

WG2: Tools – Summary

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1. WG1 – WG2 differences
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3. The “master tool”
4. Short analysis/discussion
5. Conclusions

1. WG1 – WG2 differences

WG1 subgroup for tools:

Frank Krauss, Filip Moortgat, Giacomo Polesello

WG2 subgroup for tools/new physics:

S.H., Fabrizio Parodi, Luca Silvestrini

⇒ **idea:** let's do the tools together

⇒ **substantial differences showed up**

2. WG2 Tools

Starting point to get an overview:

email to all WG1/WG2 participants, asking for

- What does your tool/code do?
In which model?
What is the input?
What is the output?
(In case of SUSY: is it SLHA(2) compatible?)
- Are there published results obtained with this tool/code?
Did you present it already during this workshop course?
If not, are you interested in a presentation?
- Is the tool/code public?
(Does even a manual exist?)
- What does the tool/code not do, i.e. what are its limitations?
- What are your future plans?

⇒ Only 12+X answers . . .

⇒ Only 12+X answers . . . (leave out what is not (planned to be) public)

+ possibly codes/authors that did not feel covered by the questions

⇒ not too much :-)

As you will see: some variety:

- codes for low-energy observables
- codes for high-energy observables
- codes for the calculation of amplitudes
- codes for connecting the GUT and the (flavor)experimental scale
- codes to pass parameters/results from one code to another
- codes for UT/CKM fits

And this is what there is:

(ordered roughly thematically)

Code # 1:

Name: no name [*Silvestrini*]

Description: $K\bar{K}$ mixing, $B_{(s)}\bar{B}_{(s)}$ mixing, $b \rightarrow s\gamma$, $b \rightarrow sl^+l^-$
in NMFV MSSM

Availability: planned

Code # 2:

Name: no name [*Isidori, Paradisi*]

Description: low-energy flavor observables in the (N?)MFV MSSM

Availability: planned/partially public

Code # 3:

Name: no name [*Bobeth, Ewert, Haisch*]

Description: rare B and K decays in/beyond SM

Availability: planned

Code # 4:

Name: no name [*Chankowski, Jäger, Rosiek*]

Description: FCNC observables in MSSM

Availability: planned

Code # 5:

Name: no name [*Bozzi, Fuks, Klasen*]

Description: squark/gluino production at LO for NMFV MSSM

Availability: planned

Code # 6:

Name: FCHDECAY [*Bejar, Guasch*]

Description: FCNC Higgs decays in NMFV MSSM

Availability: yes (web page)

Code # 7:

Name: FeynHiggs [*Hahn, Heinemeyer, Hollik, Weiglein*]

Description: Higgs/EWPO phenomenology in the (N)MFV MSSM

Availability: yes (manual, web page, \oplus on-line version)

Code # 8:

Name: no name [*Bejar, Guash*]

Description: FC Higgs/top decays in 2HDM I/II

Availability: planned

Code # 9:

Name: FeynArts/FormCalc [*Hahn*]

Description: (arbitrary) one-loop corrections in (N)MFV MSSM

Availability: yes (manual, web page)

Code # 10:

Name: SLHALib2 [*Hahn*]

Description: read/write SLHA2 data, i.e. NMFV/RPV/CPV MSSM, NMSSM

Availability: yes (manual, web page)

→ more on **SLHA2** later

Code # 11:

Name: Spheno [*Porod*]

Description: evaluates NMFV MSSM parameters from GUT scale input

Availability: yes (manual, web page)

Code # 12:

Name: SoftSUSY [*Allanach*]

Description: evaluates NMFV MSSM parameters from GUT scale input

Availability: yes (manual, web page)

Would be nice if the “planned availability” codes would really become available, including manual, web page etc.

Code # 12+X, X=1:

Name: UTfit

Description: Unitarity Triangle fits (Bayesian), in SM and beyond

Availability: yes (web page)

Code # 12+X, X=2:

Name: CKMFitter

Description: CKM fits (Frequentist), in SM and beyond

Availability: yes (web page)

⇒ all codes including short description are included in our write-up

3. The “master tool”

One code/tool is good!

Many codes/tools are better!

Q: How can one connect different tools such that

- input/output is compatible
- (combination of) tools can be used by non-experts
(non-expert = non-author of the code)
⇒ mostly in the hands of the authors ...

A: Two obvious possibilities (maybe more?):

- 1) Interface code that handles input/output → SLHA2
- 2) “master tool”: Über-code that takes care

A few words on SLHA2: \Rightarrow MSSM (+ extensions) only!

[P. Skands et al. '03 - '07]

SLHA(2) = Collection of rules to unambiguously define input/output

- interface for MSSM (+ extensions) tools (new models \Leftrightarrow priv. defs.)
- ASCII format
- Block structure for different parameters/observables
- parameters defined via Lagrangian
- observables defined via “agreement”

Spectrum generators \rightarrow cross section/decay packages \rightarrow event generators

+ : IT WORKS!

- : only if implemented by the authors of the code
- : “only” for MSSM + extensions

NEW: inclusion of NMFV/RPV/CPV in the MSSM + NMSSM:

SLHA \rightarrow SLHA2

I/O made easy via SLHALib2 [T. Hahn '06]

C++ classes [P. Skands '07]

read/write SLHA2 data, i.e. NMFV/RPV/CPV MSSM, NMSSM

The “master tool”

⇒ effort in collaboration with CMS physicists [*O. Buchmüller et al.*]

Über-code for the combination of different tools:

- tools are included as subroutines
- compatibility ensured by collaboration of authors of “master tool” and authors of “sub tools”
- one “master tool” for one model . . .

⇒ evaluate observables of one parameter point consistently with various tools

Example: flavor observables and high p_T observables can be combined

⇒ Connected to the MAIN POINT of this workshop!

Status of the “master tool”:

- one model: (MFV) MSSM
- two tools: code # 2: *b*-physics observables [*Isidori, Paradisi*]
code # 7: Higgs, EWPO [*FeynHiggs*]
- added: χ^2 analysis code (→ similar directions as SFitter, Fittino)
- planned: inclusion of more tools

Use of the “master tool”:

Now: Test/select points for (ATLAS/)CMS analysis

Future: Test (future) data with various tools

So far (reality): one χ^2 analysis with two tools ...
in a simplified version of the MSSM

analysis ⇒ part of the “New Physics/Benchmarks” part

4. Short analysis/discussion

Open points, possibly addressed in forthcoming workshops:

- What is still missing?
 - Are all relevant WG2 fields covered?
 - Are all relevant WG1 fields covered?
- How can it be ensured that code/calculation is useful for others
 - Can experimentalists make use of them?
 - What are the wishes of the experimentalists?
 - Interaction between theory and experiment?
- How to keep tools activities alive?
 - ⇒ meeting for follow-up activities: tonight, Room 4-1.021
 - How to proceed with the combination of tools?
 - SLHA-type agreement for flavor physics?

5. Conclusions

- **Tools** are an **essential part** of this workshop!
- Aparent **differences** between WG1 and WG2 ... **unsolved**
- little survey with all WG1/WG2: **~ 12+X answers** (only) but with some variety
- codes for: low-energy observables
high-energy observables
the calculation of amplitudes
connecting the GUT and the (flavor)experimental scale
pass parameters/results from one code to another
UT/CKM fits
- Combination of codes:
 - SLHA(2) for (N)MFV/RPV/CPV MSSM, NMSSM
 - **“master tool”** (two sub-tools included so far, more is planned)
⇒ χ^2 analysis performed
- Future: what is missing?
how to proceed with combination?
SLHA-type agreement for flavor physics?