

ILC Physics Analyses at DESY (Hamburg)

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DESY Hamburg

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Overview

Mature Analyses

New Analyses

Summary

Overview

topics

- ▶ main area: SUSY and Cold Dark Matter
- ▶ together with Zeuthen, Orsay, Munich: Higgsstrahlung
- ▶ polarisation determination from W^+W^-

manpower in full simulation physics analyses

- ▶ 3 supervisors
- ▶ 3 postdocs (one on maternity leave)
- ▶ 1 experienced PhD student
- ▶ 1 PhD and 1 Diploma student started in autumn
- ▶ 3 PhD students will switch from hardware to analysis now

Single Photons + Missing Energy (C.Bartels)

Simple final state with many physics applications:

- ▶ model-independent WIMP search (hep-ph/0403004)
- ▶ radiative neutralino production (hep-ph/07071642)
- ▶ extra dimensions (LC-PHSM-2001-010)
- ▶

Detector and accelerator issues:

- ▶ photons \rightarrow ECAL resolution, photon ID
- ▶ missing energy \rightarrow
 - ▶ hermeticity
 - ▶ LUMICAL
 - ▶ beam background \rightarrow rejection of radiative Bhabhas
- ▶ irreducible background $e^+e^- \rightarrow \nu\nu\gamma$: Polarisation

Single Photons + Missing Energy (C.Bartels)

WIMP search presented at LCWS07 (Cosmology session):

- ▶ simulation: LDC01_01Sc, Mokka 6.1
- ▶ reconstruction: PFlow: WOLF + homemade cluster merging

Since then:

- ▶ switch to Mokka 6.4, θ -dependent calibration
 - ▶ collaboration with O. Kittel, J. Reuter on radiative neutralino interpretation
 - ▶ first checks of LDC01_05Sc
 - ▶ ready to jump onto the new MC production samples
- ⇒ **for more details c.f. Christophs talk in the next session!**

$e^+e^- \rightarrow W^+W^-$ (I. Marchesini)

- ▶ semileptonic channel: $2 \text{ jets} + l + \nu$
- ▶ goal: provide absolute scale for polarisation measurement
- ▶ detector issues:
 - ▶ PFlow
 - ▶ Lepton-ID
 - ▶ invariant mass resolution, WW / ZZ separation

$e^+e^- \rightarrow W^+W^-$ (I. Marchesini):

Status:

- ▶ Mokka 5.4, LDC00Sc, 4T
- ▶ LEPTracking
- ▶ TrackwiseClustering
- ▶ WOLF

establish event selection:

- ▶ force 3 jets with Durham algorithm
- ▶ 1 jet has isolated track (5°) with $p_t \geq 10$ GeV
- ▶ $N_{tracks} \geq 5$
- ▶ Neutrino: $p_t^{miss} \geq 5$ GeV, $\Sigma E \leq 450$ GeV
- ▶ no rad. return: $\sqrt{s'} \geq 100$ GeV

$e^+e^- \rightarrow W^+W^-$ (I. Marchesini):

next steps:

- ▶ τ s: give slightly worse mass resolution - exclude?
- ▶ more sophisticated Lepton-ID?
- ▶ switch to LDC01_05Sc / LDCPrime_05Sc
- ▶ try Pandora?
- ▶ kinematic fitting?

$e^+e^- \rightarrow \tilde{\tau}_1^+ \tilde{\tau}_1^-$ (O. Stempel)

- ▶ started with SPS1a' (Point 1), later D' (Point 3)
- ▶ SIMDET/SGV studies from H.U. Martyn and Z.Zhang *et al* exist
- ▶ detector issues:
 - ▶ PFlow, τ -ID
 - ▶ hermeticity, LUMICAL, beam background \rightarrow rejection of 2 photon events
- ▶ status:
 - ▶ fresh diploma thesis work
 - ▶ started to implement the event selection in Marlin using SIMDET events
 - ▶ switch to full simulation as soon as mass production gets available

$$e^+ e^- \rightarrow \tilde{\tau}_1^+ \tilde{\tau}_1^- \quad (\text{D. Käfer})$$

- ▶ Point 6: heavy stable particle
- ▶ **very exotic:** $\tilde{\tau}$ s get stuck in detector and decay later (seconds, minutes, years)
- ▶ superWIMP scenario: \tilde{G} is LSP
- ▶ $\tilde{\tau}$ lifetime and mass \Rightarrow gravitation constant
- ▶ SIMDET study from H.U. Martyn exists
- ▶ detector issues:
 - ▶ Tracking, esp. dE/dx
 - ▶ calorimeter readout (late decays!)
- ▶ status:
 - ▶ just started
 - ▶ At which point could a superWIMP scenario be recognized, so that calorimeter readout philosophy could be reevaluated?

Just starting / Soon to come:

- ▶ $e^+e^- \rightarrow \tilde{\tau}_1^+ \tilde{\tau}_1^-$ (P. Schade): $\tilde{\tau}$ polarisation measurement
- ▶ $e^+e^- \rightarrow \tilde{\chi}_2^0 \tilde{\chi}_1^0 \rightarrow \mu^+ \mu^- \tilde{\chi}_1^0 \tilde{\chi}_1^0$ (N.D'Ascenzo)
- ▶ $e^+e^- \rightarrow \gamma G$: Extra dimensions (C. Bartels)
- ▶ $e^+e^- \rightarrow \tilde{\chi}_1^0 \tilde{\chi}_1^0 \rightarrow \gamma \tilde{G} \gamma \tilde{G}$: SUSY Point 7 GMSB (N.N.), non-pointing γ s

Topic Summary

- ▶ SUSY: $e^+e^- \rightarrow \tilde{\tau}^+\tilde{\tau}^-$
 - ▶ $\tilde{\tau}$ polarisation (start with not too small Δm)
 - ▶ SPS1a' (POINT 1), later D' (POINT 3): low Δm , $\tilde{\tau}$ co-annihilation
 - ▶ ϵ (POINT 6): meta-stable $\tilde{\tau}$, gravitino superWIMP dark matter
- ▶ SUSY: $e^+e^- \rightarrow \tilde{\chi}^0\tilde{\chi}^0$
 - ▶ $\tilde{\chi}_2^0\tilde{\chi}_1^0 \rightarrow \mu^+\mu^-\tilde{\chi}_1^0\tilde{\chi}_1^0$ in α (POINT 5): $\tilde{\chi}_2^0$ and $\tilde{\chi}_1^\pm$ degenerated
 - ▶ $\tilde{\chi}_1^0\tilde{\chi}_1^0 + ISR\gamma$: heavy $\tilde{\chi}^0$
 - ▶ $\tilde{\chi}_1^0\tilde{\chi}_1^0 \rightarrow \gamma\tilde{G}\gamma\tilde{G}$ POINT 7 GMSB, gravitino dark matter
- ▶ further exotics with photons and missing energy
 - ▶ model-independent WIMP search
 - ▶ ADD extra dimensions
- ▶ Polarisation measurement with $e^+e^- \rightarrow W^+W^-$

Status Summary

- ▶ only one mature full simulation study right now
- ▶ the majority of analyses just started
- ▶ a steep ramp up in manpower currently happens
- ▶ some analysts are also burdened with grid production ⇒ help very welcome!
- ▶ once LDC01_05Sc, LDC' ... MC becomes available, all analyses will switch to it