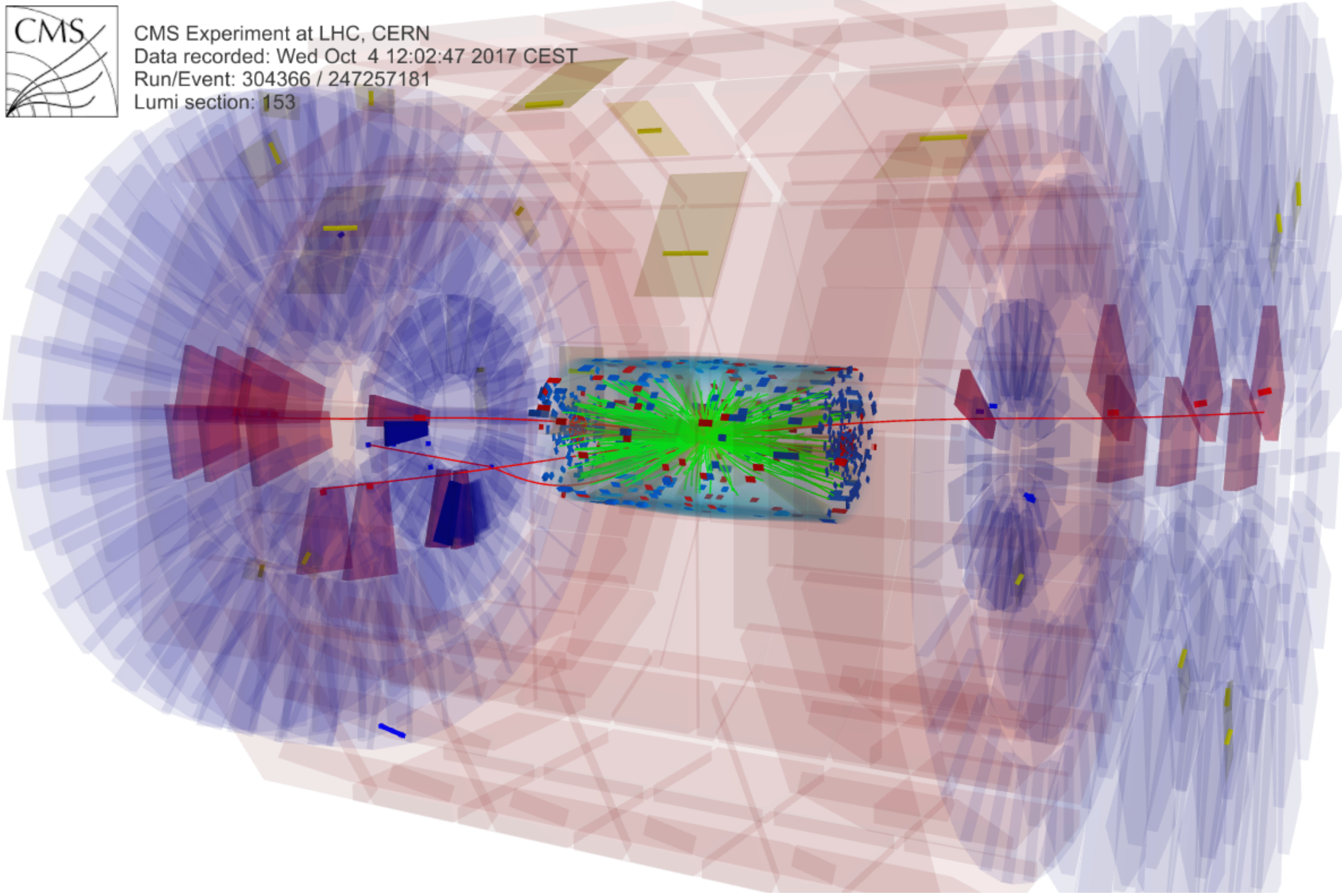
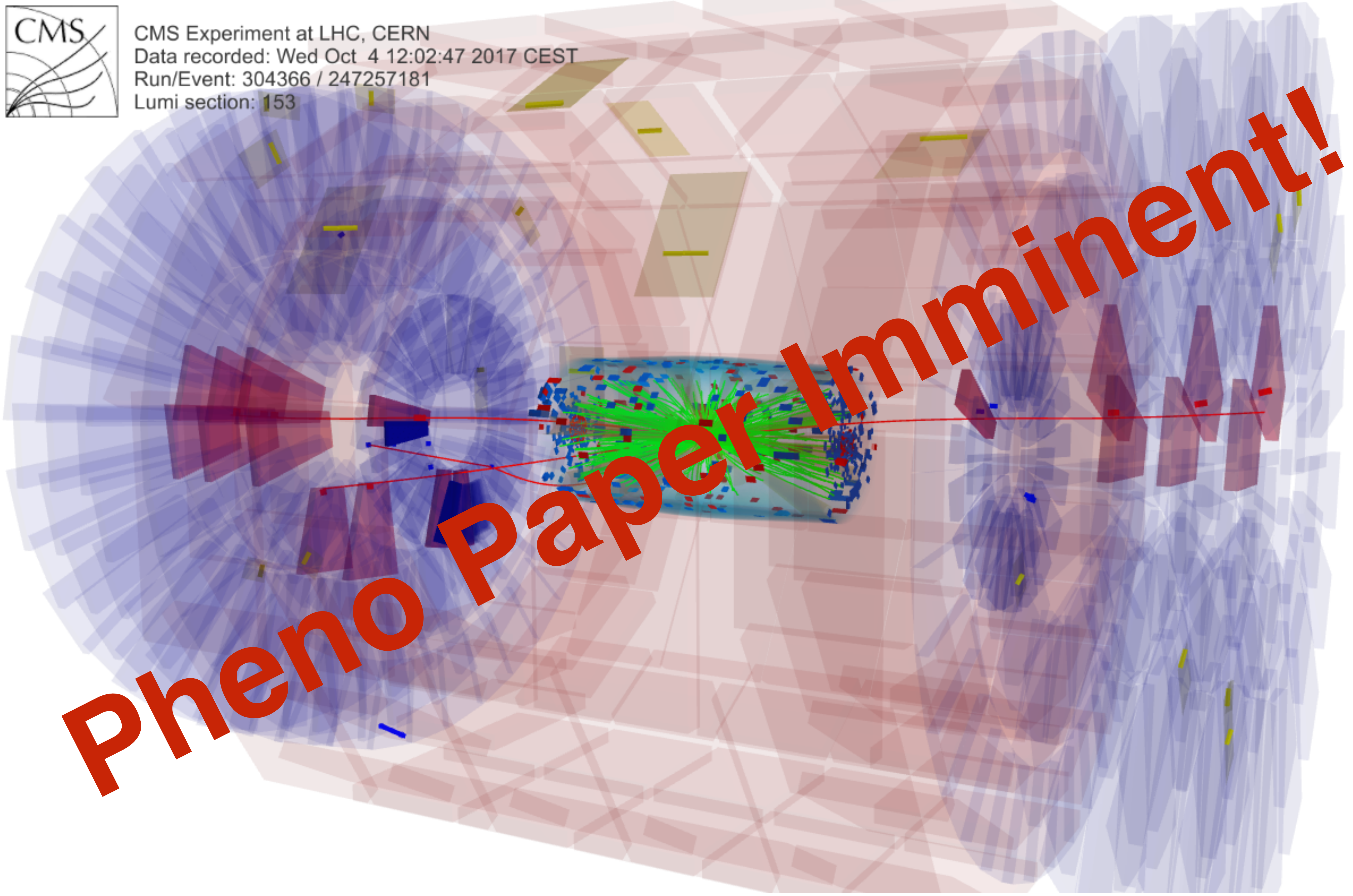


Searches for NMSSM Signatures with Low Missing E_T at the CMS Detector

Alexander Titterton

NMSSM Workshop, Montpellier, 2018

University of BRISTOL
UNIVERSITY OF Southampton
Science & Technology Facilities Council Rutherford Appleton Laboratory
NEXT



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$$NLSP \rightarrow \text{Higgs} \; + LSP$$
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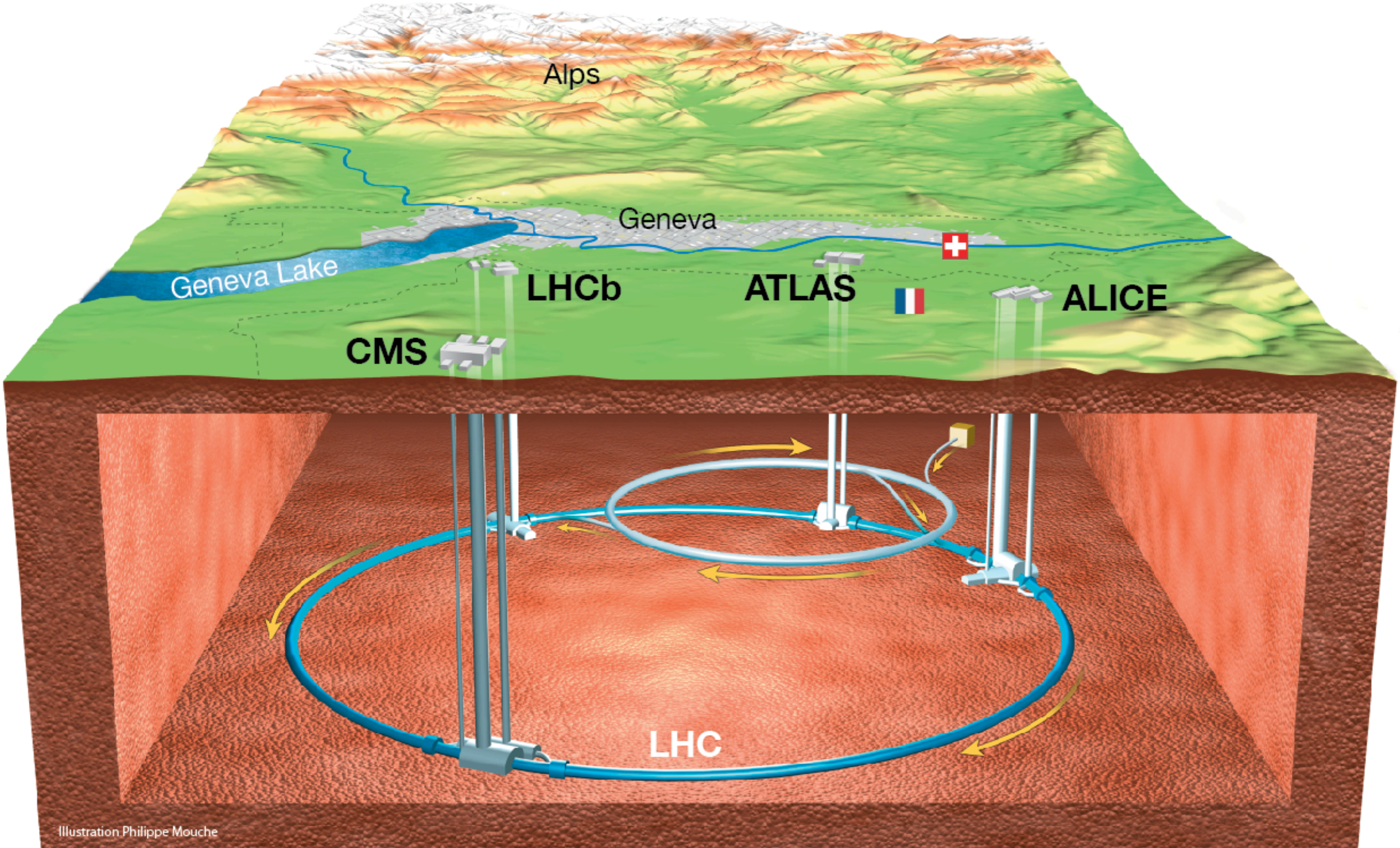
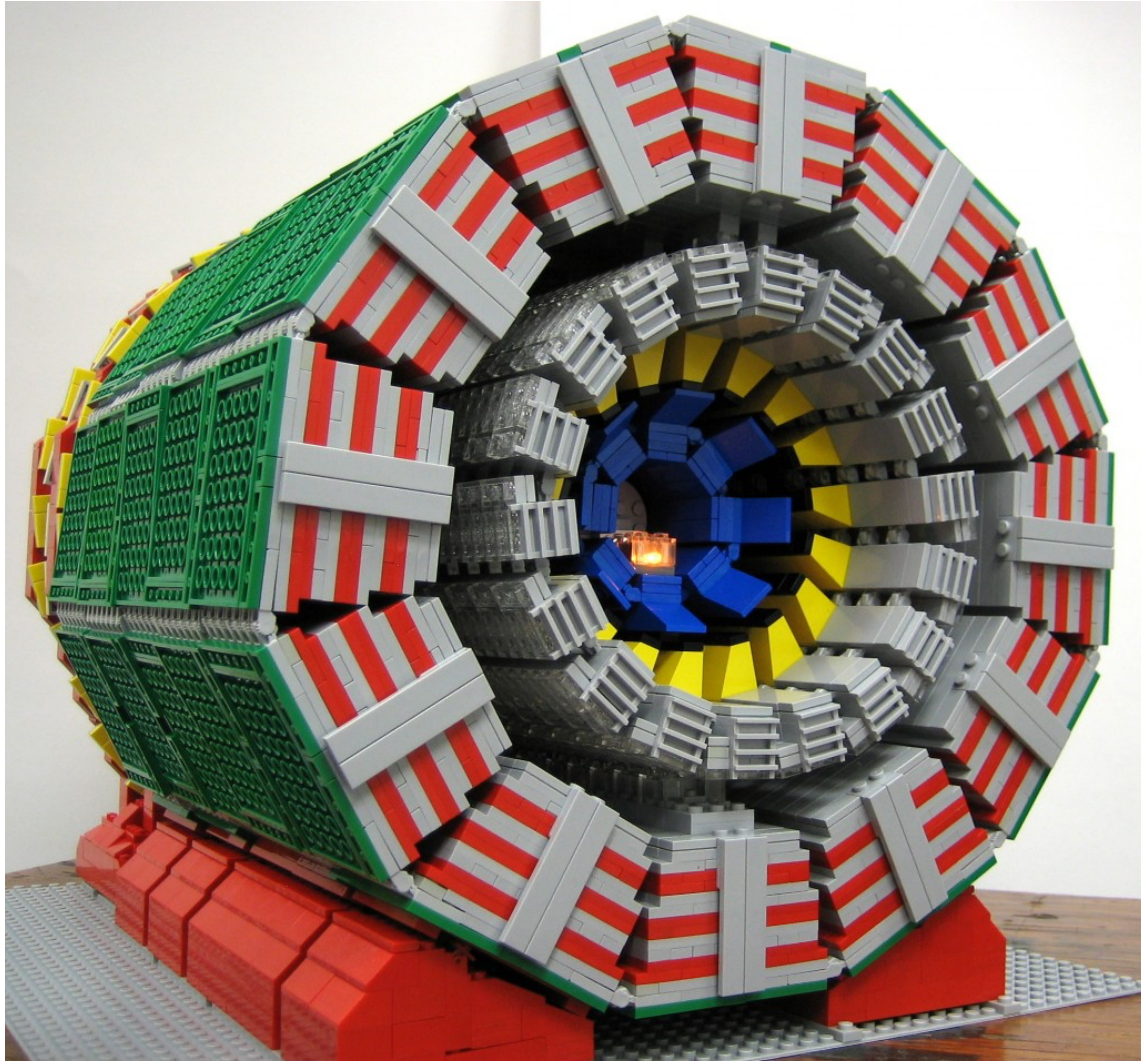
- Looking at p p --> squarks, gluinos in initial state.

