Recasting LHC analyses

Suchita Kulkarni
HEPHY, Vienna

Why?

- More models than the experimentalists can possibly cover

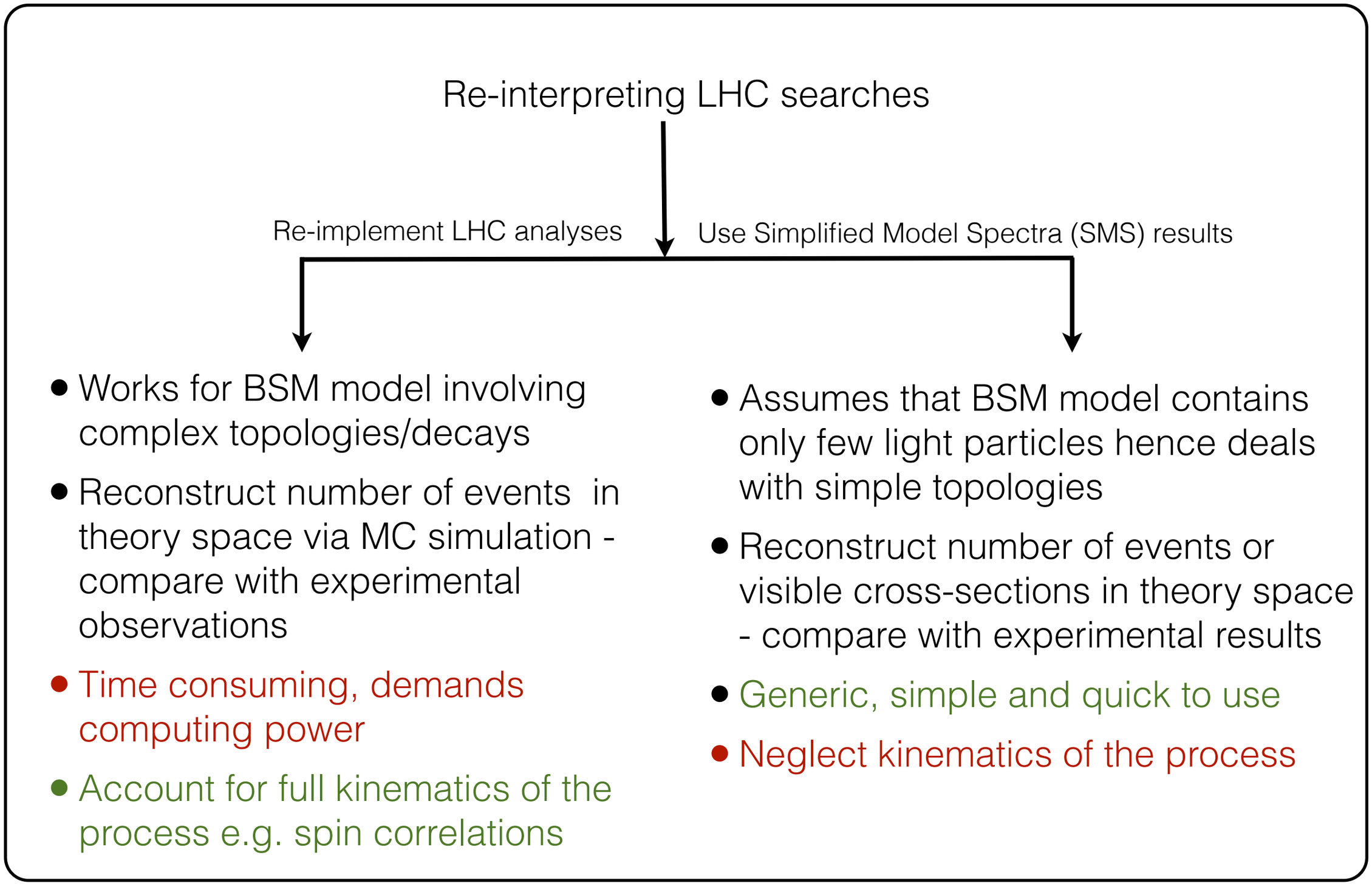
- Simplified models is one way to present analysis interpretations and although they are generic, limits obtained using simplified models can be conservative

- No other way but to recast an analysis to answer the question: “What are the limits from LHC for a particular BSM scenario?”

