



MadDM



Dark Matter Phenomenology
in the MG5_aMC@NLO framework

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with

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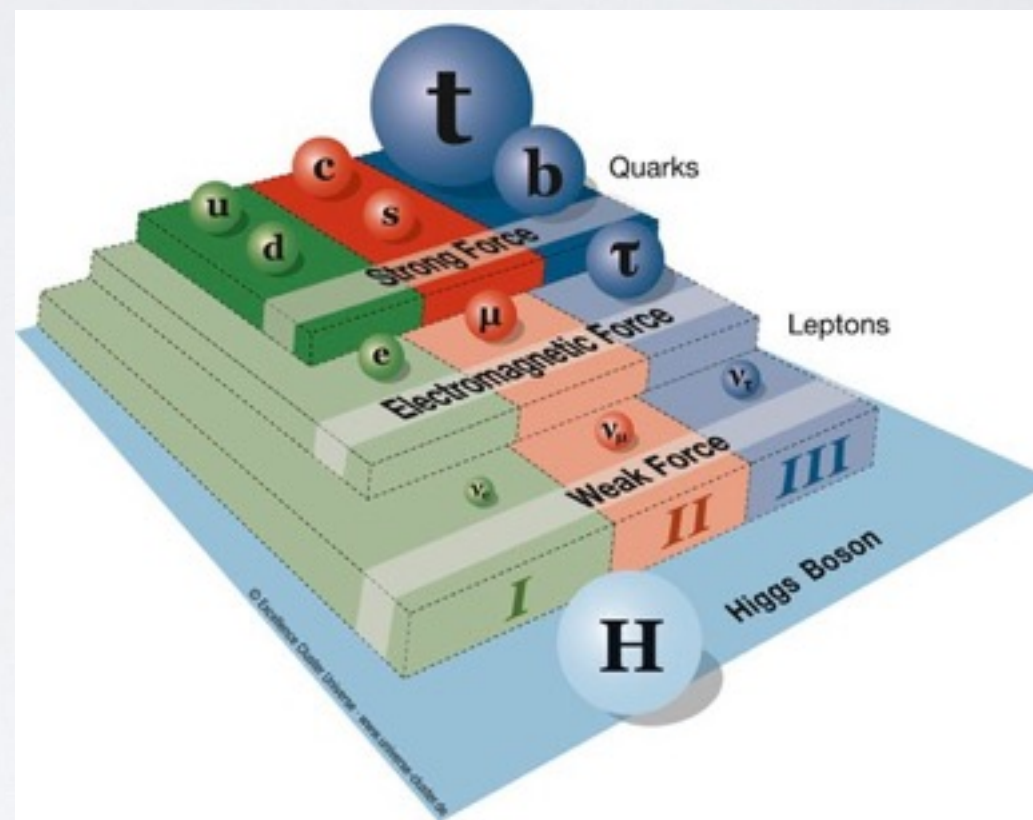
arXiv:1505.04190

BSM Physics in LHC era

- Standard Model has been very successful in explaining observed particle physics phenomena.

Some deficiencies:

- ★ Baryogenesis.
- ★ Leptogenesis.
- ★ Neutrino Masses.
- ★ Dark Matter.
- ★ Dark Energy.



- DM is very well motivated for New Physics beyond SM.