- Want to turn this into experimental analysis.


Alps
Geneva
Geneva Lake
LHCb
ATLAS
ALICE
CMS
LHC
Illustration Philippe Mouche

Propaganda

Propaganda



- Fig. 1: The CMS detector

Propaganda

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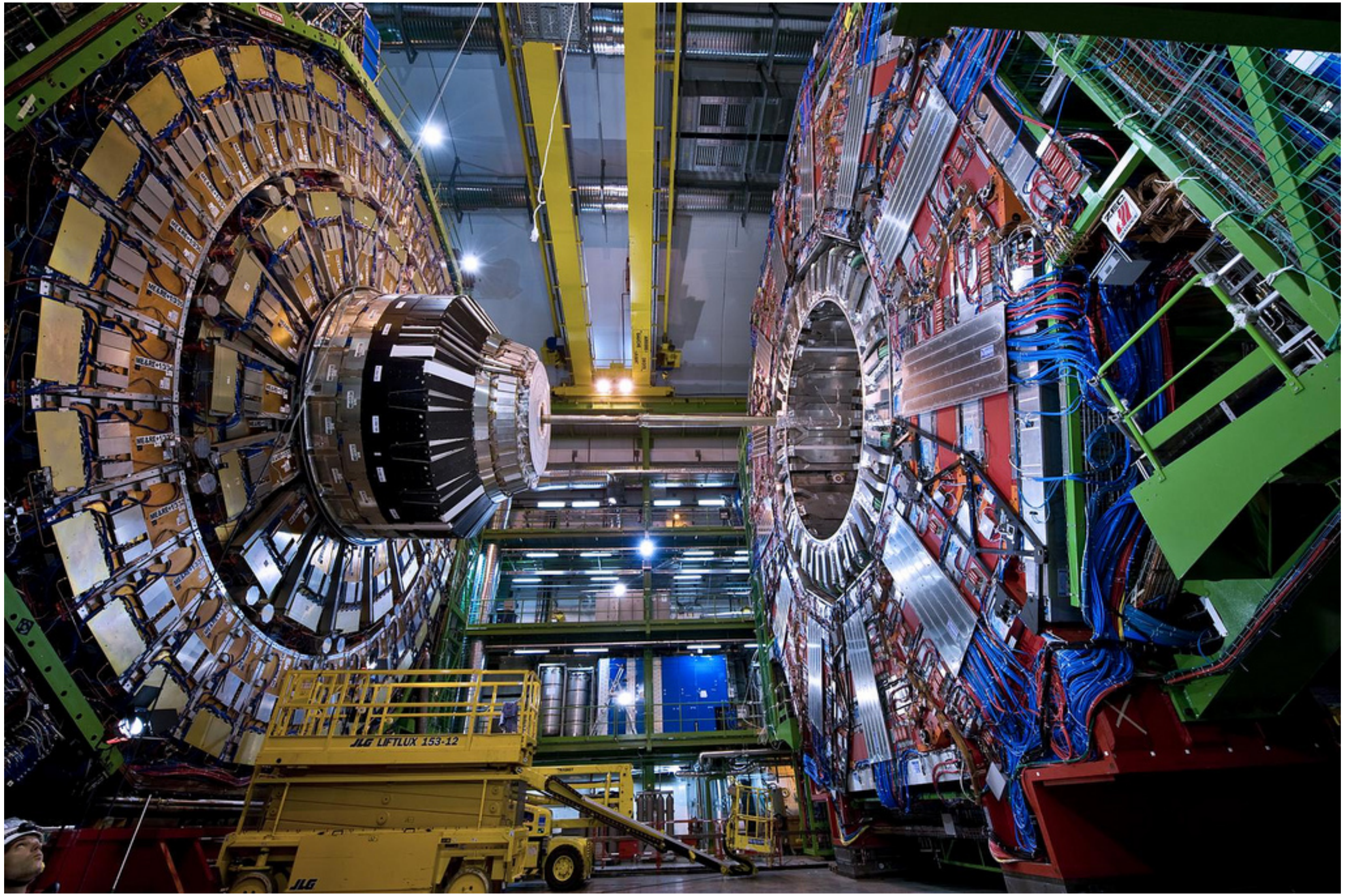

- Fig. 2: Oversized novelty version for outreach purposes

Simulation Tools

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- Decay/shower particles using Pythia 8.
- Simulate the detector measurements using Delphes.

Simulation

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- Benchmark points: (From Arxiv:1412.6394)

	$M_{\tilde{q}}$ [GeV]	$M_{\tilde{g}}$ [GeV]	$M_{\tilde{t}}$ or $M_{\tilde{b}}$ [GeV]	σ [pb]
P1	1000	1010	decoupled	~ 1.362
P2	1400	1410	decoupled	~ 0.1377
P3	1100	900	decoupled	~ 2.312
P4	1500	1300	decoupled	~ 0.2018
P5	1400	1410	$M_{\tilde{t}} = 750$	~ 0.1378
P6	1100	1110	$M_{\tilde{b}} = 750$	~ 0.737
P7	1500	1300	$M_{\tilde{t}} = 750$	~ 0.202
P8	1400	1200	$M_{\tilde{b}} = 750$	~ 0.3577

Cut & Count Analysis

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- Depending on the shape of the resulting plots we can then see whether the efficiency of the cuts or the cross-section dominates.

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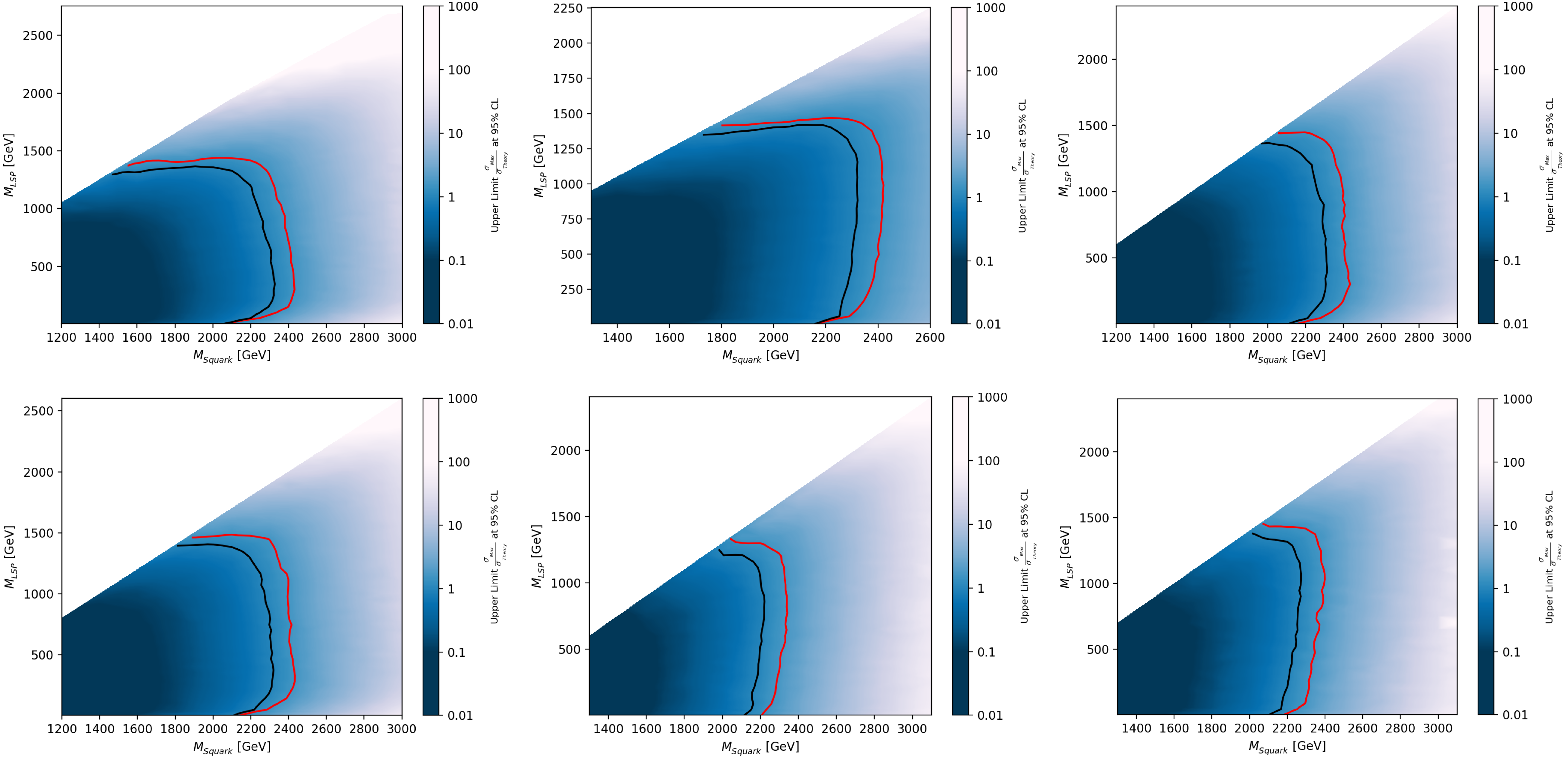
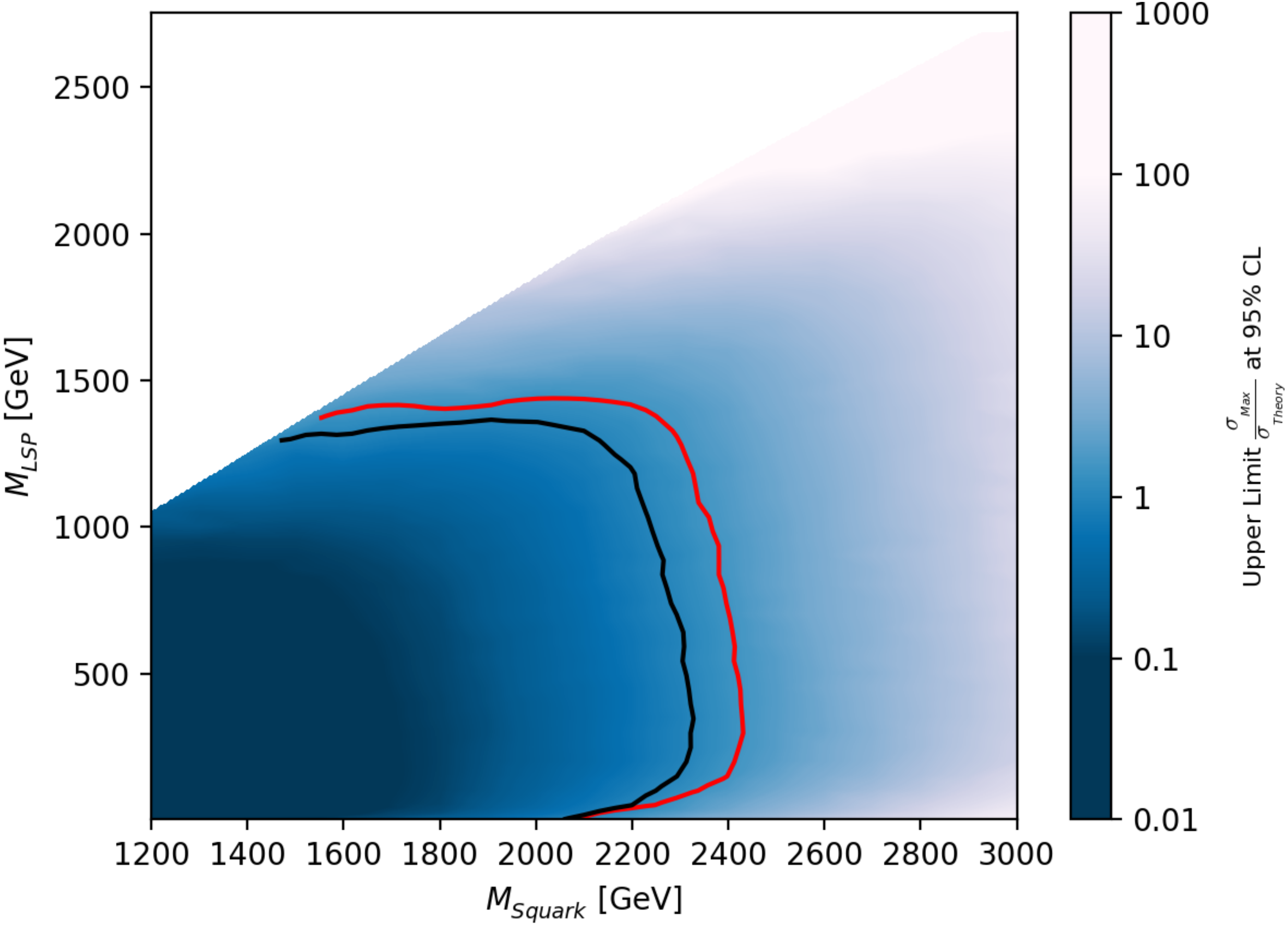
Simulation



