Comparing RGE-Codes for Fittino

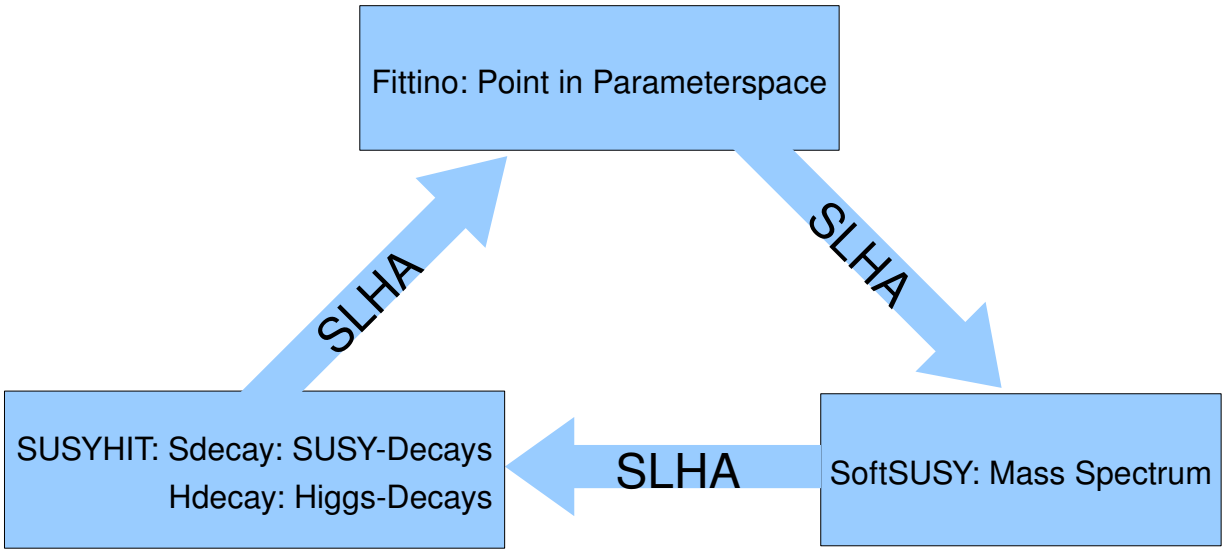
Matthias Hamer, Carsten Hensel
II. Physikalisches Institut, Universitaet Goettingen

Fittino Workshop, DESY Hamburg, 29.-30.10.2009

Outline

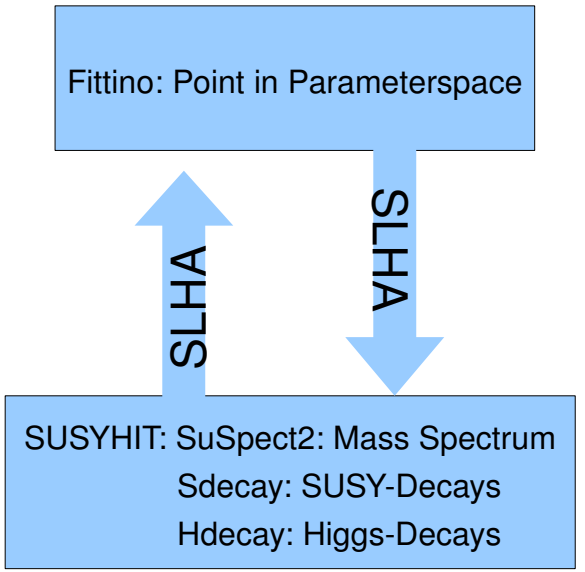
- The SoftSUSY and SuSpect Interfaces
- Remaining problems with Interfaces
- Comparison of SPheno, SoftSUSY and SuSpect
  - Parameterspace
  - Observables
  - (Very First) Results

SoftSUSY and SuSpect Interfaces



- SoftSUSY-Interface
- written for SoftSUSY 3.0.9
- slight modifications to SoftSUSY and SUSY-HIT were necessary
- Seems to work fine for mSUGRA, GMSB and AMSB

- SuSpect Interface
- Written for SuSpect 2.41 embedded in the SUSY-HIT package (v1.3)
- H-Decay 3.4 and S-Decay 1.3b for Decay-Calculations
- Seems to work fine for mSUGRA. Other models not yet tested. Not commited yet.

