

# TEASER FOR BSM TUTORIAL ON $Z'$ STUDIES FOR FUTURE COLLIDERS

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# Goal

- Learn the pipeline: from model to collider analysis
  - Focus on pre-discovery scenarios, as opposed to model characterization

Model whitepaper:

FY, “Di-jet resonances at Future Hadron Colliders: A Snowmass whitepaper” [1308.1077]

- Only preliminary to-do: (most time-consuming)
  - Should install ROOT

[root.cern.ch](http://root.cern.ch)

- Basic programming skills will be helpful
  - And enough hard drive space ( $O(10+)$  GB) for MC events

# Software tools

Will be covered during tutorial

- MadGraph 5 v.2.6.6

<https://launchpad.net/mg5amcnlo>

Alwall, Frederix, Frixione, Hirschi, Maltoni, Mattelaer, Shao, Stelzer, Torrielli, Zaro [1405.0301]

- Within MG5 (accept all default prompts)

MG5\_aMC> install pythia8

<http://home.thep.lu.se/~torbjorn/Pythia.html>

Sjöstrand, Ask, Christiansen, Corke, Desai, Ilten, Mrenna, Prestel, Rasmussen, Skands [1410.3012]

MG5\_aMC> install Delphes

<https://cp3.irmp.ucl.ac.be/projects/delphes>

De Favereau, Delaere, Demin, Giammanco, Lemaître, Mertens, Selvaggi [arXiv:1307.6346]

[For automatic NLO QCD:]

MG5\_aMC> generate p p > t t~ [QCD]

# Software tools – For Mac users

## My errors installing mg

Thanks to Dan Yu (IHEP)

- Symbol not found: `__PyErr_ReplaceException`:
  - if you go to `/System/Library/Frameworks/Python.framework/Versions/` and copy the folder 2.7 into `/Library/Frameworks/Python.framework/Versions` it solves the problem
- Error: cannot open file "AvailabilityMacros.h"
  - `xcode-select --install`
  - open `/Library/Developer/CommandLineTools/Packages/macOS_SDK_headers_for_macOS_10.14.pkg`

# Step-by-step

Model whitepaper:

FY, “Di-jet resonances at Future Hadron Colliders: A Snowmass whitepaper” [1308.1077]

- Generate Z' signal events
  - Understand model parameters in MG5 `param_card.dat`
  - Understand preselection cuts in MG5 `run_card.dat`
  - MG5 to Pythia8 to Delphes pipeline
    - Understand Delphes card
  - Implement simple cut and count collider analysis
- Generate SM dijet background
  - MLM matching basics and interface with Pythia8
  - Preselection cuts and how to generate background events efficiently
- Combine signal and background to determine sensitivity
  - Make discovery and exclusion sensitivity plots