M_{LSP} [GeV]
M_{Squark} [GeV]
Upper Limit $\frac{\sigma_{Max}}{\sigma_{Theory}}$ at 95% CL
1000
100
10
1
0.1
0.01
2500
2000
1500
1000
500
2250
1750
1250
750
250
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000



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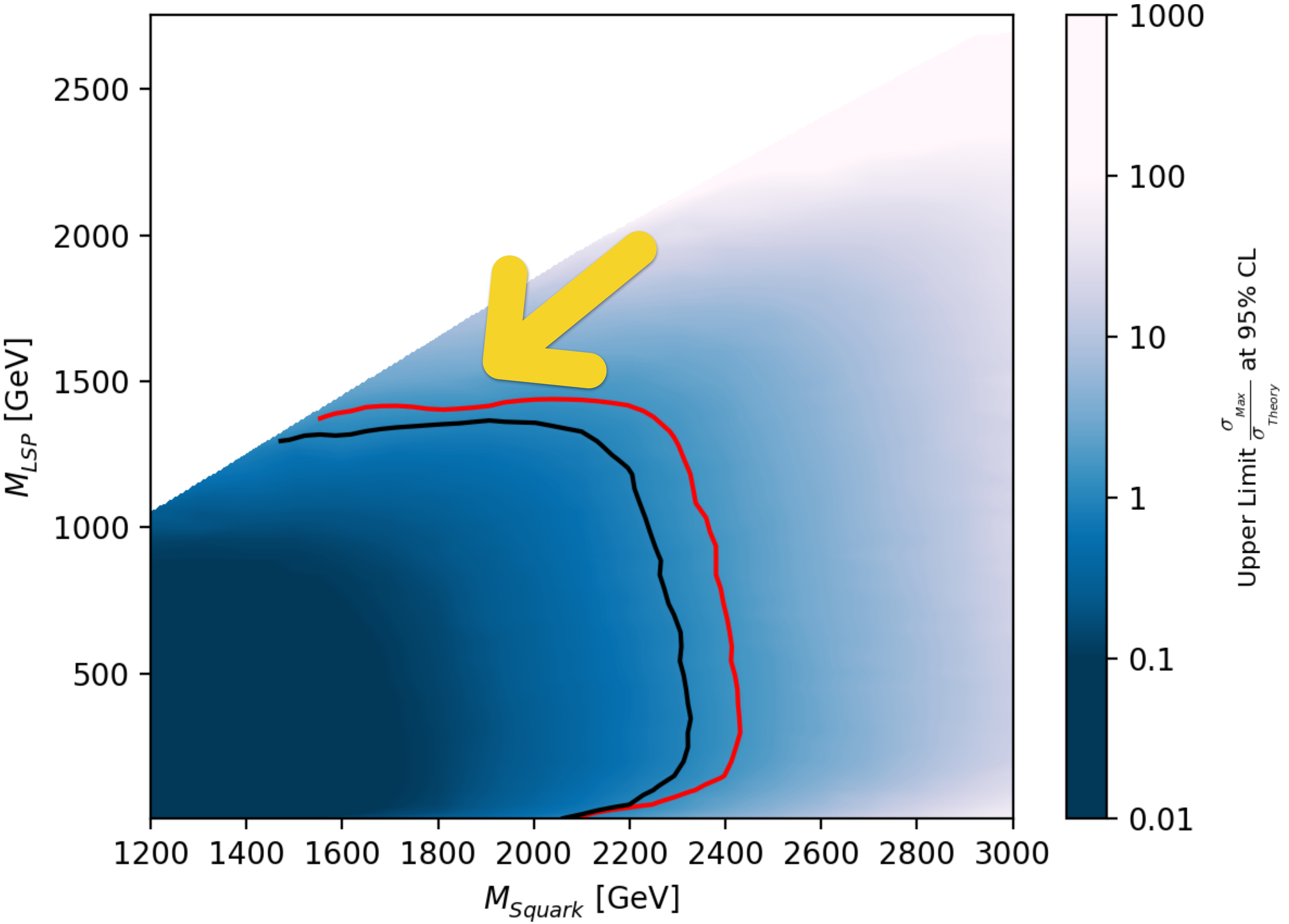
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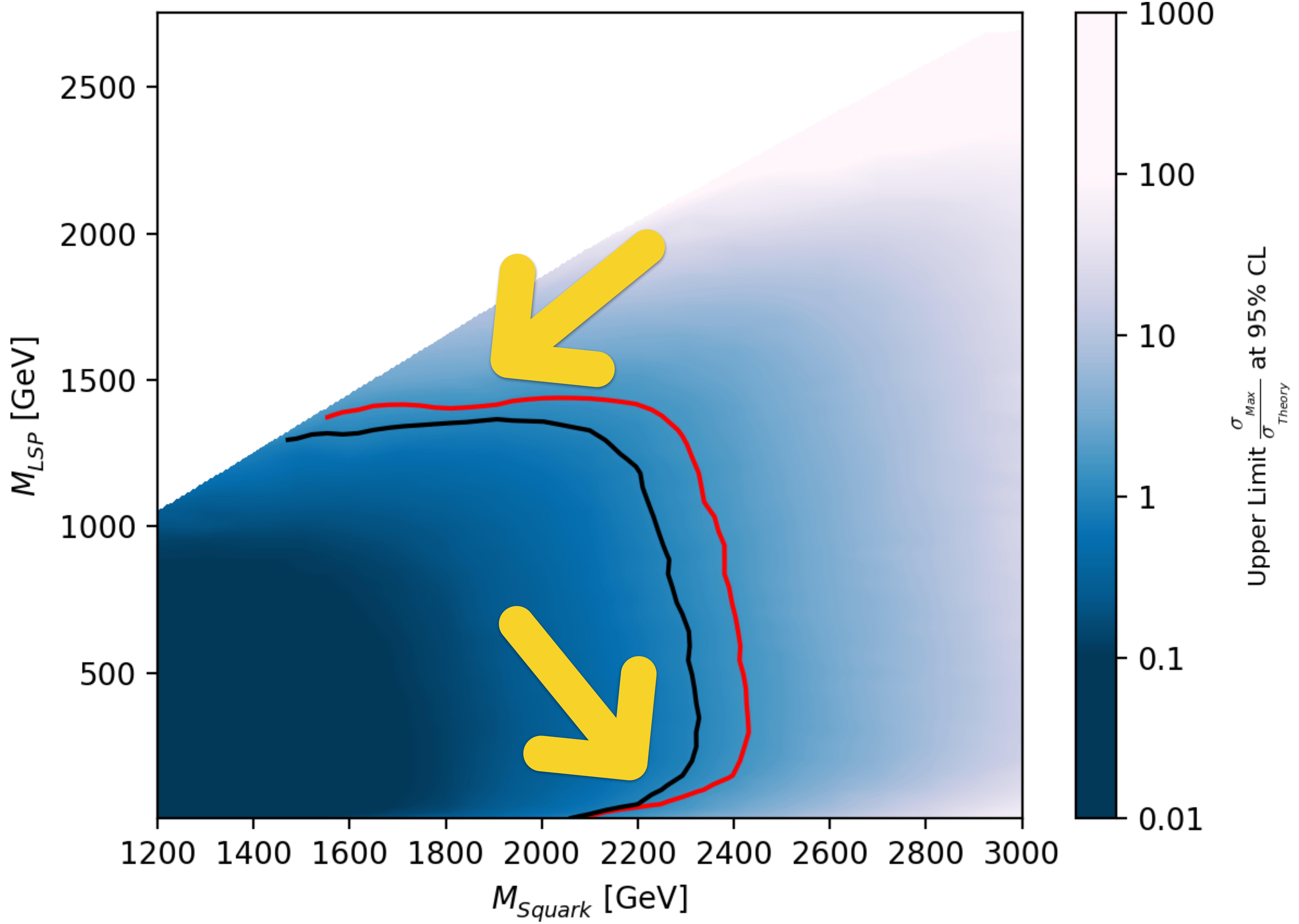