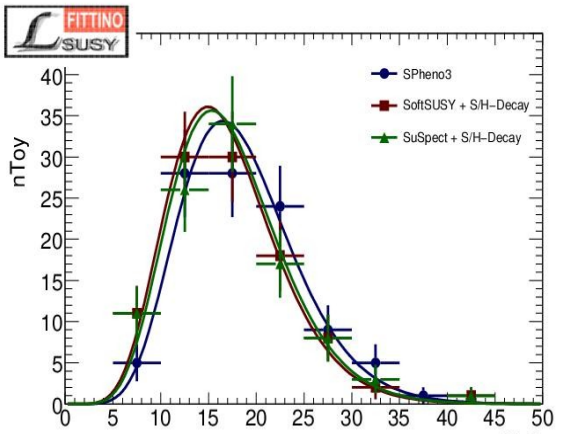


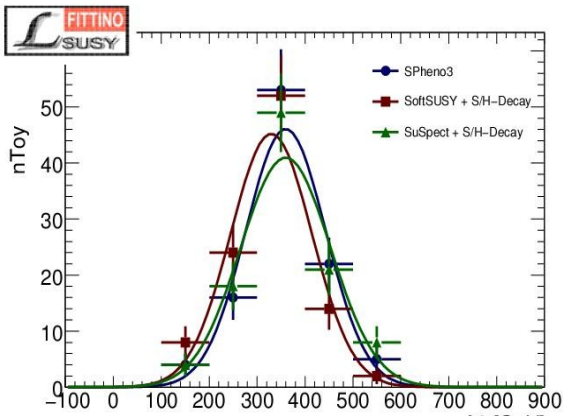
Remaining problems (selection)

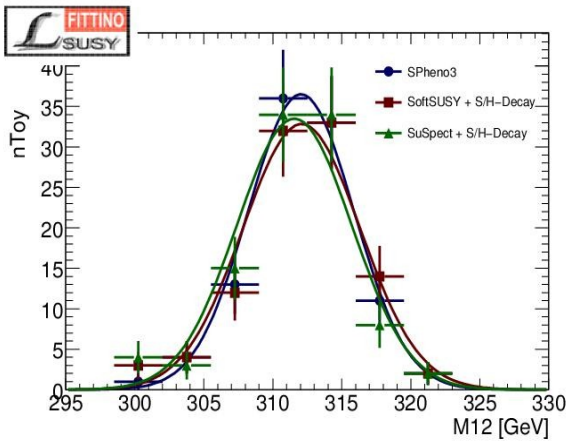
- All Modells: Out-of-the-box-SUSYHIT doesn't write some Quark-Masses/Z-Mass/Tau-Mass → Fittino uses Standard-Values → bounds and/or wrong Observable-Prediction
  - **Solution: Modify SUSYHIT such, that it writes these masses. Works, except for Charm-Mass so far.**
- AMSB: negative Gluino mass
  - **Solution: Force SoftSUSY to switch sign. (Why? Is this correct??)**
- MSSM: not extensively tested, but first tries were not successfull
  - **Solution: Should exist.**
- NMSSM/XMSUGRA have not been tested yet (compatibility with SoftSUSY/SuSpect?)
  - **Solution: Test it! → most likely new problems**
- Some modifcations to the Fittino source code and parser-files are still quite ugly
  - **Solution: Review the changes, rewrite code – not urgent**
- The SuSpect Interface is working only for mSUGRA by now.
  - **Needs to be completed**

A First Comparison

- Picked a small M12-Interval in the LE-preferred region
  - A0: 400 GeV
  - M0: 70 GeV
  - tan β: 13
  - M12: ε [250;410] GeV
- Chosen a set of Observables such, that (nearly) every mass-sector is included.





