

non-simplified SUSY $\tilde{\tau}$ -coannihilation at LHC \neq ILC.

- LSP: lightest SUSY particle/partner
- ILD: International Large Detector
- ILC: International Linear Collider
- R-Parity: Z_2 symmetry on the model that forbids the renormalizable couplings.
 - ↳ more clearly, \rightarrow it prevents unwanted terms in the theory in order to not violate experimental bounds in the phenomenology.
- GUT scale: grand unification energy \rightarrow above this, EM, weak and strong forces are believed to be equal in strength, and become one united force.
- $\tilde{\tau}$: stau \rightarrow superpartner of τ lepton.
- superpartner: according to SUSY, all fermions must have a boson partner, and all bosons must have a fermion partner.
 - ↳ unbroken SUSY predicts that $m_{\text{particle}} = m_{\text{superpartner}}$
- naturalness: a theory not containing dimensionless numbers too large or too small.
- Generations:

	<u>QUARKS</u>	<u>LEPTONS</u>
1 st \rightarrow	u, d	e, ν_e
2 nd \rightarrow	c, s	μ , ν_μ
3 rd \rightarrow	t, b	τ , ν_τ

- coannihilation \rightarrow mutual annihilation of colliding pairs.
- HL-LHC \rightarrow high luminosity LHC.
- b-tagging: identifying jets originated from the bottom quark.
- Detector response is simulated with Delphes 3.0.9
 - Also used in Snowmass studies

- Able to include pile-up
 - FastJet \rightarrow pile-up subtraction, jet clustering.
 - Pythia 6 \rightarrow Z_2^* tune
 - PROSPINO2 \rightarrow NLO / cross section calculated.
 - Full-Hadronic Search:
 - long decay chains \rightarrow multiple jets \rightarrow large hadronic energy, large missing p_T .
 - H_T : scalar sum of **Jet** momenta
 - \downarrow
 - cuts: $p_T > 50 \text{ GeV}$
 $|\eta| < 2.5$
 - MHT: missing hadronic E_T \rightarrow abs of negative vectorial sum
 - \downarrow
 - cuts: $p_T > 30 \text{ GeV}$
 $|\eta| < 5$
 - SM background of this search is mostly from:
 - $Z\nu\nu + \text{jets}$
 - $W_{\ell\nu} + \text{jets from } W$
 - $t\bar{t} + \text{jets (min 1 } W \text{ leptonic decay)}$
 - At high MHT, QCD background can be neglected.
 - Baseline selections: (8 TeV)
 - Minimum 3 Jets, $p_T > 50 \text{ GeV}$, $|\eta| < 2.5$, $H_T > 1000 \text{ GeV}$
 $MHT > 500 \text{ GeV}$
 - To avoid QCD background:
 - $|\Delta\phi(j_n, MHT)| = \text{azimuthal angle difference between leading jets \& MHT}$
- $(n = 1, 2)$ $|\Delta\phi(j_n, MHT)| > 0.5$ $|\Delta\phi(j_3, MHT)| > 0.3$

- Veto events at:

$p_T > 10 \text{ GeV}$ $|\eta| < 2.4$ (isolated muons)

$p_T > 10 \text{ GeV}$ $|\eta| < 2.5$ (electrons)