Update on Kinematic Fits

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Proof of Principle: Semi-Leptonic $t\bar{t}$

- Higher statistics: 200k events
- 13355 semi-leptonic events after acceptance cuts
- 12979 events converge forLM technique

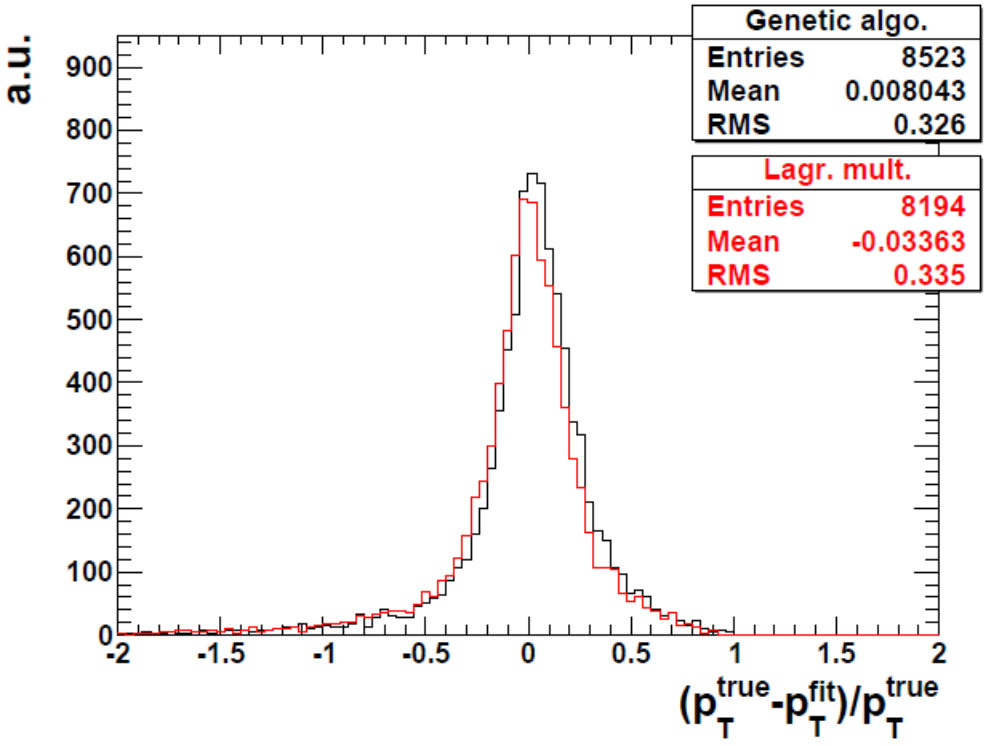


Figure 2: p_T resolution of reconstructed unmeasured neutrino in semileptonic $t\bar{t}$ events

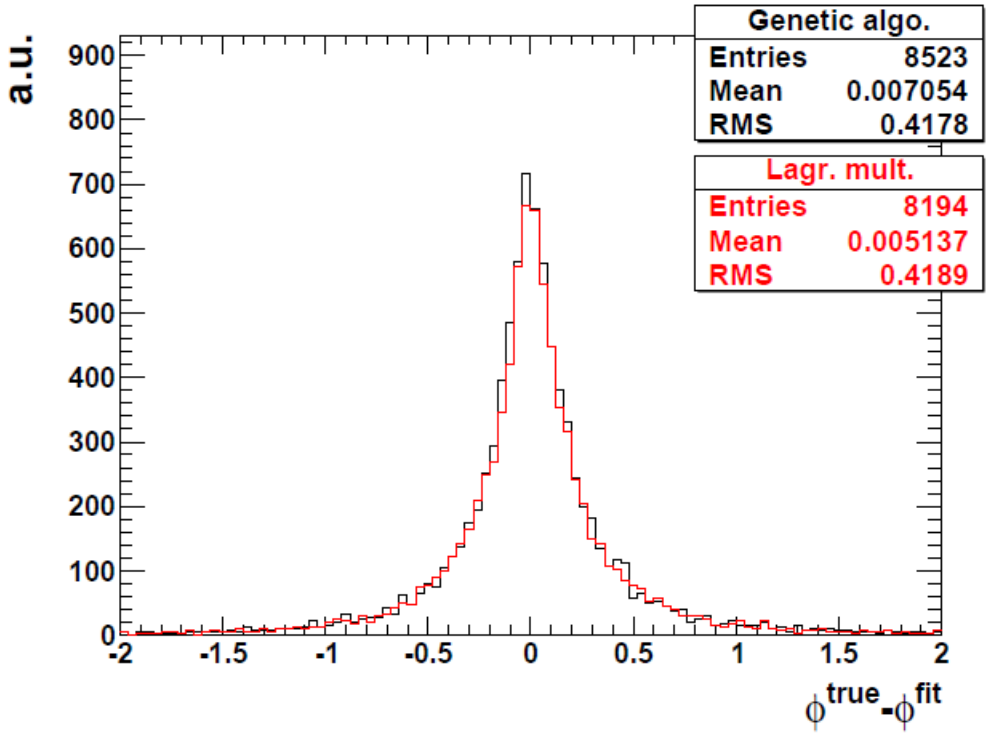


Figure 3: ϕ resolution of reconstructed unmeasured neutrino in semileptonic $t\bar{t}$ events