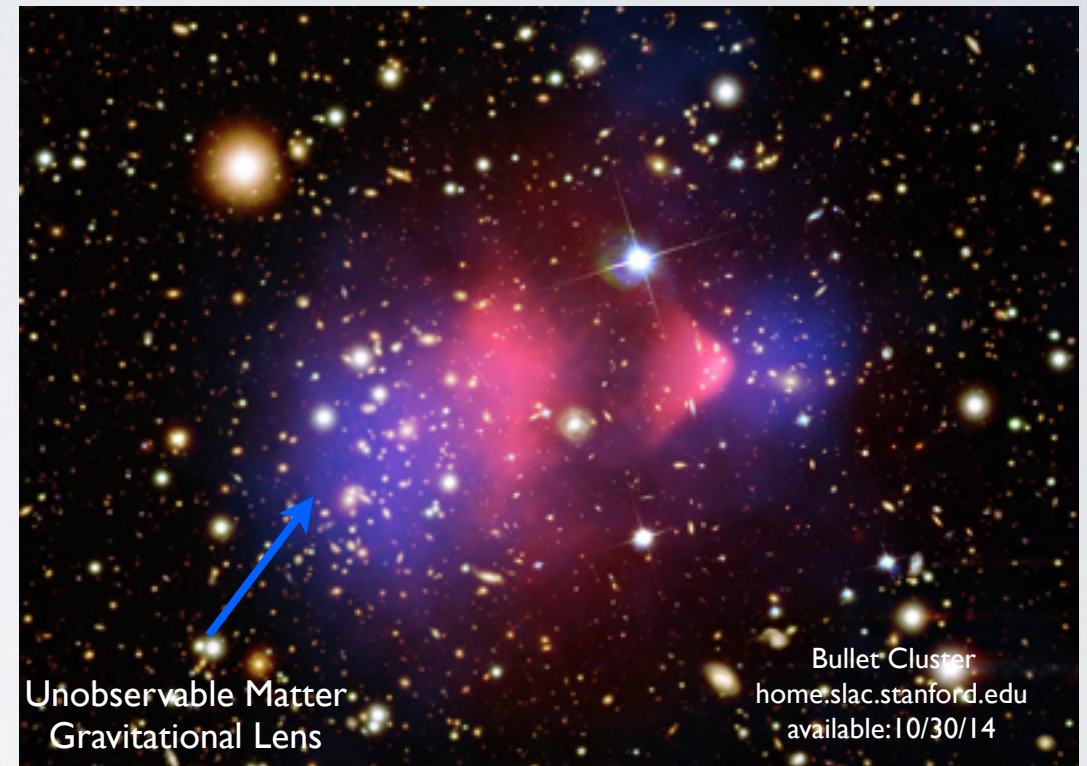
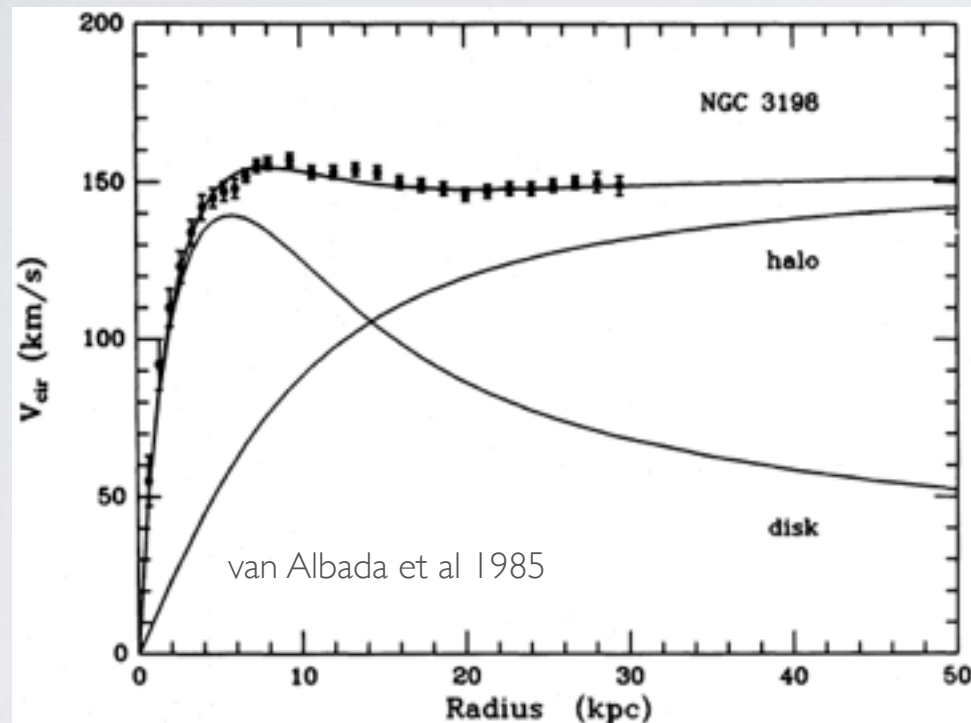
Why?

Many intriguing and undeniable hints that DM exists

DARK MATTER

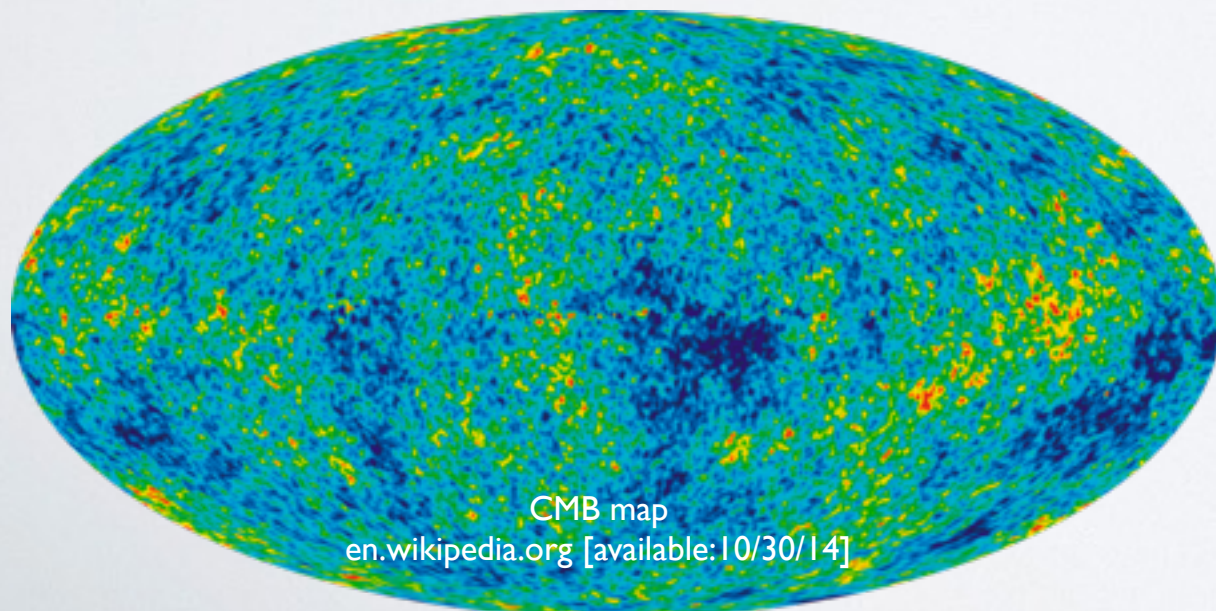
Evidence From Astrophysics and Cosmology