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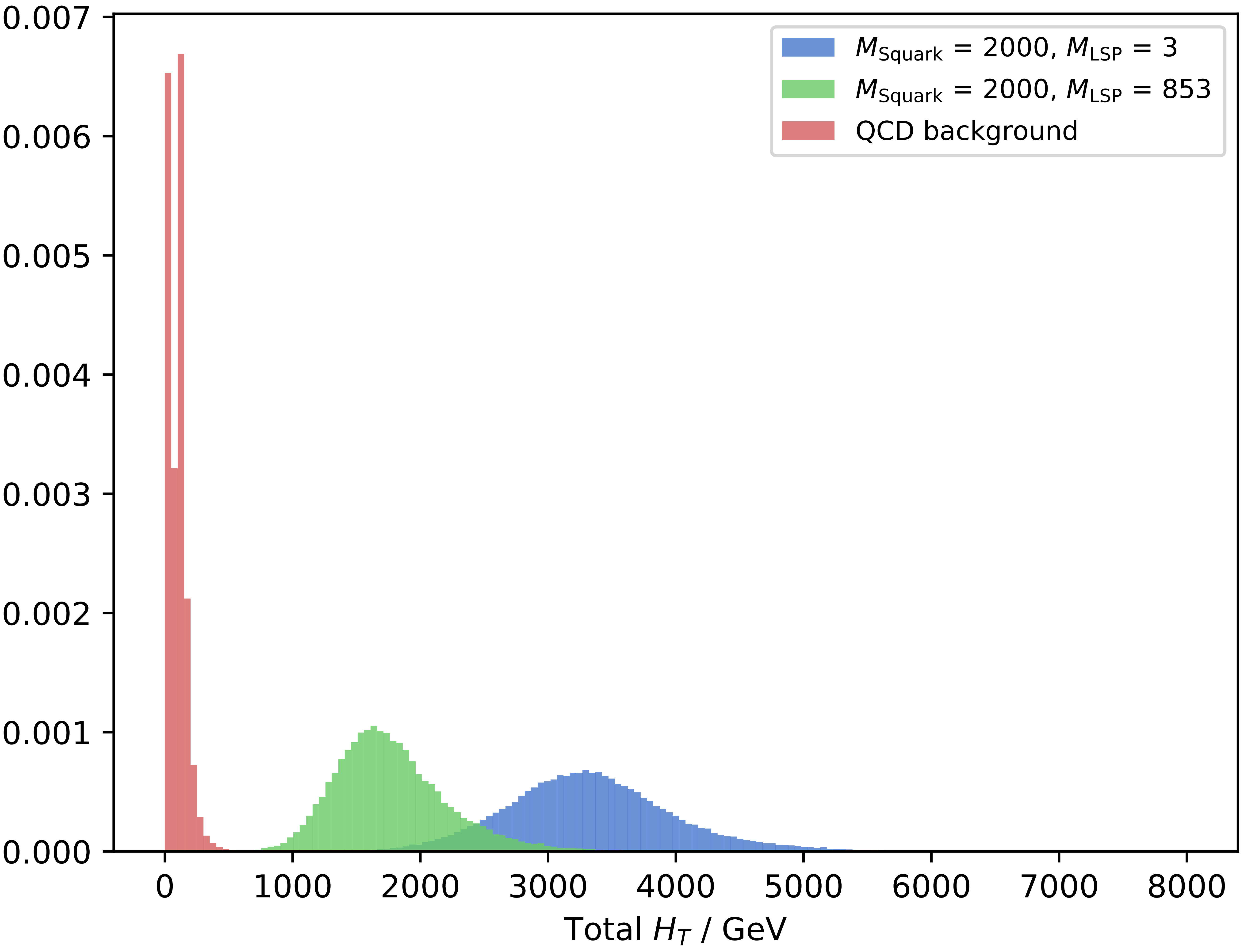
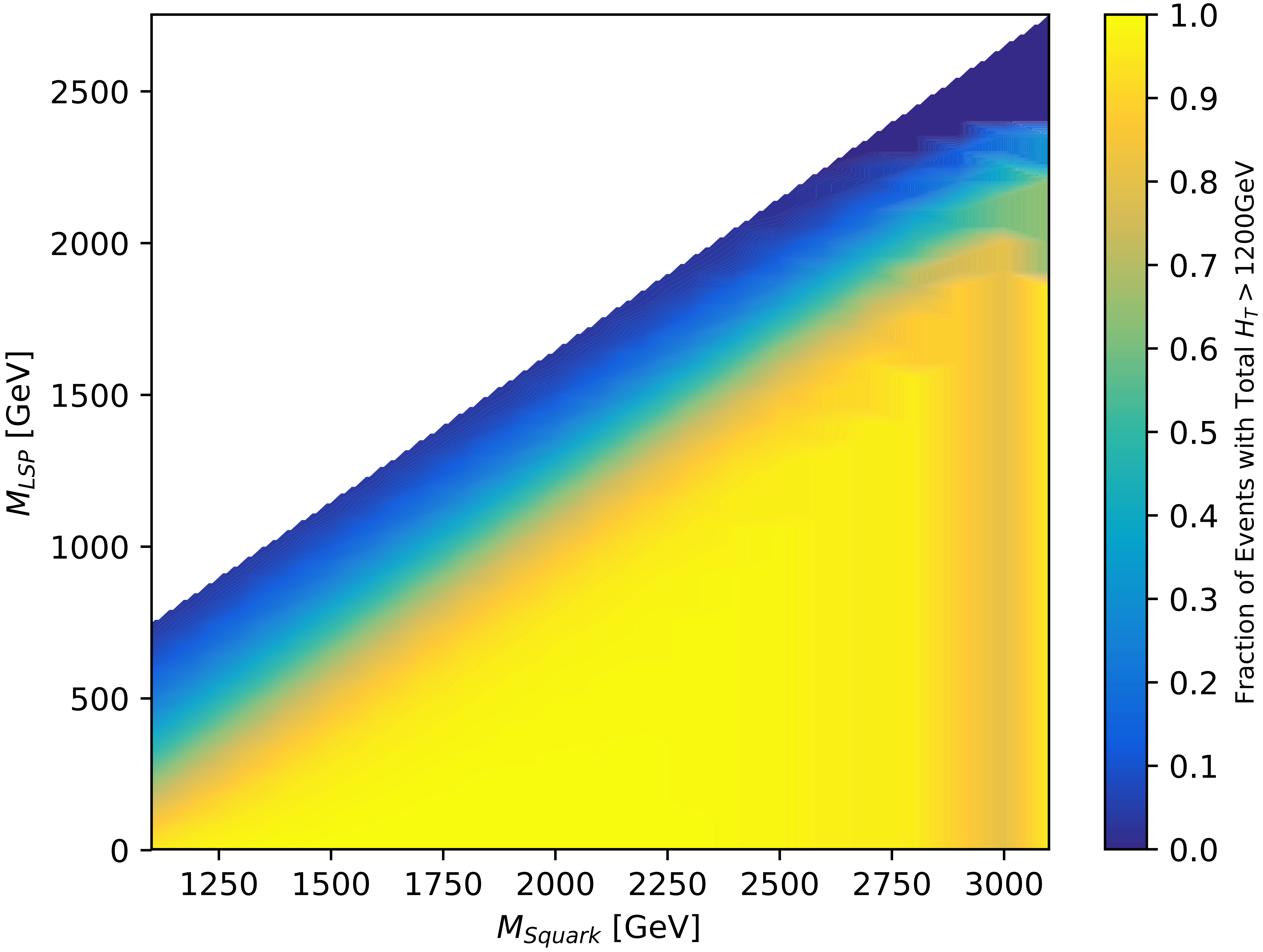
Signal Properties





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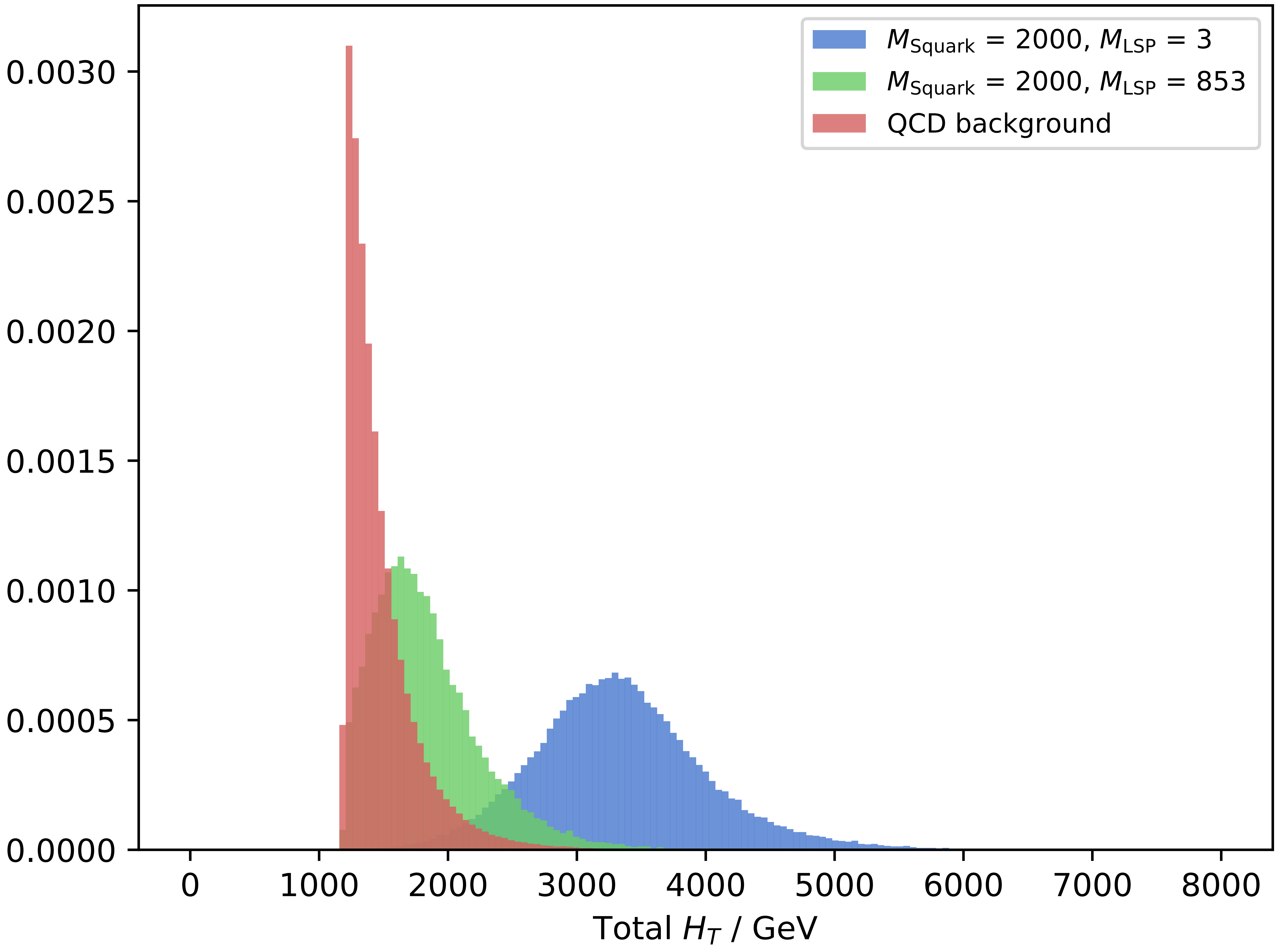

