ILD and SiD Benchmark Analyses and the Next Steps…

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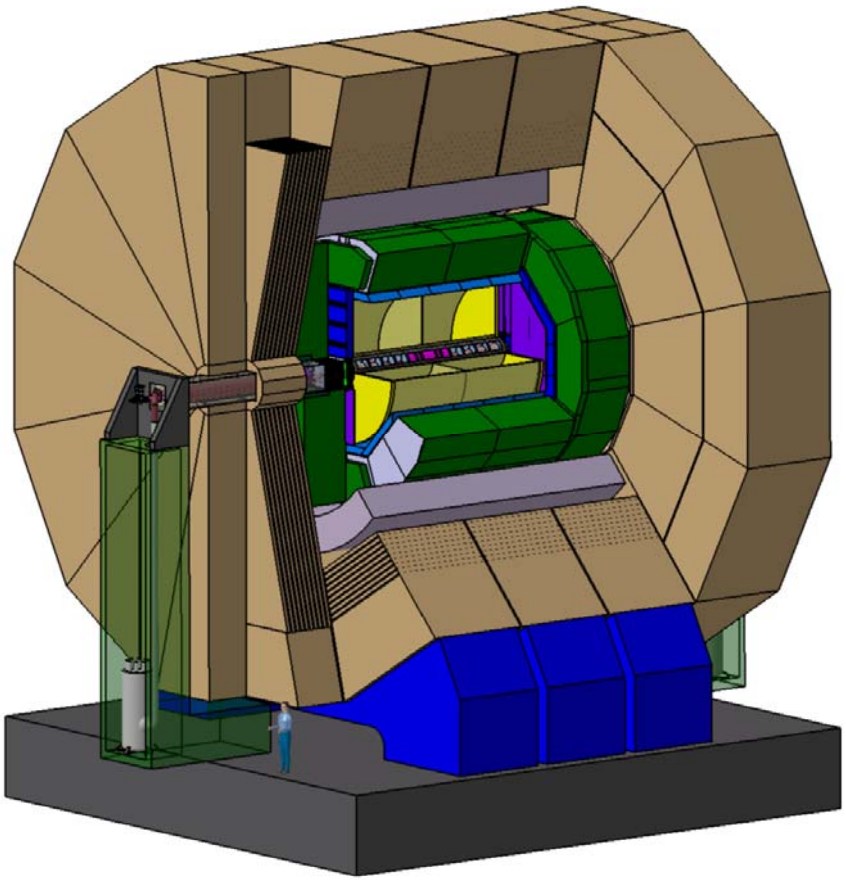


This talk:

❶ ILD c.f. SiD
❷ Post-IDAG Priorities

❶ ILD c.f. SiD

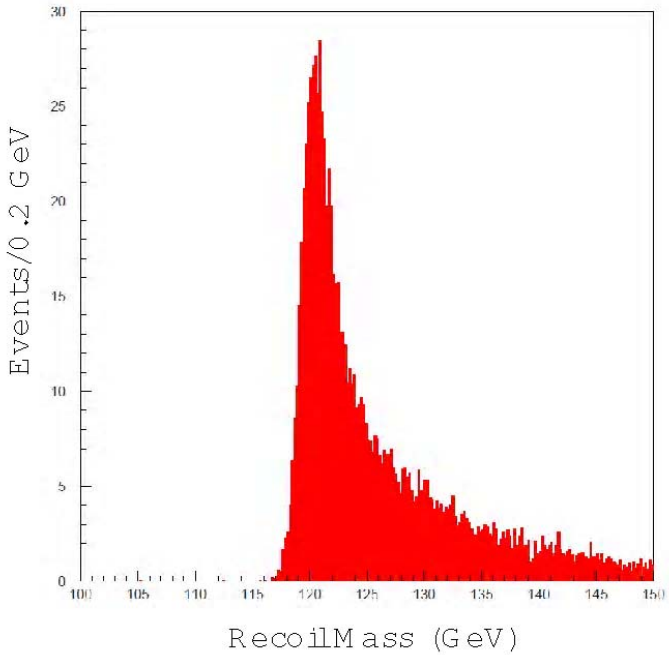
Context:

- ★ **Both SiD and ILD have produced some interesting bench-marking results**
- ★ **By comparing results, what can we learn about ILD ?**

$e^+e^- \rightarrow HZ$: Higgs Recoil Mass

SiD

- Fix background in fit
- High stats. signal sample
- Template-based fit (bin-size dependency?)



