



## Quick start guide

J. E. Camargo-Molina,<sup>\*</sup> B. O’Leary,<sup>†</sup> and W. Porod<sup>‡</sup>  
*Institut für Theoretische Physik und Astronomie, Universität Würzburg*  
*Am Hubland, 97074 Wuerzburg*

F. Staub<sup>§</sup>  
*Bethe Center for Theoretical Physics & Physikalisches Institut der Universität Bonn,*  
*53115 Bonn, Germany*

## Introduction

**Vevacious** brings together a variety of public tools. This guide aims to provide a quick start guide to help you through the installation and basic setup required to evaluate the vacuum structure of a parameter point. **Vevacious** should work with any UNIX based system. In this guide we assume that you have installed a C++ compiler such as gcc, Mathematica (at least version 7), python (at least version 2.7.1) and a fortran compiler such as gfortran. We also assume that the model you want to study is already implemented in SARAH and **Vevacious** so that you will be using one of the model files included with the package. For a detailed guide on installation, possible options and in particular how to implement your own models (including SUSY spectrum generation) we refer you to **Vevacious** manual [1].

## Requirements

Before we dive into the details for the installation of **Vevacious**, you should install the following programs in your system.

- Numpy and SciPy
- HOM4PS2 [2]
- PyMinuit [3]
- CosmoTransitions [4]
- LHPC
- SARAH [5] (Although not necessary for a first test run, we recommend that you download SARAH as it is necessary for using **Vevacious** with models beyond the default models provided (MSSM and NMSSM, allowing stau VEVs or stau and stop VEVs in addition to the normal Higgs and singlet VEVs).

We recommend that you keep **CosmoTransitions**, **LHPC** and **SARAH** in the same folder together with **Vevacious** as it will simplify your setup. From now on we will refer to this folder as **\$VEVACIOUSPATH**. Below you can find some details about the installation of each of this programs.

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<sup>\*</sup>jose.camargo@physik.uni-wuerzburg.de

<sup>†</sup>ben.oleary@physik.uni-wuerzburg.de

<sup>‡</sup>porod@physik.uni-wuerzburg.de

<sup>§</sup>fnstaub@th.physik.uni-bonn.de

## Python libraries

The Python environment is needed by `Vevacious`. Be sure you have installed at least version 2.7.1. The libraries `Numpy` and `SciPy` are needed for `CosmoTransitions`. You can download and find installation instructions for both of these here: <http://www.scipy.org/install.html>

## HOM4PS2

[http://www.math.nsysu.edu.tw/~leetsung/works/HOM4PS\\_soft\\_files/HOM4PS\\_Linux.htm](http://www.math.nsysu.edu.tw/~leetsung/works/HOM4PS_soft_files/HOM4PS_Linux.htm)

HOM4PS2 is an executable and you won't need to install anything else for it to work. Extract the contents to `$VEVACIOUSPATH/HOM4PS2`. Be sure to try some of the examples to check it is working.

## PyMinuit

<http://code.google.com/p/pyminuit/>

You can find detailed instructions for installation step by step here: <http://code.google.com/p/pyminuit/wiki/HowToInstall> We strongly recommend that you use `PyMinuit` with some simple examples before continuing.

## CosmoTransitions

<http://chasm.uchicago.edu/cosmotransitions/>

Just extract the contents of the package in your `Vevacious` folder. Be sure that `Python`, `Numpy` and `SciPy` are working properly.

## LHPC

<http://www.hepforge.org/downloads/lhpc/>

LHPC needs only to be extracted to your `Vevacious` folder and compiled with “make”.

## SARAH

<http://sarah.hepforge.org>

SARAH is a `mathematica` package and as such needs no installation.

## SARAH model file

`Vevacious` needs to be provided with the tree-level potential, the one-loop effective potential and tadpole equations for the particular model you want to study. Although it can be done manually, the process is significantly easier if you use `SARAH` to generate a model file for `Vevacious` including this information. For this you will have to implement the particular model of your interest (if it is not already implemented). However, for this quick start guide we can rely on the provided model files and examples. If you are interested in implementing a different model, check section VII of [1]. For a list of model files included with `Vevacious` check section VII of [1].

