

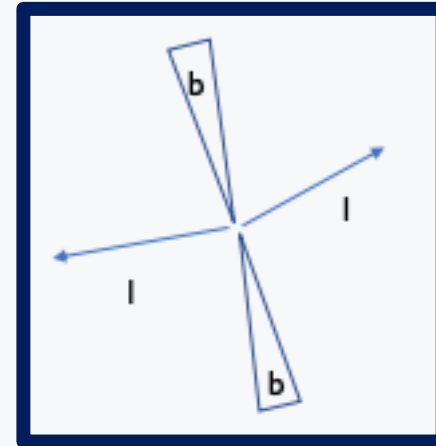
SEARCH FOR SUPERSYMMETRY SIGNATURES WITH HIGGS BOSONS

Kristina Znam

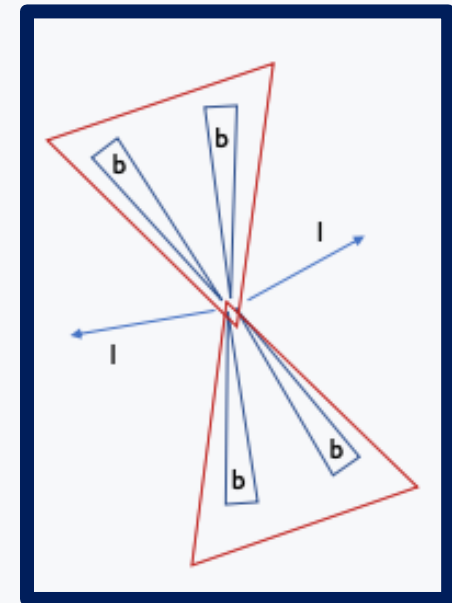
Advisor: Professor Evelyn Thomson

MOTIVATION

- Searches for physics beyond the standard model are top priority for the field
- Supersymmetry could answer many questions
 - unification of forces, Higgs mass, candidates for dark matter
- Prior search for stop LSP (charged lepton + b-jet), could these techniques be applied to chargino LSP (charged lepton + 2 large-radius jets)?
- Feasibility of using large-radius jets for this search



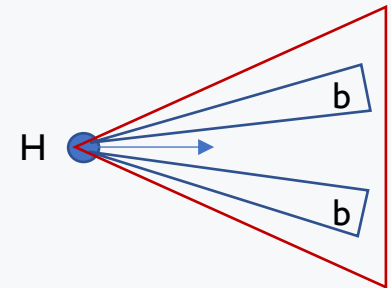
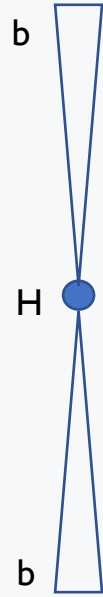
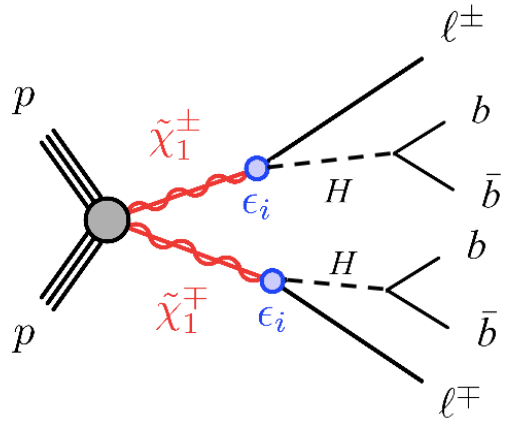
stop pair production