- This talks 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



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

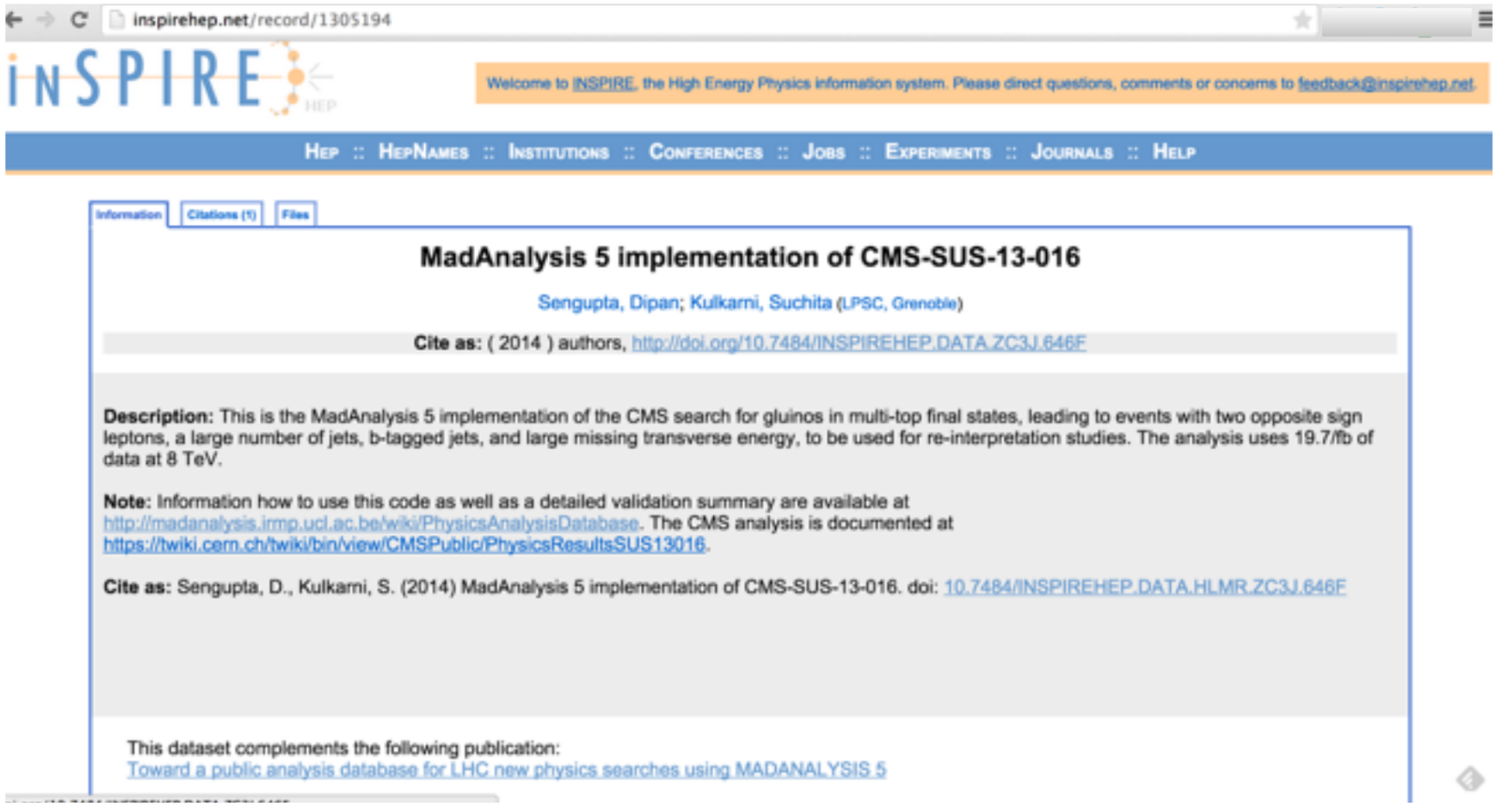
- MadAnalysis5 - Public Analyses Database (MA5 PAD) (5 SUSY analyses, uses Delphes, LHE/hepMC/hep file) **arXiv:1405.3982, Dumont, SK et.al.**