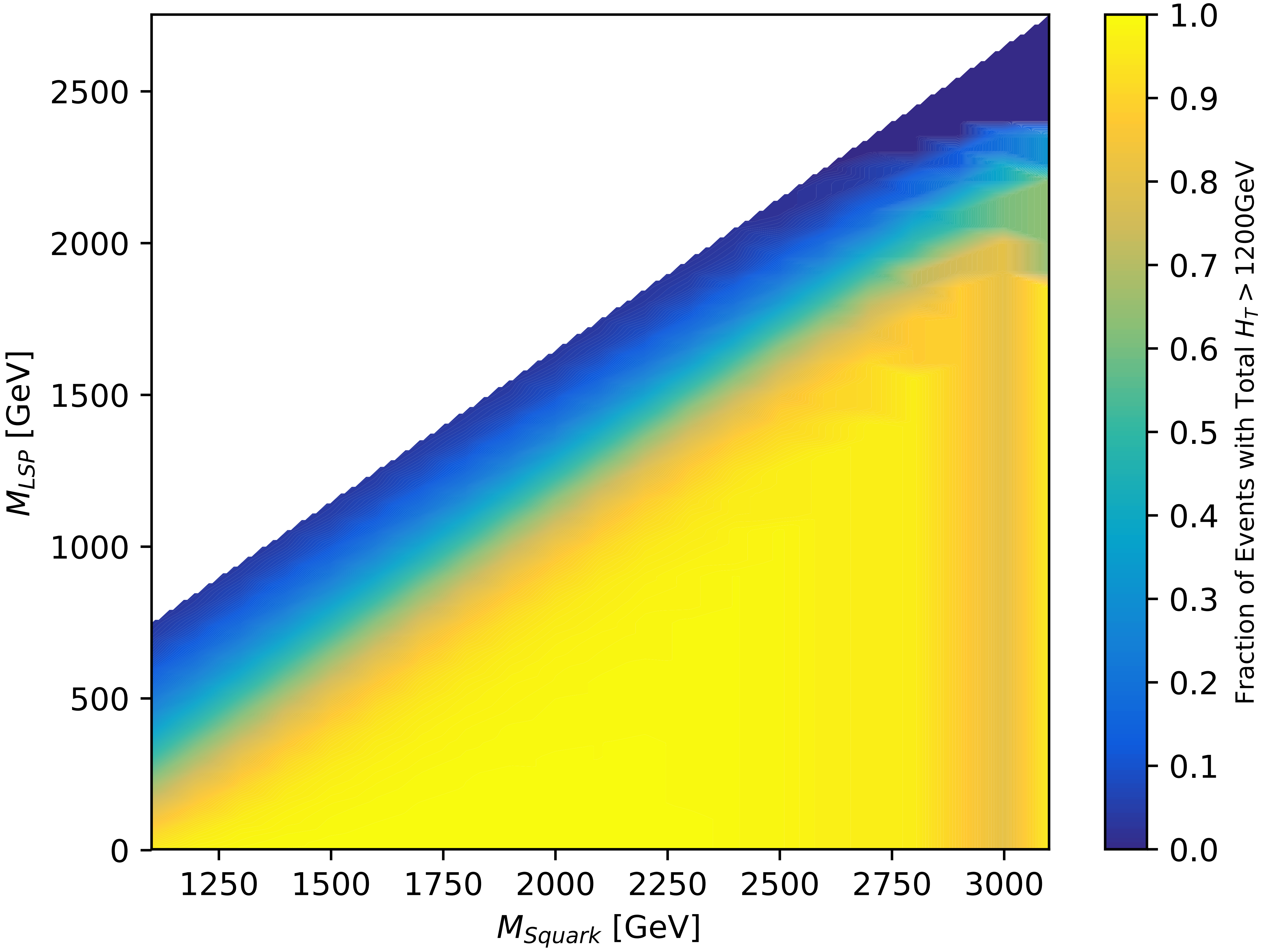

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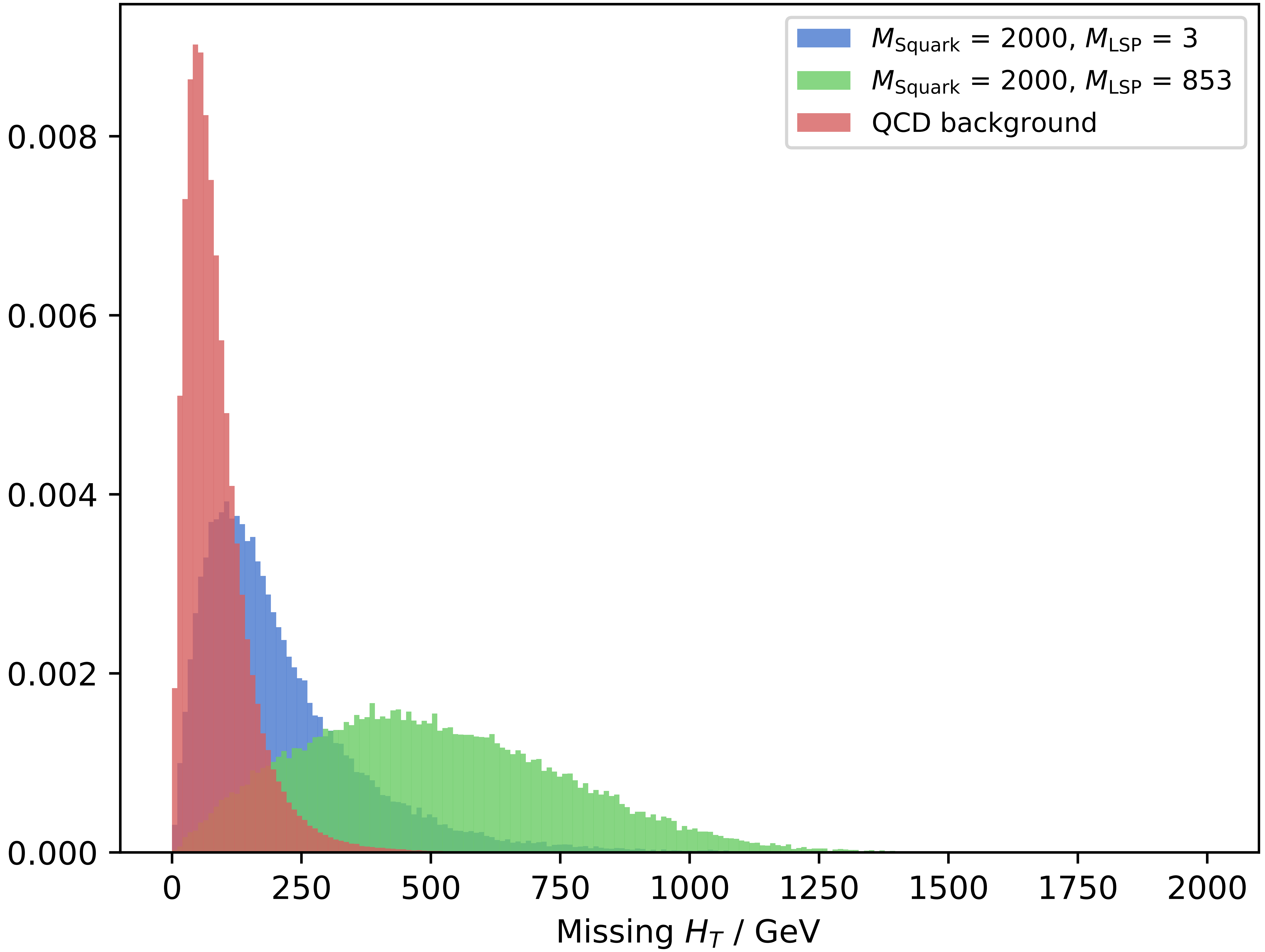

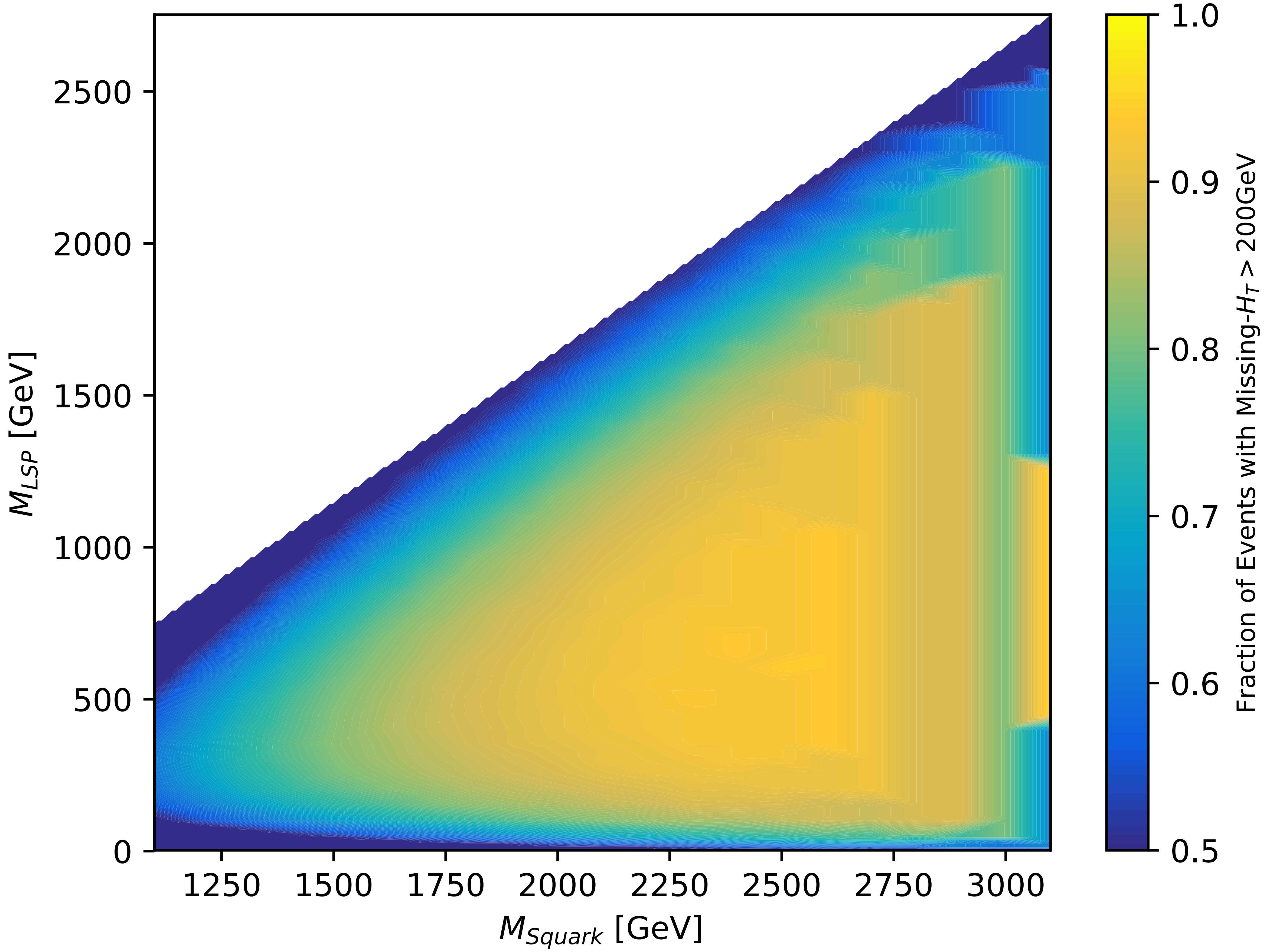

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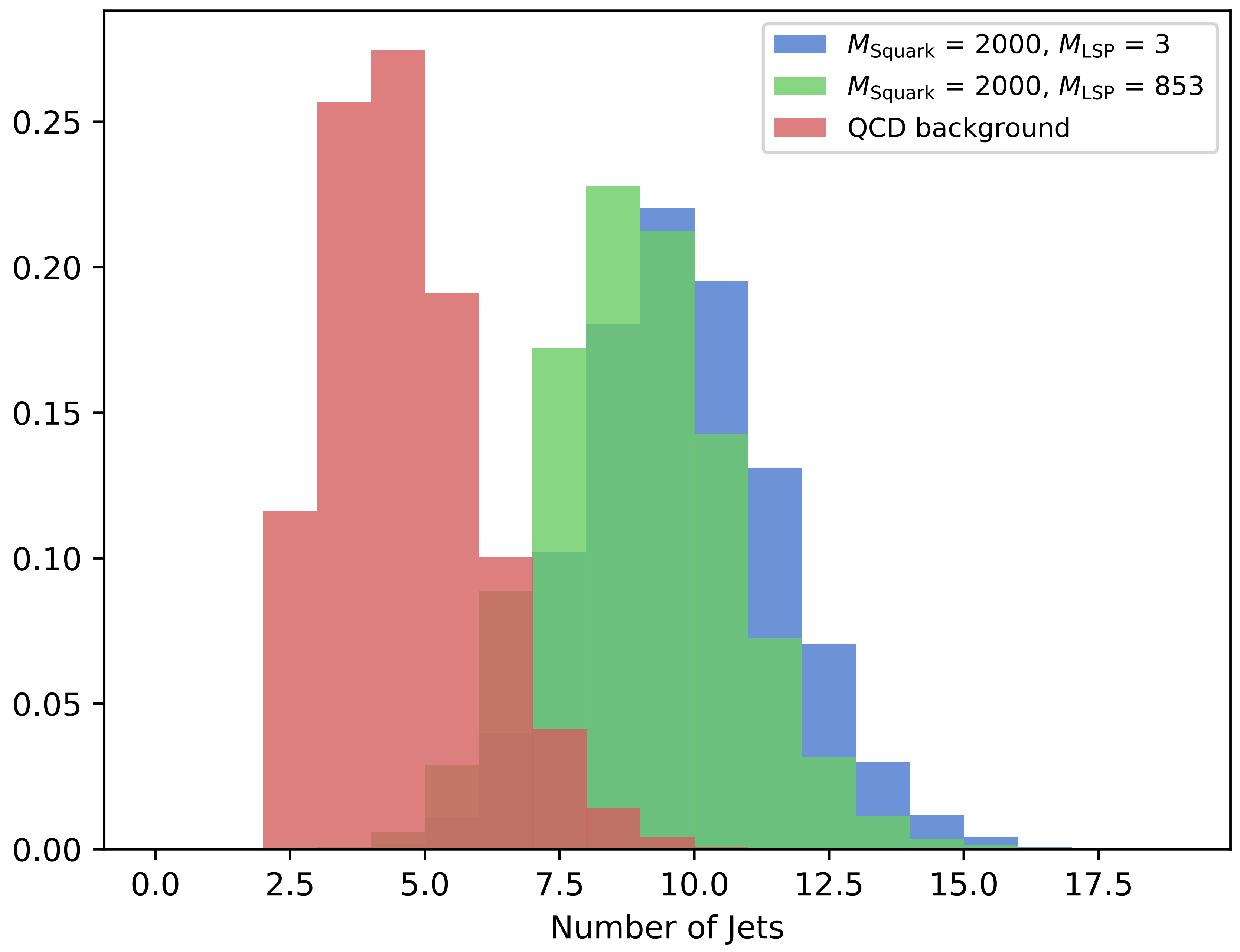

