



Improving Classification of ttH Events

Graham Van Goffrier – University of Maine

ATLAS Experiment

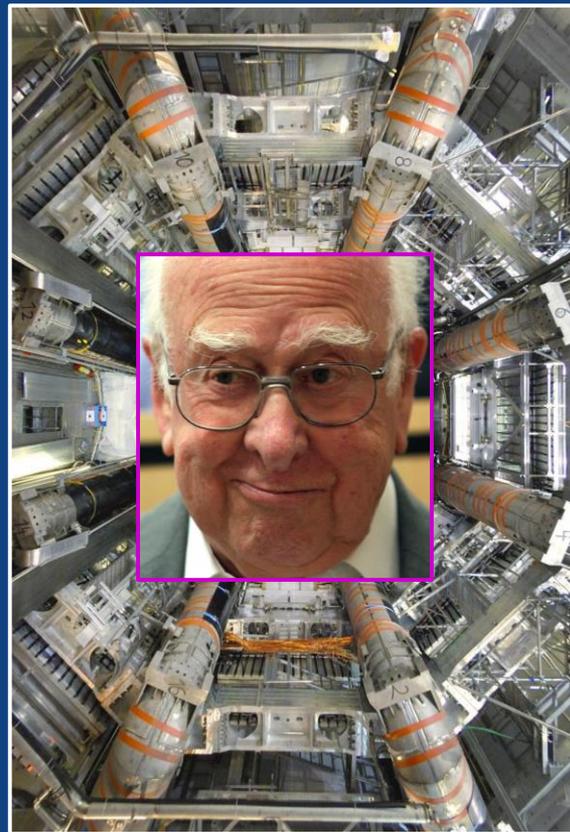
Project Advisors:

Alexander Held and Dr. Tancredi Carli

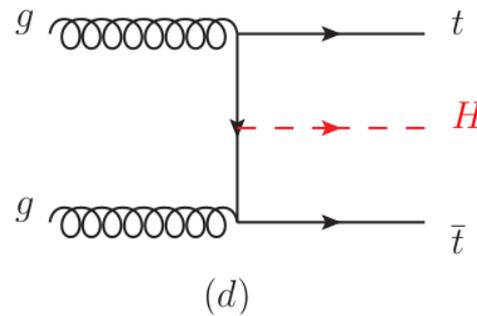
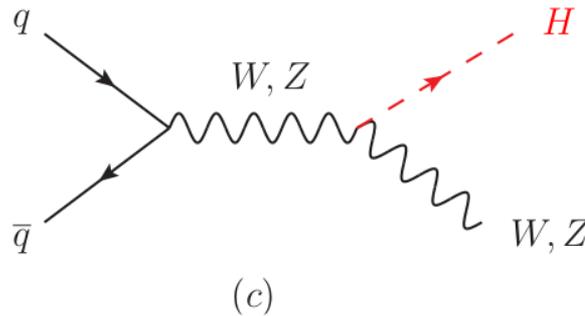
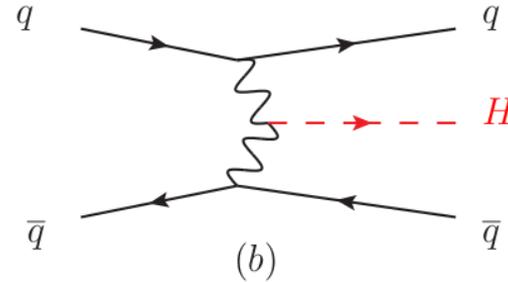
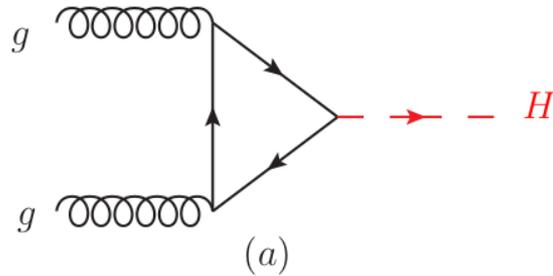
Background: ATLAS Experiment

- One of two multipurpose LHC detectors
- Data analyzed for many purposes
- But we're only going to talk about one:

