# Report from *Physics: Missing Energy* and *Physics: Jet and photon Energy Messurements*

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# Introduction

- Jets and photons:
  - Detector-close issues. I will only list the talks, as most of this was covered in a previous talk
  - Physics
    - Higgs self-coupling from ZHH
    - pMSSM
    - ttH Yukawa
    - $\nu_R$ in extra dimensions
- Missing energy:
  - Non-pointing $\gamma$
  - $\tilde{\chi}_2^0$ and $\tilde{\chi}_1^\pm$ benchmark
  - SPS1a' $\tilde{\tau}$
  - Missing mass from kinematic cusps
  - Higgs self-coupling from $\nu\nu$HH

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# Jets & photons

The talks on detector-close issues:

- Marcel Reinhard: $\gamma$ reconstruction in ILD.
- Calorimetry options:
  - Christian Grefe: Options for multi-TeV.
  - Felix Selkow: Compensation in the CALICE prototype.
  - Stephen Magill: Putting a dual read-out calorimeter in SiD02.
  - Adam Para: Di-jet reconstruction in a crystal calorimeter.

# Missing Energy: Issues

- Typical physics: Almost any “visible” new physics, $\nu$ rich SM, including Higgs.
- Missing information
  - What is really missing ? Hermiticity
  - What is really seen ? Background sensitivity
  - What should have been seen ? Beam properties
  - How well do we measure what we see ? Detector

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# The physics talks

- Full sim studies:
  - Nanda Wattimena: Non-pointing $\gamma$'s from $\tilde{\chi}_1^0$ decays in GMSB
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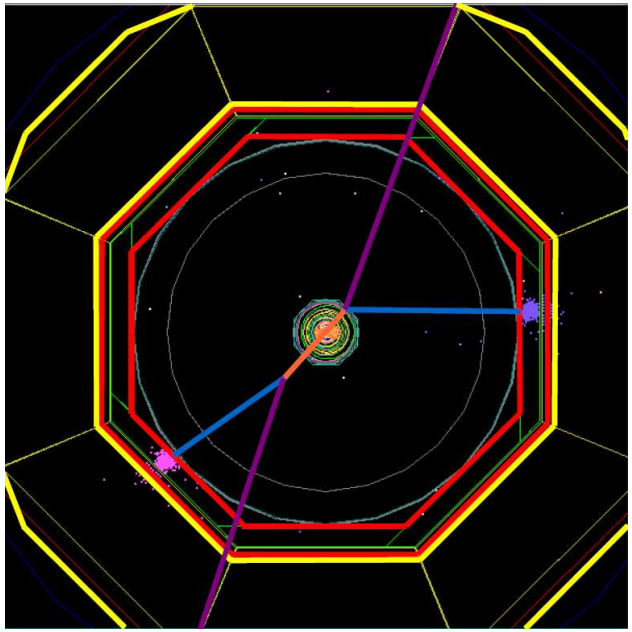
# The physics talks

## $\tilde{\chi}_1^0 \rightarrow \tilde{G}\gamma$ Decays

GMSB



### What we expect ...

- 2 highly energetic $\gamma$
- displaced vertices
- missing transverse energy

### ... and what we need to see it

- ECAL energy resolution
- ECAL position and angular resolution
- detector hermeticity

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# The physics talks

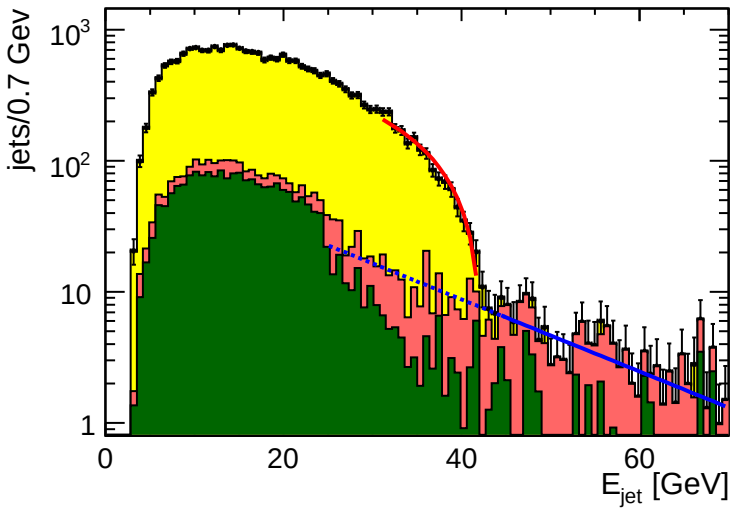


## Fitting the $\tilde{\tau}_1$ mass: Endpoint

GMSB

- Only the upper end-point is relevant.
- Region above 45 GeV is signal free. Fit exponential.
- Fit line to (data-background fit extrapolation):
  - MINUIT, ML fit, with MINOS+HESSE.