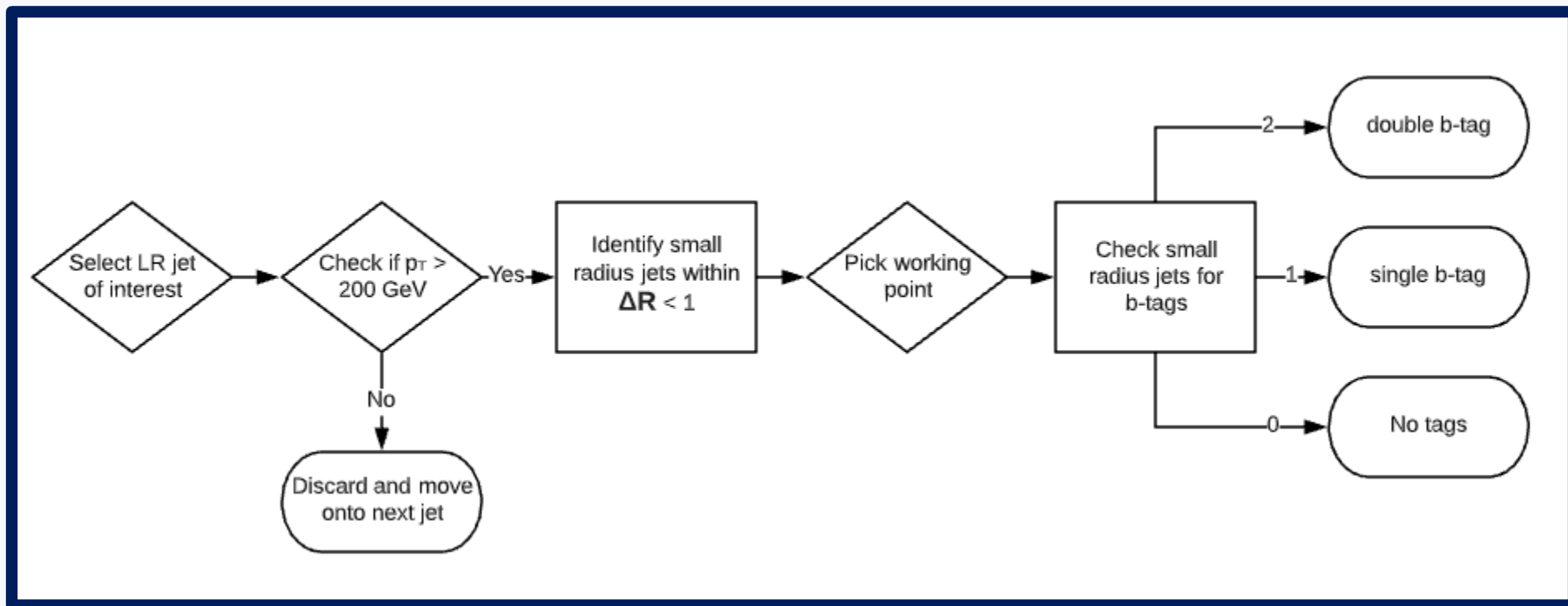
chargino pair production

INTRODUCTION

- Supersymmetry signatures for an R-parity violating model, allows the (lightest supersymmetric particle) to decay to standard model
- Chargino LSP decay into Higgs boson + charged lepton
- Final State from chargino pair production:
 - 2 charged leptons (electrons and muons)
 - 2 large radius jets that contain boosted Higgs to 2 b quarks
- Files: 600 GeV pair produced chargino, 100% BR to Hl, 100% BR for H to bb

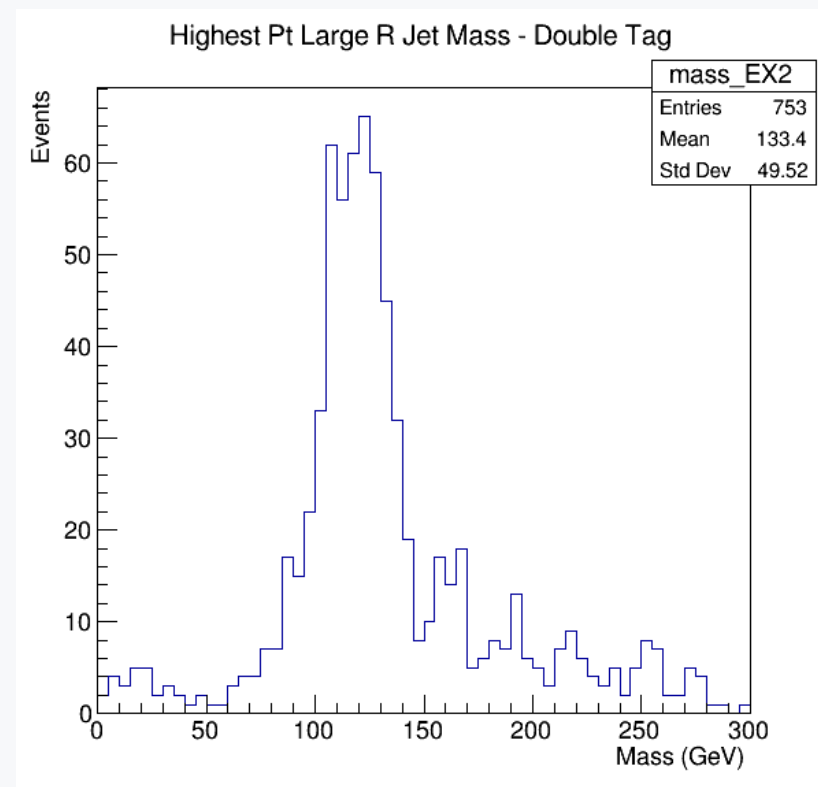
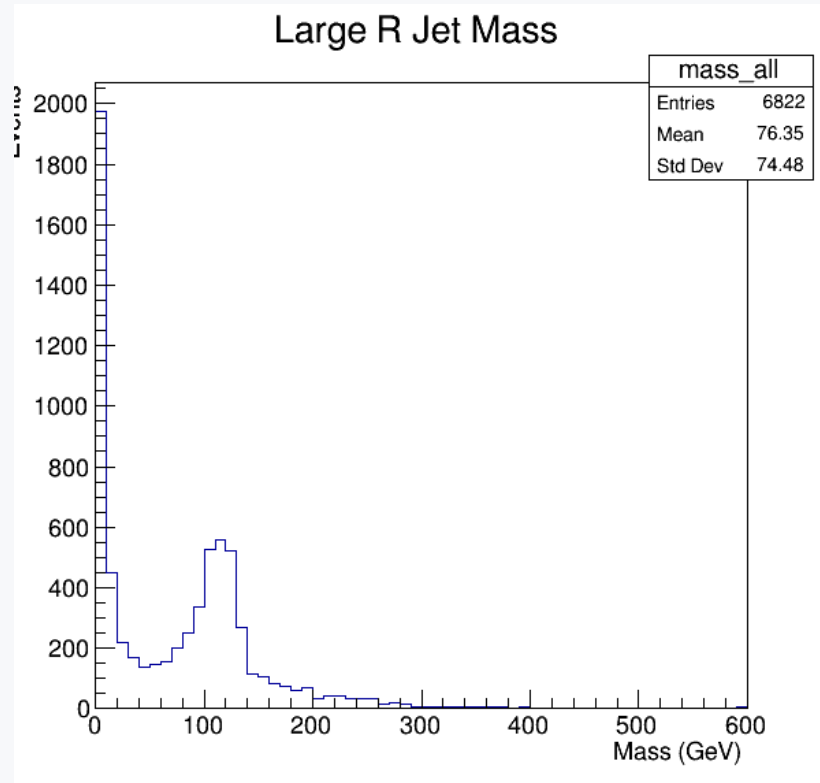


