How to optimize the ILC energy for measuring ZH

Preliminary

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Introduction

- Usual ILC scenario for ZH(120): 500 fb-1 at $\sqrt{s}$=350 GeV (the top threshold)
- Here we show that running at $\sqrt{s}$~Mh+100

  is more adequate since one has:

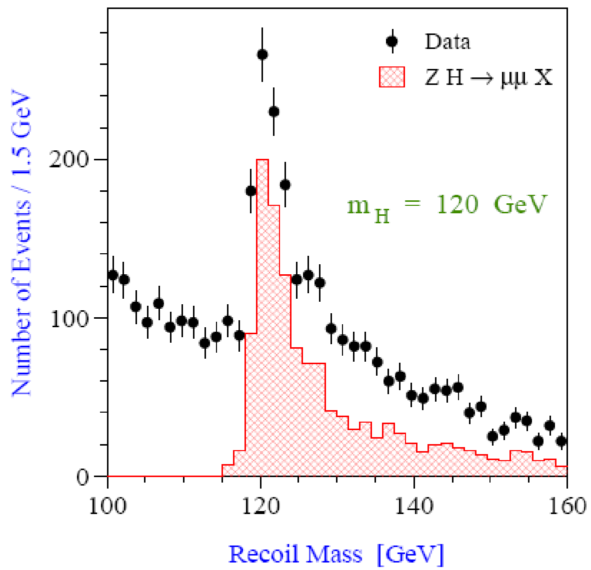
  - σ(HZ) twice larger if Mh=120 GeV

  - the recoil mass for H$\ell\ell$ is 3 times better
- Also it seems much more useful to spend

  luminosity at maximum ILC energy but, there, the mass resolution is unacceptable

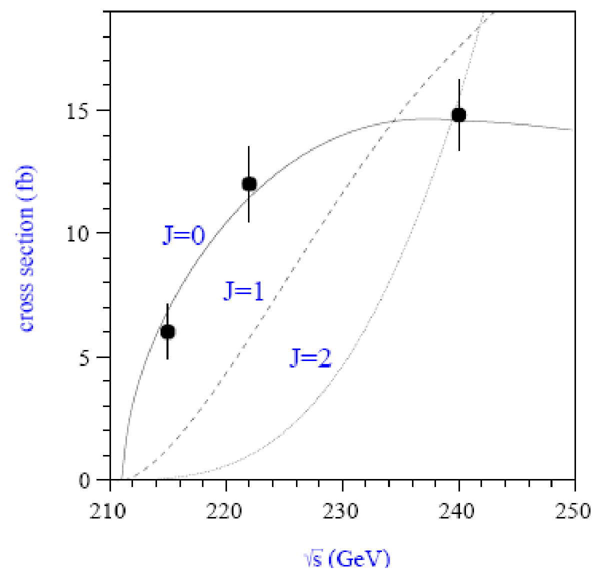
Running at 350 GeV

- TESLA TDR at 350 GeV: σ_{Mh}=1.5 GeV in $H\ell\ell$
- This goes like $E_{CM}p^2$
- At 220 GeV ~3 times better
- Similar gains are observed in the hadronic mode



Running at 220 GeV

- Threshold scan is needed
- Fast rising σhZ
- Objections:
- Undulator ? To be checked
- How does $\mathcal{L}$ vary with s ?
- Beamstrahlung



Beamstrahlung

- Formula where $x=E/E_0$ at the beam level

$$f(x) = a_0 \delta(1-x) + a_1 x^{a_2} (1-x)^{a_3}$$

- There is a 'hard-core' with a_0 ~0.5 at 500 GeV
- + a peaked distribution
- -> With a better momentum resolution there is always improvement

How does $\mathcal{L}$ vary with E?

- $\mathcal{L}$ can be maintained constant with s provided δ is taken constant:

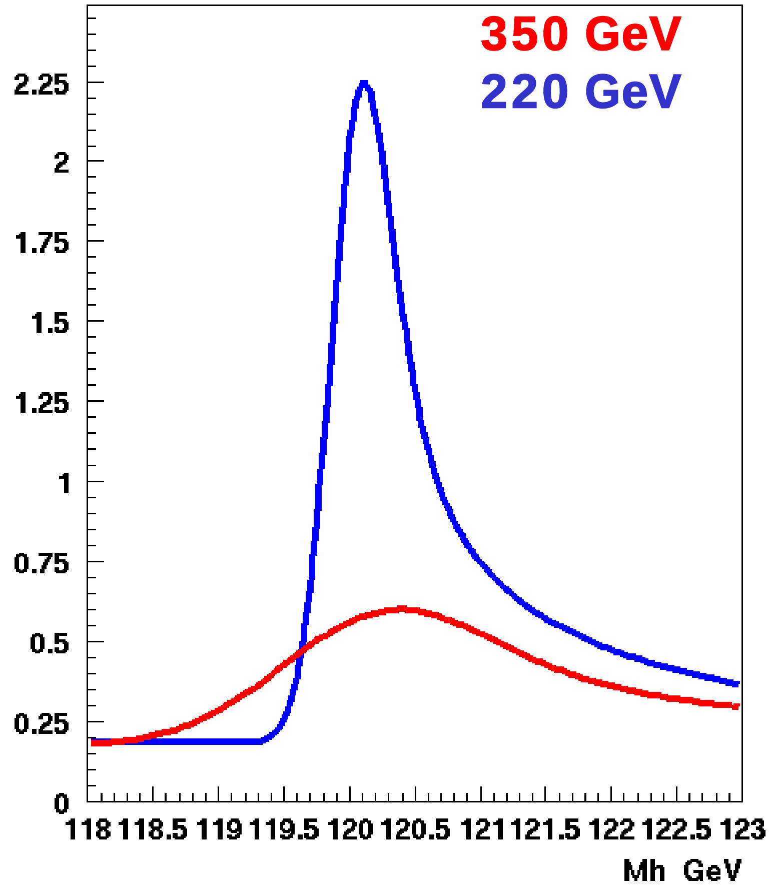
$$L \sim \eta \frac{P_{\text{electrical}}}{E_{CM}} \sqrt{\frac{\delta_E}{\varepsilon_{n,y}}} H_D$$