$E_{\tau,max} = 41.96^{+0.15}_{-0.13}$ GeV (true value 42.54 GeV)
$M_{\tilde{\tau}_1} = 107.69^{+0.03}_{-0.06}$ GeV.




NB: $dM_{\tilde{\tau}}/dM_{\tilde{\chi}^0_1} \approx 1.1$: Even if $\Delta(M_{\tilde{\chi}^0_1}) \approx 100$ MeV the error from $M_{\tilde{\chi}^0_1}$ largely dominates.

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NB: Not much sensitivity to $M_{\tilde{\tau}_1}$ from cross-section at 500 GeV - too high !

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With beam-polarisation and 1 ab$^{-1}$ : 5.4 $\sigma$ signal, $\Delta g/g$= 9% @ 500 GeV

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# The physics talks

## Signal significance

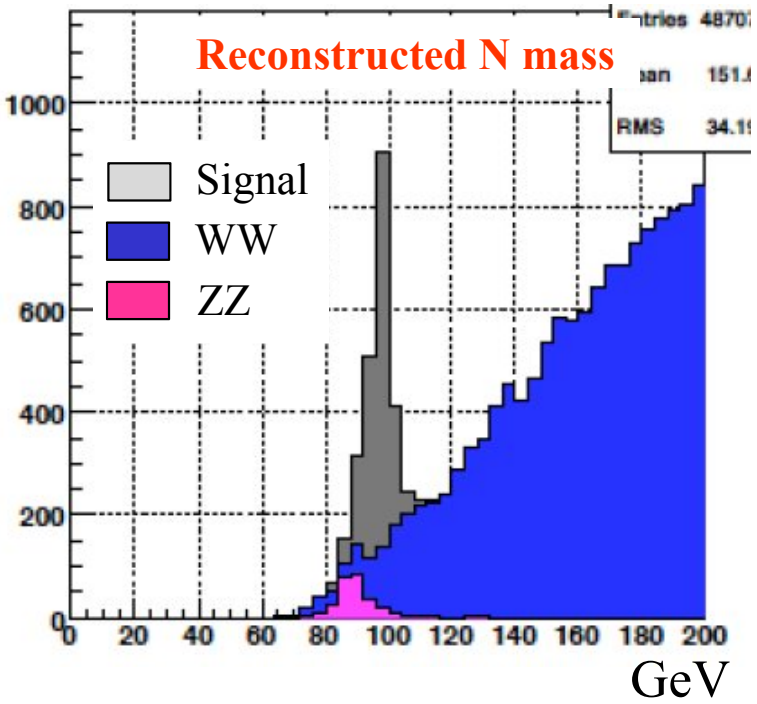
The sensitivity to N was estimated after the selection cut.

- Singal: 1,537
- BG: 800

→ Signal significance : 31.6

→ Δσ(νN→νμqq): 3.2%

**Right-handed neutrinos of the 1st KK mode can be observed at ILC.**




The next step

- Xsec measurement of electron and muon modes.
- Study of the 2nd KK mode.

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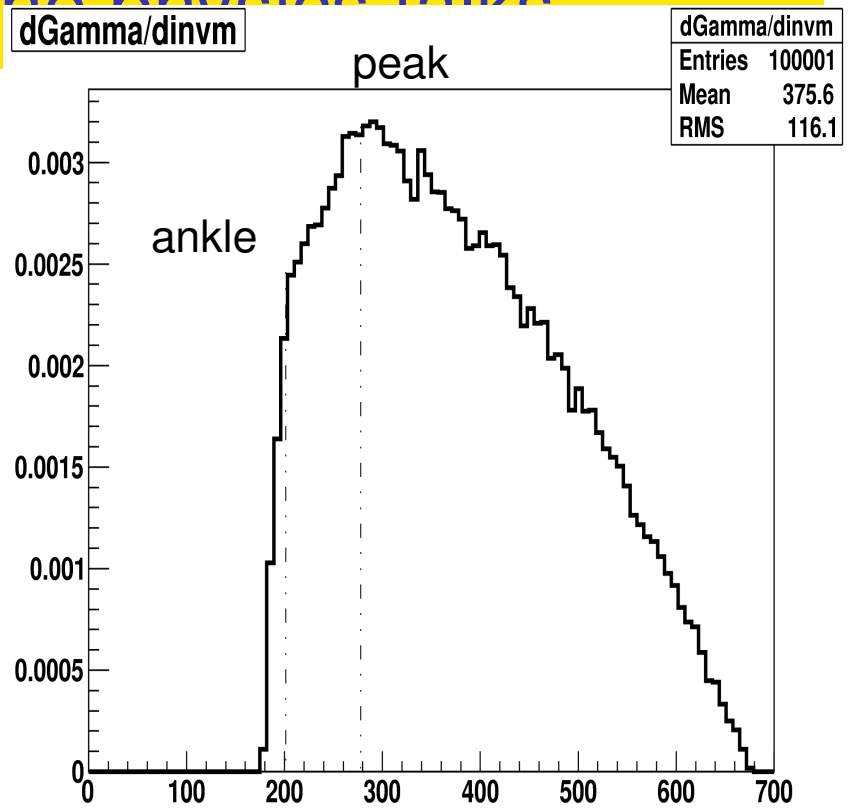