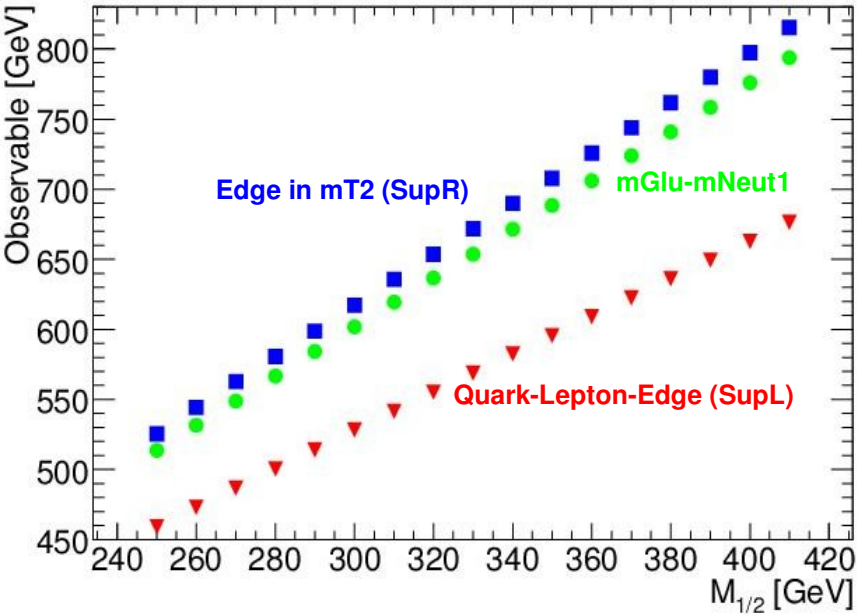


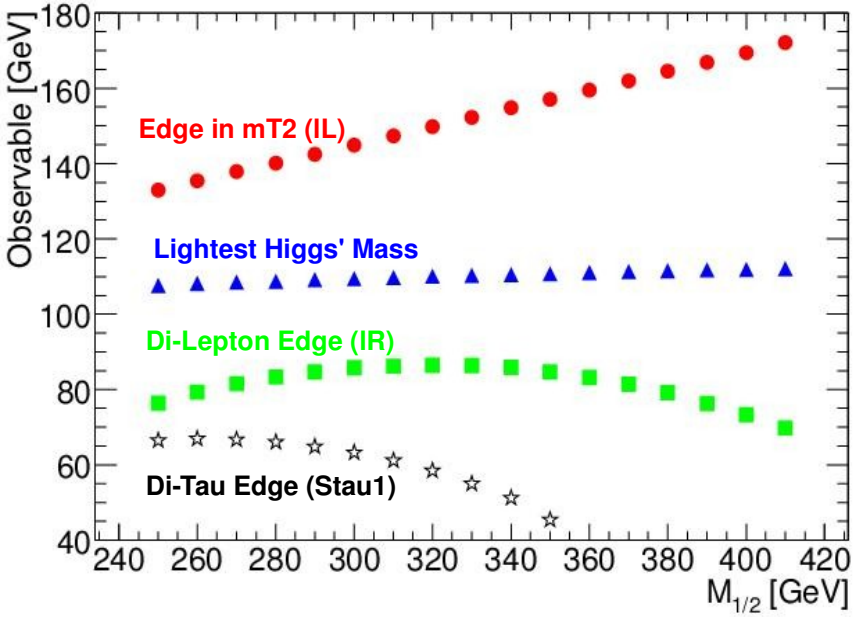
- For each Value of M12:
  - 100 Pulls/Toy Fits
  - Each Observable Set fitted with SoftSUSY, SPheno and SuSpect (100 x 17 x 3 = 5100 in total)
  - Get distributions for all fitted Parameters and Chi2
  - Interpret Width of Gaussian as Uncertainty

