



MC4BSM Summary

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LPC “data challenge” workshop
Fermilab, May 21, 2015

This talk is summarizing

- a phenomenology workshop
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The theorist answers:

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Yes.

Are there any well motivated such models?

No.

You bet. Let me tell you about those. Actually I have a paper...

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Is there any Monte Carlo which can simulate those models?

I'm the wrong person to ask. Ask a phenomenologist.

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Yes.

Can LHC be sensitive to model X?



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Not this particular model.
In our note we only show
MSUGRA plots.

Is there any analysis which is
looking for this model?

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Manpower. But talk to a
phenomenologist, they can
probably recast it for you...

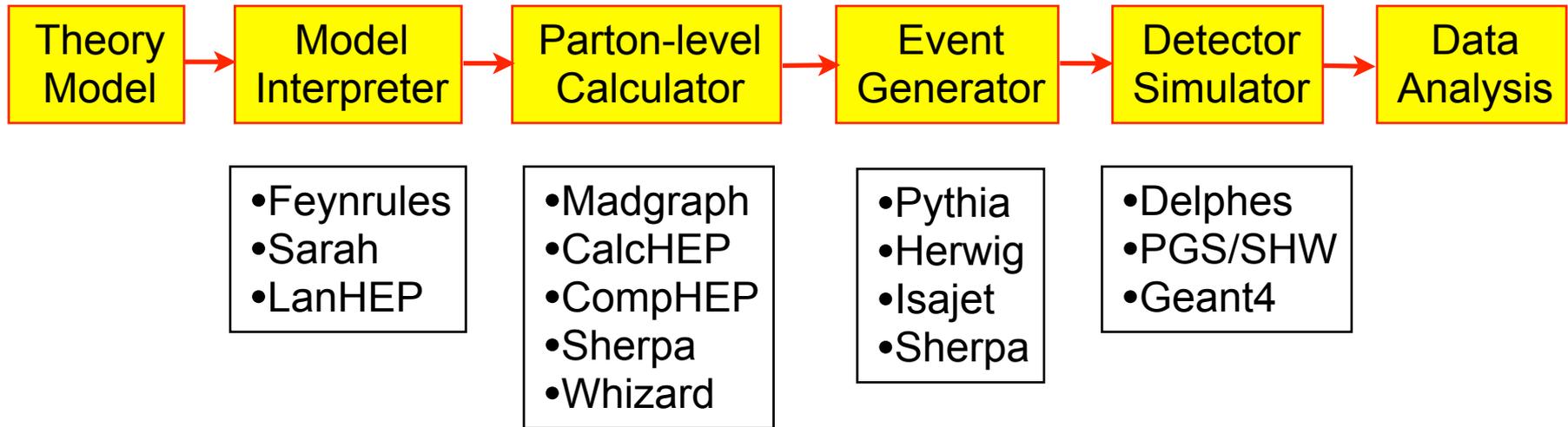
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Can LHC be sensitive to model X?

Is there any analysis which is
looking for this model?

Why not?! It's a great model.

The Production Line in HEP



- The tools are standardized, automated, user-friendly
 - Les Houches Event (LHE) file standard for sharing events
 - Universal Feynrules Output (UFO) standard for sharing theory models
- Great teaching tools in the classroom. One can use
 - Parton-level calculators to do textbook problems, make plots
 - Event generators to teach QCD
 - Detector simulators to teach theorists how a real experiment works
- Knowledge of these tools is essential for phenomenologists⁴

MC4BSM* workshops

advertisement

- Held annually* since 2006:

- Fermilab, 2006
- Princeton, 2007
- CERN, 2008
- UC Davis, 2009 (jointly with “Missing Energy” workshop)
- Copenhagen, 2010
- Cornell, 2012
- DESY, 2013
- KAIST, Korea 2014
- LPC, Fermilab 2015



- Followed by a one day “data challenge” CMS workshop at Fermilab LPC
- **Goal:** *“to gather together theorists and experimentalists interested in developing and using Monte Carlo tools for Beyond the Standard Model Physics** in an attempt to be prepared for the analysis of data focusing on the LHC”*

* MC4BSM = Monte Carlo [Tools] For Beyond Standard Model [Physics]

** excluding supersymmetry

Other venues

advertisement

- A sister European workshop: “TOOLS”
 - TOOLS 2006, Annecy
 - TOOLS 2008, MPI Munich
 - TOOLS 2010, Southampton
- LHC Olympics
 - CERN 2005, 2006
 - KITP Santa Barbara 2006
 - Princeton 2007
- Graduate-level summer schools
 - PiTP 2005, Princeton
 - PiTP 2007, Princeton
 - TASI 2011, Boulder
 - CompHEP/CalcHEP
 - PYTHIA
 - PGS
 - MicrOMEGAs