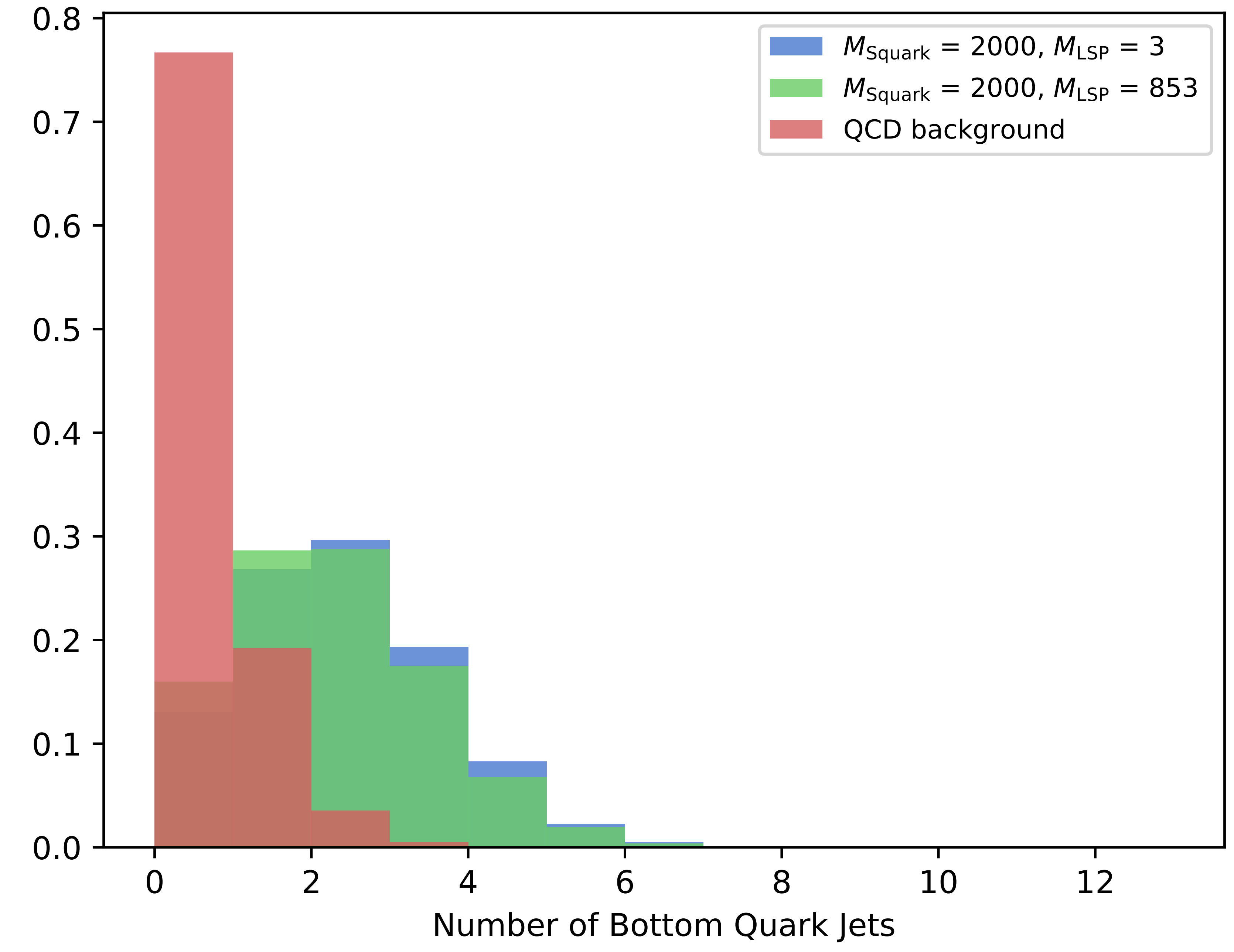

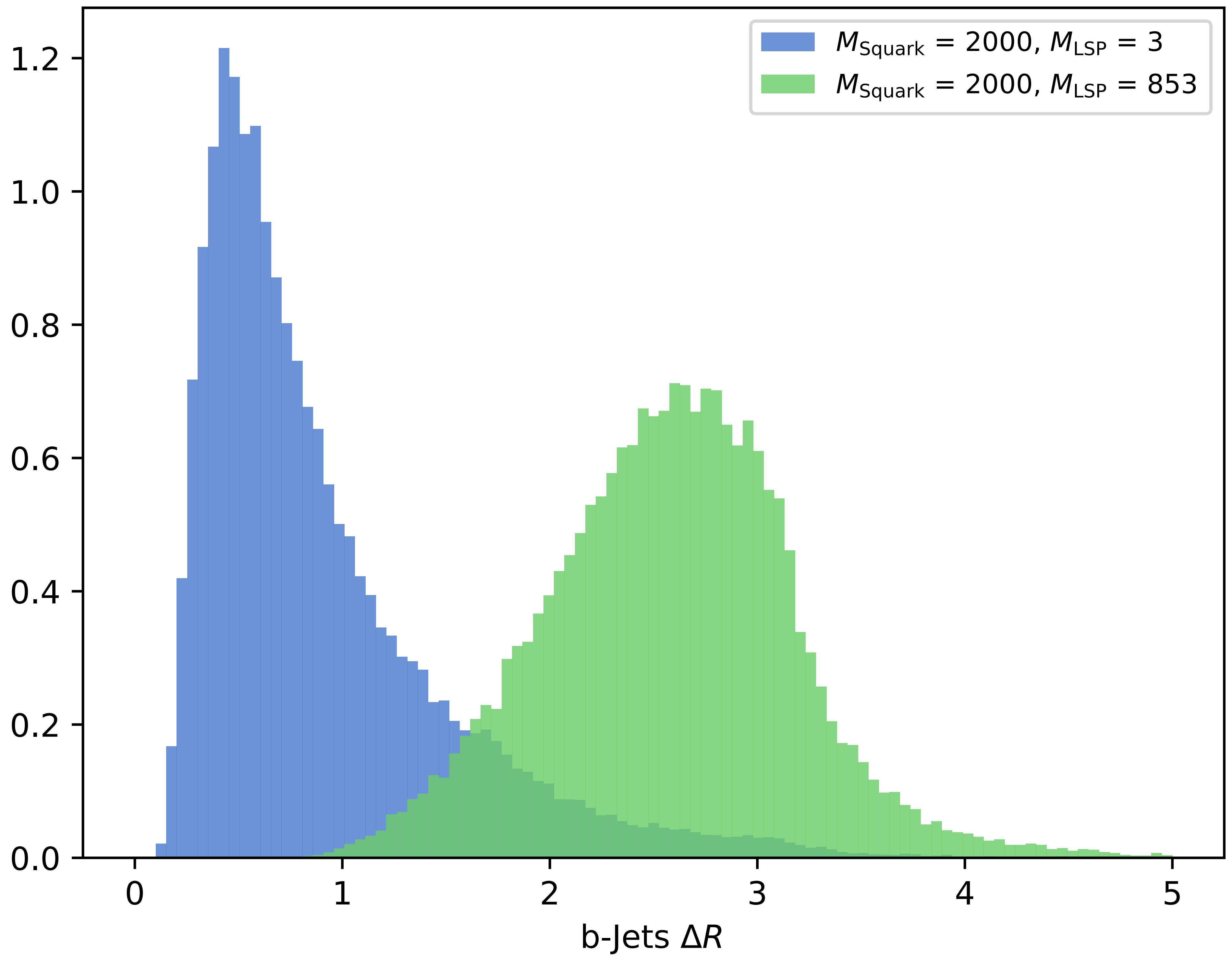

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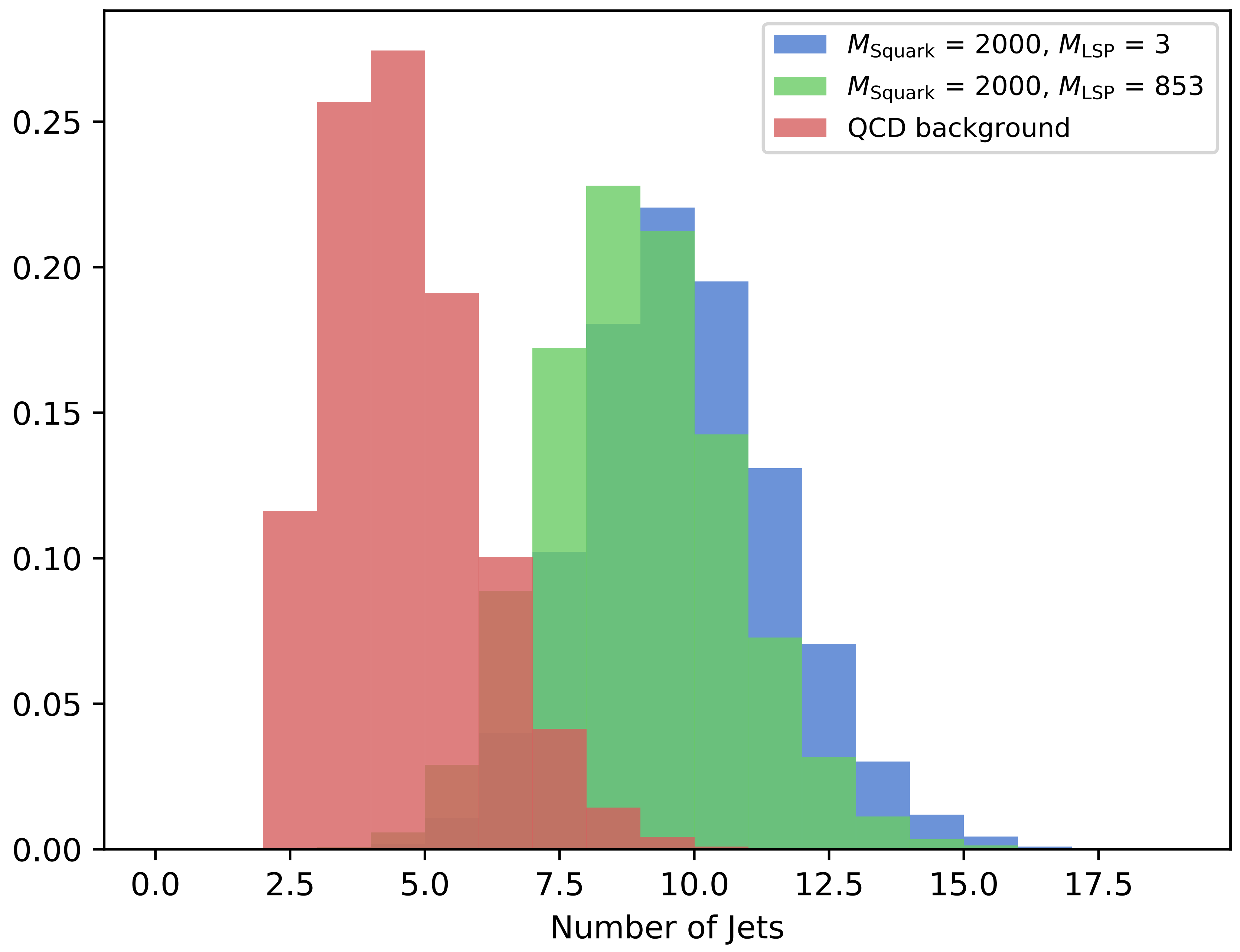