H I G G S

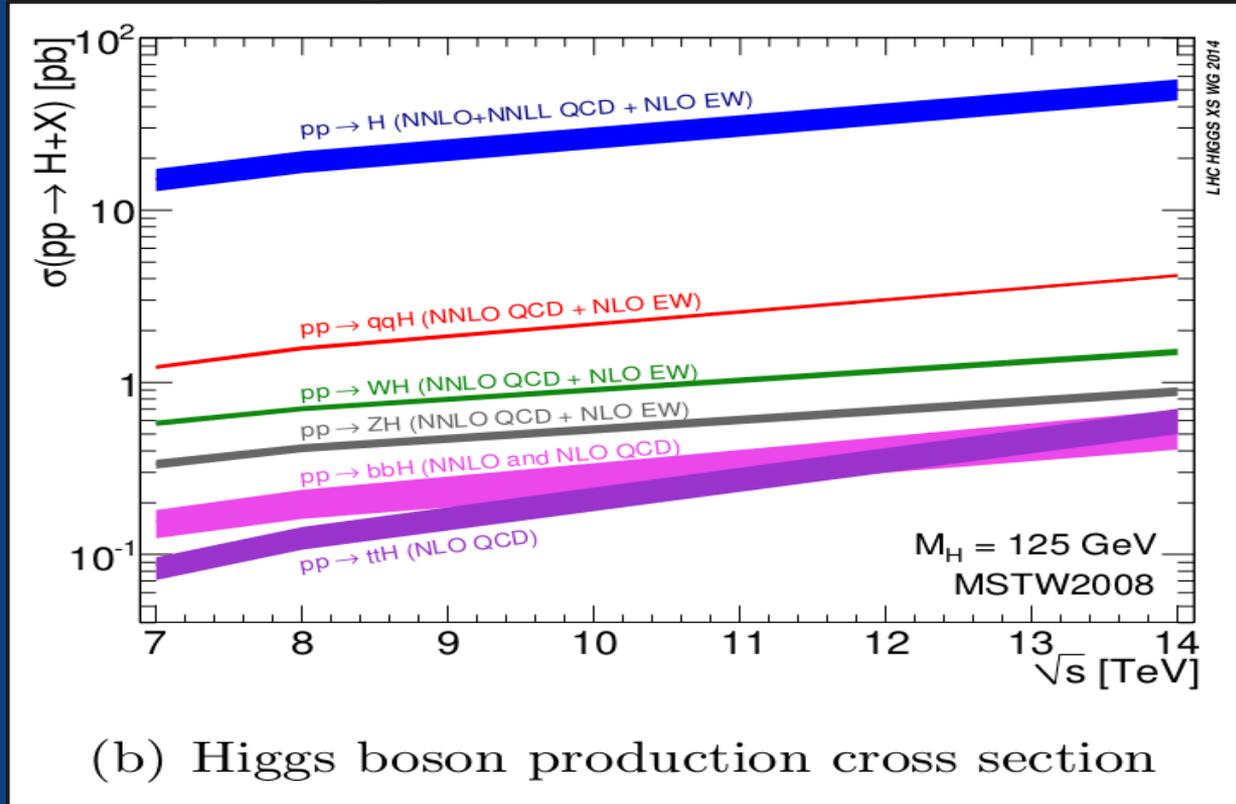


Background: ttH Events



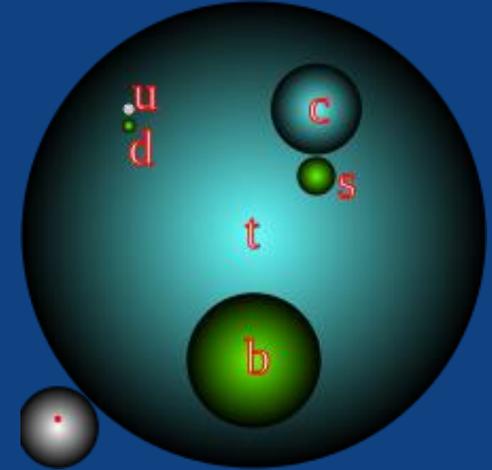
(a) Higgs boson production diagrams

Background: ttH Events