TAGGING HIGGS TO BB DECAYS

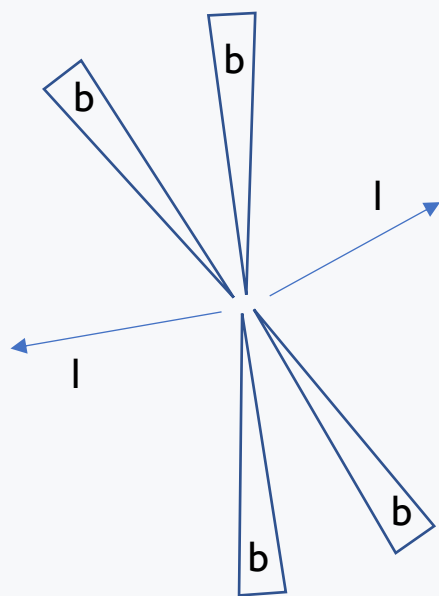


<https://arxiv.org/abs/1906.11005>

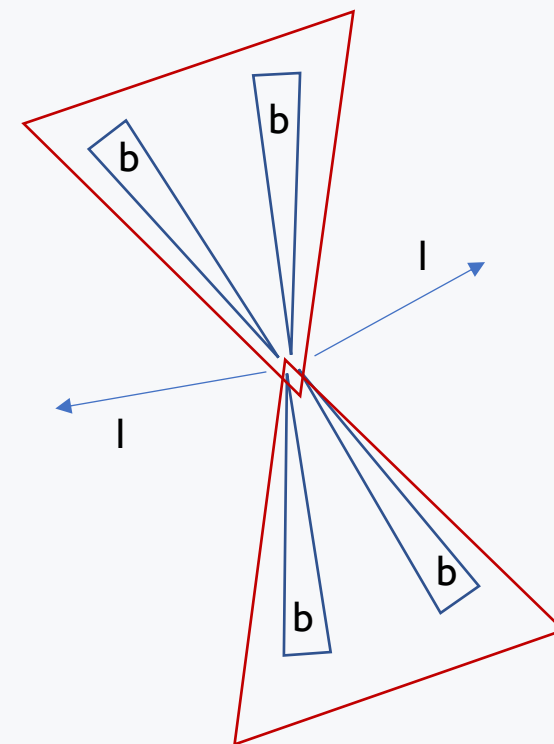
TAGGING HIGGS TO BB DECAYS



SELECTION EFFICIENCIES



- Is it efficient to resolve the 2 b-jets into one large-radius jet?
- If yes, greatly reduces combinatorics
 - 2 leptons + 2 jets = 2 possible pairings
 - 2 leptons + 4 jets = 6 possible pairings



