Matter and the Universe

Topic 1: *Fundamental Particles and Forces*

SUSY parameter determination at ILC

Annika Vauth (DESY)

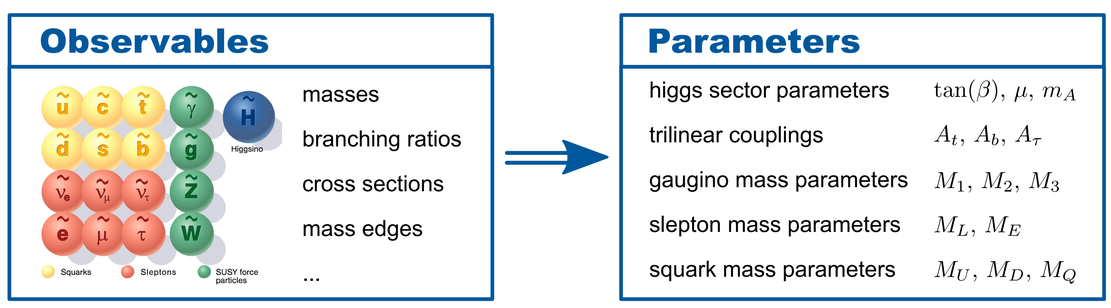
Motivation

There are many reasons to search for physics beyond the Standard Model. One prominent theory is Supersymmetry.

- Parts of SUSY parameter space excluded
- Many possibilities for light SUSY remain

If SUSY is observed:

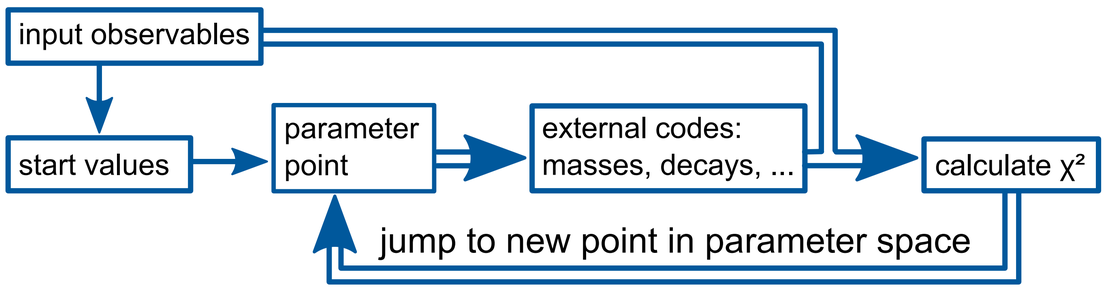
➡ **Can we determine the underlying model's parameters?**



Parameter reconstruction with Fittino

To determine the model parameters from measured quantities, the fit program Fittino [arXiv:0412012] can be used to

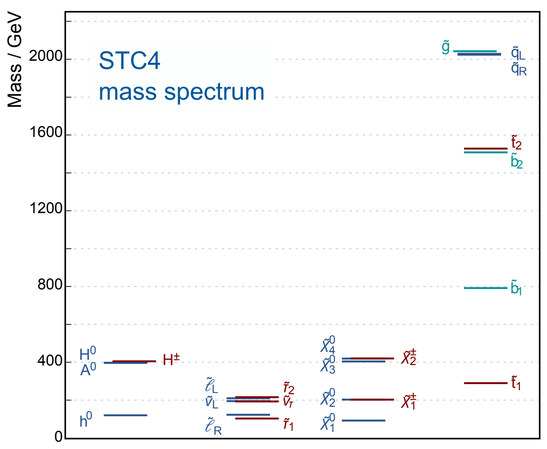
- Find a starting point using tree level estimates,
- Find the central values of the parameters,
- Evaluate the parameter correlations and uncertainties.

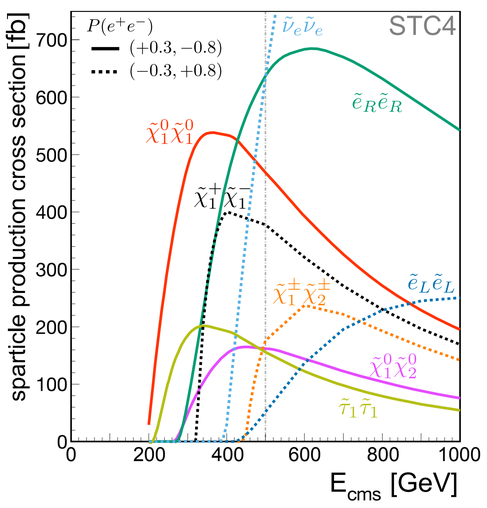


The new STC4 benchmark point

Features of the "STC4" (for $\tilde{\tau}$ co-annihilation model 4) pMSSM benchmark model [arXiv:1307.0782]:

- consistent with current LHC limits
- $\tilde{\tau}$ not degenerate with $\tilde{e}$ and $\tilde{\mu}$, small mass difference between $\tilde{\tau}_1$ and lightest SUSY particle
- predicted relic density agrees with observed value