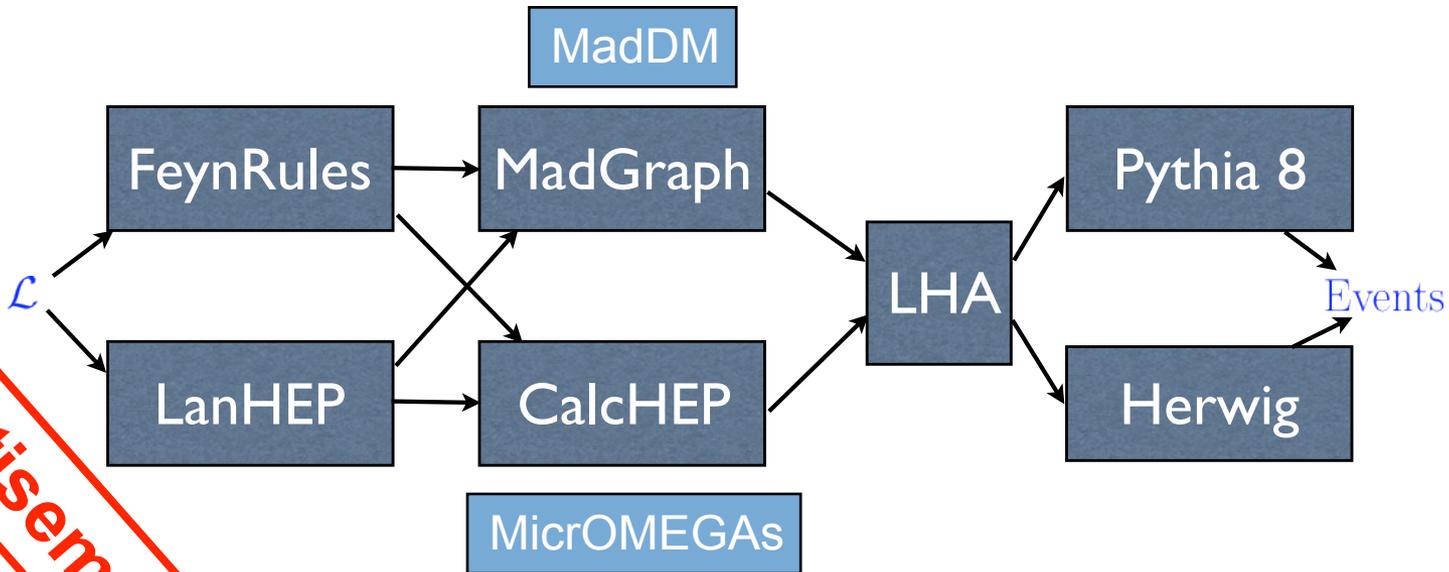


TASI 2011



Progress in MC Simulation Tools

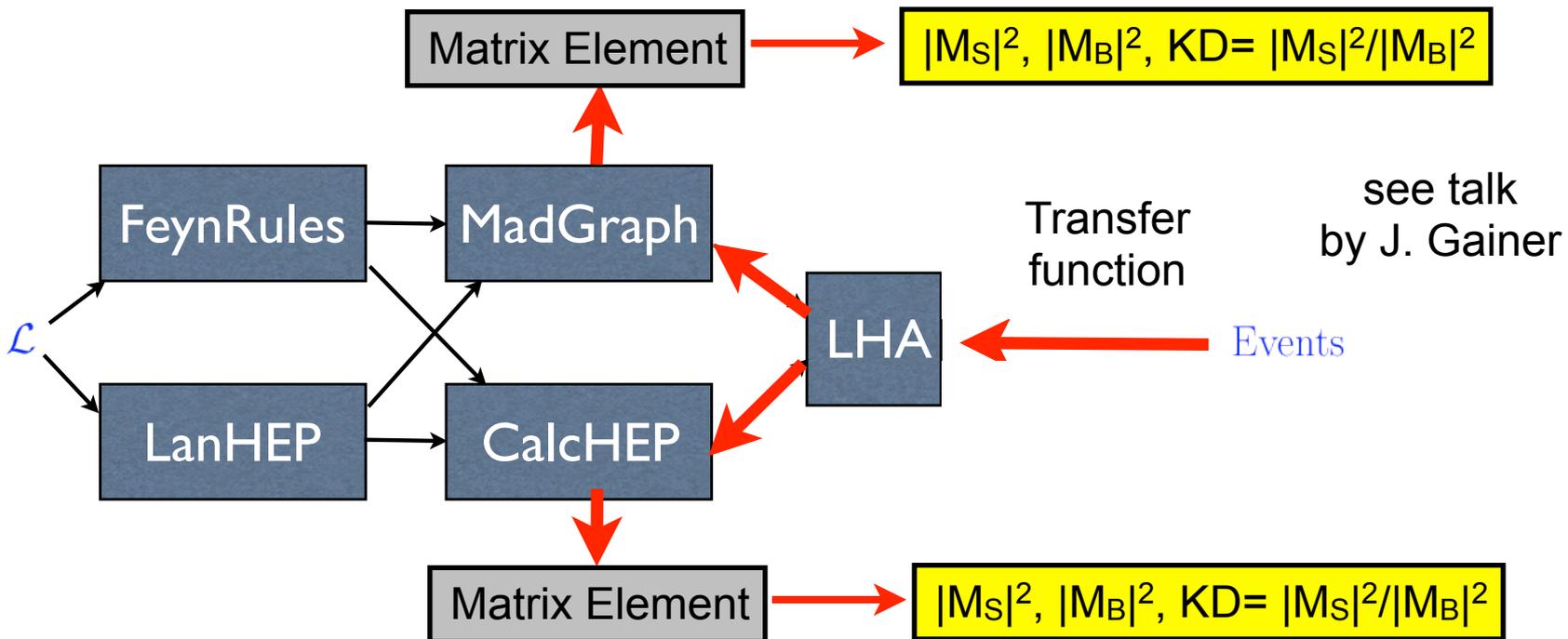
- A lot of effort in the theory community towards **automation**, **standardization** and **generalization** of the MC tools
 - MC4BSM-6 workshop: computer tutorials illustrating the full chain
 - detailed writeup: [arXiv:1209.0297](https://arxiv.org/abs/1209.0297), repeated at each subsequent workshop
- The tools are applicable to dark matter calculations as well
 - MicrOMEGAs, MadDM



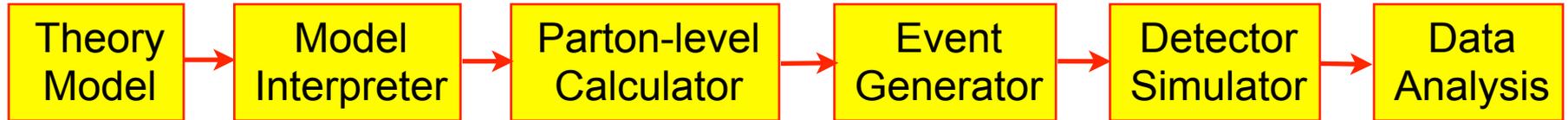
advertisement

From events to ... matrix elements!

- The same chain of tools can be run in reverse:
 - theorists are interested in going all the way back to the Lagrangian
 - experimentalists are interested in going back only to the Matrix Element
- Can be done for both Signal and Background
- Redundancy is a virtue: allows for cross-checks
 - examples in Higgs to 4 leptons: MELA, MEKD, MEM@NLO, Madweight