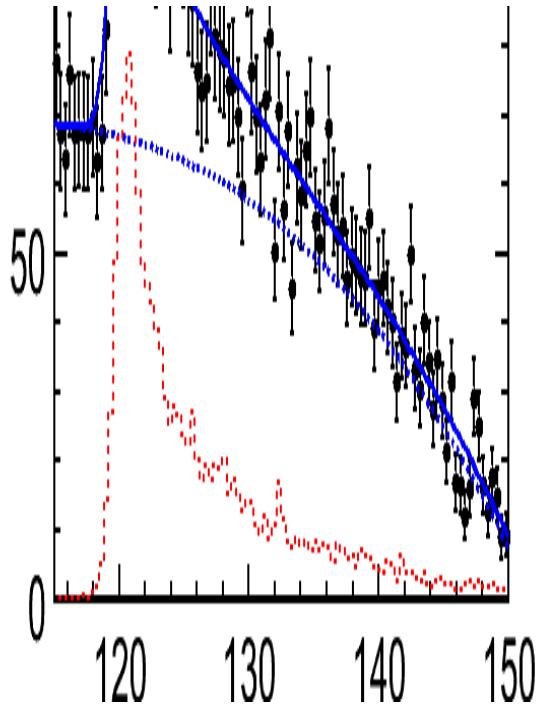
$\mu^+\mu^- X$

75 MeV

77 MeV

ILD

- Float background in fit
- High stats. background sample
- Functional fit



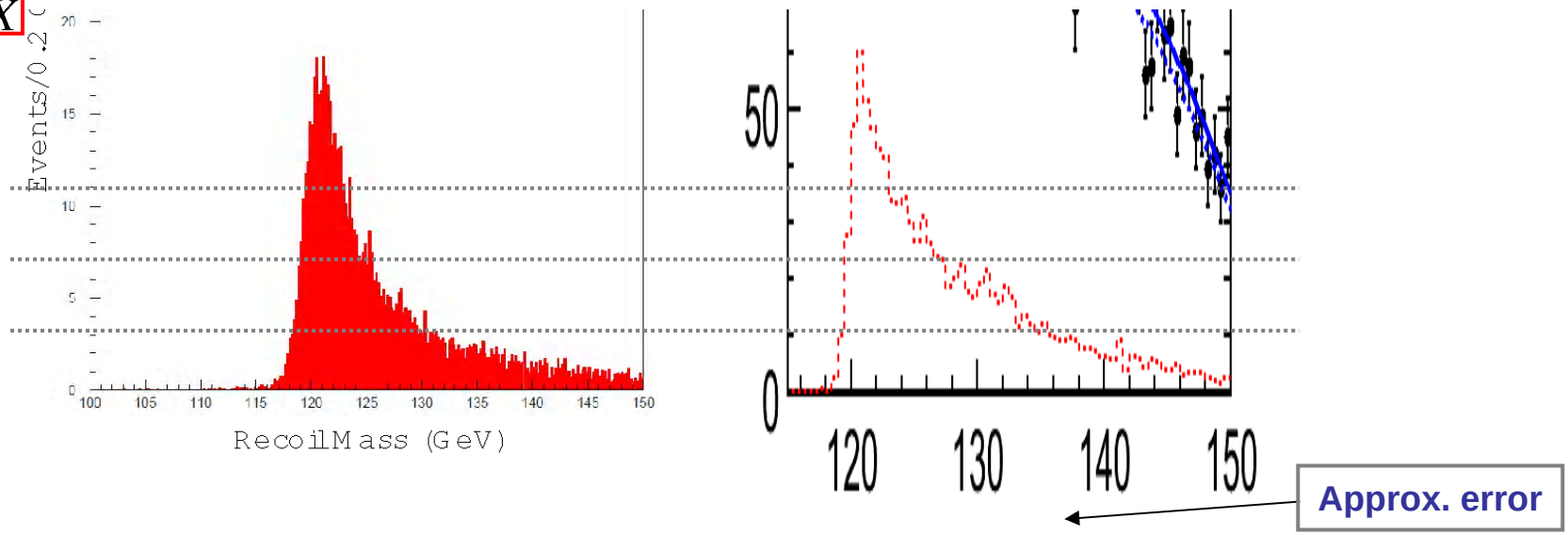
84±6 MeV

77±5 MeV

★ Resolution driven mainly by generated (wrong) lumi. Spectrum

★ Results probably consistent

e^+e^-X



102 MeV
90 MeV

204±23 MeV
135±16 MeV

- ★ **ILD background large (includes Bhabha component)**
- ★ **ILD distribution is broader (e-tracking, treatment of Brems, material ?)**
- ★ **Other differences**
  - **template fitting: strong dependence of SiD fit result on bin size**
    e.g. 200 MeV ➞ 50 MeV: ~30 % (from memory) difference in mass resolution