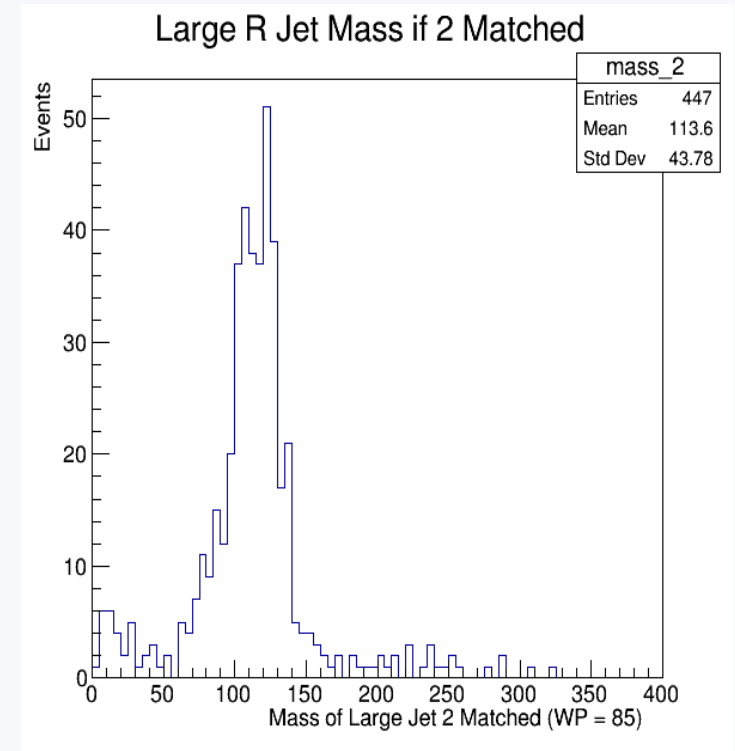
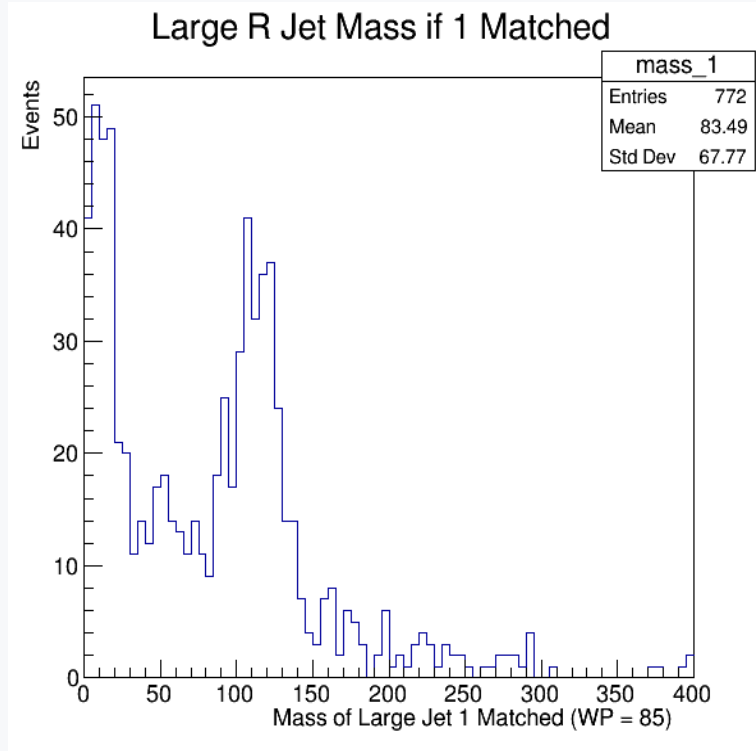
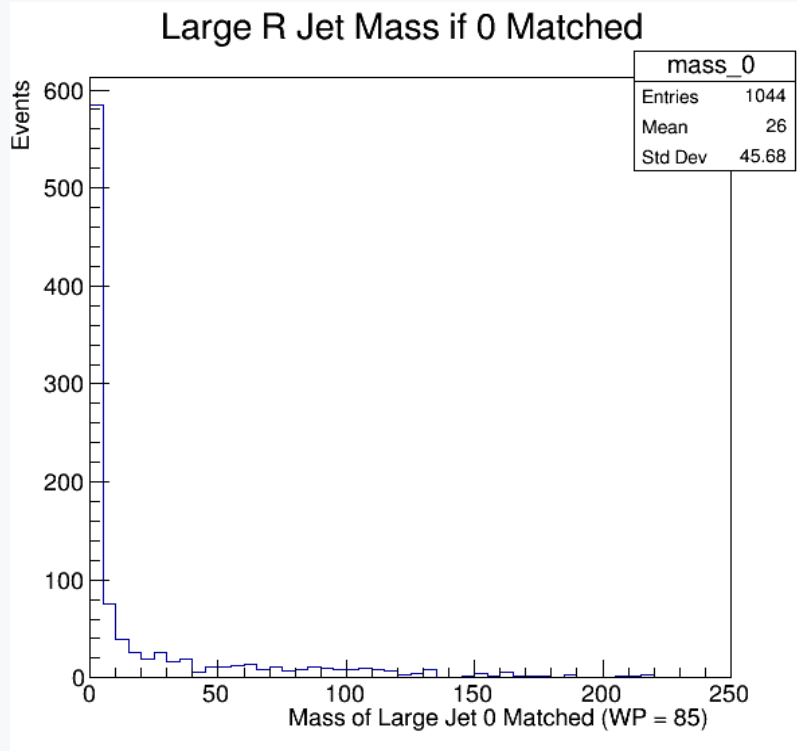
Working Point = 85%

SELECTION EFFICIENCIES

Selection Efficiency for Large-Radius Jets					
Requirement	2 charged leptons	2 Large-Radius Jets $p_T > 200$ GeV and $ \text{Eta} < 2.4$	Mass > 50 GeV	Each Jet Has At Least 1 b-tagged	Each Large-Radius Jet Has 2 b-tagged
Number of Events	3369	2439	1017	737	201

Selection Efficiency for Small-Radius Jets				
Requirement	2 charged leptons	4 Small Radius Jets $p_T > 50$ GeV and $\text{Eta} < 2.4$	2 b-tagged	4 b-tagged
Number of Events	3369	1416	1192	202