Rotational velocities of spiral galaxies



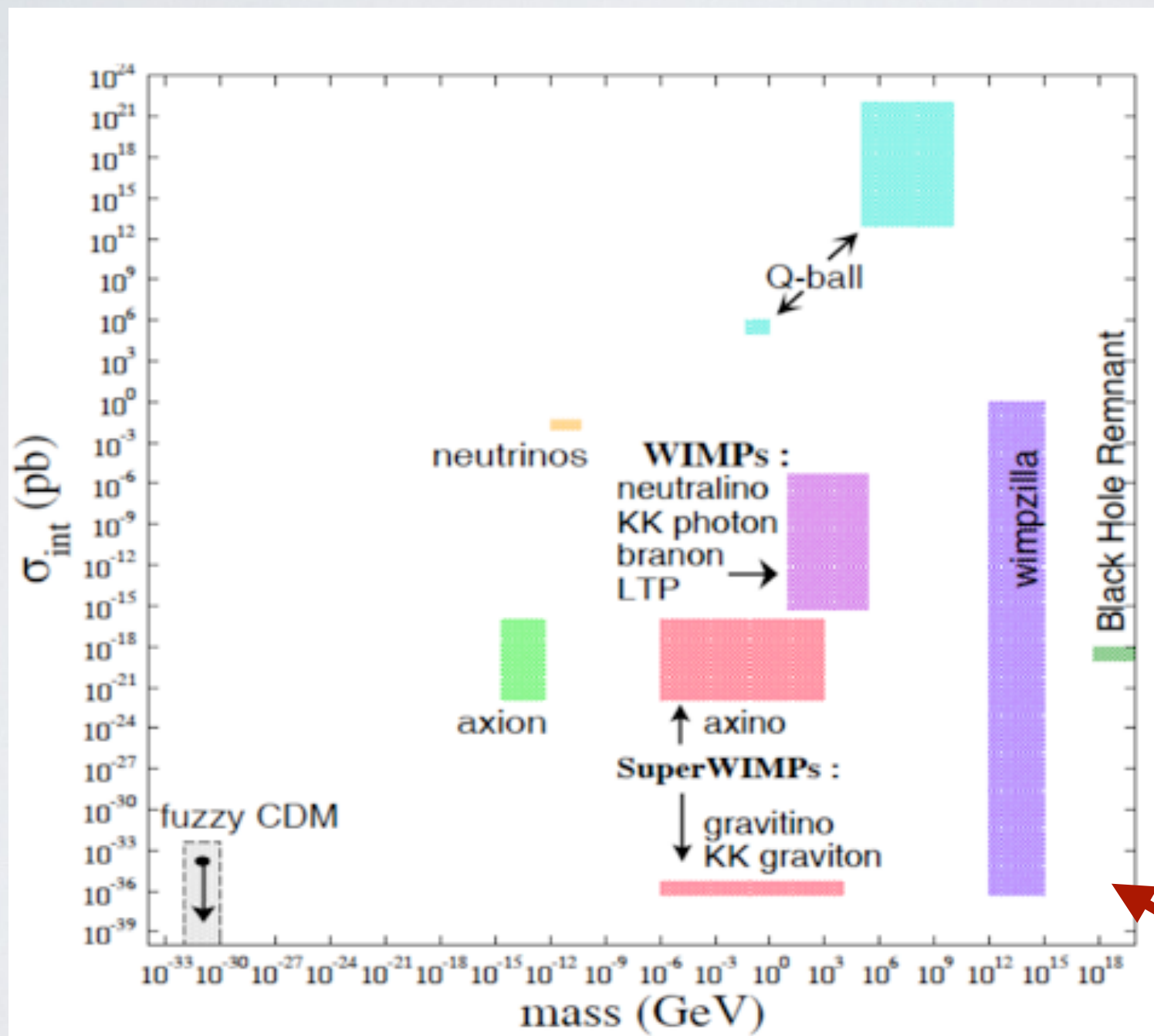
Gravitational Lensing

Velocity dispersions, CMB maps, N-body simulations

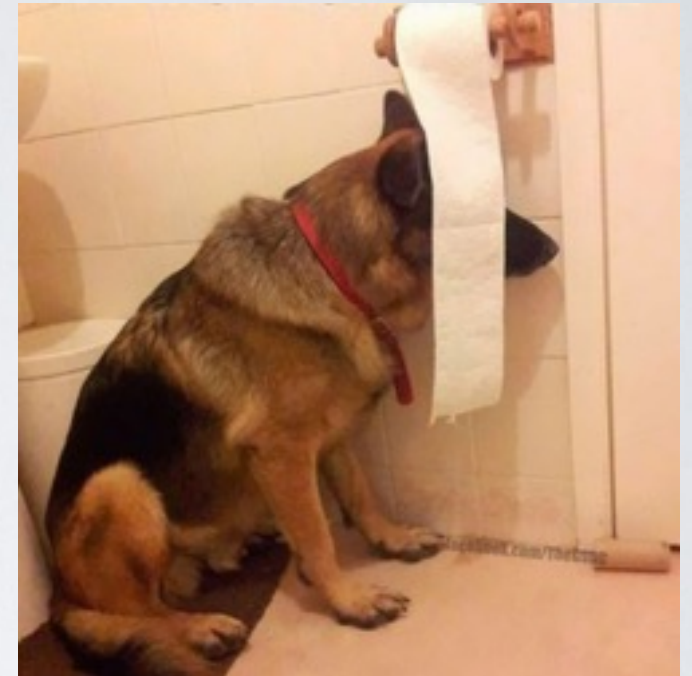