Needs further investigation

Cross section Error differences:

	SiD	ILD	Estimated
			Only have changes for 100 % polarisation
$\mu^+\mu^- X$	±0.33 fb	±0.45 fb	±0.32 fb
$e^+e^- X$	±0.46 fb	±0.74 fb	±0.45 fb
	• Fix background in fit	• Float background in fit	• Fix background in fit

$e^+e^- \rightarrow HZ$ Higgs BR

Br(H→cc)

Channel	ILD	SiD
ZH→qqcc	30	6 %
ZH→νν̄qq	15	11 %
ZH→llqq	28	

★ **Tracked down "feature" in ILD qqcc analysis**

- **Problem with one cut: removes 75% signal and 80 % background**
- **Should have been caught but time pressure…**

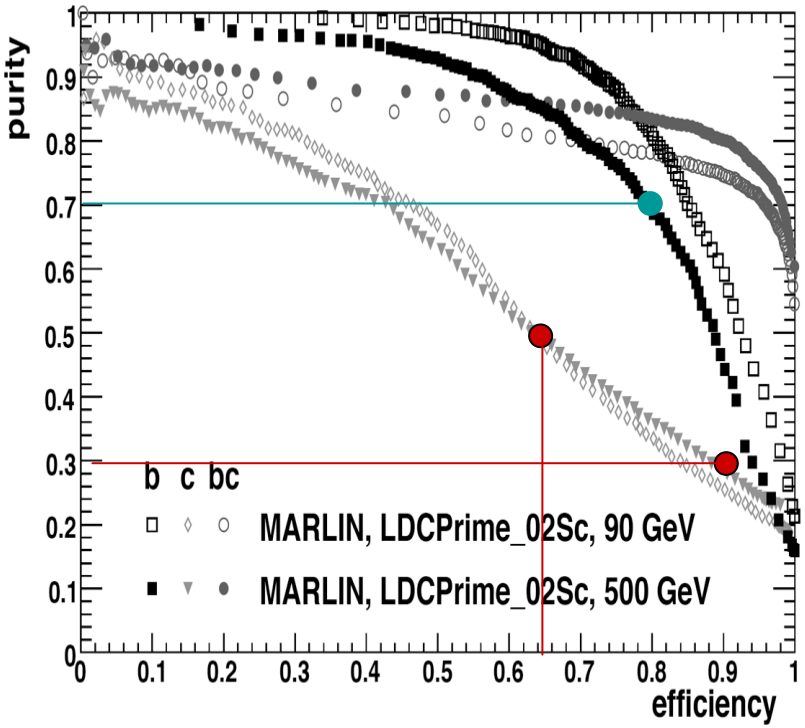
★ **SiD analysis more sophisticated, e.g. ANN vs cuts**

