

Recasting LHC analyses

Suchita Kulkarni
HEPHY, Vienna

Why?

- More models than the experimentalists can possibly cover
- Simplified models is one way to present analysis interpretations and although they are generic, limits obtained using simplified models can be conservative
- No other way but to recast an analysis to answer the question: “What are the limits from LHC for a particular BSM scenario?”
- This talk takes an overview of many recasting efforts available on the market

Apologies in advance if I have missed any effort, please bring it up

Re- interpreting LHC searches - two major ways

Re-interpreting LHC searches

Re-implement LHC analyses

Use Simplified Model Spectra (SMS) results

- Works for BSM model involving complex topologies/decays
- Reconstruct number of events in theory space via MC simulation - compare with experimental observations
- Time consuming, demands computing power
- Account for full kinematics of the process e.g. spin correlations

- Assumes that BSM model contains only few light particles hence deals with simple topologies
- Reconstruct number of events or visible cross-sections in theory space - compare with experimental results
- Generic, simple and quick to use
- Neglect kinematics of the process

Analyses reimplementation

Public
Private

- **RIVET** (> 20 SUSY mostly 7 TeV analysis, hepMC/hep/LHE) **arXiv:1003.0694, Buckley et.al.**
 - One of the oldest, used by ATLAS extensively
 - Designed for unfolded data, useful for SM measurements
- **RECAST** **arXiv:1010.2506, Cranmer et.al.**
 - Interface between theorists requests and experimentalists
 - Collects requests for alternative signals to be processed by the analyses, experimentalists process these requests
- **ATOM** (Should have a large database, no detector simulation)
 - Is a fork of RIVET, uses efficiency maps for reconstructed objects