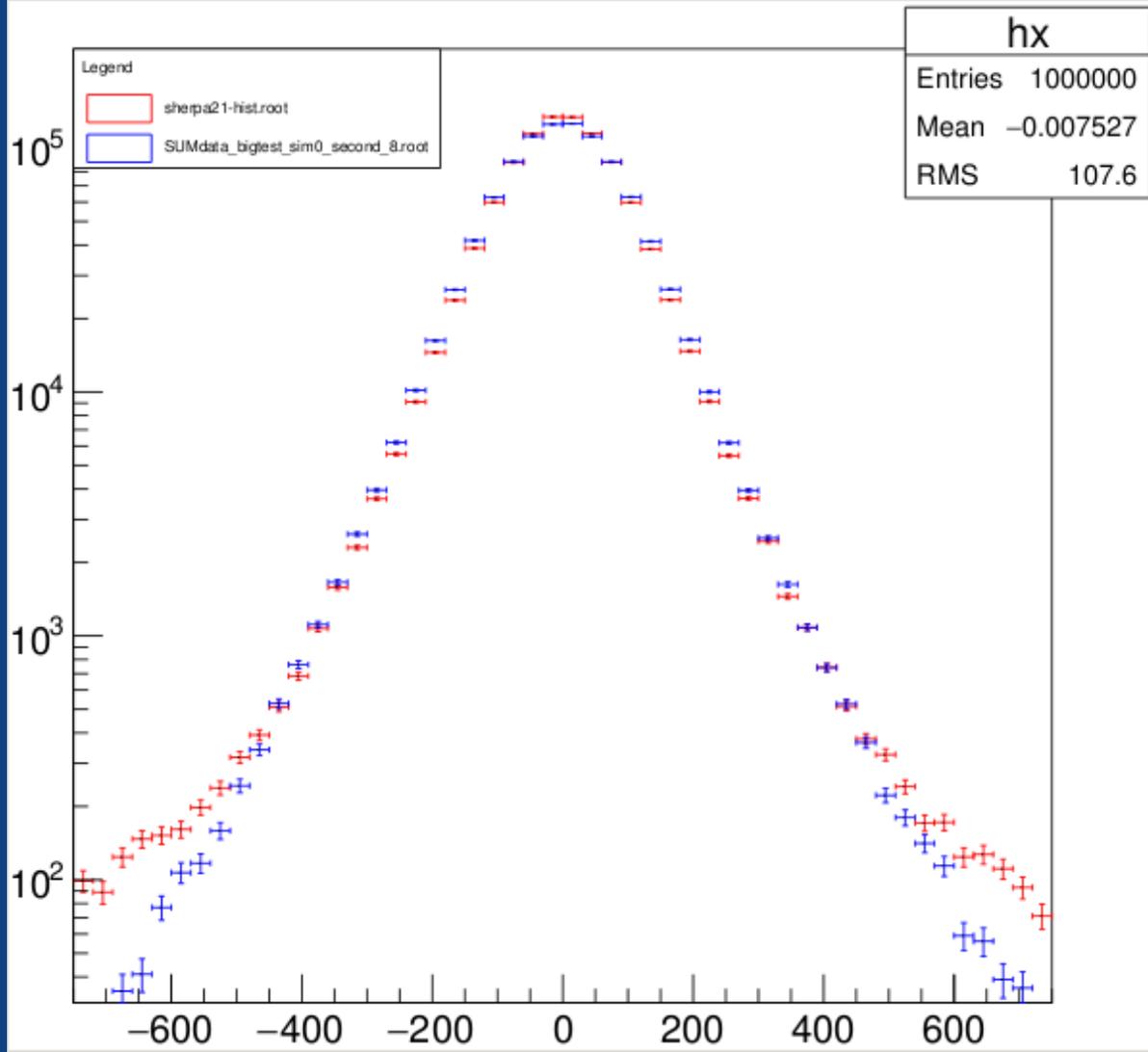
Background: ttH Events

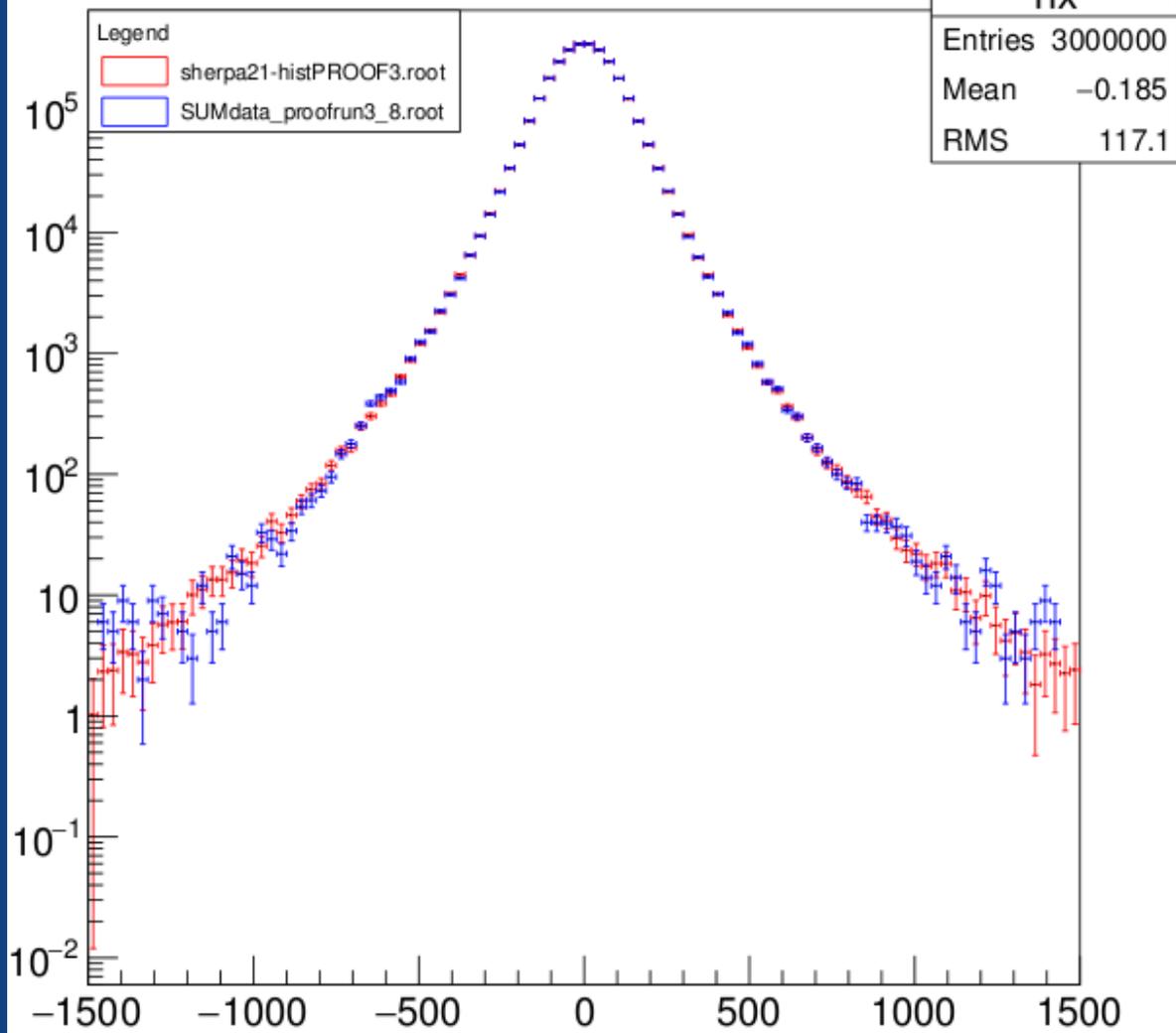
- So, why are we interested in ttH?
- Top quark is heaviest, decays directly
- ttH \rightarrow measurement of Top properties
- Yukawa coupling between Top and Higgs
- Potential gateway into new physics!
- Important to develop new, better classification techniques