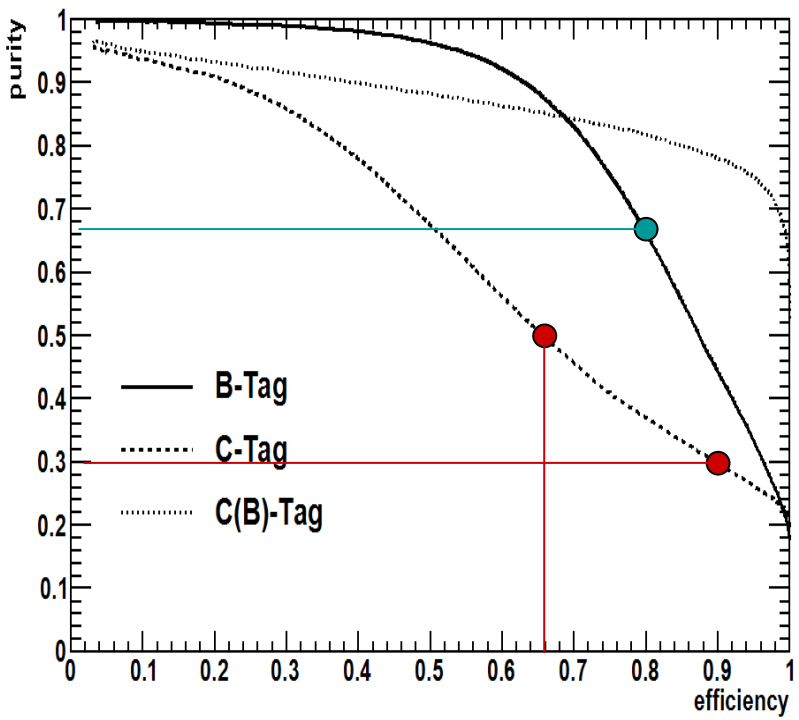
★ **No indication of large difference in underlying flavour tag performance**

- see next page

SiD c.f. “ILD” Flavour Tagging

500 GeV





Tau Pairs

Cross section:

	Uncertainty	N_{signal}	N_{back}	
SiD	±0.28 %	128708	3099	1 high weight $\gamma\gamma \to \ell^+\ell^-$
ILD	±0.33 %	105369	1926 + 10133	
	±0.31 %	105369	1926	

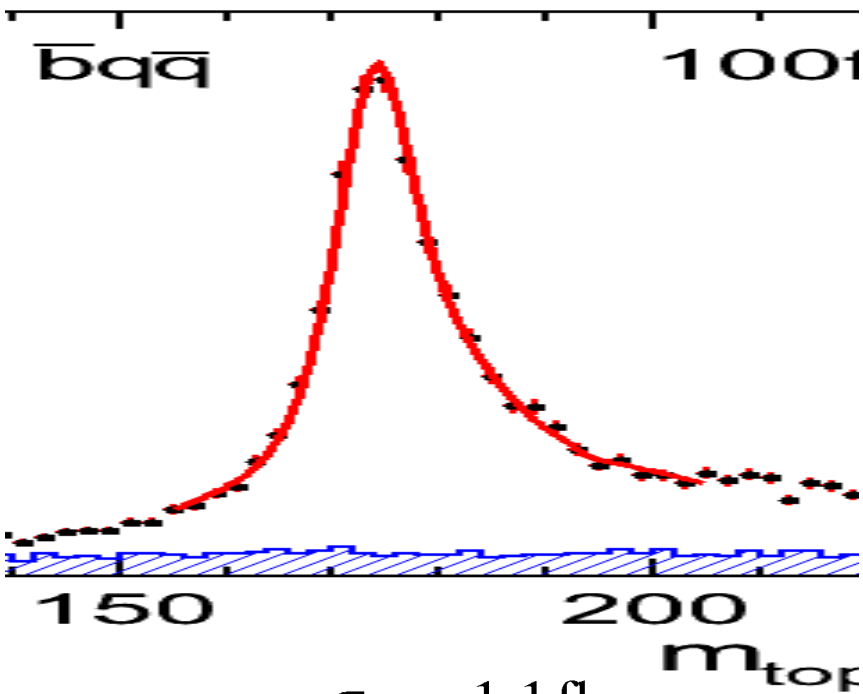
SiD $|\cos\theta| < 0.95$

ILD $|\cos\theta| < 0.90$ + additional cut on tau energy to remove Bhabha background (special presel sample)