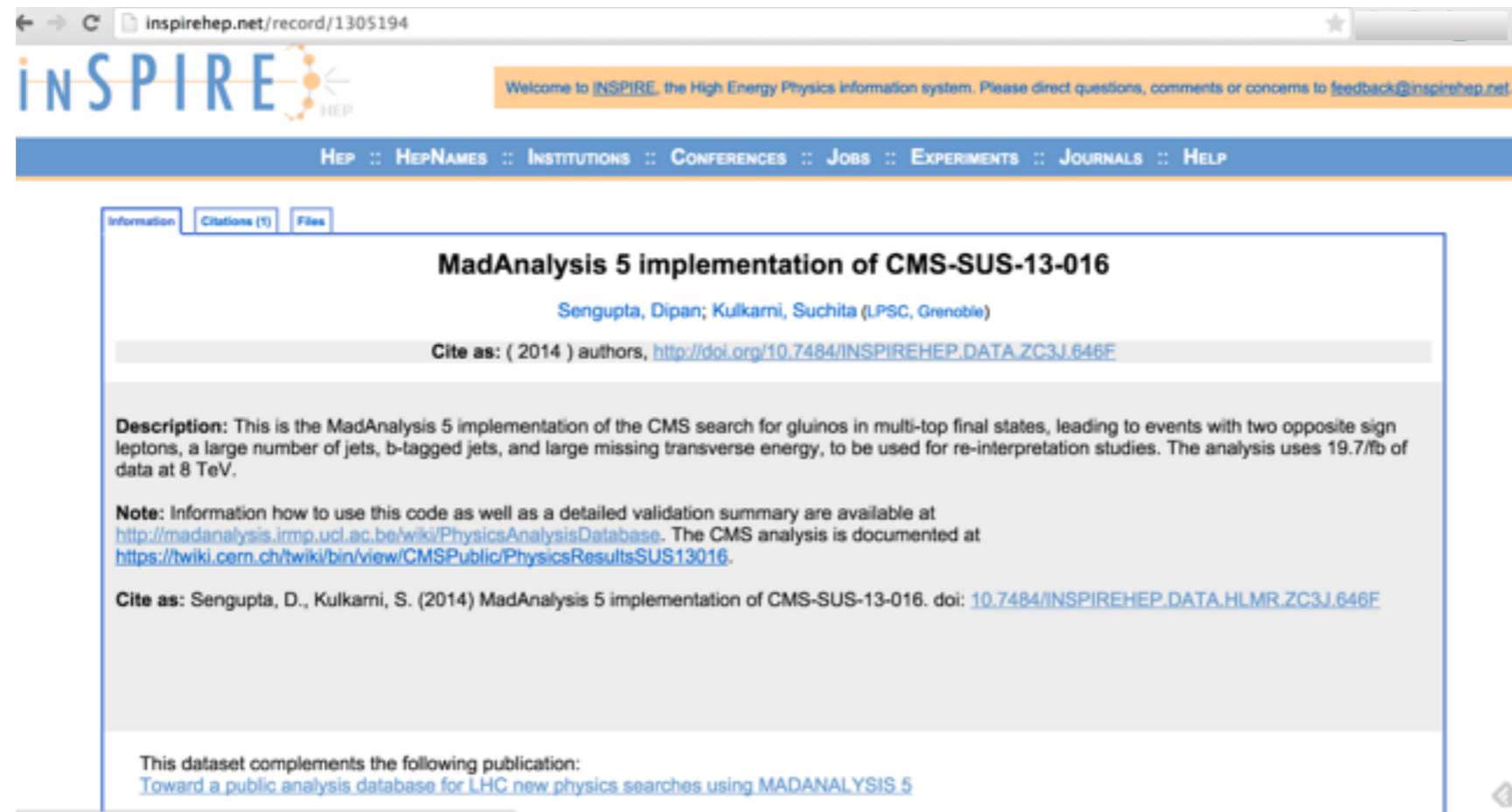
Analyses reimplementation

- **CheckMATE** (11 SUSY analyses + ATLAS monojet, uses Delphes, hep/hepMC)
arXiv:1312.2591, Drees et.al.
- Precompiled database of validated LHC analyses, preselects the most sensitive analyses for testing BSM scenario
- **MadAnalysis5 - Public Analyses Database (MA5 PAD)** (5 SUSY analyses, uses Delphes, LHE/hepMC/hep file) **arXiv:1405.3982, Dumont, SK et.al.**
- User friendly, command line tools for simple tasks, validated analysis published with a DOI via SPIRES
- Extensions for exotica analyses framework underway

MA5 PAD: <http://madanalysis.irmp.ucl.ac.be/wiki/PhysicsAnalysisDatabase>

MA5 PAD

- Convenient way of documentation and long term preservation of of the analyses performed by ATLAS and CMS
- Modular approach, easy to extend, everybody who implements and validates an existing ATLAS and CMS analysis can publish it
- Provides feedback to the experimentalists about documentation and use of their results



The screenshot shows a web browser window with the URL inspirehep.net/record/1305194. The page features the INSPIRE logo and a navigation menu with links for HEP, HEPNAMES, INSTITUTIONS, CONFERENCES, JOBS, EXPERIMENTS, JOURNALS, and HELP. The main content area is titled "MadAnalysis 5 implementation of CMS-SUS-13-016" and lists the authors Sengupta, Dipan; Kulkarni, Suchita (LPSC, Grenoble). It includes a citation string: "Cite as: (2014) authors, <http://doi.org/10.7484/INSPIREHEP.DATA.ZC3J.646F>". A description states: "This is the MadAnalysis 5 implementation of the CMS search for gluinos in multi-top final states, leading to events with two opposite sign leptons, a large number of jets, b-tagged jets, and large missing transverse energy, to be used for re-interpretation studies. The analysis uses 19.7/fb of data at 8 TeV." A note provides links for more information: <http://madanalysis.irmp.ucl.ac.be/wiki/PhysicsAnalysisDatabase> and <https://twiki.cern.ch/twiki/bin/view/CMSPublic/PhysicsResultsSUS13016>. Another citation string is provided: "Cite as: Sengupta, D., Kulkarni, S. (2014) MadAnalysis 5 implementation of CMS-SUS-13-016. doi: [10.7484/INSPIREHEP.DATA.HLMR.ZC3J.646F](http://doi.org/10.7484/INSPIREHEP.DATA.HLMR.ZC3J.646F)". At the bottom, it mentions that the dataset complements the publication "Toward a public analysis database for LHC new physics searches using MADANALYSIS 5".

MA5 PAD

- DOI via SPIRES
- Identify versions of the code systematically, every improvement in the analysis code gets a separate DOI, we know exactly which version was used

inspirehep.net/record/1305194

Welcome to [INSPIRE](#), the High Energy Physics information system. Please direct questions, comments or concerns to feedback@inspirehep.net.