  - 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

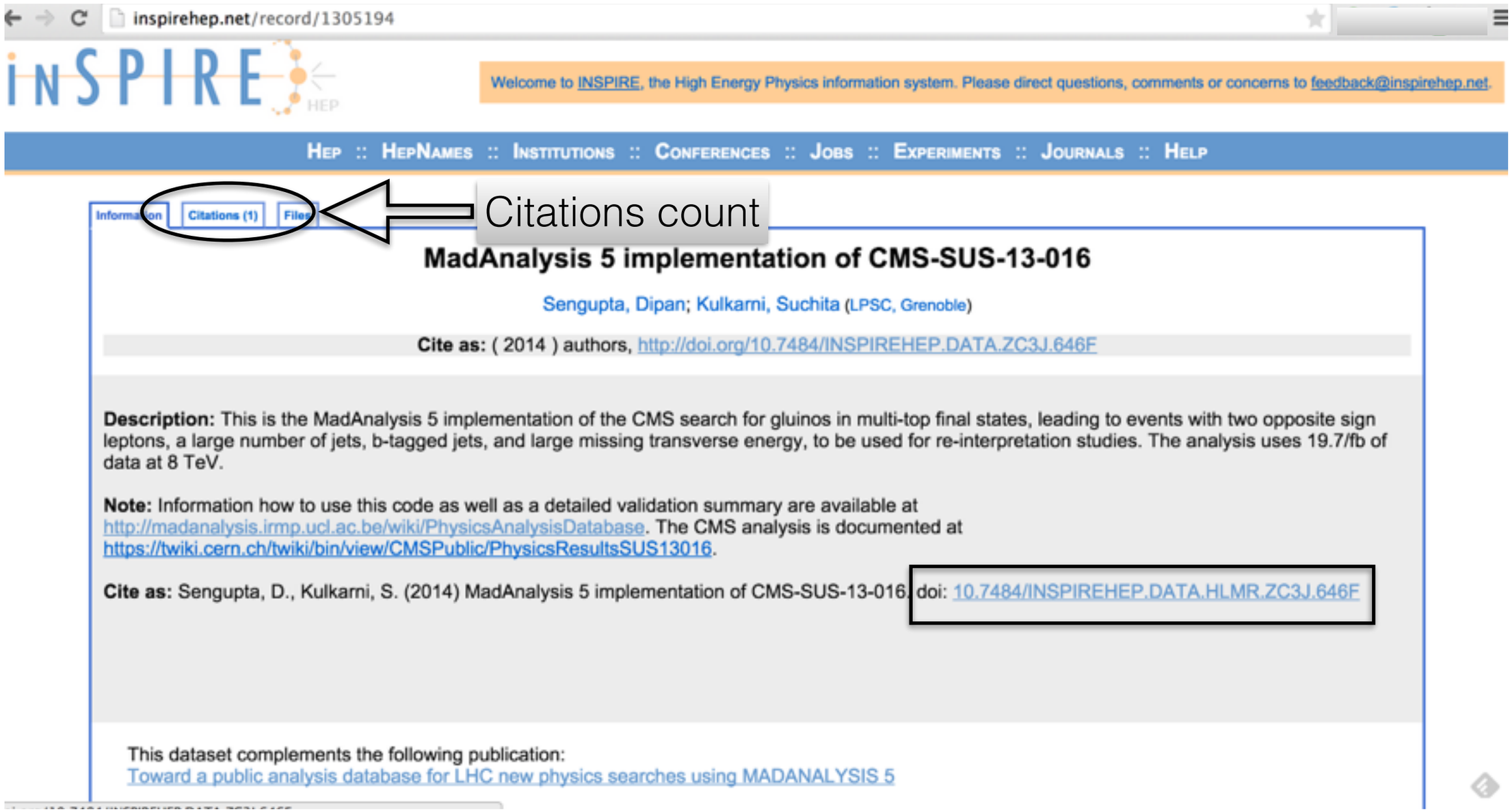
MA5 PAD

- Convenient way of documentation and long term preservation of of the analyses preformed 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