Polarisation: ILD needs to add full set of channels

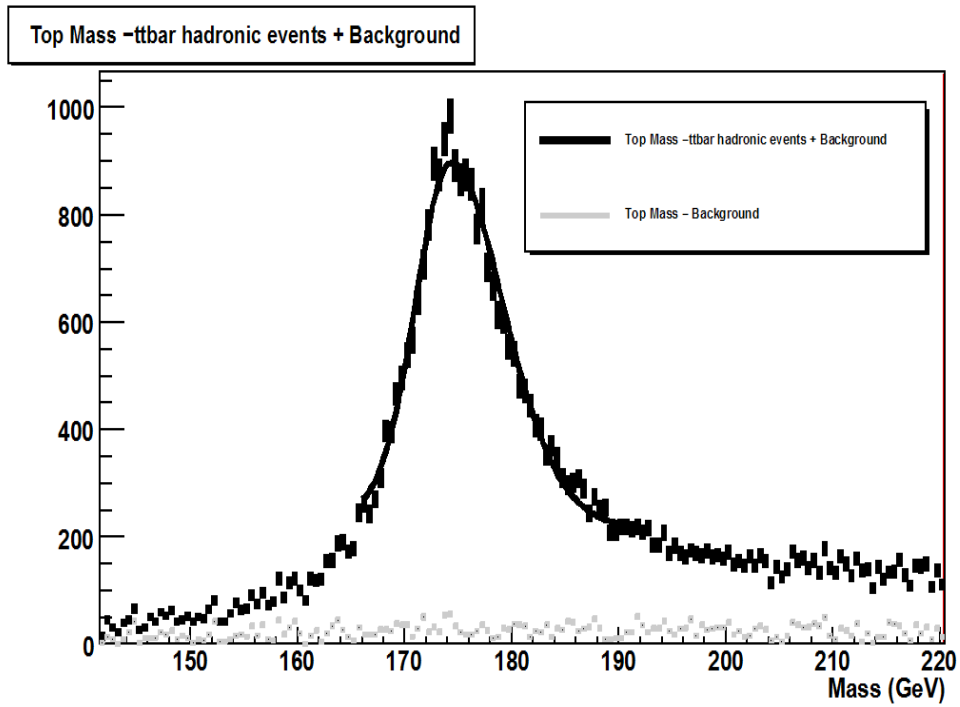
Top production

ILD



$$\sigma_\sigma = 1.1\,\text{fb}$$
$$\sigma_m = 44\,\text{MeV}$$

SiD

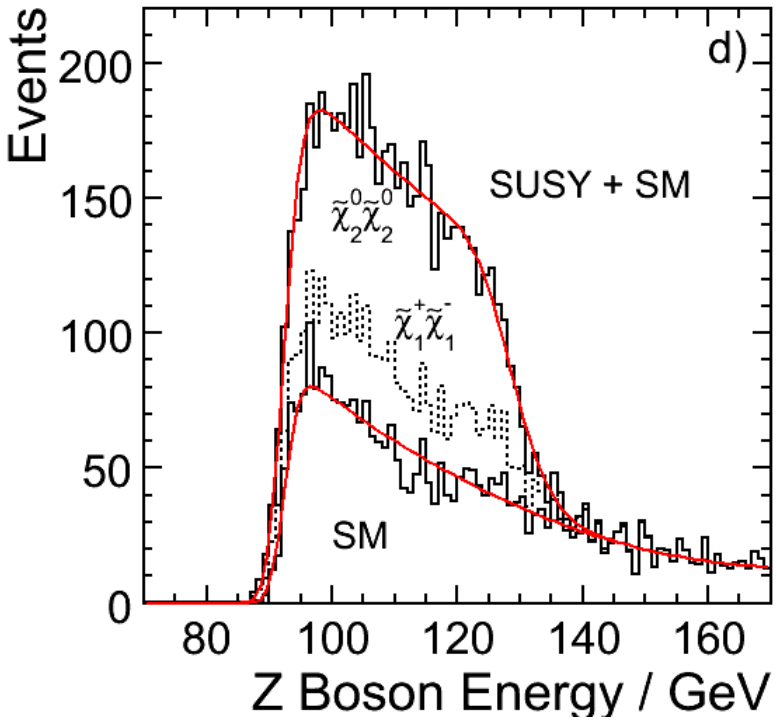


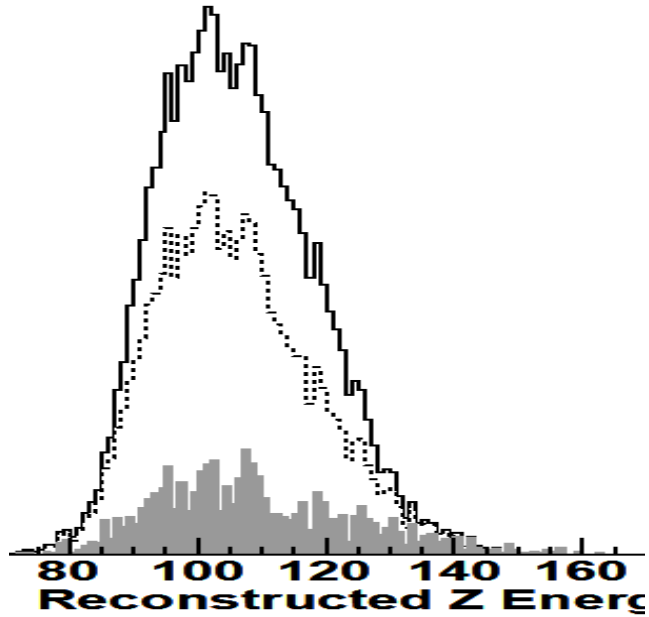
$$\varepsilon = 31\,\%$$
$$\sigma_\sigma = 1.4\,\text{fb}$$
$$\sigma_m = 53\,\text{MeV}$$