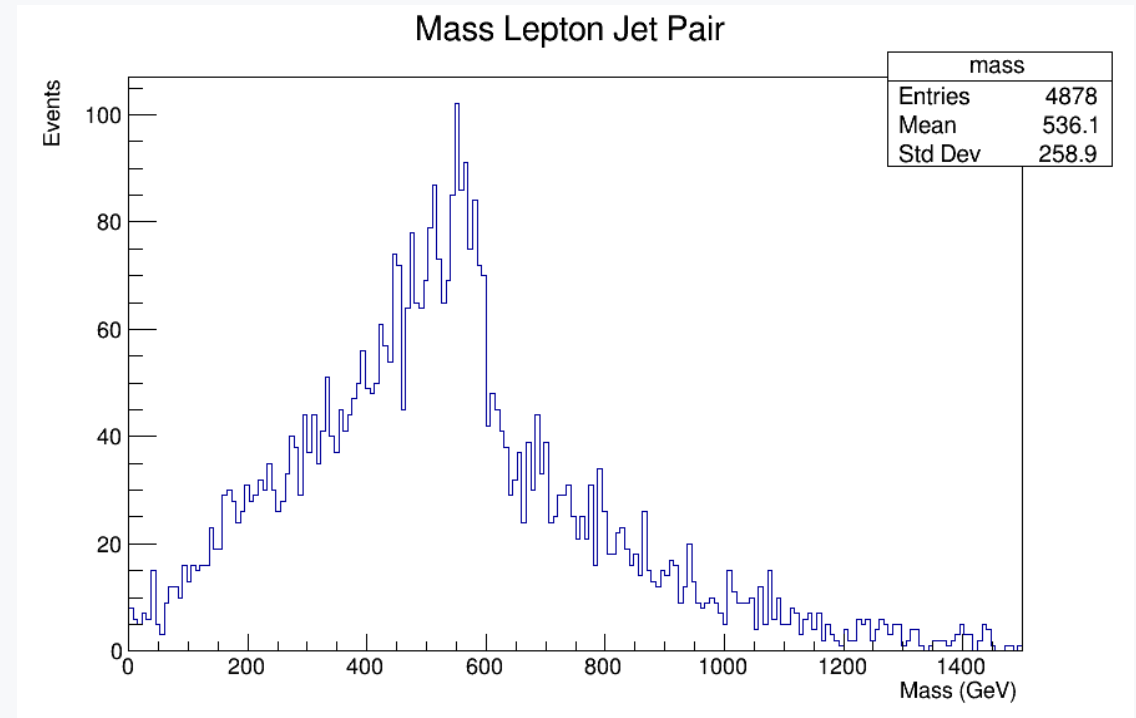
KINEMATICS LARGE-RADIUS JETS



MASS ASYMMETRY STUDY

- Select two highest p_T jets and two highest p_T leptons
- Calculate invariant mass of both possible pairings
- Plot one with smaller mass asymmetry

$$\text{Mass Asymmetry} = \left| \frac{M_{\text{pair1}} - M_{\text{pair2}}}{M_{\text{pair1}} + M_{\text{pair2}}} \right|$$



OBSTACLES

- Availability of files – used different available ones to start
- B-tagging large-radius jets – read [papers](#), watched [summer school lectures](#)
- Technical jargon and acronyms – asked questions

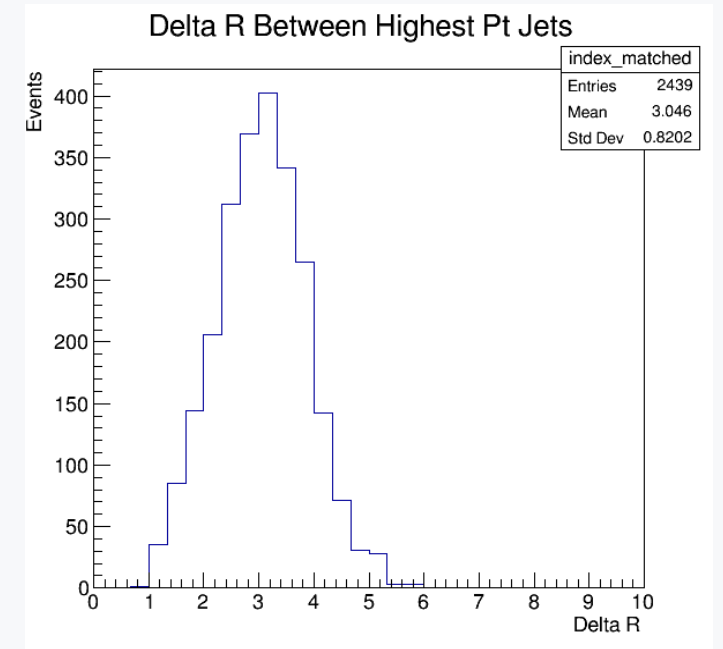
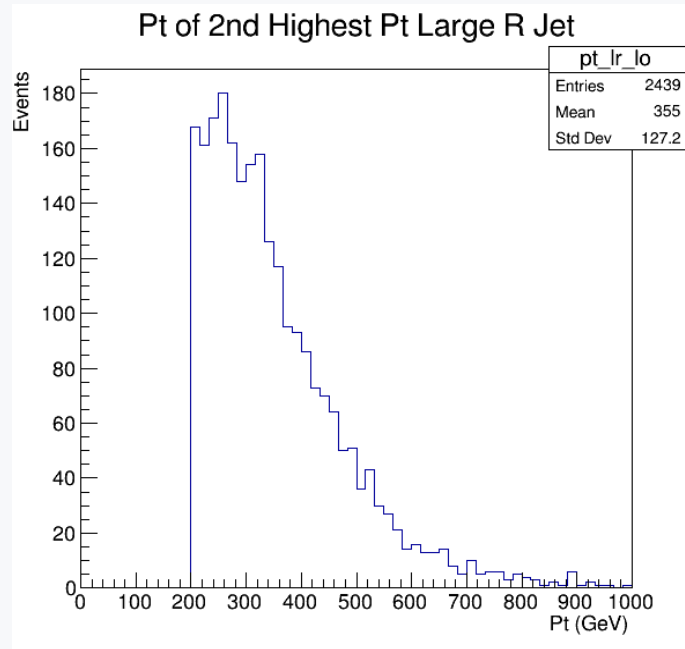
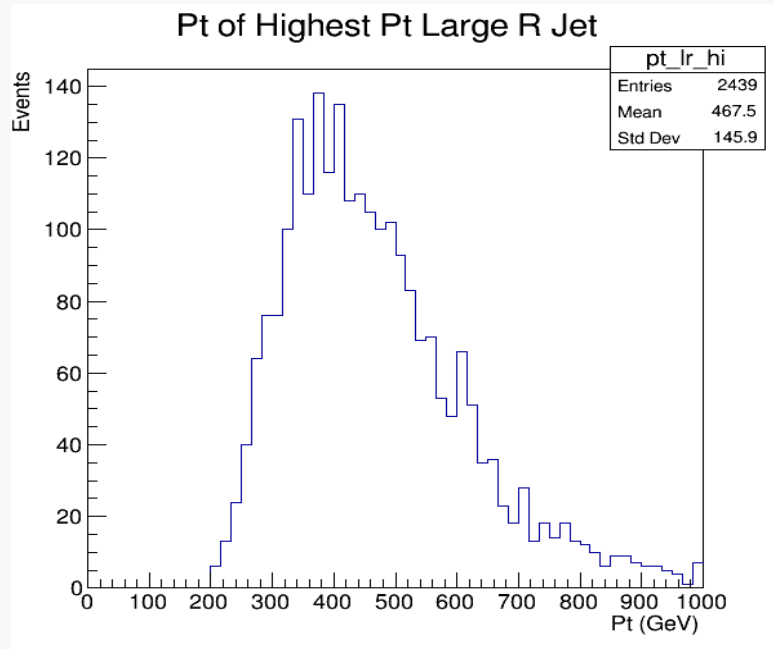
CONCLUSION