Dark Matter Complementarity

- We have no sense of where new physics is **hiding**



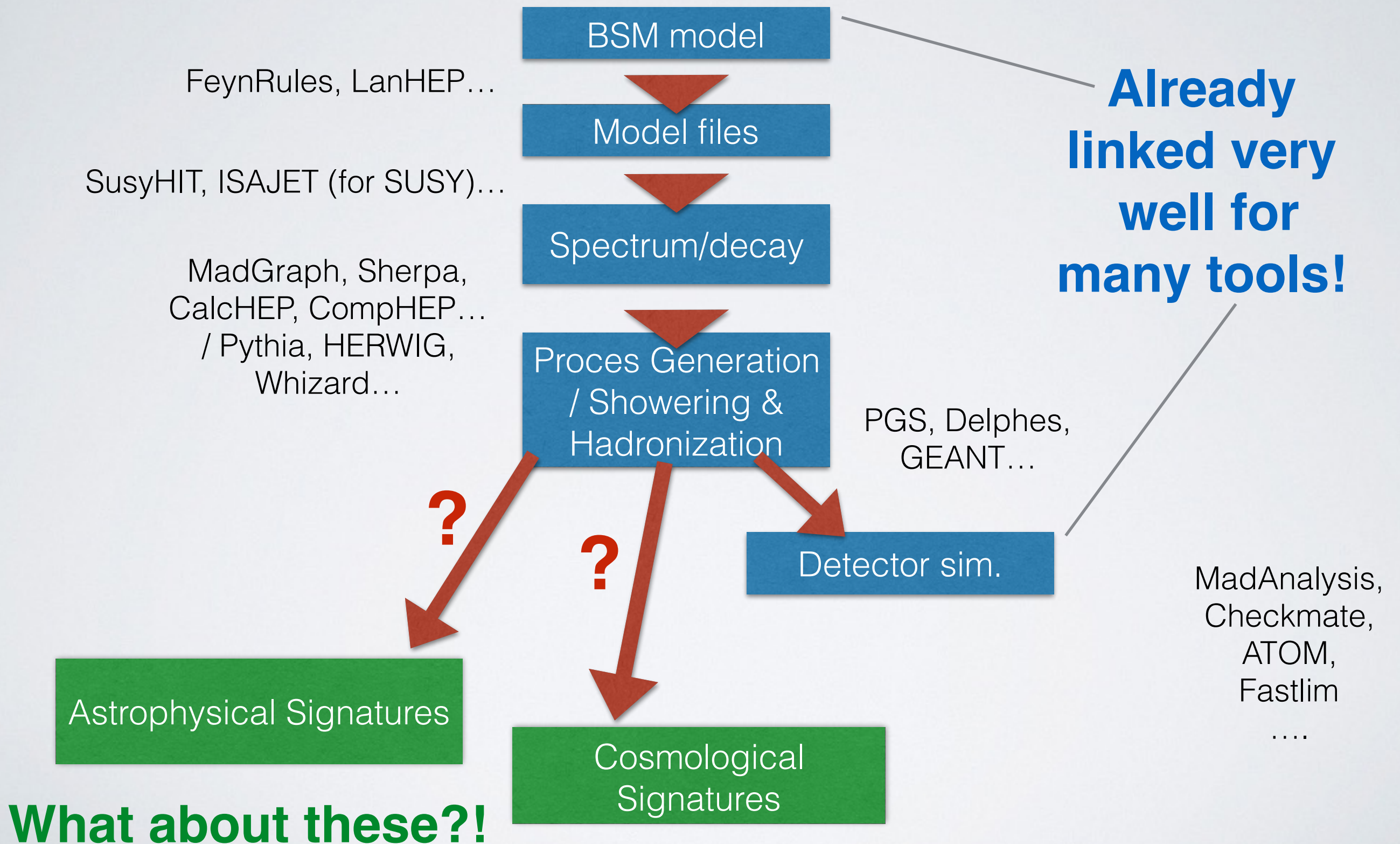
http://home.physics.ucla.edu/~arisaka/home/Dark_Matter/