★ **ILD has lower error: detector or better analysis ?**

- **In addition questions about robustness of SiD template fitting**

Chargino/Neutralino





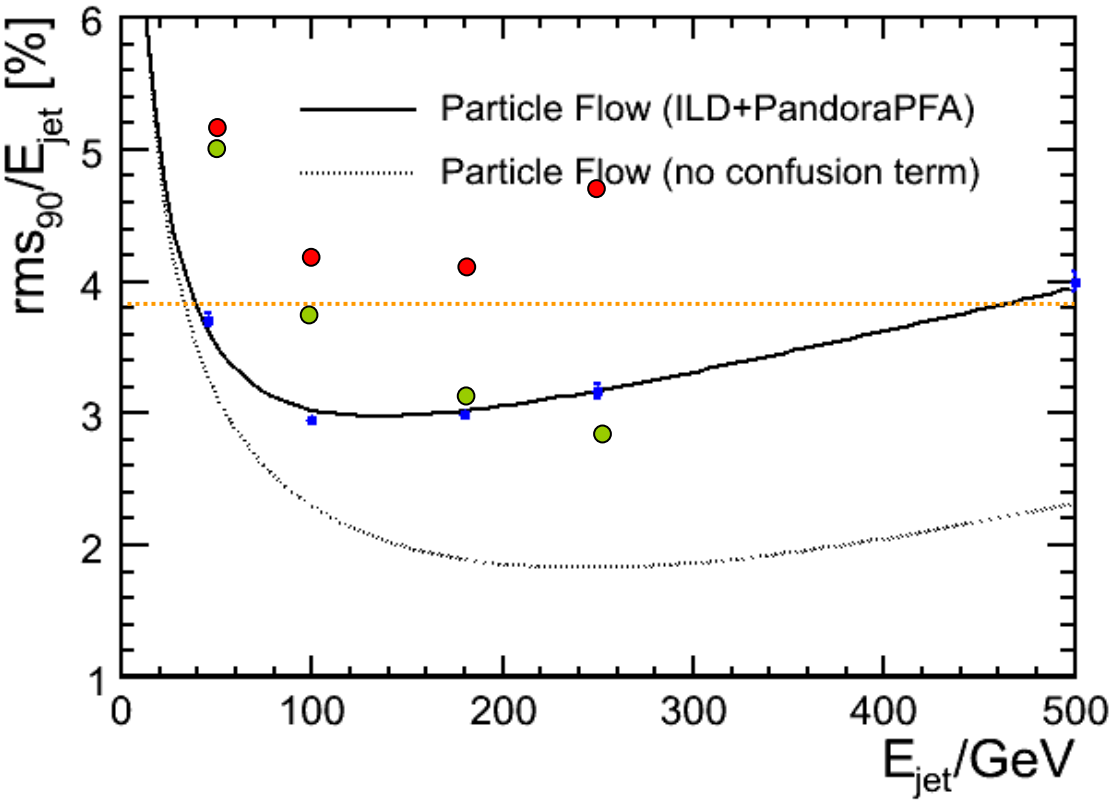
$$\sigma(e^+e^- \to \tilde{\chi}_1^+\tilde{\chi}_1^-) = \pm 0.64\,\%$$
$$\sigma(e^+e^- \to \tilde{\chi}_2^0\tilde{\chi}_2^0) = \pm 2.1\,\%$$

