Leibniz-Institut für
Astrophysik Potsdam

Higgstools

Topic: Particle physics

Michael Hübner / Scitrace workshop / 15.06.23

Big Picture

Aim of the project

Provide an easy interface for researchers to combine and interpret various Higgs-related measurements to custom beyond the Standard Model physics models. Unifying three previously independent libraries (HiggsPredictions, HiggsBounds, HiggsSignals).

Scientific goals

HiggsTools is a toolbox for comparing a wide class of BSM models to all available experimental results from searches for new (scalar) particles and measurements of the 125 GeV Higgs boson at colliders.

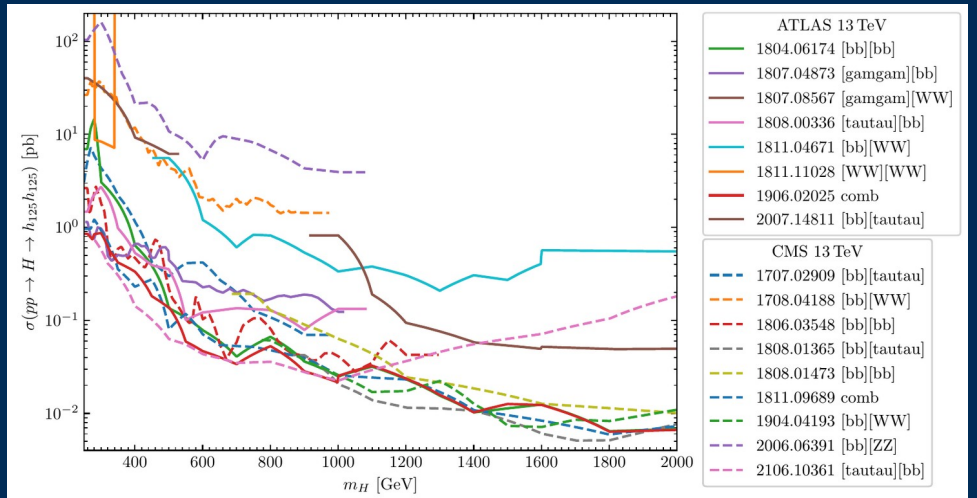


Figure 4: 95% confidence-level cross section limits on the process $pp \to H \to h_{125}h_{125}$ from the experimental searches in various final states. The dashed lines show results from the CMS collaboration, whereas the solid lines show results from the ATLAS collaboration.

e-Print: [arXiv:2210.09332] [hep-ph]

How does my workflow look like?

Simple

Just a script, notebook, or a few one-liners from some external software

(personal project)

Middle

A series of scripts building a linear workflow (steps) using standard or custom libraries

Fully automatic or with interactive sub-steps

(collaborative project)

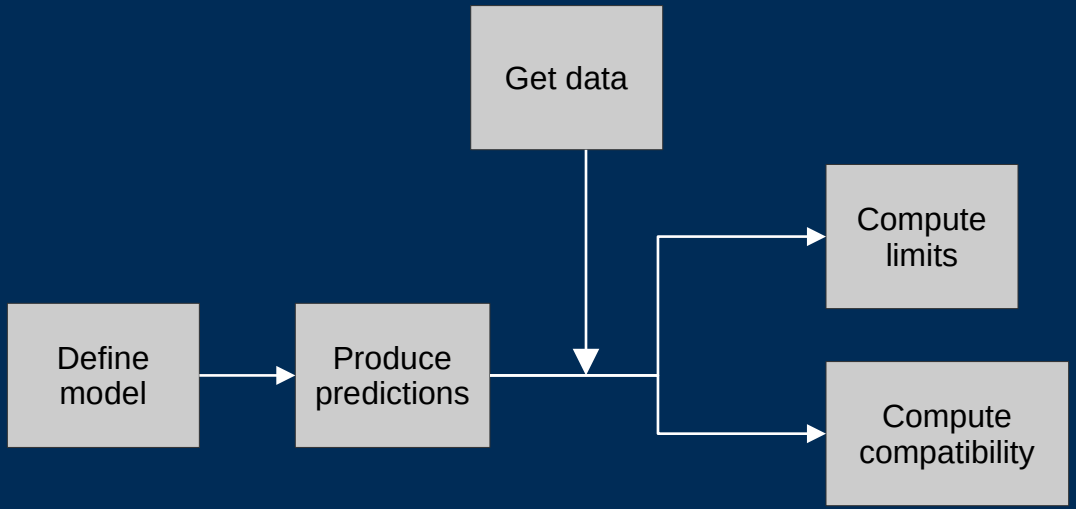
Complex

A complex series of scripts, building a non-linear workflow, with various environments and custom libraries

(large project pipeline)

From single script to workflow

I can split my project in 4 independent steps



Workflow Input Data

Where are my input data from?

- https://gitlab.com/higgsbounds/hbdataset
- https://gitlab.com/higgsbounds/hsdataset

Which License has my input data?

Mostly CERN data published mostly under CC-BY-4.0 & CC0

How do I get the data?

Cloning the repos

Is there some authentification mechanism?

Authentification is only required to actively contribute to the code itself, simple usage works without authentification.

How big are my data?

In the order of ~100 MB

Which format has your data ?

JSON, csv

Output of the workflow

What is the output of your workflow?

Theory predictions for BSM models (HiggsPredictions), limits on the corresponding parameters (HiggsBounds), compatibility with existing rate measurements (HiggsSignals)

Results are given as tables/dictionaries and can be represented as plots using e.g. matplotlib

What is the structure/format of your data?

Tables/dictionaries that can be stored as JSON or csv files

How large are your data?

A few MB (excluding plots)

Which (custom) source codes

Do I use a custom library?

Yes, the HiggsTools library and its subcomponents: https://gitlab.com/higgsbounds/higgstools

What is the license of this code?

GPLv3.

Where is the code stored, how to access it?

On https://gitlab.com/higgsbounds/higgstools

Parameters

Scientific parameters

An arbitrary amount of physical model parameters depending on the complexity of the studied model. They are either defined in the user’s code or can be provided via SLHA files.

Technical parameters

Unsure…

Installation procedure

Which OS do you use?

Linux Debian bullseye (but should work on any OS with somewhat standard Python, C++, Mathematica implementations)

Which language do you use?

Python, C++, Mathematica

How to install the software you need?

Following instructions on:

https://gitlab.com/higgsbounds/higgstools

- pip install
- cmake

Do you know the versions of the the software you use?

- C++17 compliant compiler
- gcc >= 9
- clang >= 5
- cmake >= 3.17
- Python >= 3.5