- Reconstructing chargino mass with large-radius jets works
- This channel is feasible for study
- Personally: developed data analysis skills, learned ROOT, revised theory behind experiment

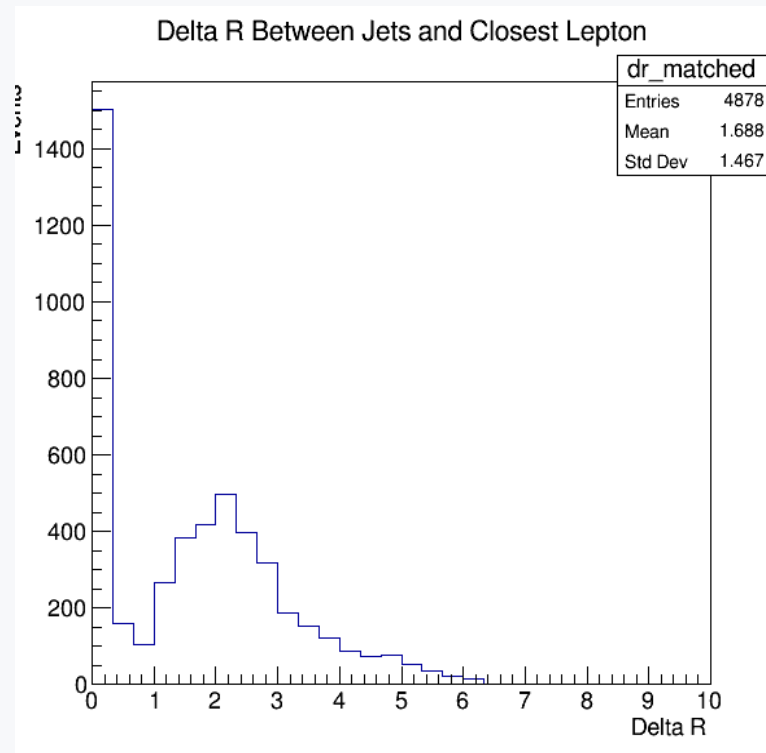
QUESTIONS?

BACKUP

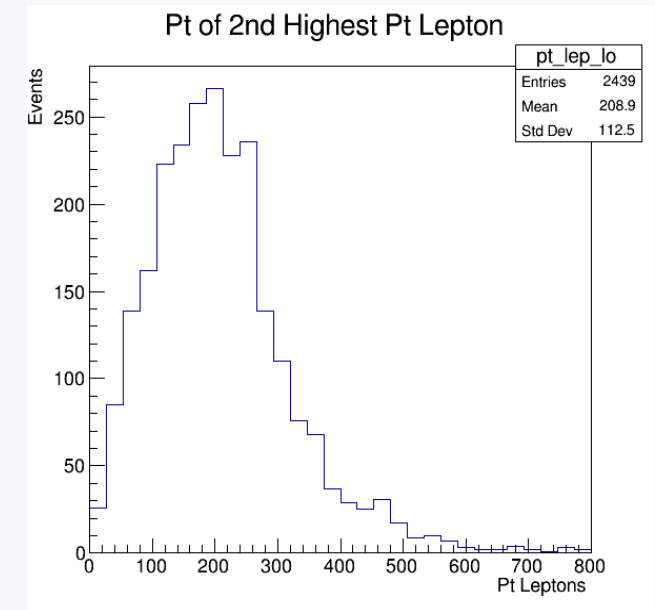
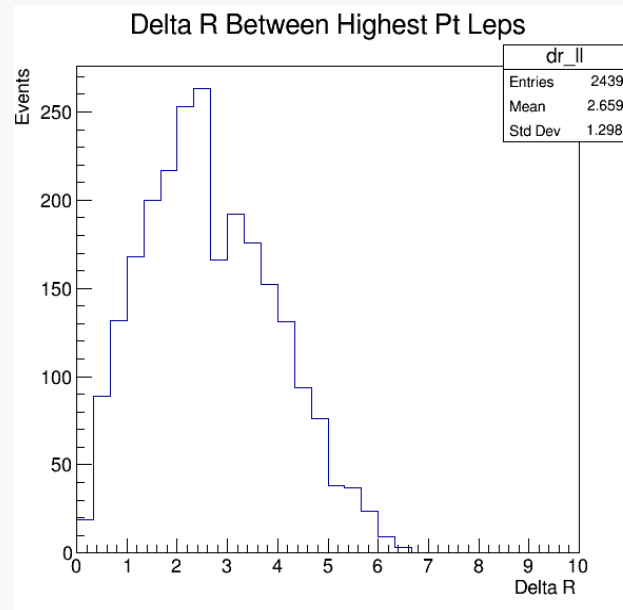
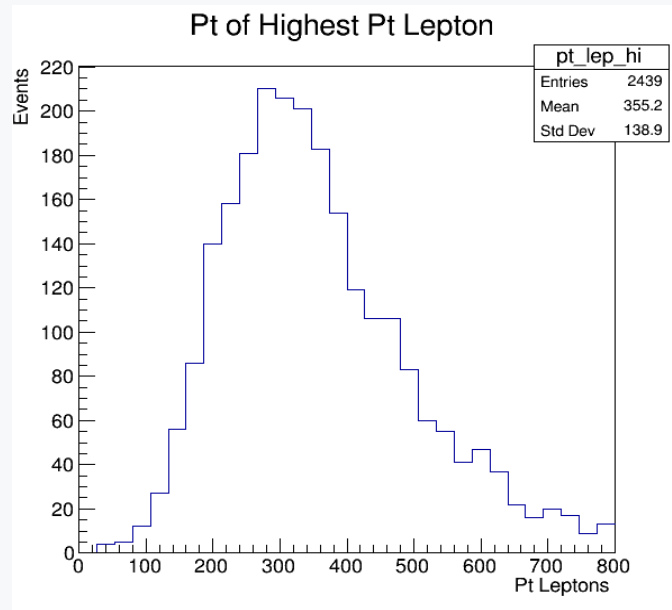
KINEMATICS - JETS