$$\sigma(e^+e^- \to \tilde{\chi}_1^+\tilde{\chi}_1^-) = \pm 0.9\,\%$$
$$\sigma(e^+e^- \to \tilde{\chi}_2^0\tilde{\chi}_2^0) = \pm 4.2\,\%$$

★ **ILD errors much smaller – likely to be due to 40 % better jet energy resolution and hence WW/ZZ separation**

Jet Energy Comparison

- SiD
- 4th (Gaussian not rms_{90} – but tails) (Different simulation)



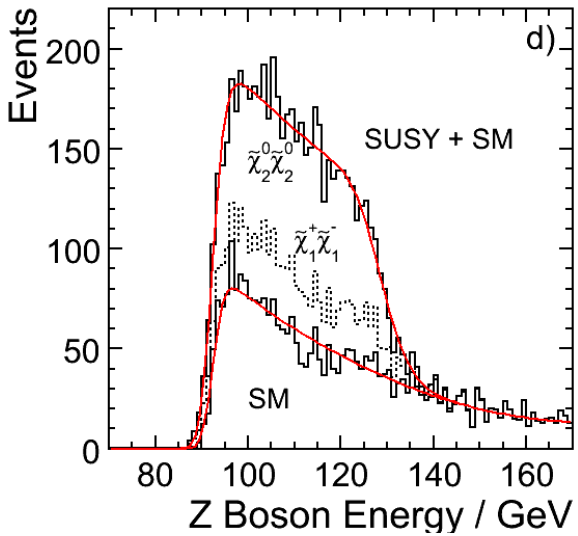
- SiD/ILD ~ 1.35 - 1.55
- 4th/ILD ~ 1.3 - 0.9

★ **But errors on masses from SiD are very much smaller than ILD !**

e.g. $m(\tilde{\chi}_1^0)$ **1 GeV vs 54 MeV**

★ **This is understood**

- **ILD extract masses from the positions of the kinematic edges**
- **SiD generate a sample with one of the gaugino masses shifted by 0.5 GeV and then perform a template fit (robustness?)**
- **SiD method effectively uses the cross section: we believe this isn't correct. The cross section can not be used to constrain the mass as it depends on other SUSY parameters**



❷ Post-IDAG Priorities

★**The bad news…**

- IDAG has requested that all concepts **redo 250 GeV m_H** analysis with **new Monte Carlo** samples !
- Reason: current results not valid !
- **The problem:**
  - samples generated with **Guinea Pig** luminosity spectrum with ISR switched on
  - ISR applied in this way does not know about cross sections
  - The applied again in generator
  - Affects signal badly
  - Also affects background – double ISR likely to increase background
- **The solution:**
  - regenerate (all/main) 250 GeV files !
  - repeat recoil mass analysis !
- **The impact:**
  - mass production needs to start up again (sorry)
  - will have to concentrate on this: other samples very very very low priority