## SUSY spectrum Generator for your model

`Vevacious` will need an SLHA file including the information for the parameter point you want to study. This can be created with any SUSY spectrum generator (`SUSPECT` [6], `SoftSUSY` [7], `SPheno` ...) if the model of your choice

is already implemented. For generating your SLHA file it is not necessary that the implementation assigns VEVs to fields beyond the ones usually considered.

In the case that you want to generate spectrum generating code for your particular model, it is possible to make SARAH do this and get a specific version of SPheno. This is explained in detail in [1].

However, in a first step to get Vevacious up and running, you can rely on the provided SLHA input files for particular parameter points included with Vevacious.

## Quick Start

Finally, we get to the Vevacious setup. As a first step you need to download Vevacious from:

<http://vevacious.hepforge.org/>

You should extract the content of the package in `$VEVACIOUSPATH/VEVACIOUS`.

As mentioned above, you will also need a SLHA file with all the numerical values for your parameter point. We will assume that you were able to install all the required programs/environments treated in the previous section.

## Compiling Vevacious

The Makefile should be edited to have the correct paths to the header files and library file of LHPC (these are `$LHPCPATH/include/` and `$LHPCPATH/lib/`). LHPC version 0.8.2 or higher is required. After this is done you just need to run `make`.

## Preparing Vevacious

Once you have installed all the required programs, got yourself a SLHA file for the parameter point and compiled Vevacious, you are almost done. There are many options that can be passed to Vevacious but the purpose of this guide is to get you up and running as quickly as possible, so here we will enumerate the necessary options for a successful run. This options can be given to Vevacious as command line arguments or can be written as an initialization XML file

`$VEVACIOUSPATH/VEVACIOUS/VevaciousInitialization.xml`. If command line options are provided they will override the XML file.

Command line options:

1. `--model_file= $PATHTOMODELFILE/modelfile.vin`  
Path for the model file you want to use.
2. `--slha_file=./SPheno.spc.MSSM`  
Path of SLHA file containing the numerical values for your parameter point. In this case the file name is `SPheno.spc.MSSM`.
3. `--ct_path=$VEVACIOUSPATH/CosmoTransitions`  
Path of `CosmoTransitions`.
4. `--hom4ps2_dir=$VEVACIOUSPATH/HOM4PS2`  
Path of `HOM4PS2`.

Equivalent XML options:

1. `<model_file> $PATHTOMODELFILE/modelfile.vin </model_file>`
2. `<slha_file> $VEVACIOUSPATH/VEVACIOUS/SPheno.spc.MSSM </slha_file>`
3. `<ct_path> $VEVACIOUSPATH/CosmoTransitions </ct_path>`
4. `<hom4ps2_dir> $VEVACIOUSPATH/HOM4PS2 </hom4ps2_dir>`

## Running Vevacious with provided examples

Once everything is setted up we are ready to run `Vevacious`. You will need to go to `$VEVACIOUSPATH/VEVACIOUS/bin` and run `$VEVACIOUSPATH/VEVACIOUS/bin/Vevacious.exe`. If you want to run `Vevacious` outside of the `/bin/` directory or provide your own initialization file, you can specify it with the option `--input=/PATH/TO/INIT/FILE`. This should perform the full set of steps to try to find the global minimum of the loop-corrected potential.

As a way for you to check if everything is running correctly, we have included a series of model files, SLHA input points and example output in the folders `VEVACIOUS/MSSM` and `VEVACIOUS/NMSSM`. To use them, just give `Vevacious` the location of the input files as explained above and compare with the provided output.

When `Vevacious` is finished it returns the results twice: (i) as separate file with the default name `MyResult.vout` and in XML format, (ii) attached to the used SLHA spectrum file. The result file and appended SLHA block should be self explanatory. For a detailed description of the output information check sec. VID of [1].

We would like to point that we trust the user to feed the appropriate SLHA input file for the chosen model file. Different model files require different inputs and the correct use of both is crucial for `Vevacious`. For the included models, respective SLHA input files are also bundled with `Vevacious`.

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