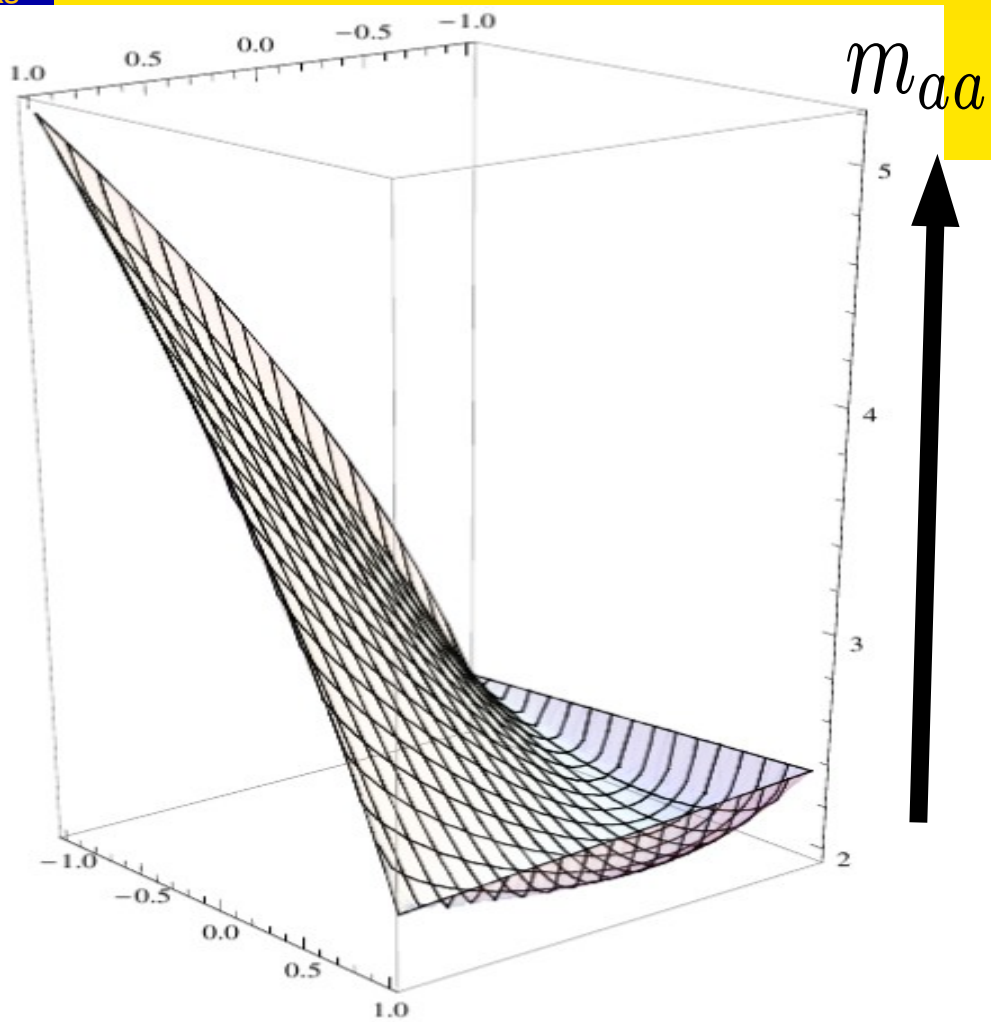

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ZHH even harder if $M_H$=140

$\nu\nu$HH @ 1 TeV promising

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Expect the un-expected: odd NLSP, detector-stable particles, squarks and gluinos, even that ILC could be the discovery machine!

# Discussion session

- Michael Peskin convinced us the new benchmarks is a good idea - but can't we call it something more interesting ;-)
- At least for *Missing Energy*, the detector is often not an issue: statistics dominated
- Beam-properties *is* an issue:
  - Beam-background spoils topology, even if it carries little energy.
  - Pairs might worsen hermiticity.
  - For end-points, cusps, thresholds, of-peak luminosity is useless.
  - Being able to choose $E_{cms}$ strengthens the power of the ILC for eg. low mass SUSY enormously.
  - Same goes for polarisation.
- To study this: We need input from our machine colleagues, and we need it now, to be able to say anything by December.

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