Used Observables

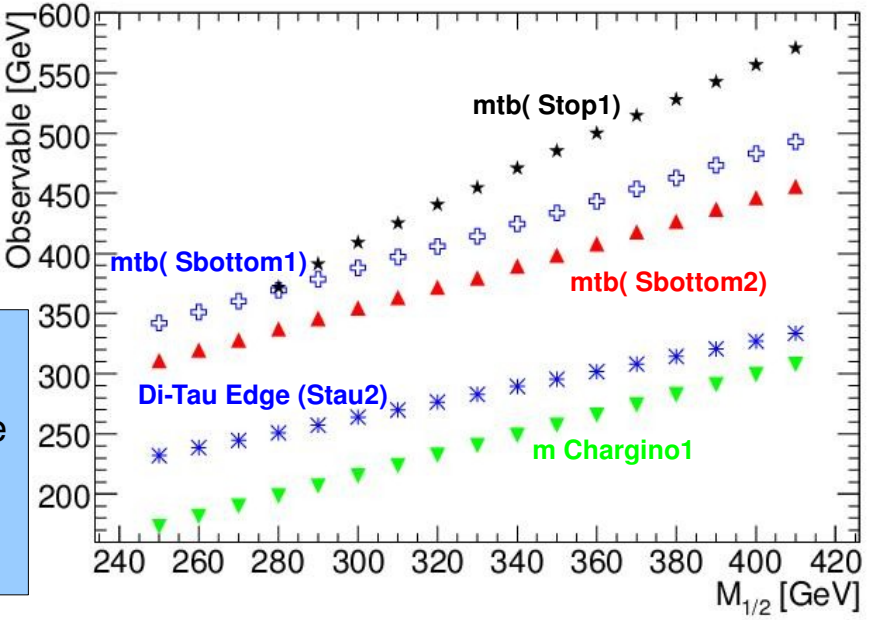
$$\sigma^2_{Obs} = \left(\max_{i,j} |(O_i - O_j)| \right)^2 + \sigma^2_{exp.}$$

Observable	Value for $M_{1/2} = 310$ GeV	
m_{h0}	109.71 GeV	$\pm$ 0.59 GeV
$m_{\tilde{\chi}_1^+}$	223.62 GeV	$\pm$ 11.22 GeV
$m_{ll}^{max}(\tilde{\chi}_1^0, \tilde{\chi}_2^0, \tilde{l}_R)$	86.24 GeV	$\pm$ 4.67 GeV
$m_{\tau\tau}^{max}(\tilde{\chi}_1^0, \tilde{\chi}_2^0, \tilde{\tau}_1)$	61.16 GeV	$\pm$ 9.01 GeV
$m_{\tau\tau}^{max}(\tilde{\chi}_1^0, \tilde{\chi}_2^0, \tilde{\tau}_2)$	269.84 GeV	$\pm$ 9.28 GeV
$m_{\tilde{g}} - m_{\tilde{\chi}_1^0}$	619.21 GeV	$\pm$ 15.3 GeV
$\sqrt{m^2_{\tilde{q}_R} - 2m^2_{\tilde{\chi}_1^0}}$	635.13 GeV	$\pm$ 12.54 GeV
$\sqrt{m^2_{\tilde{l}_L} - 2m^2_{\tilde{\chi}_1^0}}$	147.37 GeV	$\pm$ 9.63 GeV
$m_{lq}^{high}(\tilde{\chi}_1^0, \tilde{\chi}_2^0, \tilde{l}_L, \tilde{q}_L)$	541.42 GeV	$\pm$ 11.95 GeV
$m_{tb}^{max}(\tilde{\chi}_1^+, \tilde{b}_1, \tilde{g})$	397.03 GeV	$\pm$ 9.08 GeV
$m_{tb}^{max}(\tilde{\chi}_1^+, \tilde{b}_2, \tilde{g})$	363.49 GeV	$\pm$ 12.43 GeV
$m_{tb}^{max}(\tilde{\chi}_1^+, \tilde{t}_1, \tilde{g})$	425.16 GeV	$\pm$ 15.34 GeV