DM models
alone span many
orders of magnitude
in energy scales

Complementarity studies require powerful simulation tools

BSM tools in LHC era



BSM tools in LHC era

FeynRules, LanHEP...

BSM model

Model files

SusyHIT, ISAJET (for SUSY)...

MadGraph, Sherpa,
CalcHEP, CompHEP...

/ Pythia, HERWIG,
Whizard...

Process Generation
/ Showering &
Hadronization

PGS, Delphes,
GEANT...

Detector sim.

Astrophysical Signatures

Cosmological
Signatures

**Already
linked very
well for
many tools!**

MadAnalysis,
Checkmate,
ATOM,
Fastlim
....

What about these?!



MadDM emerged as an effort to link:

- **DM collider searches**, with
- **early cosmology** signatures (relic density) and
- **direct/indirect detection**.

Goal is to allow both **Experimentalists** and **Theorists** to calculate signatures of DM models at all interfaces with click of a button.

User friendly architecture of **MadGraph_aMC@NLO** provides ideal framework for MadDM development.



MadDM

MadDM emerged as an effort to link:

- **DM collider searches**, with
- **early cosmology** signatures (relic density) and
- **direct/indirect detection**.

Version 1.0 of MadDM focused on calculations of **DM relic density** (in a generic UFO model).

Version 2.0 of MadDM extends the functionality to **DM direct detection**.

Testing of model points

MadDM v.2.0 also incorporates a **simplified model testing functionality**:

The user can **compare the results to existing constraints** (relic density, direct detection cross section etc.)

Example output:

