetry at the Tevatron and the LHC

  CDF and D0 results: deviations from the SM prediction, possible hint of new physics?

  $\Rightarrow$ Clarification with LC running at the $t\bar{t}$ threshold or above?

Other constraints

- Elecroweak precision observables:

  $(g-2)_\mu$: preference for light new physics contributions has further solidified (convergence of SM predictions using low-energy e^+e^- and τ decay data as input)

  $M_{\rm W}$: preference for light new physics contributions

  $\Rightarrow$ Sensitivity could be improved with LC running at the WW threshold

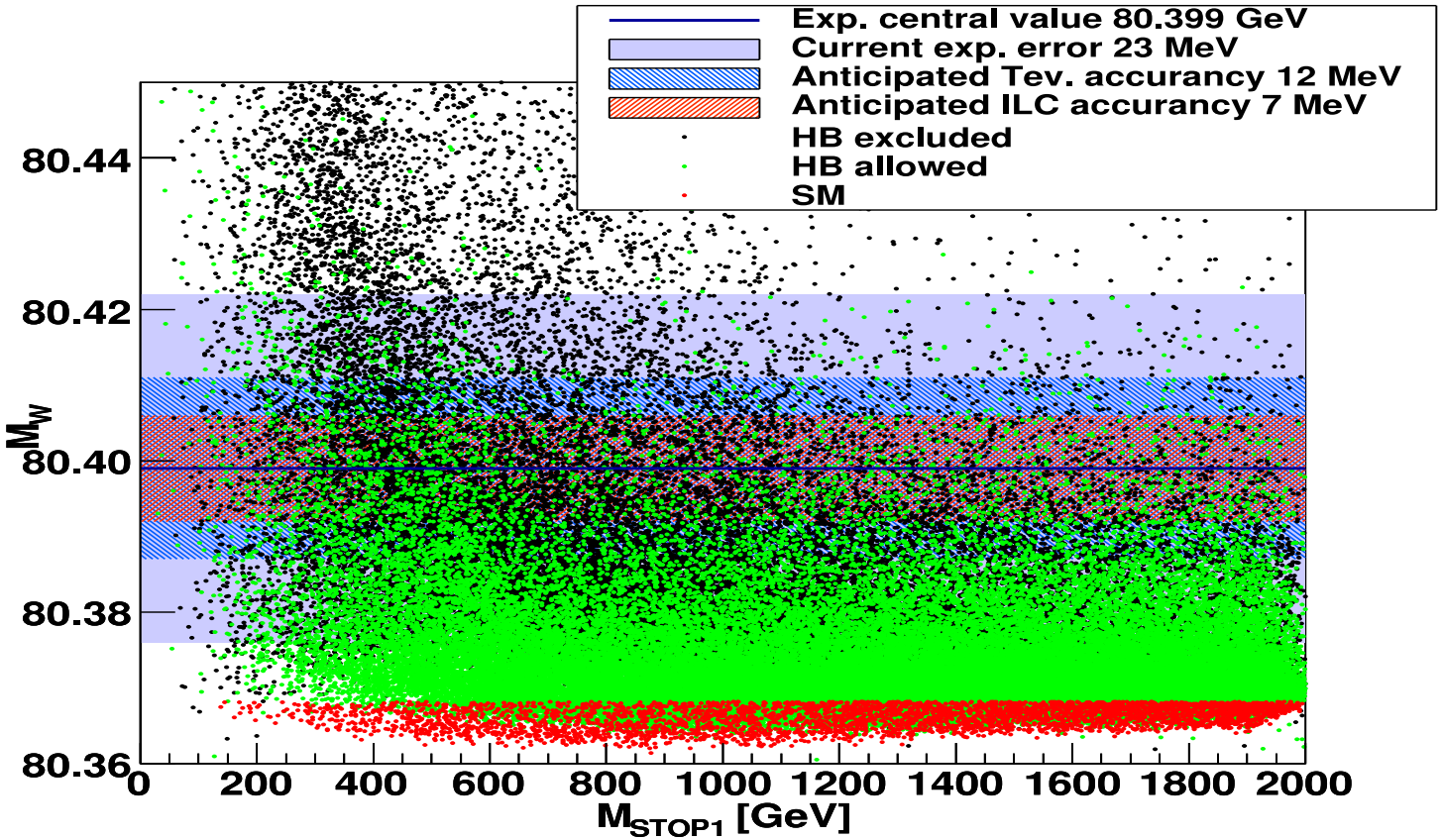
  $\sin^2\theta_{\rm eff}$: interpretation unclear because of long-standing discrepancy between $A_{\rm LR}$ (SLD) and $A_{\rm FB}$ (LEP)

  $\Rightarrow$ Could be resolved with LC running at the Z-pole

  GigaZ precision required to exploit full sensitivity

Current experimental result for $M_{\rm W}$ and future projections vs. predictions in the MSSM and the SM ($M_{\rm H_{SM}} \lesssim 130$ GeV)

[*L. Zeune, G. W. '11*]