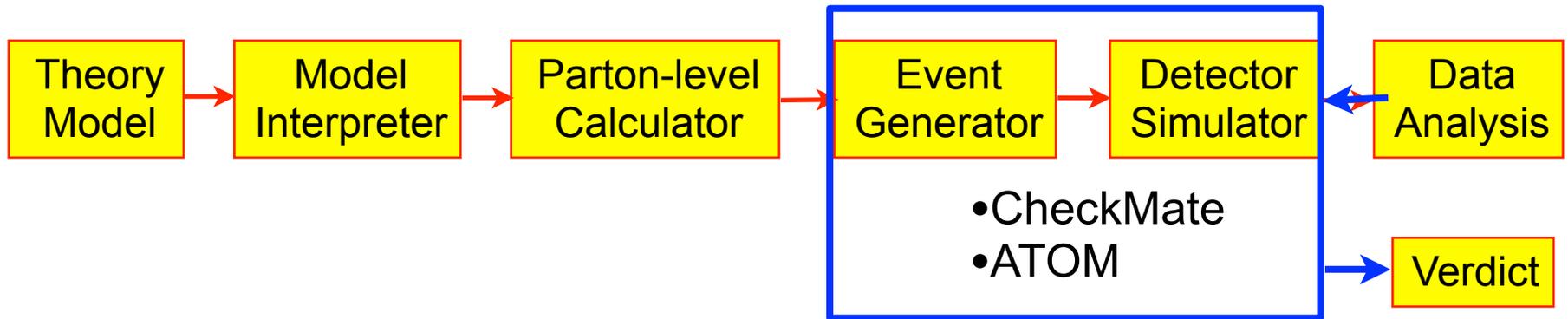


Recasting



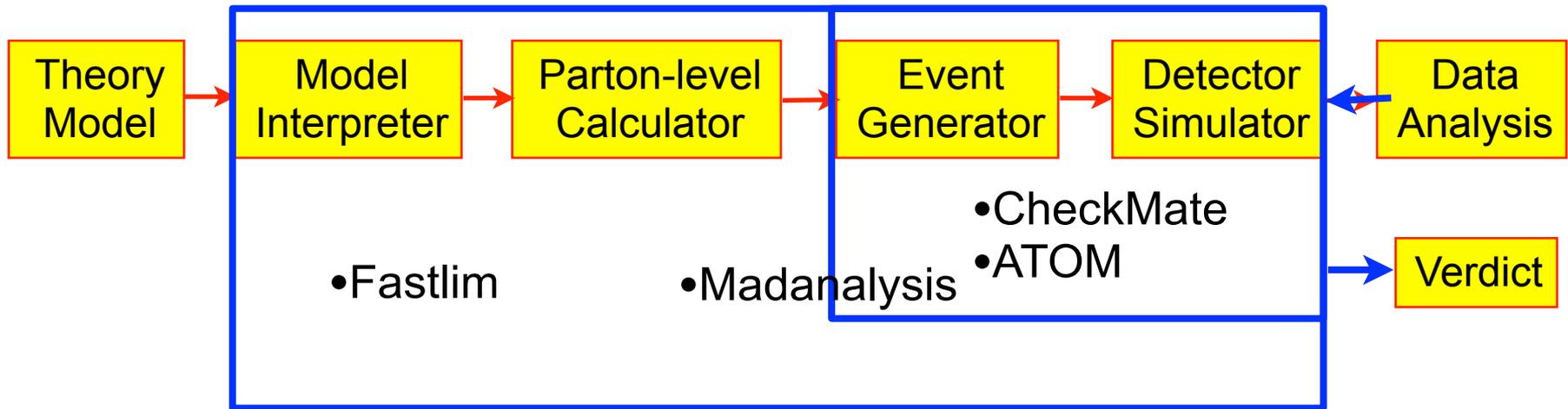
- Recasting tutorials available at the MC4BSM workshop
 - detailed writeup will be available on the arxiv later this summer
- Recasting discussions this afternoon
 - CMS-ATLAS joint dark matter (dark?) force (talk by S. Mrenna)
 - Status reports and wish lists from the developers of recasting tools
 - Checkmate (talk by Jong Soo Kim)
 - ATOM/Fastlim (talk by Kazuki Sakurai)
 - MadAnalysis 5 (talk by Benjamin Fuks)
 - Discussion of the “phenomenologists’ wish list” document (B. Fuks⁹, all)

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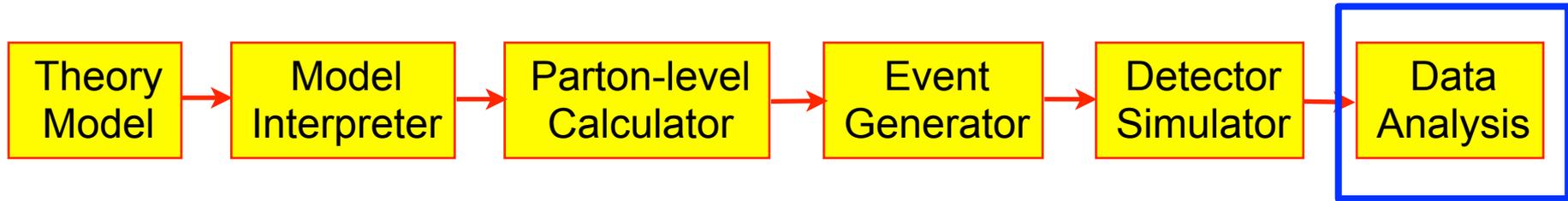
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What is happening next?



- Focus on the data analysis stage
- How to best discriminate signal from background?
 - the most pressing question before discovery
- Different approaches
 - Neural networks, boosted decision trees
 - Matrix Element Method (MEM) - related approaches and variables
 - see talk by Jamie Gainer this afternoon
 - New kinematic variables optimized for a specific signal event topology
 - the topic of the “mock data challenge” to follow.
 - Doojin Kim: introduce the signal model, kinematic variables to study/plot
 - Steve Mrenna: describe the event generation, location of the signal and background samples, how to access the root trees and make simple plots.