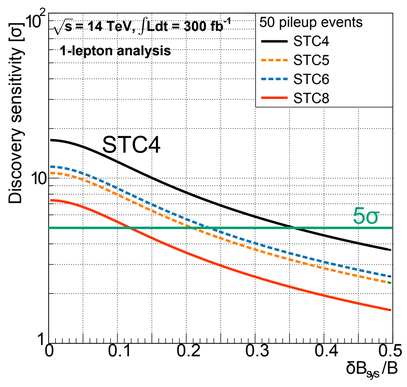


Discovery and measurements

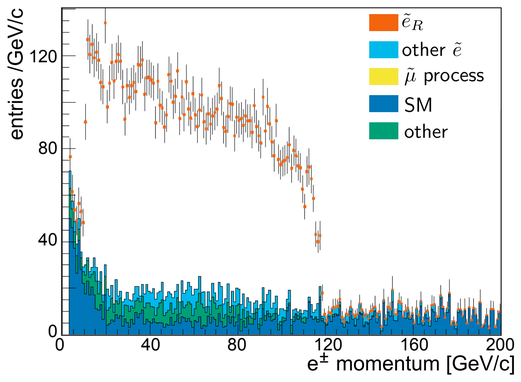
Capabilities for discovery and identification [arXiv:1307.8076]:

- **LHC14:** possibility to observe STC4 depends strongly on systematic uncertainty on the background
- **ILC**: all sleptons and light electroweakinos are accessible

Which precision would allow to determine the model parameters from the measurements?



LHC14: Discovery sensitivity with 300 fb^{-1}. The green line marks the 5-σ-level.

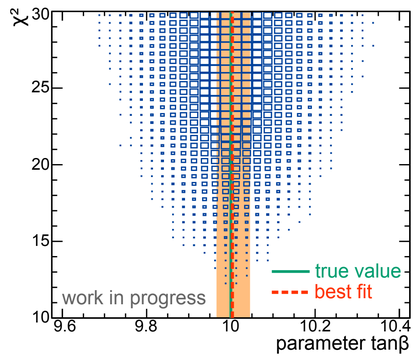


ILC500: Determination of $\tilde{e}$ / $\tilde{\chi}^0$mass vi edge detection with 10 pb^{-1} data (one week at design luminosity).

STC4 Fittino analysis

To study the feasibility of parameter reconstruction, a global fit is done with Fittino, using LHC + ILC observables.

- Similar analysis for another model in the past [arXiv:0907.2589]
- Fit to reconstruct STC4 parameters currently in progress
  - ➥ determine best fit parameter values
- Which observables and precisions are needed?
- ➡ Conclude **necessary luminosities** at different ILC energies / threshold scans

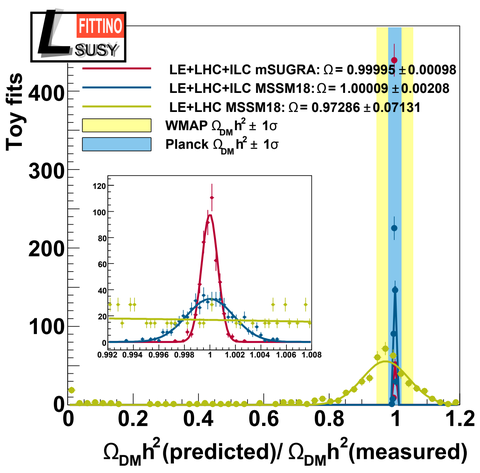


χ^2 of scanned tanβ. (SPS1a, STC4 in progress..)

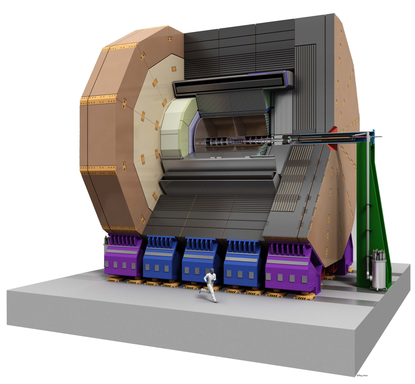
Connection to cosmology

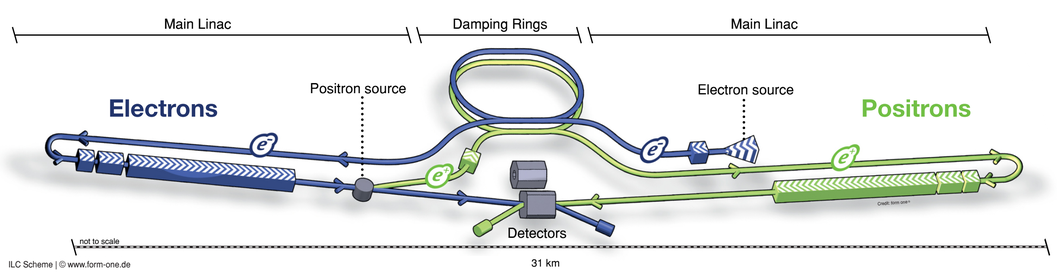
Parameter determination based on collider measurements can also improve the accuracy on the relic density:

- Agreement of $\Omega_{CDM}h^2$ predictions from fitted parameters with cosmological measurements:
  - ➥ dark matter consists primarily of lightest SUSY particles
- ➡ **High precision predictions** for direct detection experiments possible



Ratio of predicted to nominal value of Ωh^2 (SPS1a scenario, [arXiv:0907.2589]).





HELMHOLTZ ASSOCIATION