HEP :: HEPNAMES :: INSTITUTIONS :: CONFERENCES :: JOBS :: EXPERIMENTS :: JOURNALS :: HELP

Information Citations (1) Files

MadAnalysis 5 implementation of CMS-SUS-13-016

Sengupta, Dipan; Kulkarni, Suchita (LPSC, Grenoble)

Cite as: (2014) authors, <http://doi.org/10.7484/INSPIREHEP.DATA.ZC3J.646F>

Description: This is the MadAnalysis 5 implementation of the CMS search for gluinos in multi-top final states, leading to events with two opposite sign leptons, a large number of jets, b-tagged jets, and large missing transverse energy, to be used for re-interpretation studies. The analysis uses 19.7/fb of data at 8 TeV.

Note: Information how to use this code as well as a detailed validation summary are available at <http://madanalysis.irmp.ucl.ac.be/wiki/PhysicsAnalysisDatabase>. The CMS analysis is documented at <https://twiki.cern.ch/twiki/bin/view/CMSPublic/PhysicsResultsSUS13016>.

Cite as: Sengupta, D., Kulkarni, S. (2014) MadAnalysis 5 implementation of CMS-SUS-13-016 doi: [10.7484/INSPIREHEP.DATA.HLMR.ZC3J.646F](https://doi.org/10.7484/INSPIREHEP.DATA.HLMR.ZC3J.646F)

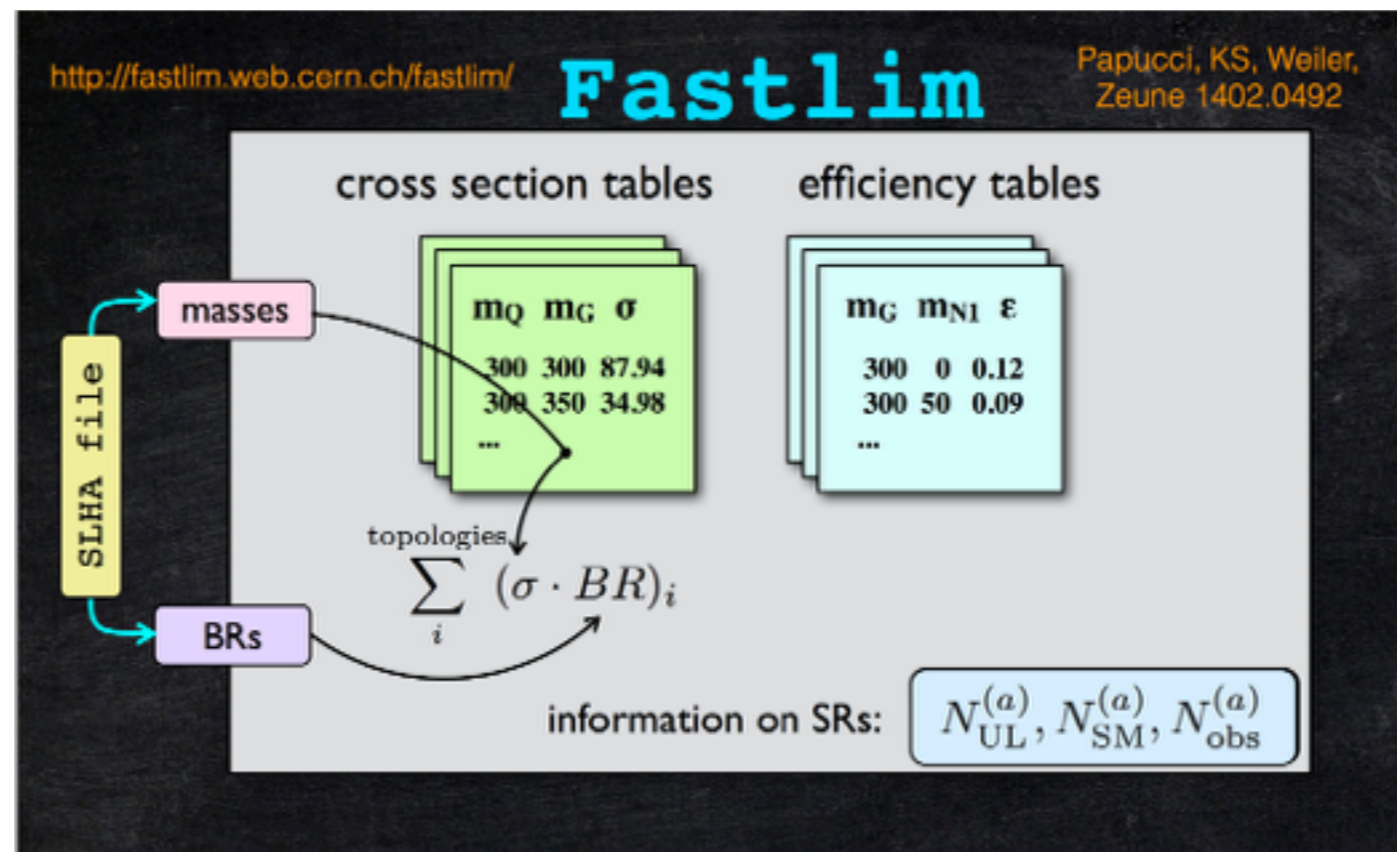
This dataset complements the following publication:
[Toward a public analysis database for LHC new physics searches using MADANALYSIS 5](#)