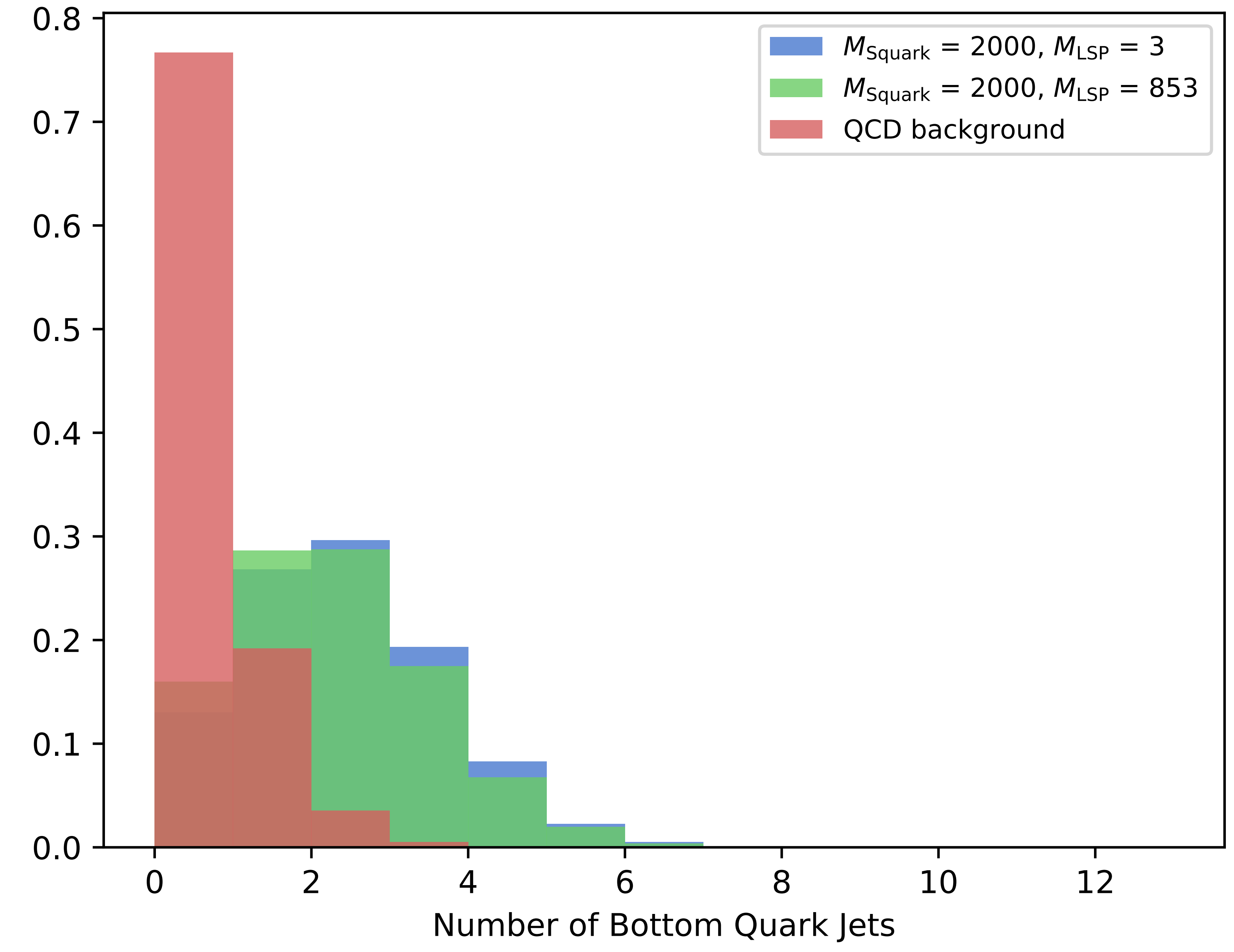

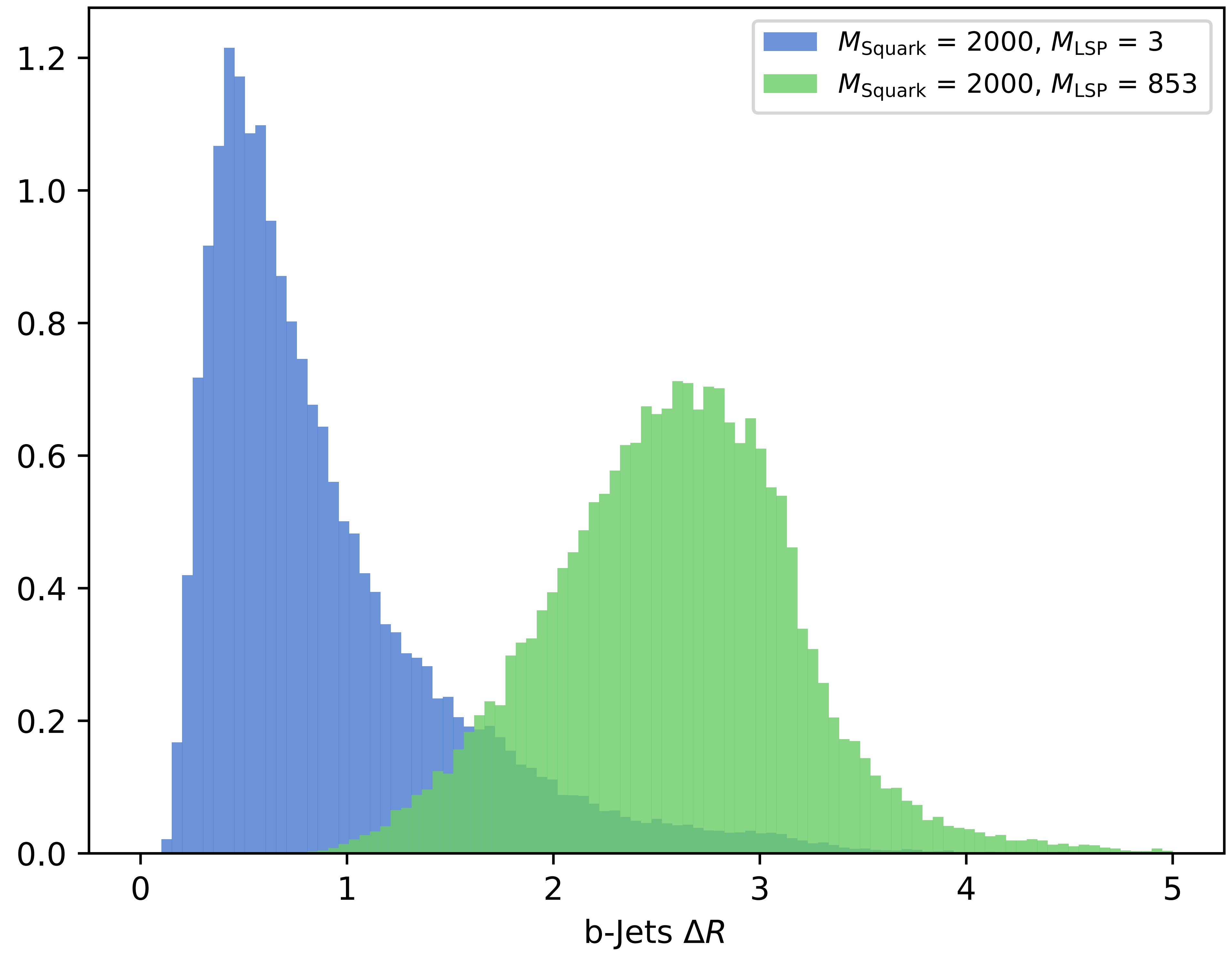

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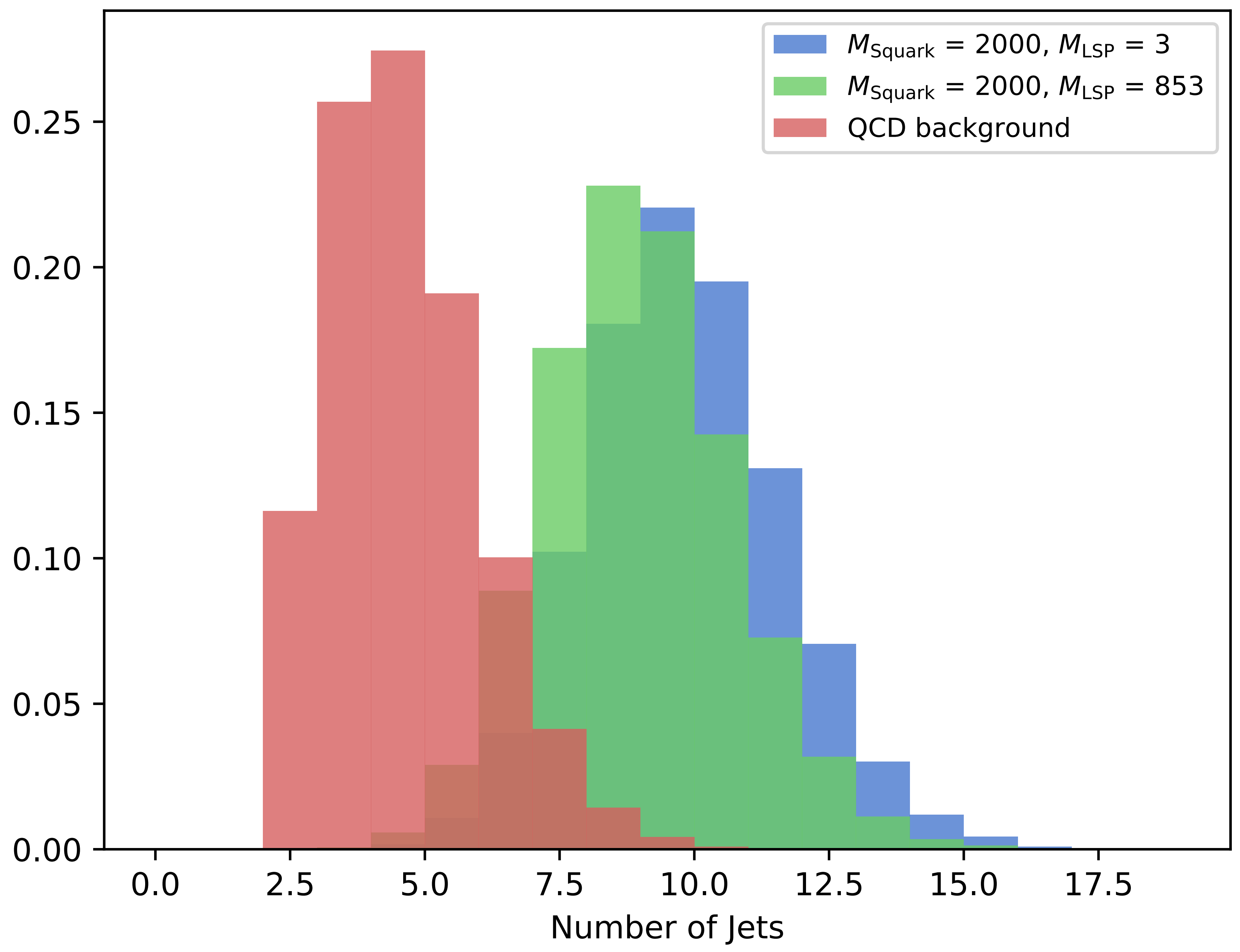