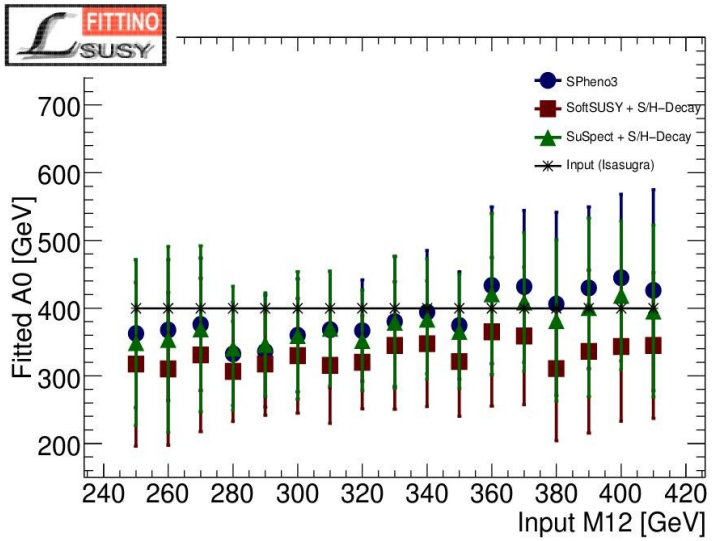


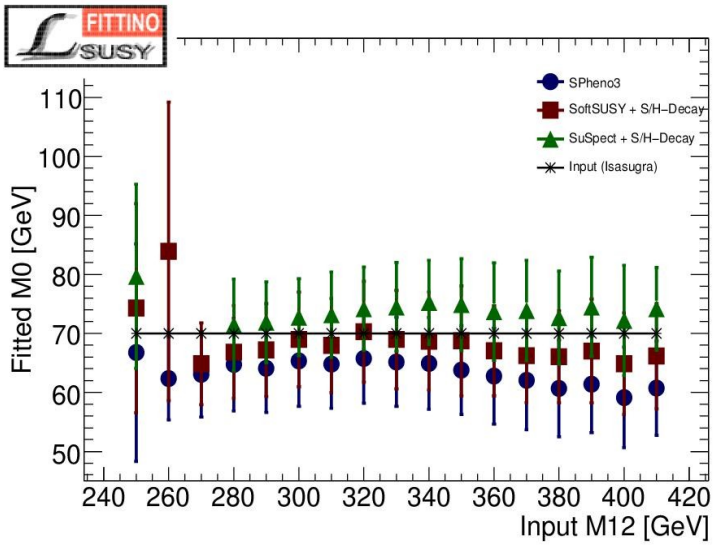


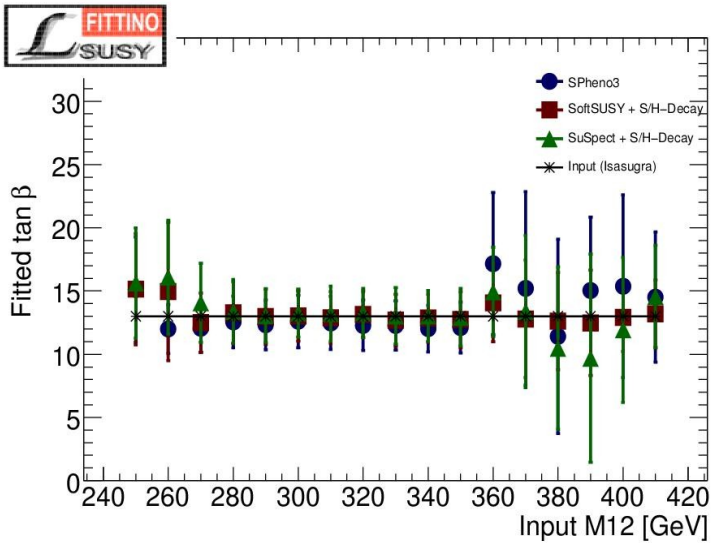
all observable-predictions were obtained by Isasugra7.79