Goals so far: Simulation testing

- MC technique still in dev., called Foam (more on this later)
- Foam is derived from an existing simulator, MadGraph
- Long-term: would like to improve the Foam technique
 - Must be able to verify it with independent comparison
- “Sherpa” MC generator is a well-established standard
- But first must confirm its consistency with MadGraph





Current Progress: Foam Testing

- “Adaptive, general-purpose Monte Carlo simulator”, 2002
- Want to efficiently generate MC events from arbitrary PDF
- Foam alg. achieves this through recursive cellular division

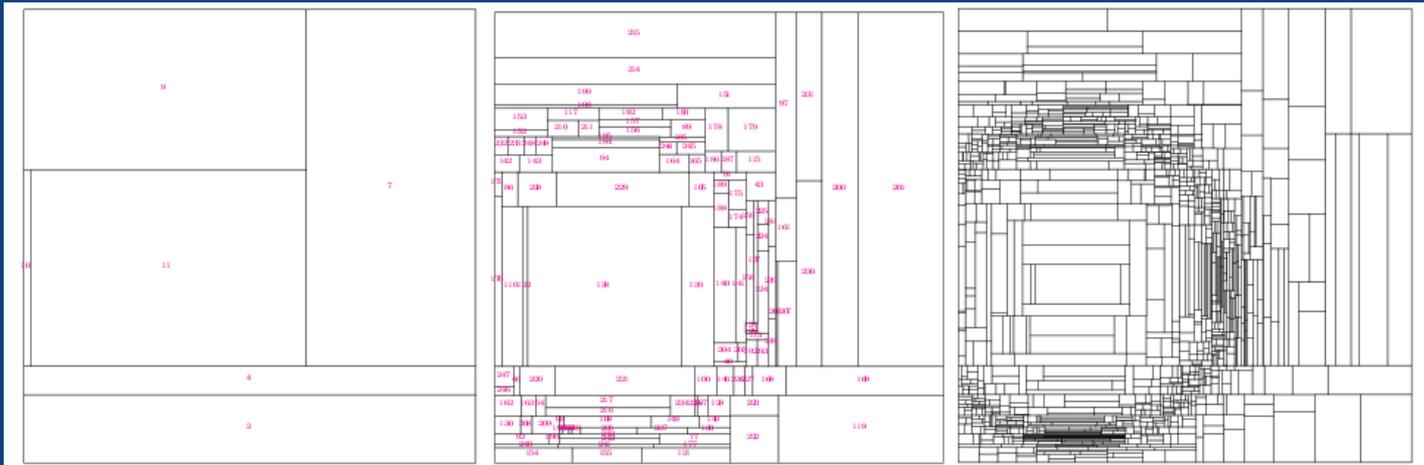


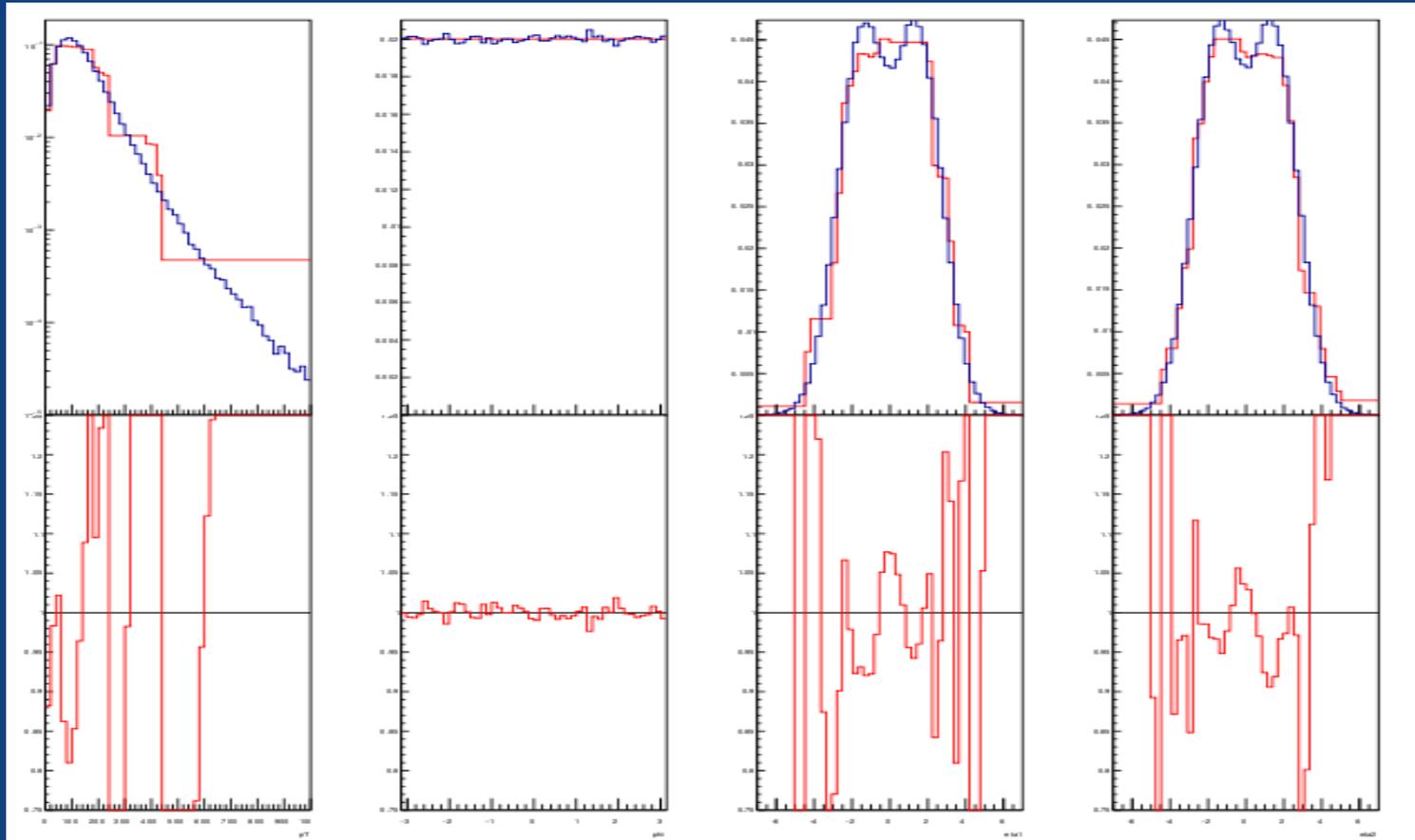
Image Credit: [4]

Content Credit: [4]

Current Progress: Foam Testing

- Generate Foam from MadGraph simulation and some PDF
- “Project” Foam on chosen parameterization of phase space
- Compare histograms with original MadGraph (same PDF)