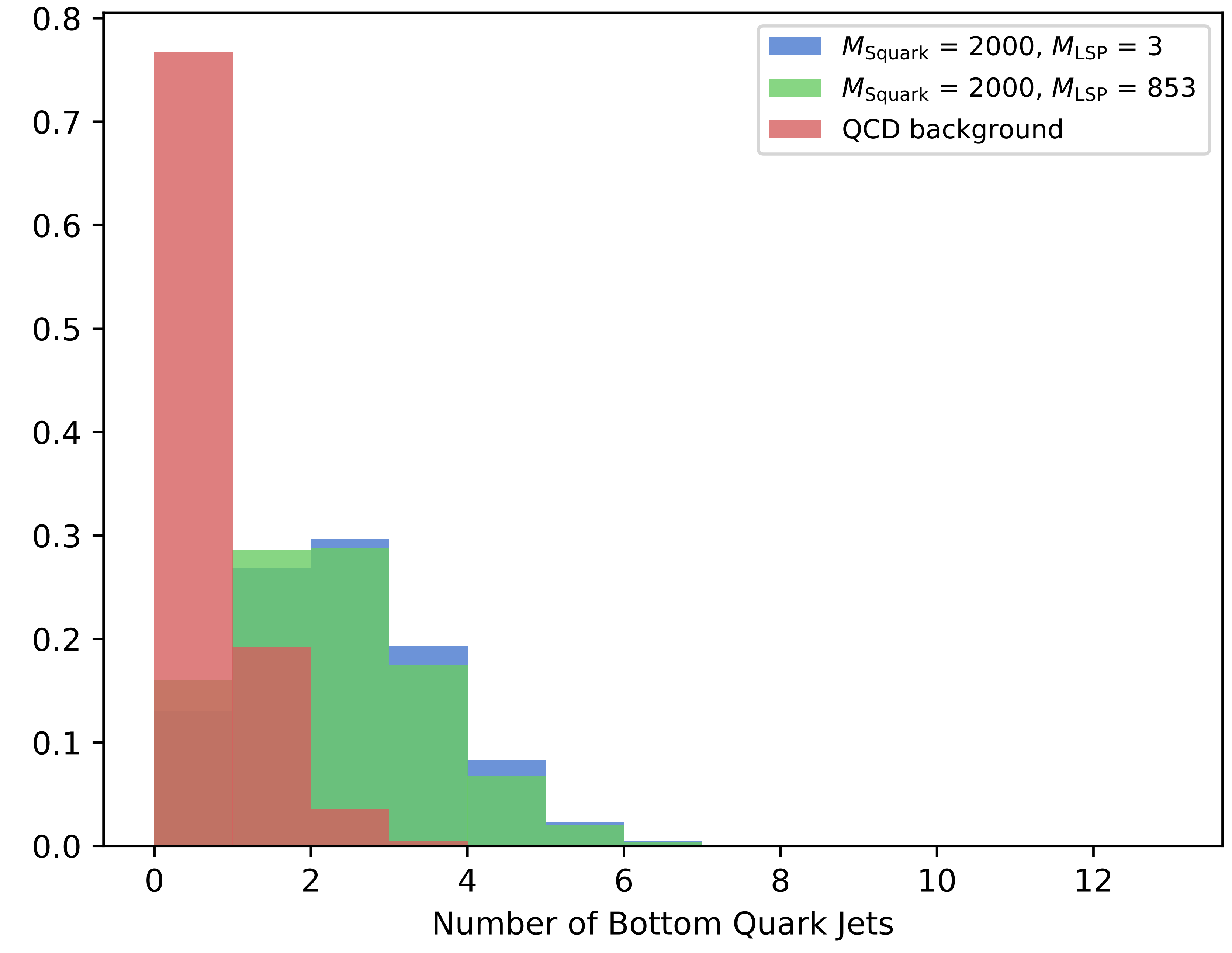

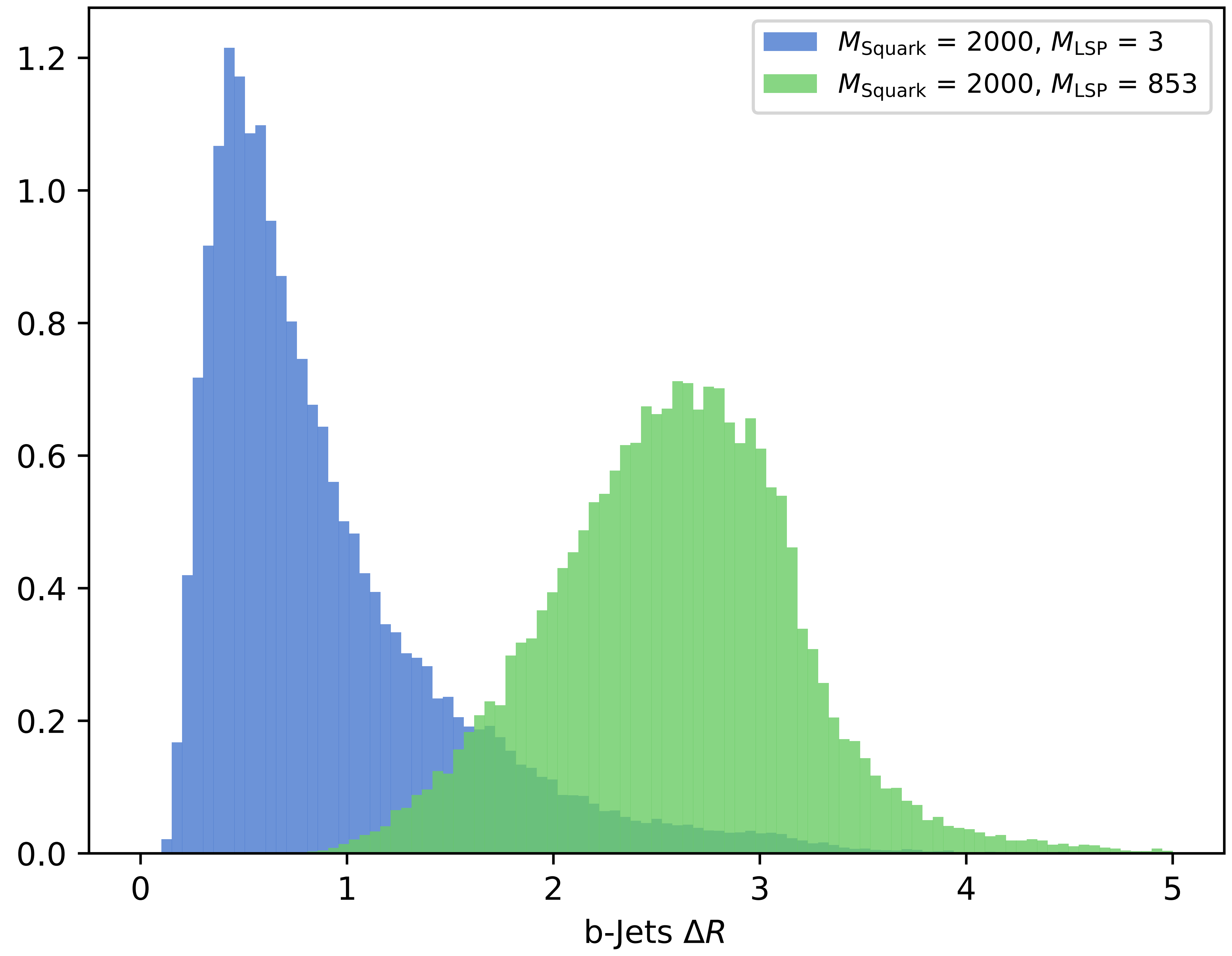

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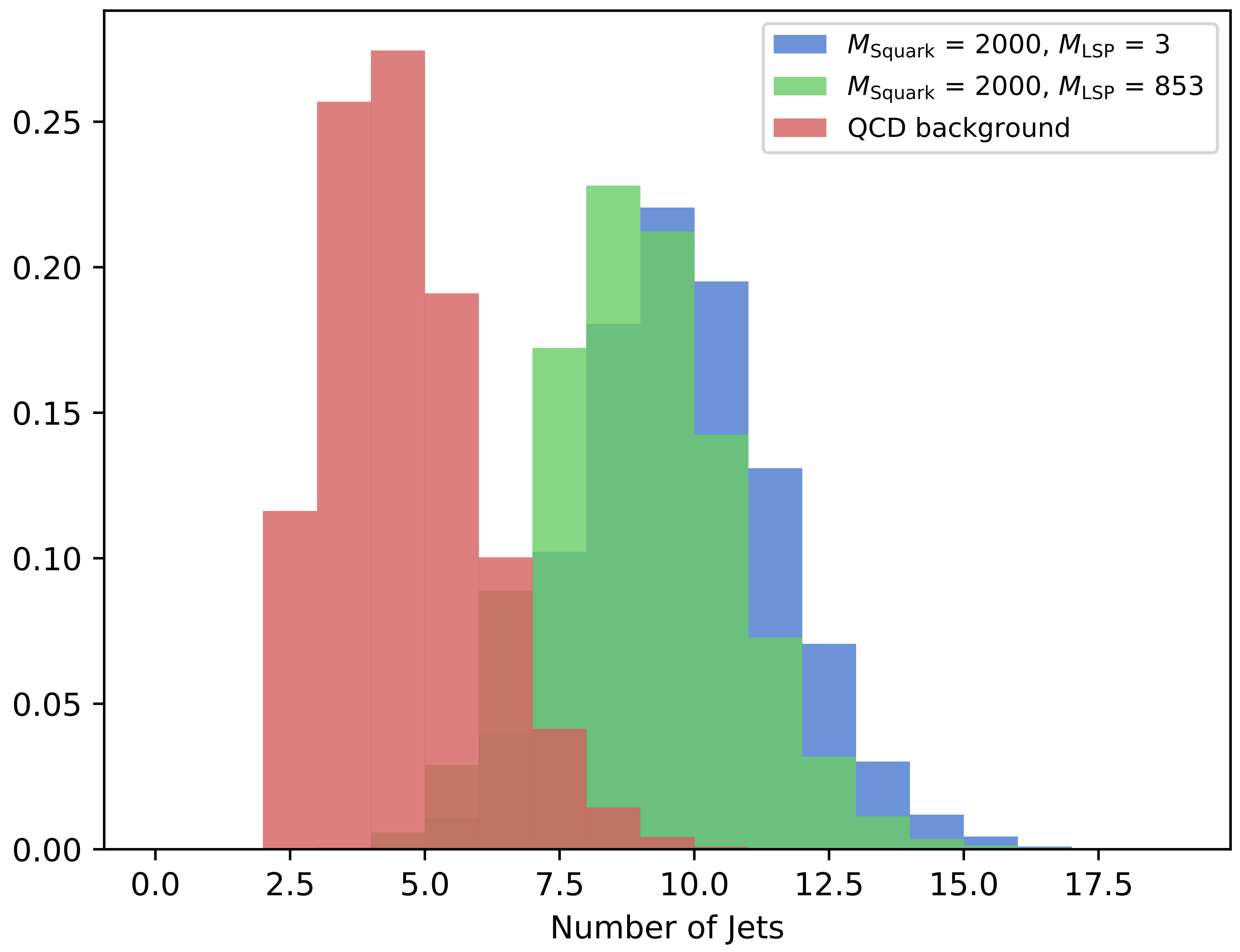
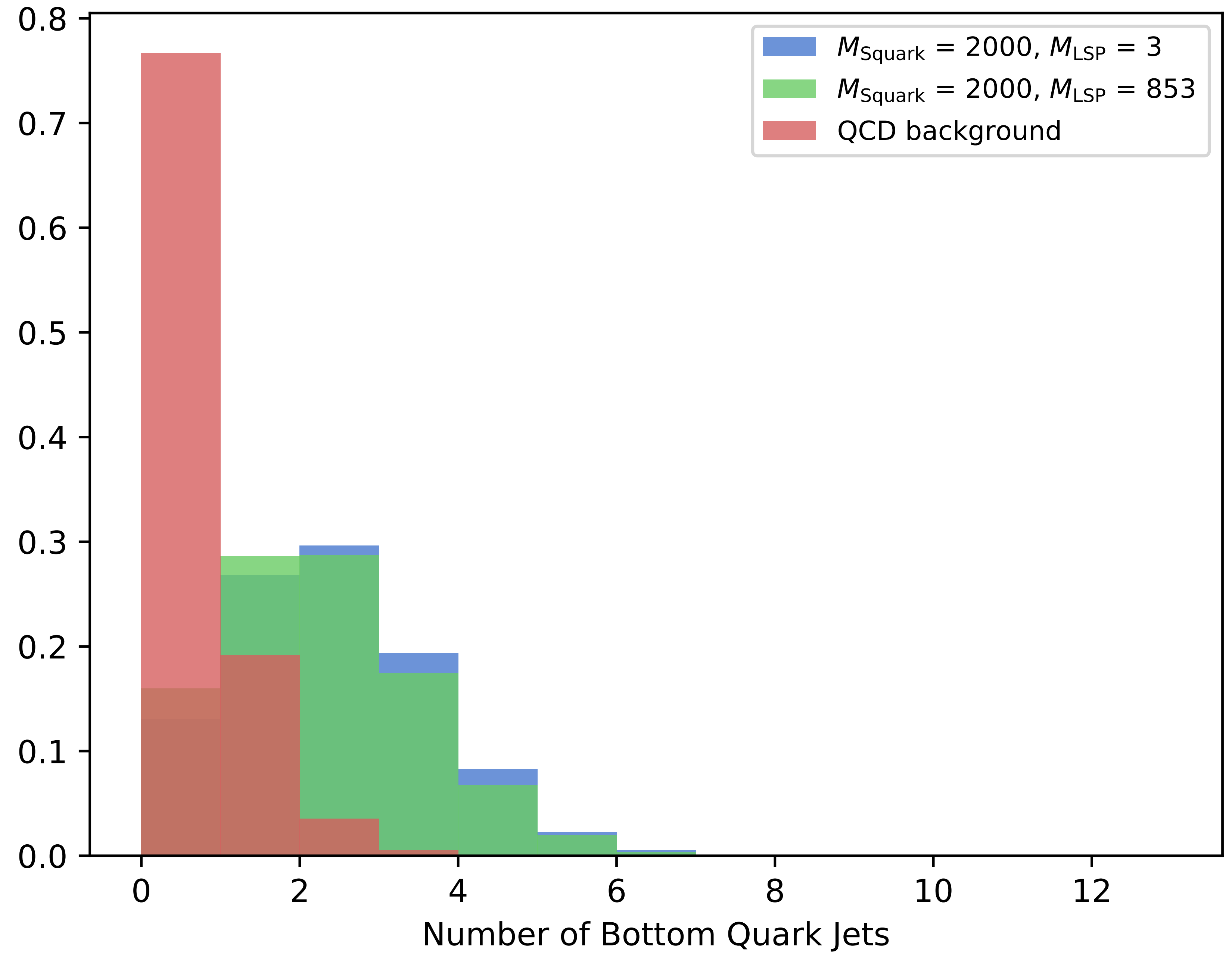
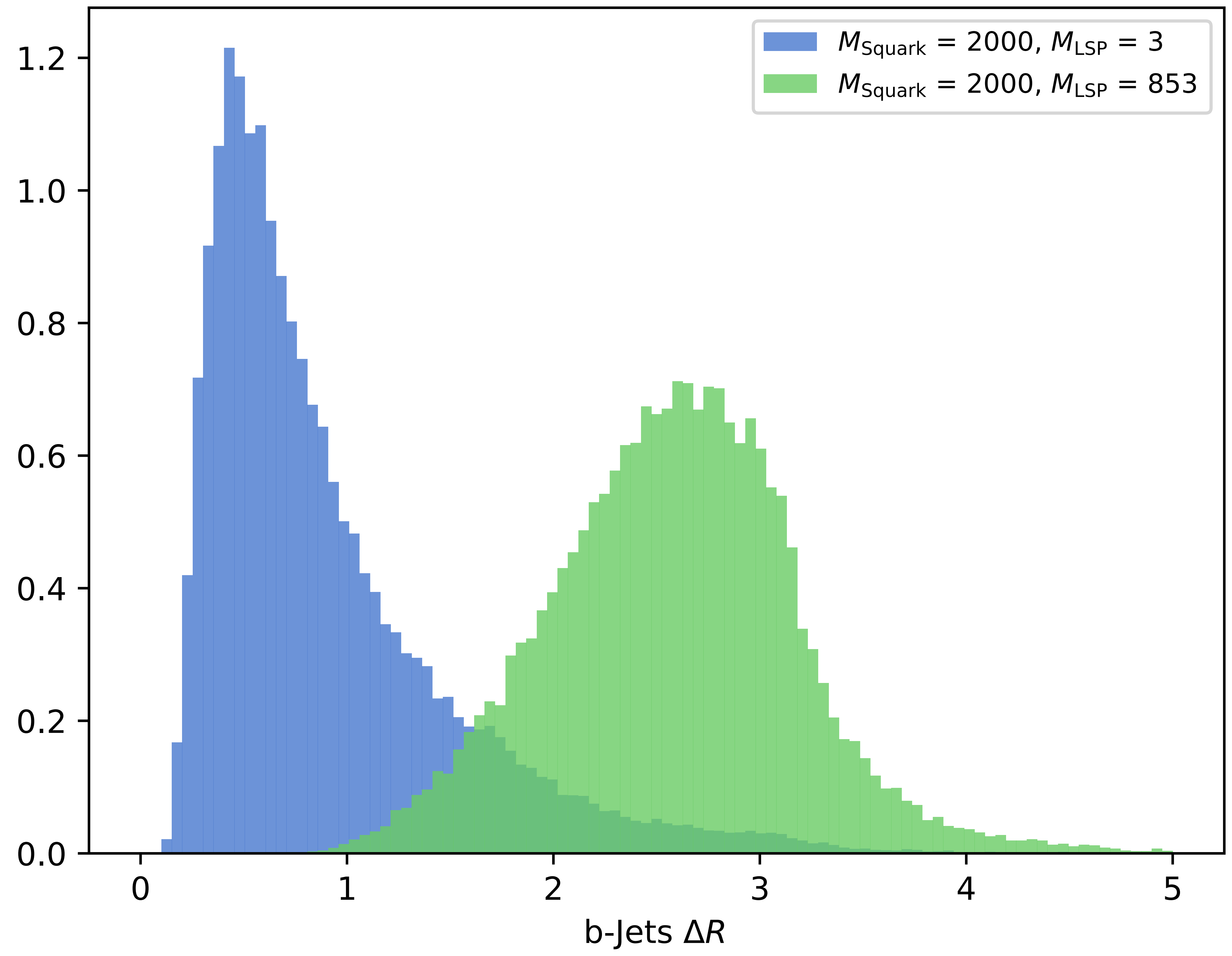
- B-jets from Higgs boson decays very close in angular separation for light LSP, could make resolving as separate jets difficult.







Conclusions and the Plan Going Forward

- Cross-section seems dominant over current searches: Low SUSY mass gives too high cross-section despite the efficiencies of the cuts.

- However we see the limits are less harsh for very light LSP.

- This region we would like to explore further.

- Current searches not so well equipped to look at low-MET final states, so in the lower cross-section areas we should expect to see a drop in sensitivity.

- Heavy squarks and light LSP means very boosted topologies, can be tricky!

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- QCD will, in reality, be a large background due to enormous cross-section.
- Bit of a pain to generate high N_jet QCD, but for experimental analysis there are central CMS samples.

Thanks!

TELL US ABOUT YOUR PROPOSAL.
WE'RE REQUESTING $3 BILLION IN FUNDING TO FIND THE HIGGS BOSON.
...WAIT. DIDN'T YOU ALREADY FIND IT A YEAR OR TWO AGO?
YES, WELL, UM.
...OK, THIS IS EMBARRASSING.
SEE, THE THING IS–
DON'T TELL US YOU LOST IT ALREADY.
LOOK.
IN OUR DEFENSE, IT'S REALLY SMALL.