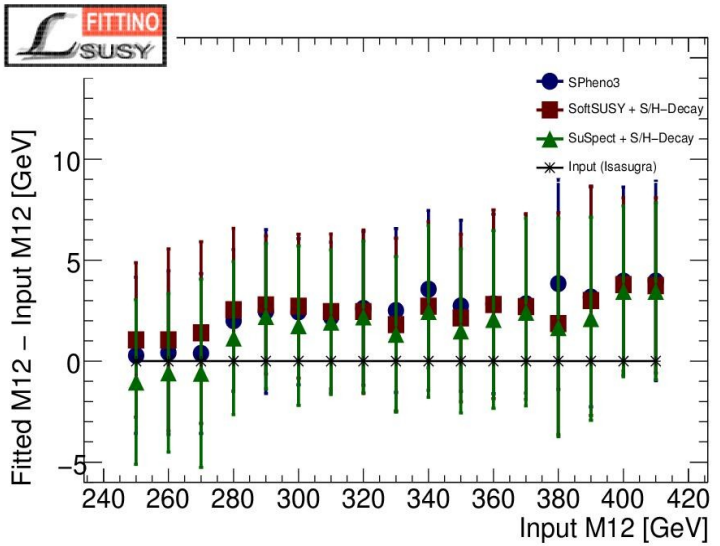


Overall Comparison

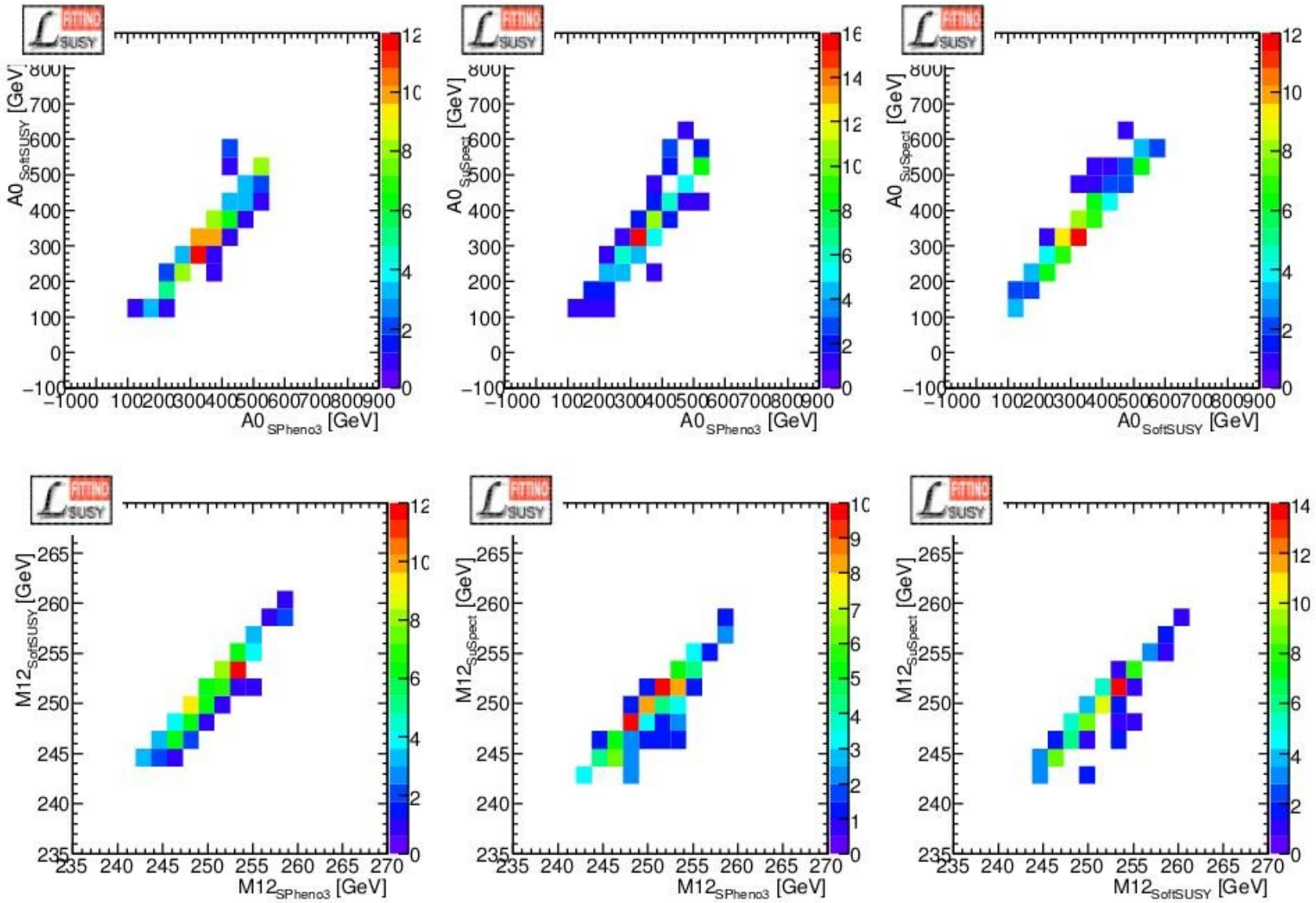




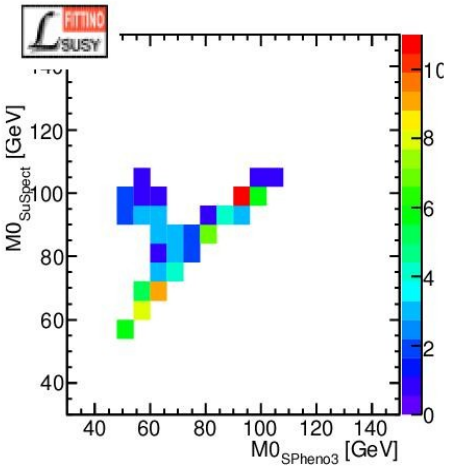




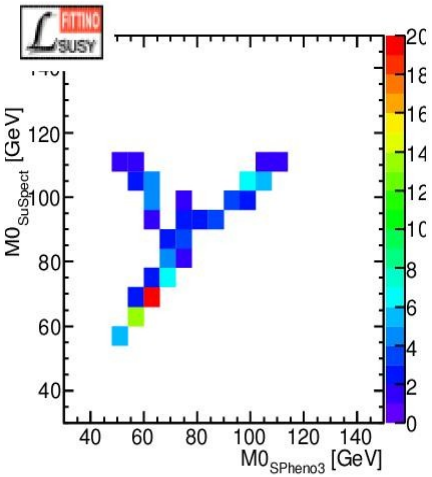
One by one Comparison: Correlations



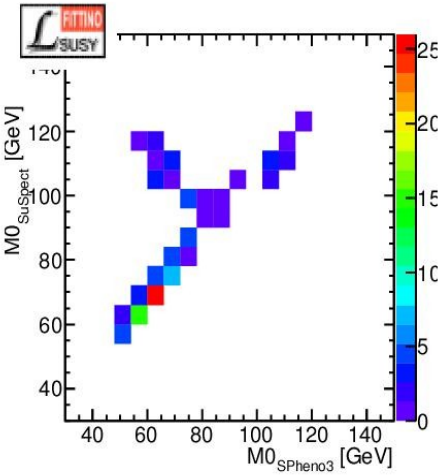
One by one Comparison: M0



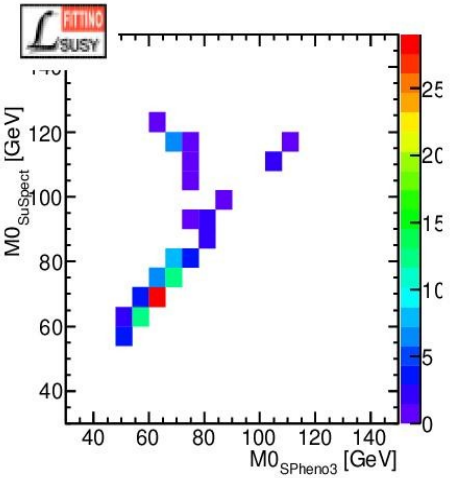
250 GeV



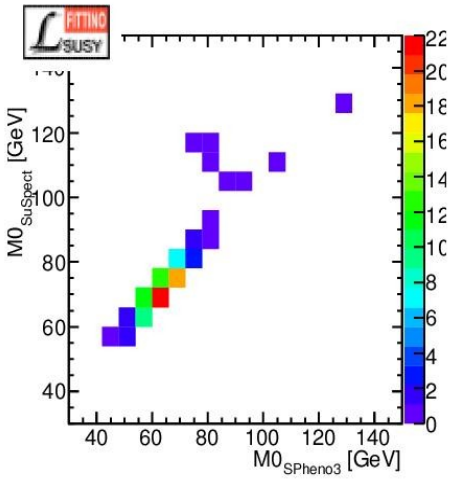
260 GeV



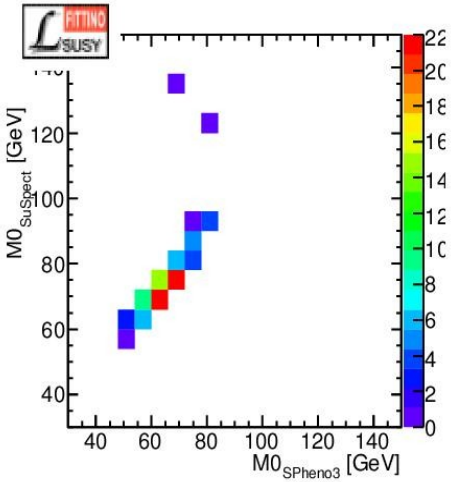
270 GeV