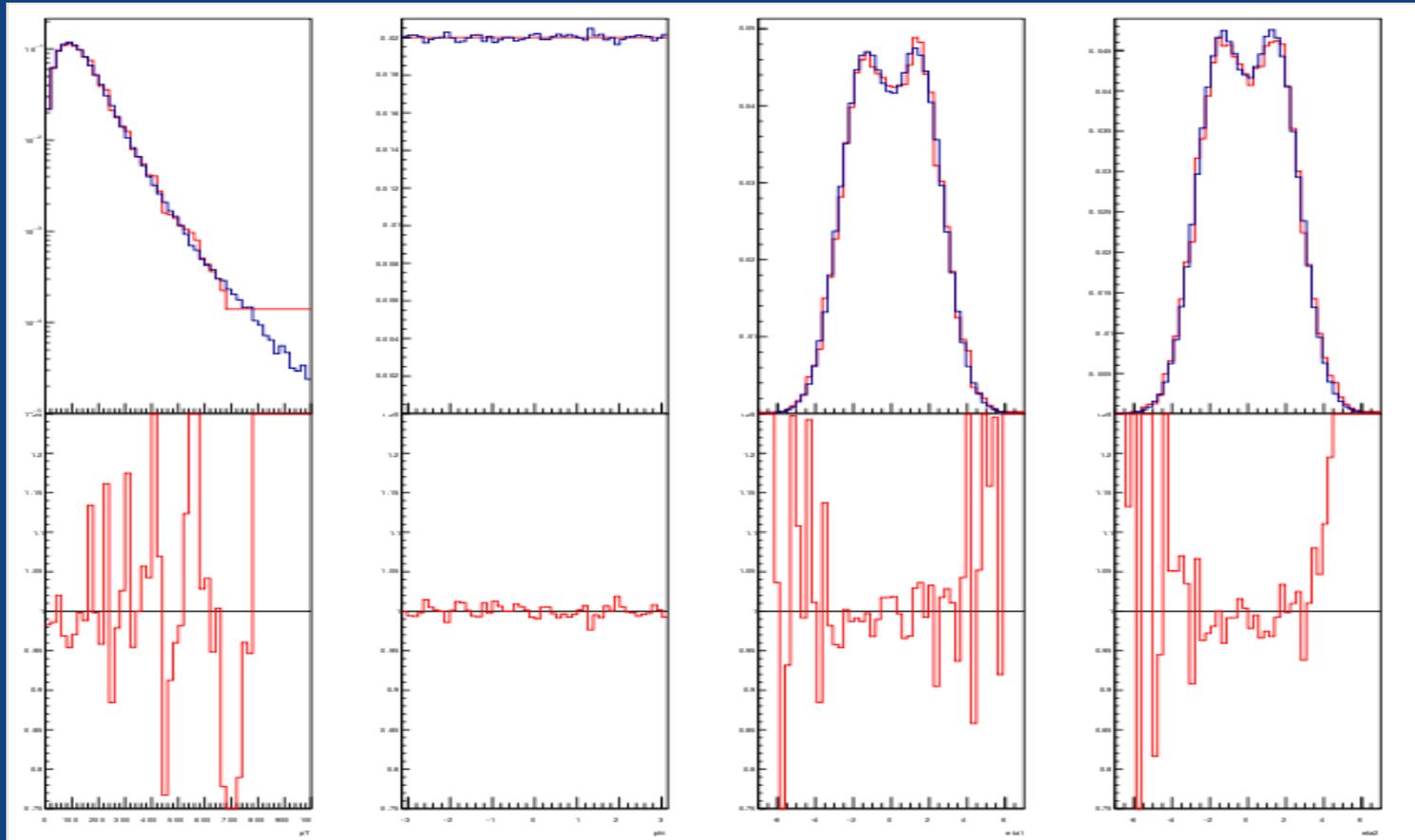
FOAM: 100 cells



pT

phi

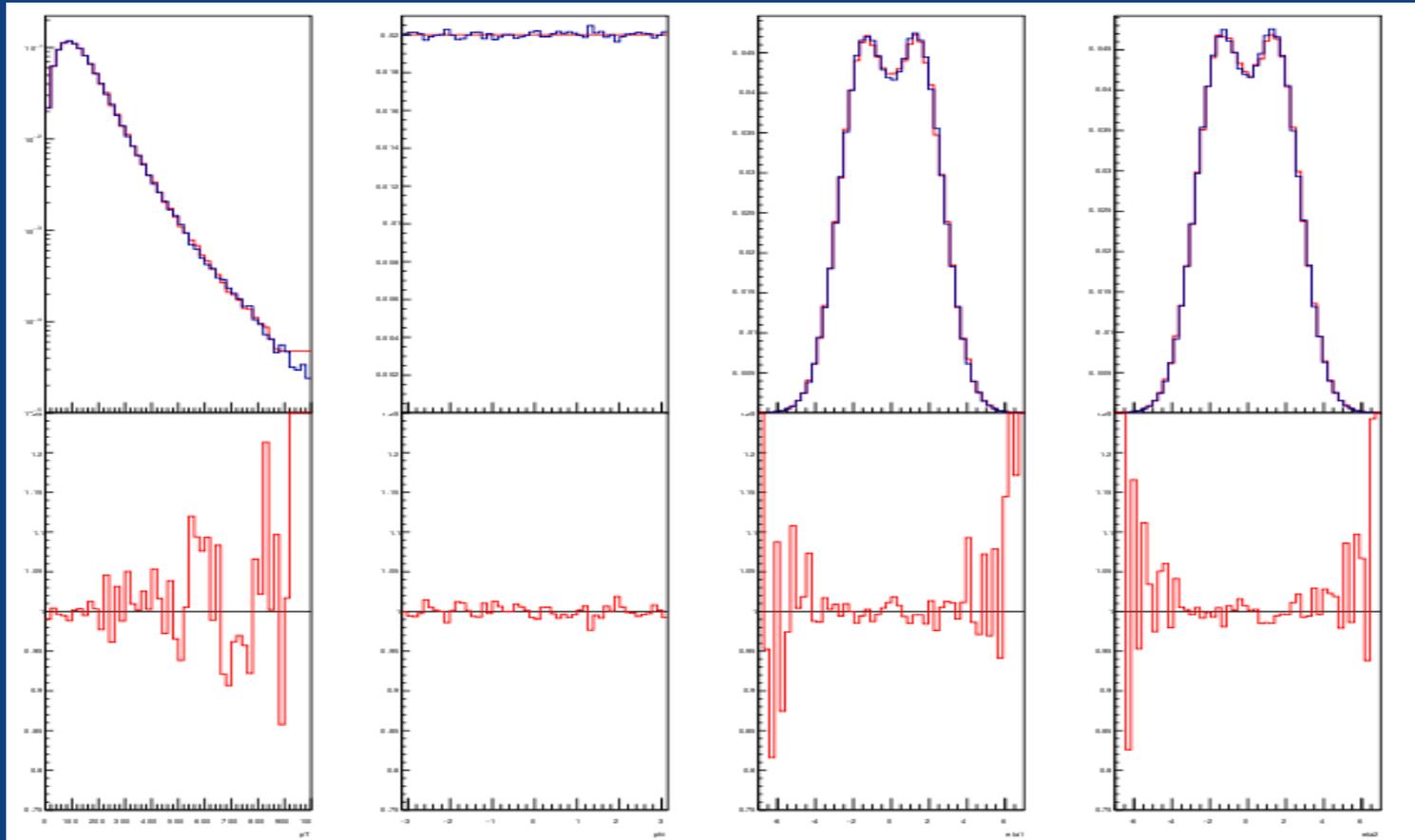
FOAM: 1000 cells



p_T

ϕ

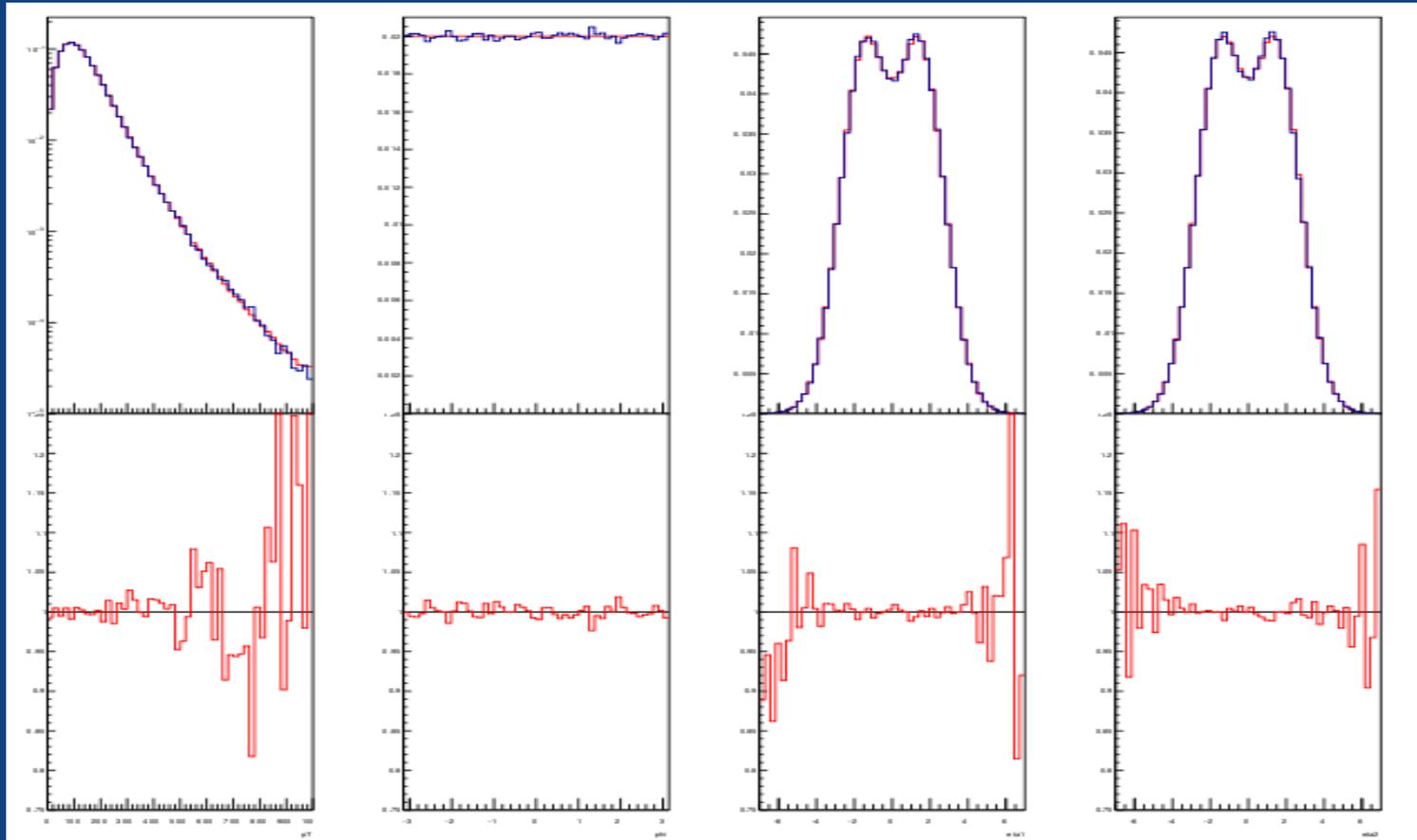
FOAM: 10000 cells



pT

ϕ

FOAM: 100000 cells



p_T

ϕ

What's next?

- Compare Foam directly to Sherpa with more statistics