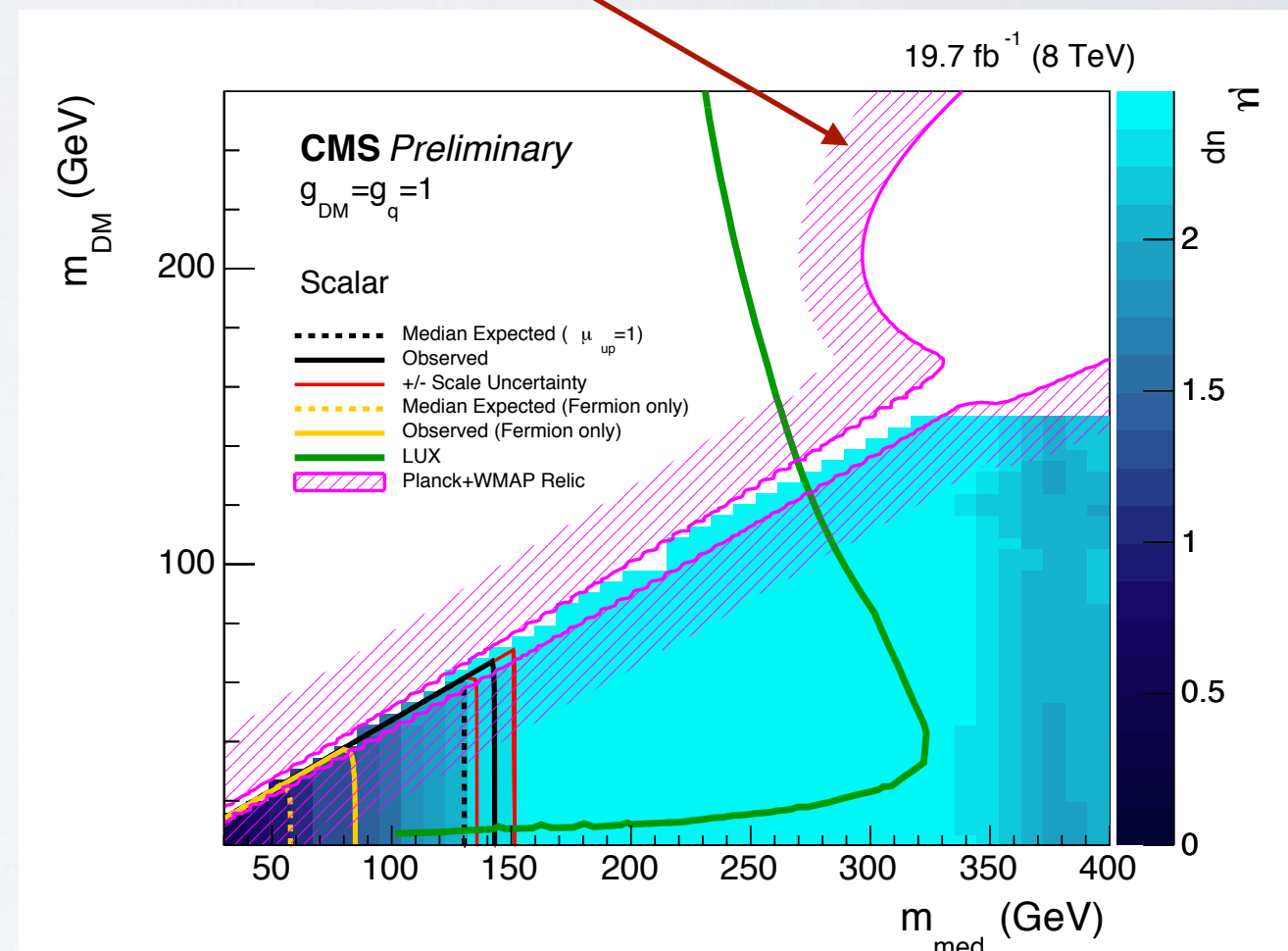
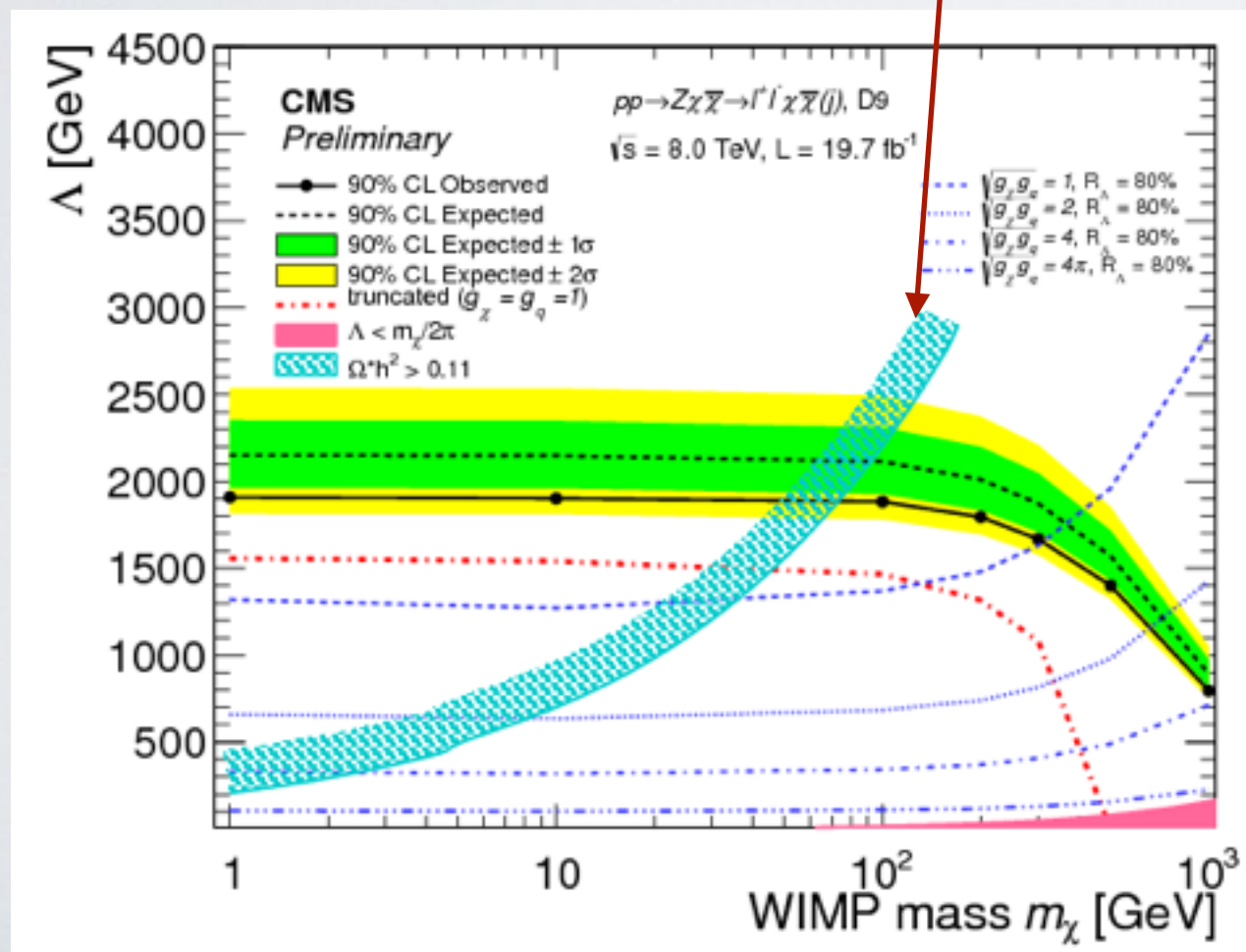
```
-----  
Running the exclusion analysis on the parameter point...  
Considering relic density and bound on SI cross section from LUX  
  
The parameter point is Excluded.  
    Excluded by relic density: True  
    Excluded by direct detection: False  
-----
```

The ultimate goal is to **confront DM models** with collider, astro physical and cosmological constraints in a fully automated framework!

