Implementation of the 3HDM in the FlexibleSUSY spectrum-generator generator

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Outline

- What is `FlexibleSUSY` and isn't it only for SUSY?
  You know about the code called `2HDMC`. Think of `FlexibleSUSY` as `YourFancyModelNameC` generator. Here I'll show you how to generate "`3HDMC`".

- This line of research comes from SUSY, where those codes are referred to as spectrum generators, hence spectrum-generator generator

- That's also why two existing spectrum-generator generators are based on `SPheno` and `SOFTSUSY`

- Nowadays, they can handle also a non-SUSY models

- Handle almost arbitrary (within reason) models

- We can help each other out

Workflow

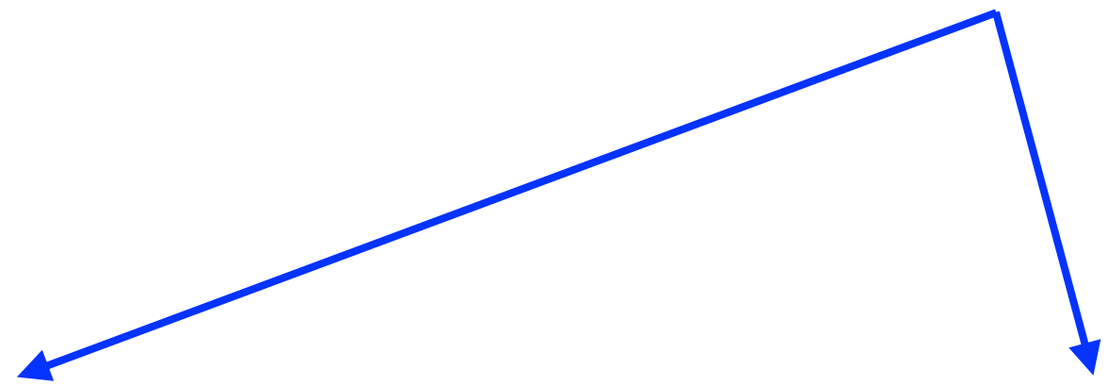
your model,
e.g. MSSM, 2HDM

→

SARAH

by F. Staub

RGEs, mass matrices, vertices, self-energies



SPheno-like

spectrum generator

Fortran

FlexibleSUSY

by Stöckiner et al.

SOFTSUSY-like spectrum generator

Wolfram Language/C++11

Test models

- We've implemented a selection of models inspired by „Three-Higgs-doublet models: symmetries, potentials and Higgs boson masses" by Venus et. al.
  - I(2+1)HDM
  - I(1+2)HDM
  - Aligned 3HDM
- These models are not tested (and probably wrong). For now, it's only to showcase some tricks in `FlexibleSUSY` and get you started. That's why we need your help!

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- Also, the last model one is completely made up

SARAH - quick live demo

Defining a model

- the model can be put directly into `SARAH` into `Models/ModelName` of in `FlexibleSUSY` in `sarah/ModelName`

- Definition of a model consists of:

  - `ModelName.m`, e.g. `I21HDM.m`

  - `parameters.m`

  - particles.m

SARAH's models in FlexibleSUSY

- One could analyze the expressions from SARAH „by hand". Not very handy for numerical analysis, though.
- There's a possibility of generating a SOFTSUSY equivalent for an arbitrary model
- The 3HDM models can be found in my fork of FlexibleSUSY
  - `git clone git@github.com:wkotlarski/FlexibleSUSY.git`
  - `git checkout 3HDM`

Lets check out what we just cloned....

- Installation instructions under http://flexiblesusy.hepforge.org

Prerequisites

Prerequisites

The following programs and packages must be available on your system to run FlexibleSUSY:

To create a spectrum generator you need

- Mathematica (version 7.0 or higher)
- SARAH (version 4.11.0 or higher)

To compile the spectrum generator you need

- C++ compiler (g++ >= 4.8.5 or clang++ >= 3.8.1, icpc >= 15.0)
- Fortran compiler (gfortran, ifort)
- Boost (version 1.37.0 or higher)
- Eigen 3 (version 3.1 or higher)
- GNU scientific library
- Lapack / Blas

Optional:

- Looptools (version 2.8 or higher)

Compilation and execution

- Compile
  - `./createmodel --name=I21HDM`
  - `./configure --with-models=I21HDM`
  - `make`
- Execute
  - lets check an example run card in `model_files/I21HDM`
  - `./models/I21HDM/run_I21HDM.x \`
    `—slha-input-file=model_files/I21HDM/LesHouches.in.I21HDM`

I21HDMC -> I12HDMC -> Aligned3HDM