

How to optimize the ILC energy for measuring ZH

Preliminary

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LAL/Orsay

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international linear collider

ECFA Study
Physics and Detectors
for a Linear Collider

ILC-Valencia 06

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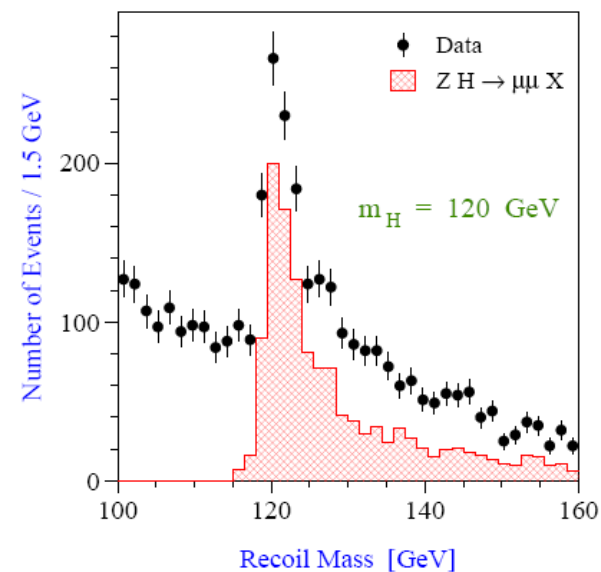


Introduction

- Usual ILC scenario for ZH(120): 500 fb⁻¹ at $\sqrt{s}=350$ GeV (the top threshold)
- Here we show that running at $\sqrt{s}\sim M_h+100$ is more adequate since one has:
 - $\sigma(\text{HZ})$ twice larger if $M_h=120$ 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

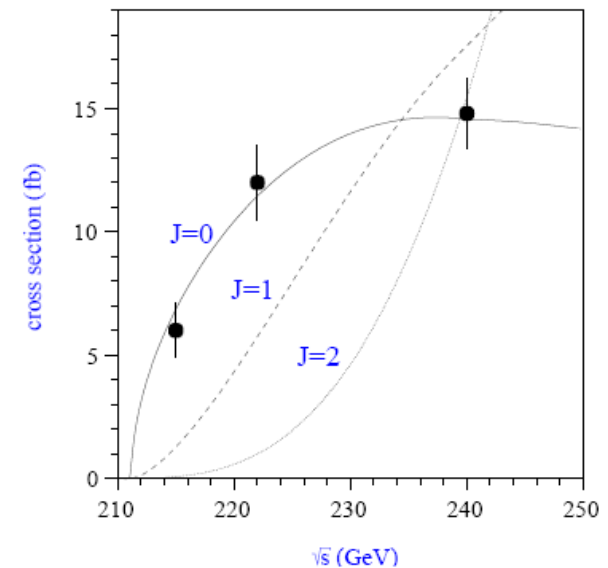
Running at 350 GeV

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



Running at 220 GeV

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





Beamstrahlung

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

$$f(x) = a_0\delta(1-x) + a_1x^{a_2}(1-x)^{a_3}$$

- There is a 'hard-core' with $a_0 \sim 0.5$ 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:

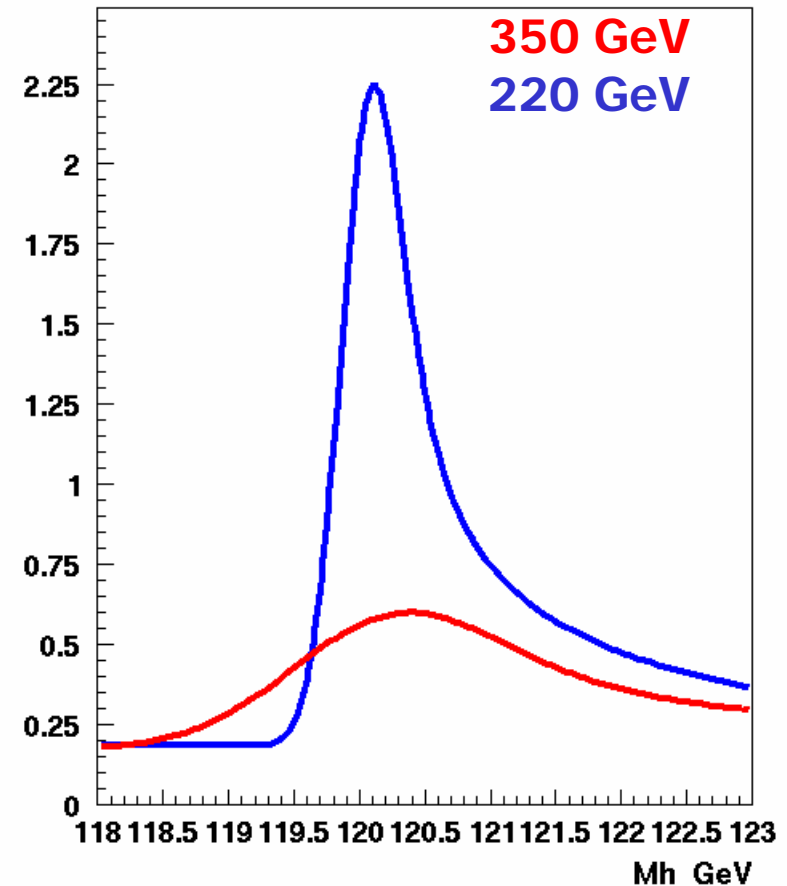
$$L \sim \eta \frac{P_{\text{electrical}}}{E_{CM}} \sqrt{\frac{\delta E}{\epsilon_{n,y}}} H_D$$