- Explore PDF cases that are difficult for MC to handle
 - Sharp peaks in multiple dimensions
 - Non-factorizable distributions
- Transform variables to help combat such difficulties
- Longer term, explore connections to other techniques: Matrix Element method, boosted decision trees, kinematic reconstruction...and more!

CITATIONS

- [1]: <https://home.cern/about/experiments/atlas>
- [2]: CERN-THESIS-2015-186
- [3]: Wikipedia, Incnis Mrsi, 18/10/2012 (CC BY-SA 3.0)
- [4]: arxiv:0203033v2

Backup: ttH branching wide

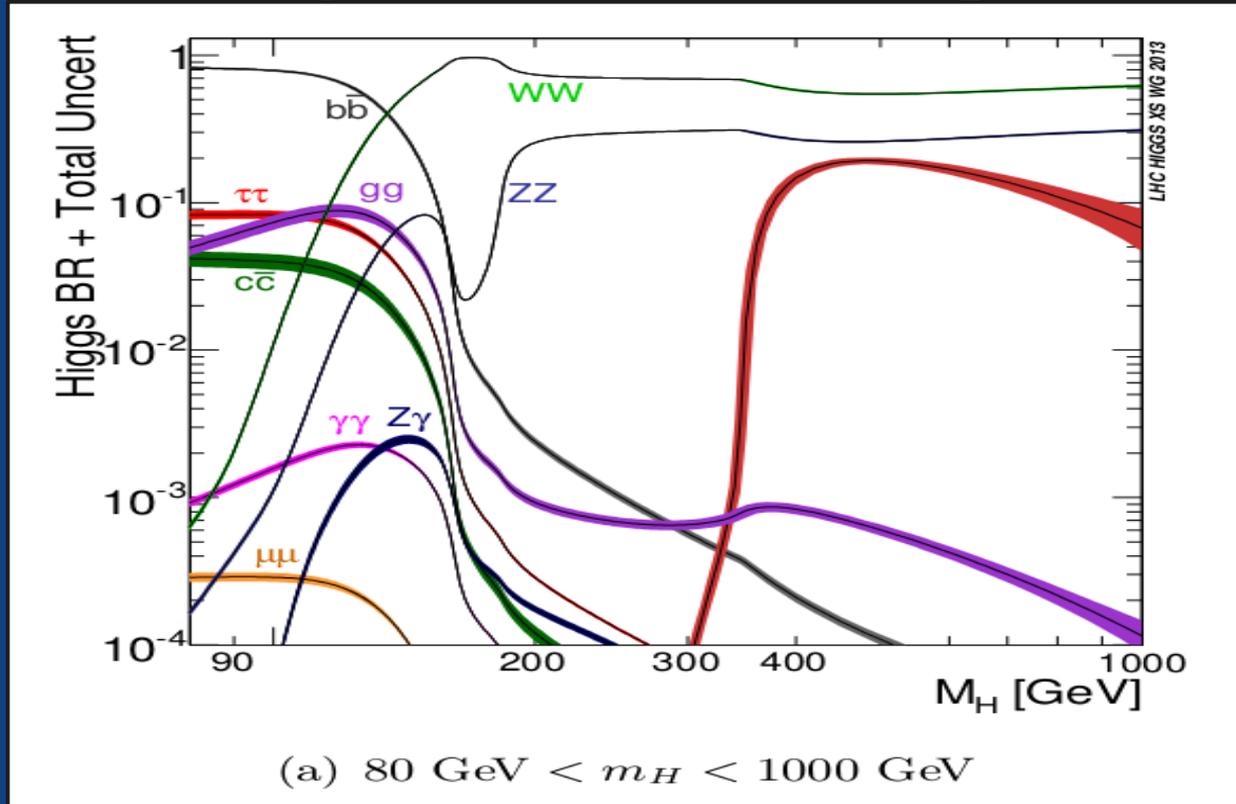


Image Credit: [2]

Backup: ttH branching ~ 125 GeV