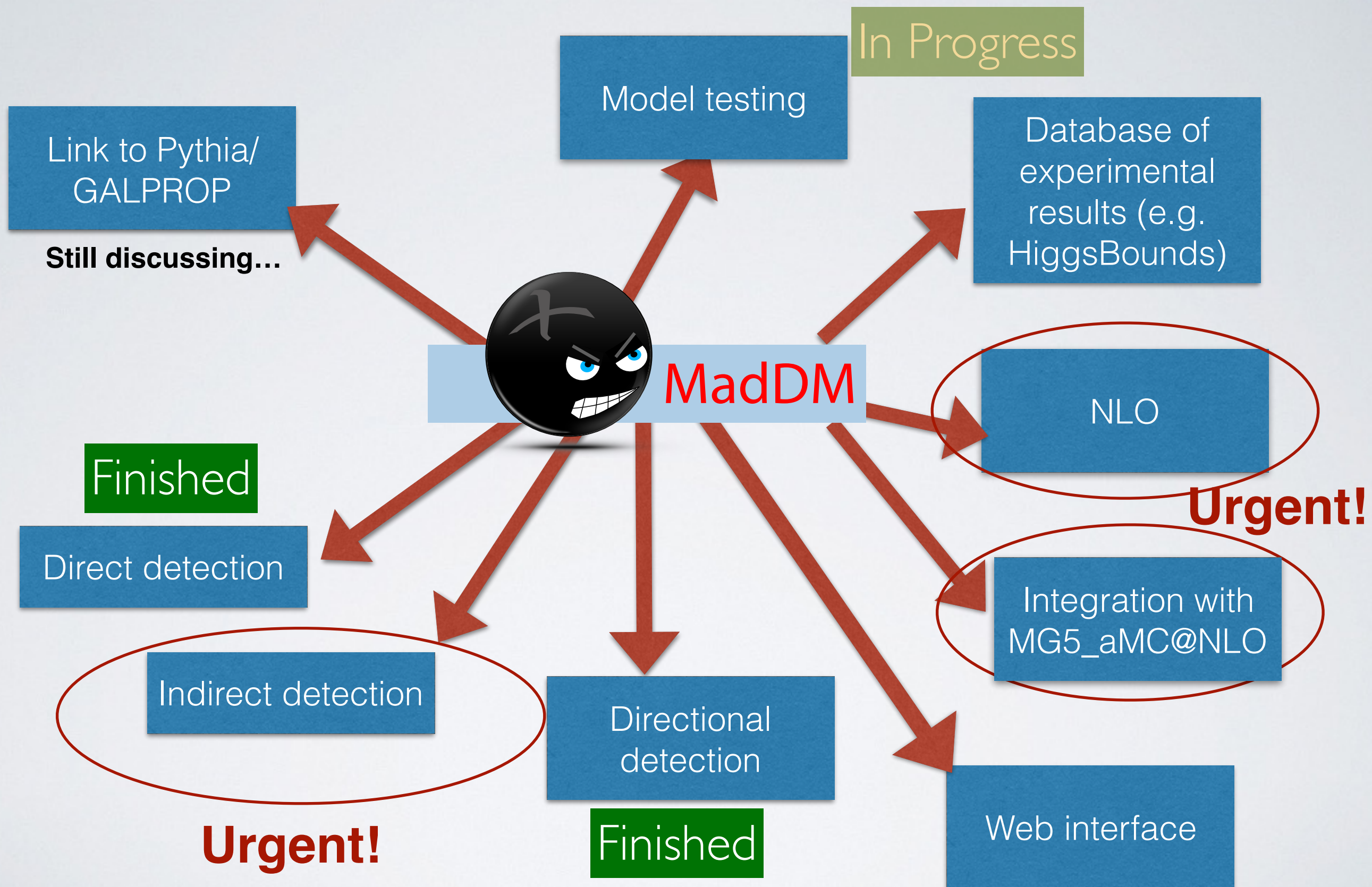
i.e. we would like to have **Collider bounds** together with **Astrophysical** and **Cosmological** signatures.

- MadDM has already been used by the CMS experiment,
in the search for DM EFT's in Mono-jet/Z analyses

Relic Density using MadDM



MadDM Status





MadDM v3.0



KEEP CALM
AND
WATCH THIS SPACE
IT'S GOING TO BE AWESOME!!

MORE
COMING SOON



Help us build the best DM phenomenology tool!