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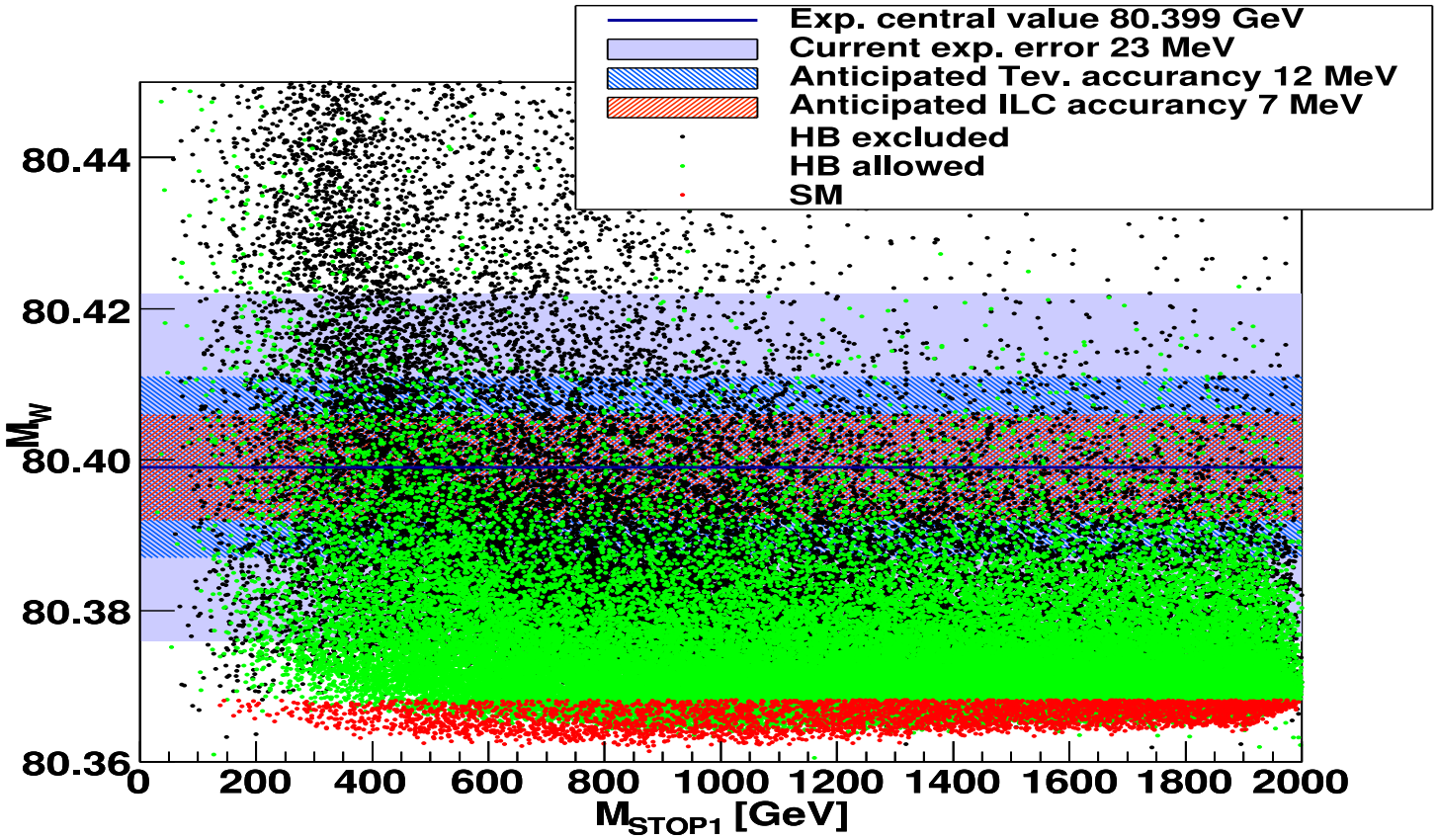

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NB: The density of points has no physical significance (like in all scatter plots of this kind)

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+ discussion; chairs: G. Moortgat-Pick, M. Peskin

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- The LC case for the update of the European strategy needs to demonstrate the physics gain not only in comparison with the present physics reach of the LHC, but also w.r.t. the expected reach of the LHC at $14\ \mathrm{TeV}$ with large integrated luminosity

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  Note: such a signal may well occur below the LEP limit of $M_{\mathrm{H_{SM}}} > 114.4\ \mathrm{GeV}$

  $\Rightarrow$ Need to push LHC analyses also in parameter regions where a SM Higgs is excluded:
  lower mass and/or lower cross section, ...

  Need to look for signs of non-standard Higgs decays:
  $H \to$ invisible, $H \to \tilde{\chi}^+\tilde{\chi}^-$, ...

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  $\Rightarrow$ High sensitivity to other mechanisms of electroweak symmetry breaking

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  yes, but the price tag must not be too high
  $\Rightarrow$ Staged approach,
  starting with Higgs factory at ≈ 250 GeV

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$\Rightarrow$ Need to provide the necessary input such that the scientific community can decide about priorities