$$\delta = E_{CM} \frac{N^2}{\sigma_z \sigma_x^2}$$

- If N is constant (particles/bunch) $P_{\text{electrical}}$ goes like Ecm
- If one maintains δ constant $\mathcal{L}$ constant means more focusing in x and/or shorter bunches
- One has to choose an optimum

Spectra

- For Hℓℓ gain of 3 with
  δ constant
- For Zqq similar gain
  -> Better s/b
- Possibility to improve
  on **invisible decays**
  where only 1 C works:
  Gain on 3x2 on $\int \mathcal{L} dt$



Comparisons

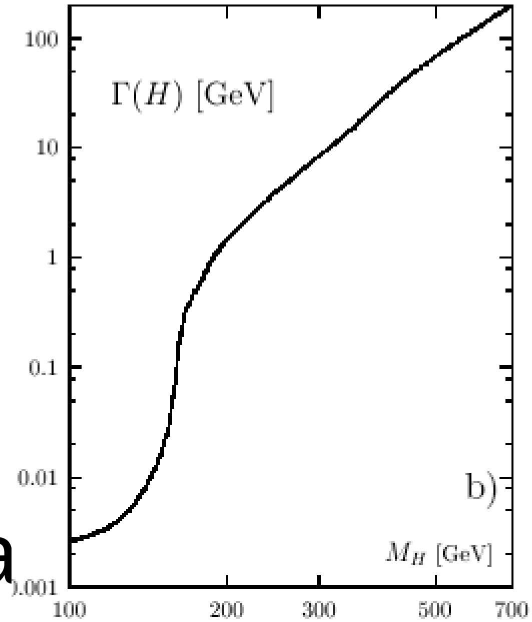
ECM	σ(H ℓℓ) fb	p ℓ GeV	σMh MeV K=510-5	ℒ(110 MeV) fb-1
500	4	122	4900	18000
350	7	83	1500	500
240	14	54	540	15
222	13	49	430	15

Measuring the Higgs width?

- Hopeless below 170 GeV
- How does Γ_h affect σ_h ?

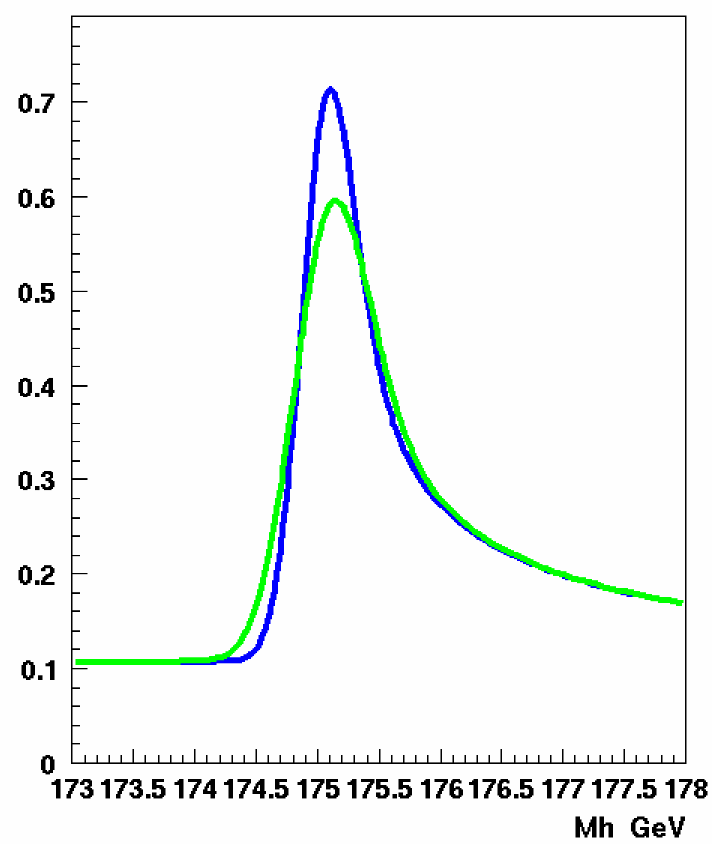
$\sigma \rightarrow \sigma + 0.65\Gamma/2$

- Note also that does not depend on Mh provided tha one works near threshold



Results

- For Mh=170 GeV



ECM	σ(Hℓℓ) fb	P ℓ GeV	σMh MeV	ℒ (20%) fb-1
350	5	71.5	843	1200
280	4	50	400	300

Conclusions

- If Mh=120 GeV, there are many good reasons to run at ~220 GeV
- Spin determination
- Maximum cross section
- Best possible mass resolution
- We should therefore see what are the limitations on the Machine side