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

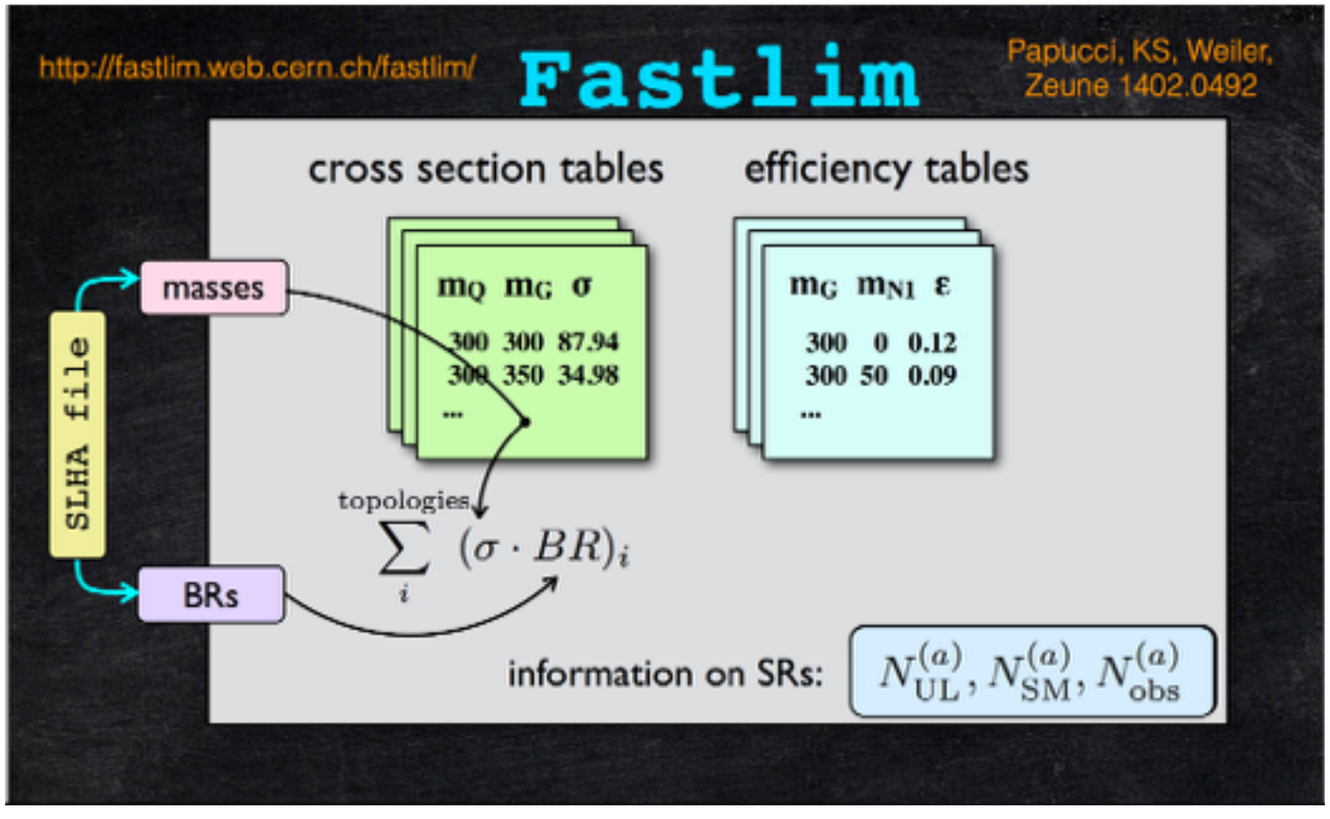


Simplified Models

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

arXiv:1405.0737, Barducci et.al.

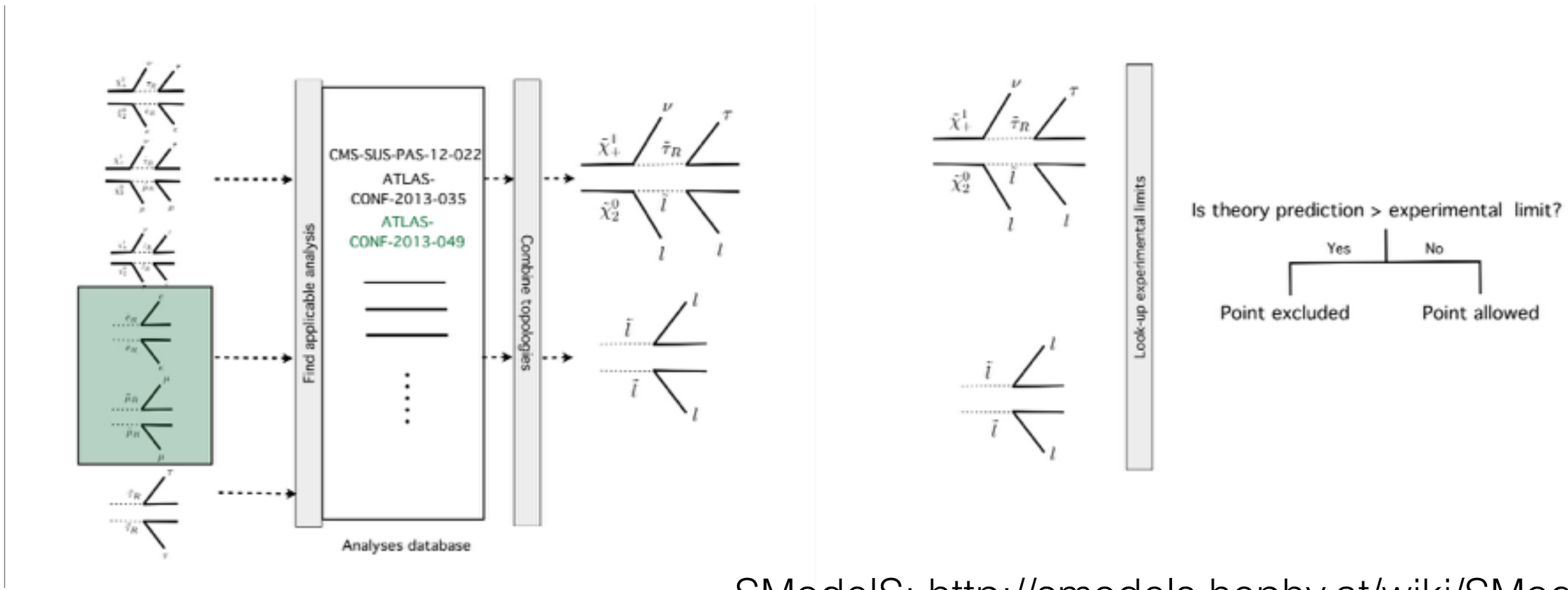
- Fastlim: efficiency maps to reconstruct the number of events in a given analysis
  - Fast but is useful only for SUSY scenarios



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 in only one aspect of the story, we should also think of preserving the results in a systematic fashion