KINEMATICS - JETS

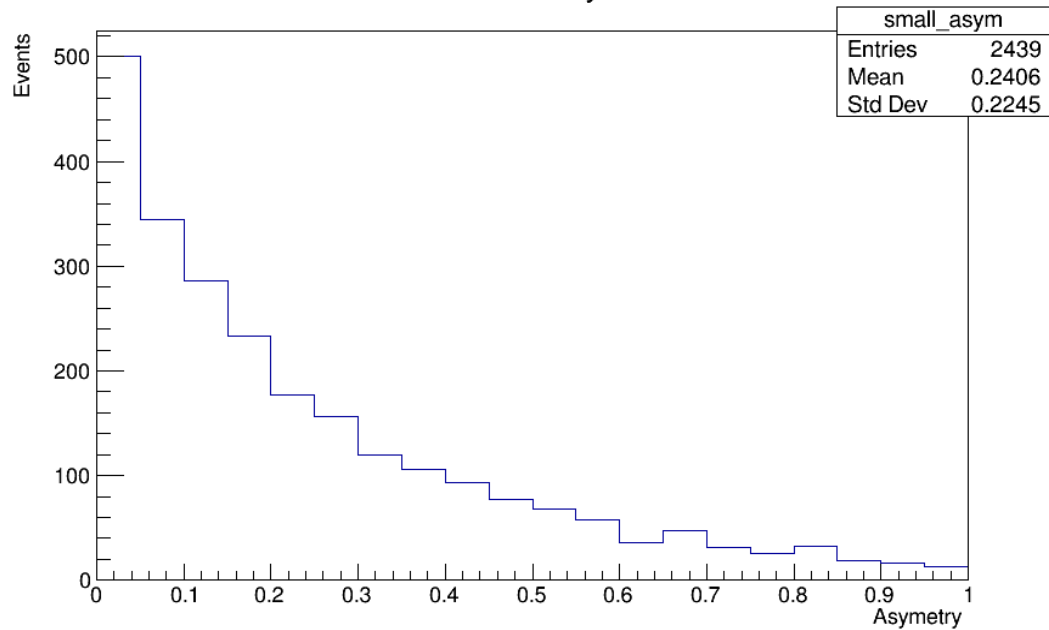


KINEMATICS - LEPTONS

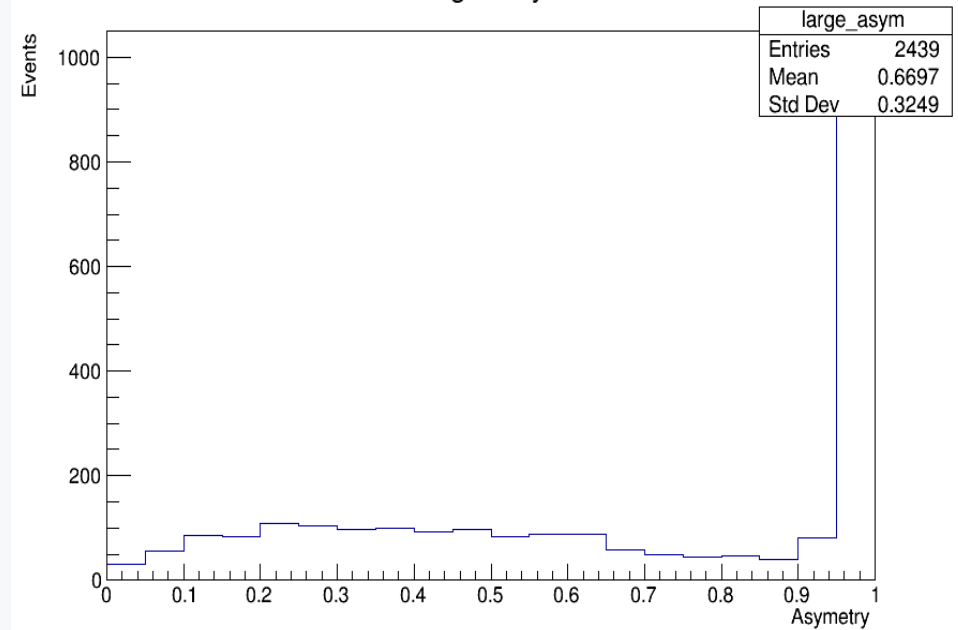


MASS ASYMMETRIES