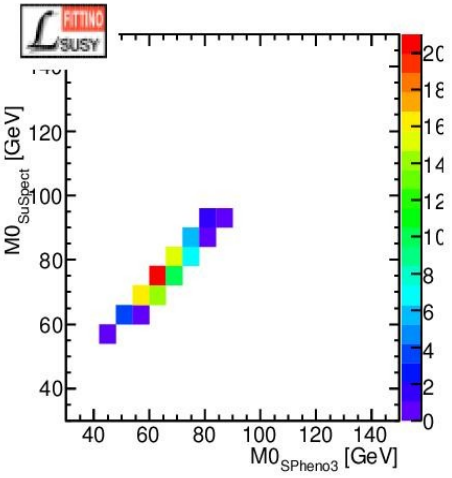
280 GeV



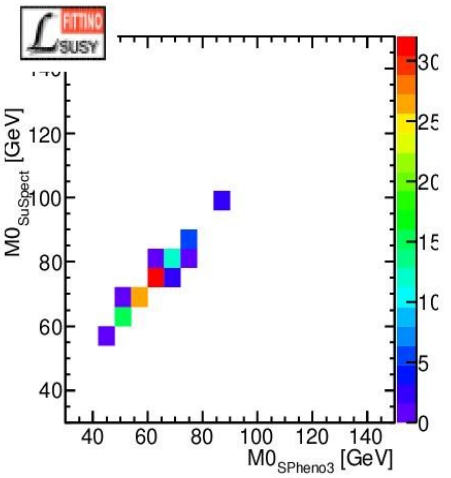
290 GeV



300 GeV



340 GeV



380 GeV

Summary/Conlcusion & Outlook

- Interval on the M12-Axis is examined
  - Not all Jobs have finished yet
  - 100 Pulls per Step are too less
- There are no big surprises in the results at the first view
- Results obtained with SPheno, SuSpect and SoftSUSY are in fair agreement
  - This is not surprising as the differences in the observable predictions by all four codes have been used as uncertainties

- Plans:
  - **On short scale:**
    - Increase statistics for some values of M12
    - Have a closer look on anticorrelated branch in M0-M0-Correlations
      - First guess: this could have to do with m_{tb}(stop1). Really? If yes: Why?
  - **On larger time scales:**
    - There's more work to do on the Interfaces. Wanted? Needed?
    - Comparison of RGE-Codes might be interesting in 'kinematic threshold regions'