Simplified Models

- Several groups: SModelS, fastlim, XQCAT
- XQCAT: Designed for heavy extra quarks based on efficiency maps

arXiv:1405.0737, Barducci et.al.

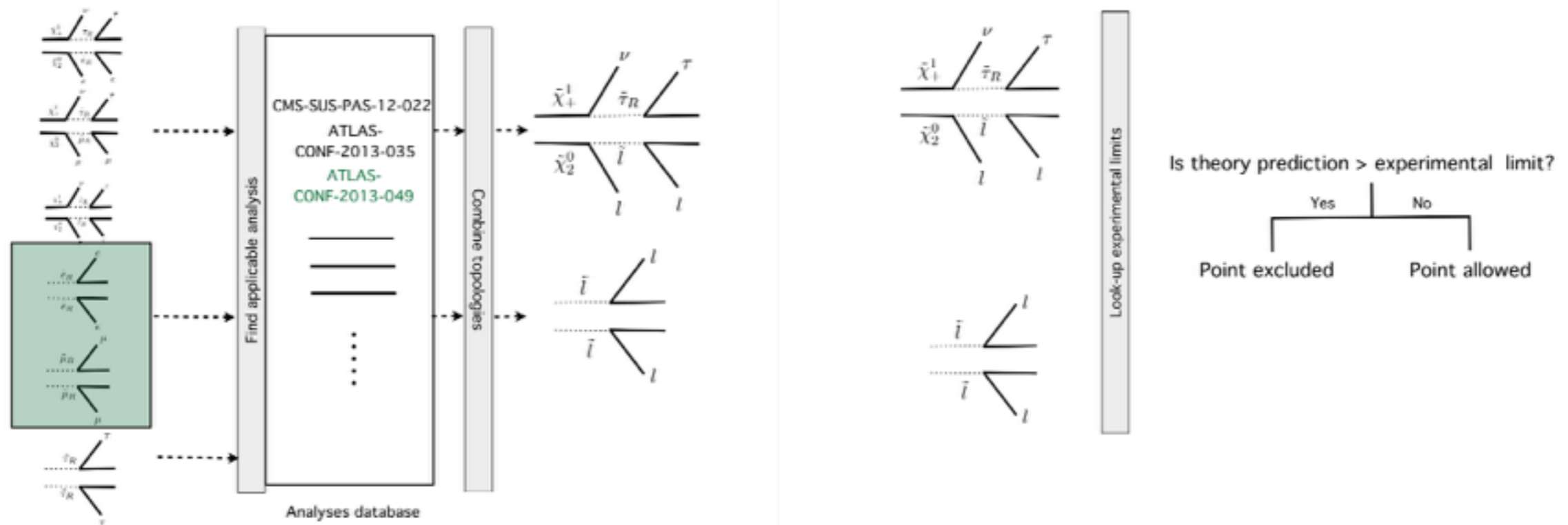
- Fastlim: efficiency maps to reconstruct the number of events in a given analysis
 - Fast but is useful only for SUSY scenarios



arXiv:1402.0492, Papucci et.al.

Simplified Models

- SModelS uses the upper limits maps directly as given by the collaborations
- Tests a BSM model against the upper limits maps by decomposing it in SMS topologies
- Works for generic BSM models with Z2 symmetry



SModelS: <http://smodels.hephy.at/wiki/SModelS>

arXiv:1412.1745, arXiv:1312.4175 Kraml, SK et.al.

Recasting LHC analyses future

- Both the simplified models and full analysis implementation approaches should be kept in mind
- The SMS results should be useful in terms of applying the results given by experimentalists directly to a theory model (interpolation between different planes should be possible)
- For reimplementing an analysis enough information should be provided on the webpage
- Validated analyses codes being made available directly in MA5 or other formats by the experimentalists is also another option to be thought about
- In general, the usage of data and results for theorists is only one aspect of the story, we should also think of preserving the results in a systematic fashion