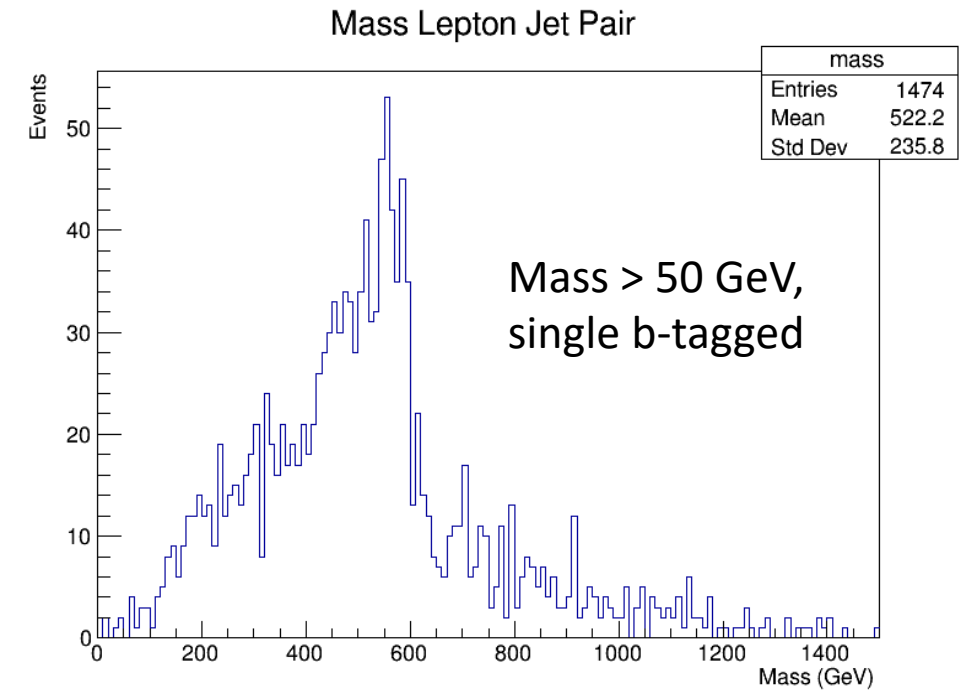
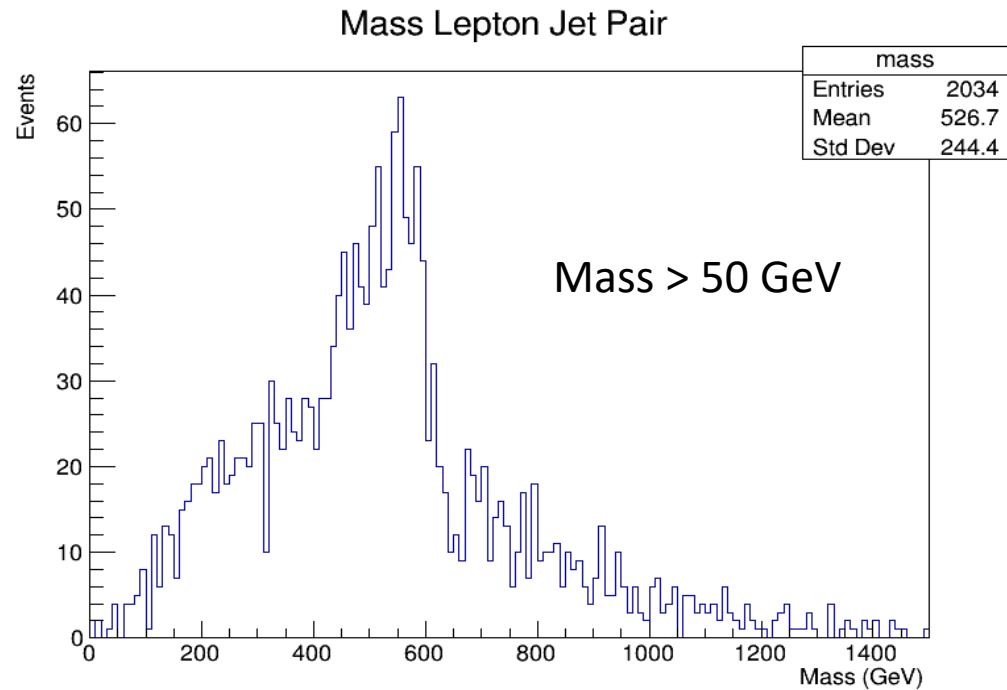
Smaller Asym



Larger Asym



MASS LEP + JET TAGGED



SINGLE TAG