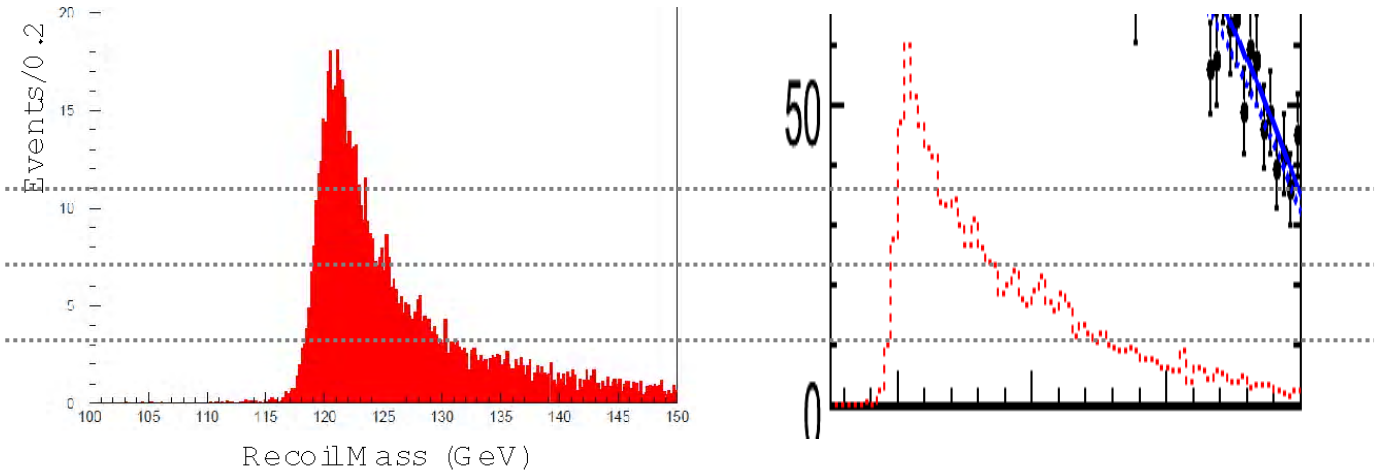
★**The opportunities…**

- chance to fix problems with this and other analyses

LoI+

Propose

- ★ Produce updated LoI physics section for IDAG meeting in **Orsay**
- ★ Have to do this for m_H
- ★ What else **needs** to be done ?
  - **must** try to understand e^+e^-X; this doesn't present **ILD** in the best light
    - tracking of electrons ? ()
    - including Bremsstrahlung photons
    - using track + ECAL for energy estimate ?



Other analysis

★I believe it is also essential to update the following:

- Higgs branching ratios
  - no criticism of current analysis
  - just that SiD were more sophisticated
  - therefore get better performance
  - not a feature of the detector
- Tau analysis
  - essential to optimise tau decay ID algorithms
  - produce P_τ results for all channels
  - this is important
  - statement during IDAG to SiD "… to take advantage of your excellent tau ID capability"
  - must address this
- ttbar A_{FB}
  - IDAG request
  - This may be difficult, e.g. A. Moll left, necessary info in DST ?
  - In addition, physics motivation…
- Others
  - should consider improvements to all benchmark analyses…
  - where appropriate, make more consistent/comparable to SiD analyses

- **Timescales**
  - **Final results to IDAG by 12th June**
    - propose that we update physics section: final draft 5th June
    - this doesn't give us much time - 6 weeks !
    - need to get organised very quickly, names, etc.
    - by the end of this week will try and contact all analysers to see what is feasible on this timescale

Other Priorities

- **Background, background, background**
  - **We need to make progress with background**
    - at very least need to study vertex detector/flavour tagging
    - fold into recoil mass analysis
    - should give this very high priority

That's all for now…