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

- 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 $H\ell\ell$ 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 $\int \mathcal{L} dt$



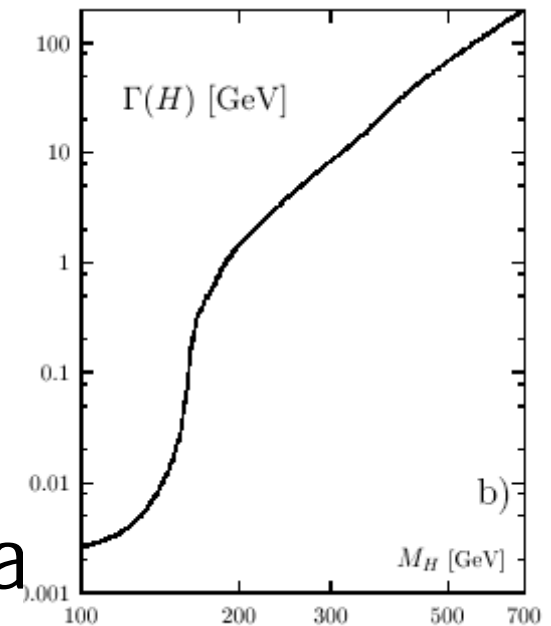


Comparisons

ECM	$\sigma(H \ell)$ fb	$p \ell$ GeV	σ_{Mh} MeV K=510-5	$\mathcal{L}(110 \text{ MeV})$ fb-1
500	4	122	4900	18000
350	7	83	1500	500
240	14	54	540	15
222	13	49	430	15

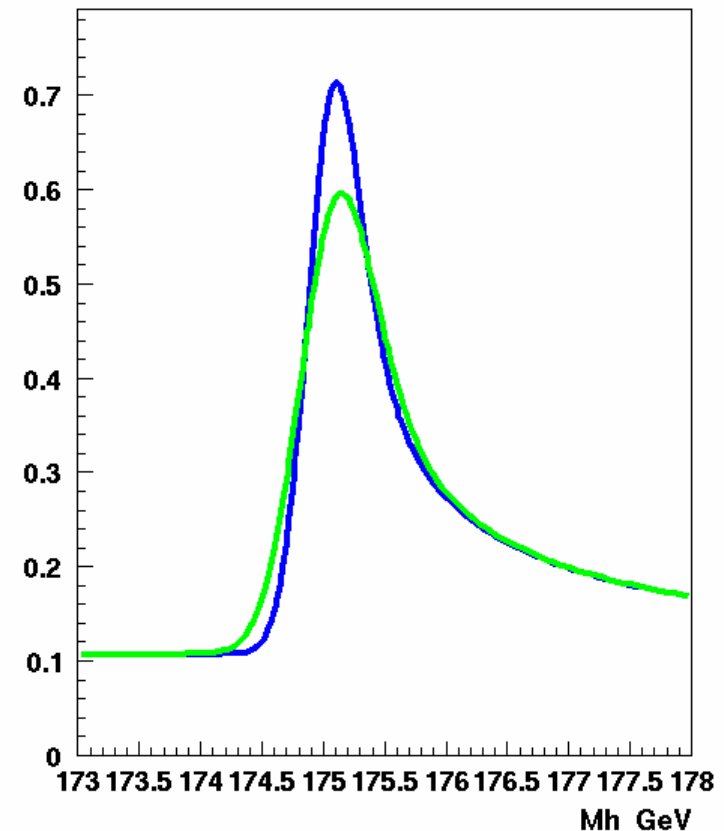
Measuring the Higgs width?

- Hopeless below 170 GeV
- How does Γ_h affect σ_h ?
 $\sigma \rightarrow \sigma + 0.65\Gamma/2$
- Note also that σ_h does not depend on M_h provided that one works near threshold



Results

- For $M_h = 170$ GeV



ECM	$\sigma(H\ell\ell)$ fb	P_ℓ	GeV	σM_h	MeV	\mathcal{L} (20%) fb ⁻¹
350	5	71.5		843		1200
280	4	50		400		300



Conclusions

- If $M_h = 120$ 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