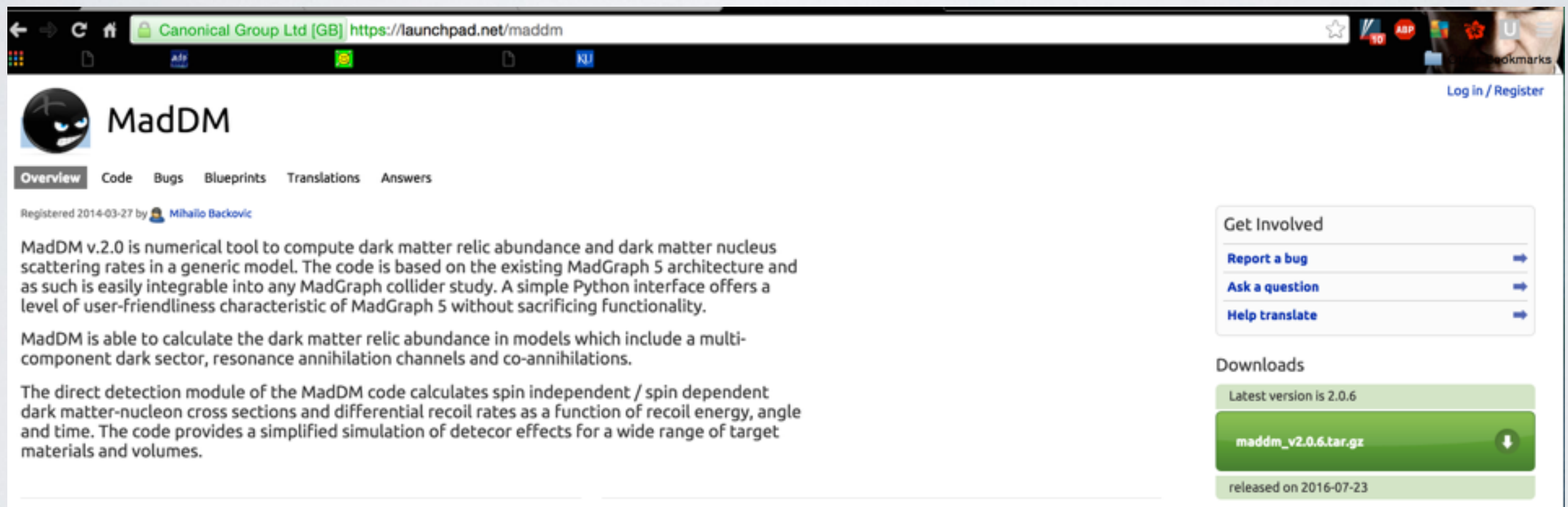
Not convinced yet?



matter

How about now?!

A version of MadDM available for download at:
launchpad.net/maddm



The screenshot shows the Launchpad.net page for the MadDM project. The browser's address bar displays the URL <https://launchpad.net/maddm>. The page header includes the MadDM logo (a stylized face with a cross) and the project name. Below the header, there are tabs for Overview, Code, Bugs, Blueprints, Translations, and Answers. The Overview tab is selected. The main content area describes the project: MadDM v.2.0 is a numerical tool for computing dark matter relic abundance and nucleus scattering rates, based on the MadGraph 5 architecture. It mentions that the code is easily integrable into any MadGraph collider study and offers a user-friendly Python interface. It also states that MadDM can calculate dark matter relic abundance in models with a multi-component dark sector, resonance annihilation channels, and co-annihilations. The direct detection module is described as calculating spin-independent and spin-dependent dark matter-nucleon cross sections and differential recoil rates as a function of recoil energy, angle, and time. On the right side, there is a 'Get Involved' section with links to 'Report a bug', 'Ask a question', and 'Help translate'. Below that is a 'Downloads' section showing the latest version is 2.0.6, with a download button for 'maddm_v2.0.6.tar.gz' and a release date of 2016-07-23.

Canonical Group Ltd [GB] <https://launchpad.net/maddm>

MadDM Log in / Register

Overview Code Bugs Blueprints Translations Answers

Registered 2014-03-27 by [Mihailo Backovic](#)

MadDM v.2.0 is numerical tool to compute dark matter relic abundance and dark matter nucleus scattering rates in a generic model. The code is based on the existing MadGraph 5 architecture and as such is easily integrable into any MadGraph collider study. A simple Python interface offers a level of user-friendliness characteristic of MadGraph 5 without sacrificing functionality.

MadDM is able to calculate the dark matter relic abundance in models which include a multi-component dark sector, resonance annihilation channels and co-annihilations.


The direct detection module of the MadDM code calculates spin independent / spin dependent dark matter-nucleon cross sections and differential recoil rates as a function of recoil energy, angle and time. The code provides a simplified simulation of detector effects for a wide range of target materials and volumes.

Get Involved

- [Report a bug](#)
- [Ask a question](#)
- [Help translate](#)

Downloads

Latest version is 2.0.6

[maddm_v2.0.6.tar.gz](#) 

released on 2016-07-23



susy.phsx.ku.edu/~mihailo/

Thank you!

Any (**constructive**) suggestions, comments,
and criticisms are welcome!