Fit Probability

- Only events are shown, for which best combination is correct combination → systematic shift to larger values
- Difference for GA vs. LM probability at largest values >0.8. Reason is different treatment of constraints:
  - LM: no contribution to χ^2 if constraint is fulfilled within some limits
  - GA: Additional contribution to χ^2 from not perfect fulfilled constraints. In case of momentum balance, true momentum balance is broken (~2 GeV) → deviation from flat distribution

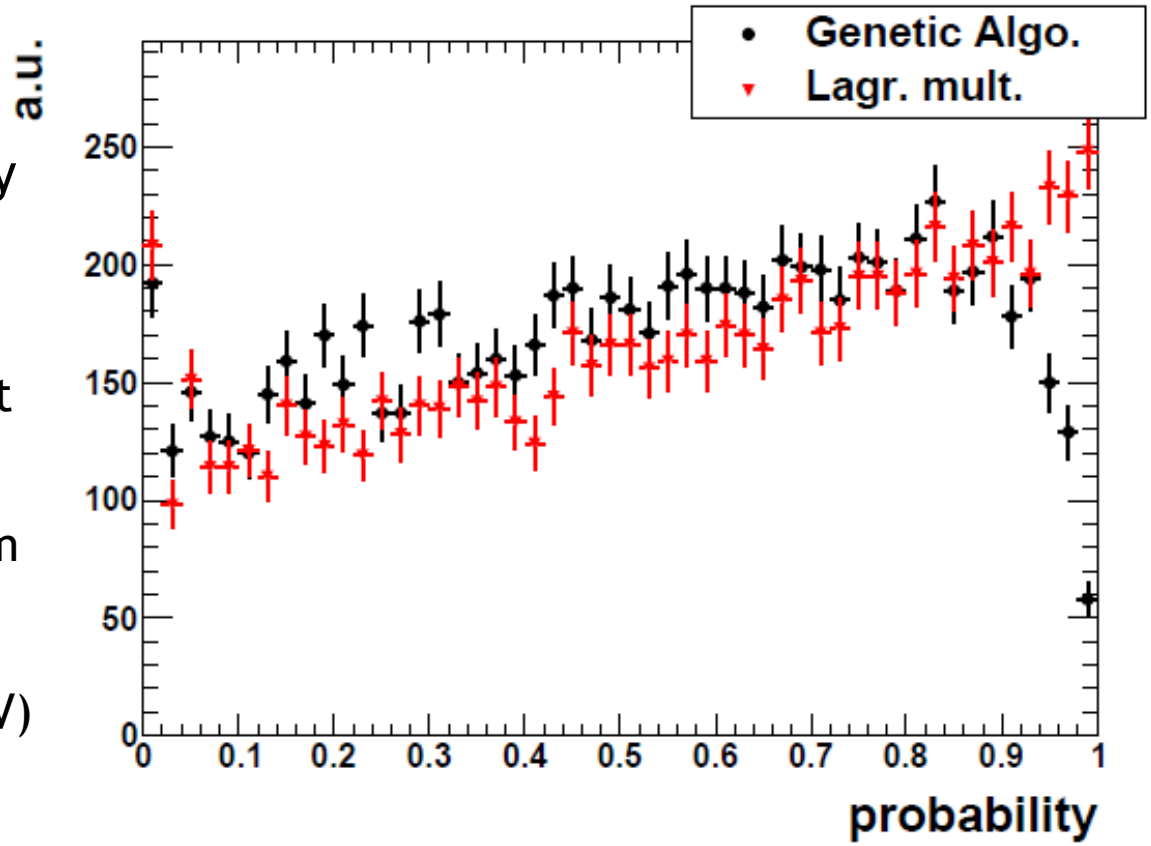


Figure 4: Fit probability for semileptonic $t\bar{t}$ events.

Is this clear enough?

Results for SUSY Events

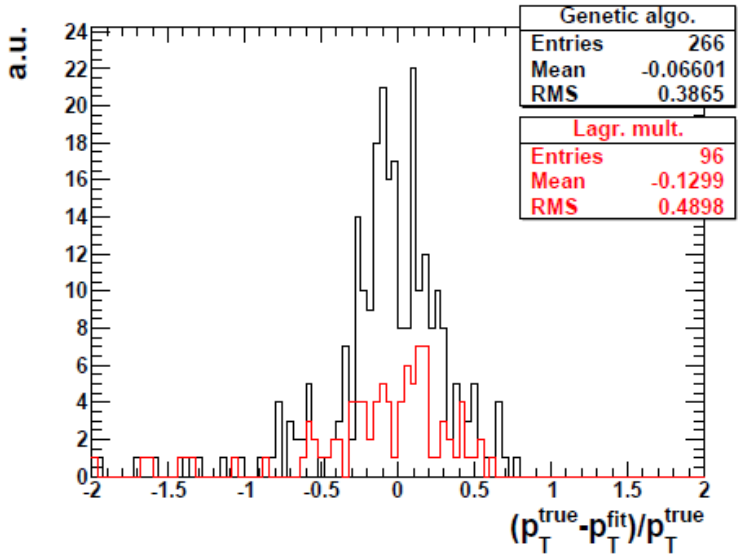


Figure 6: p_T resolution of reconstructed unmeasured neutralinos

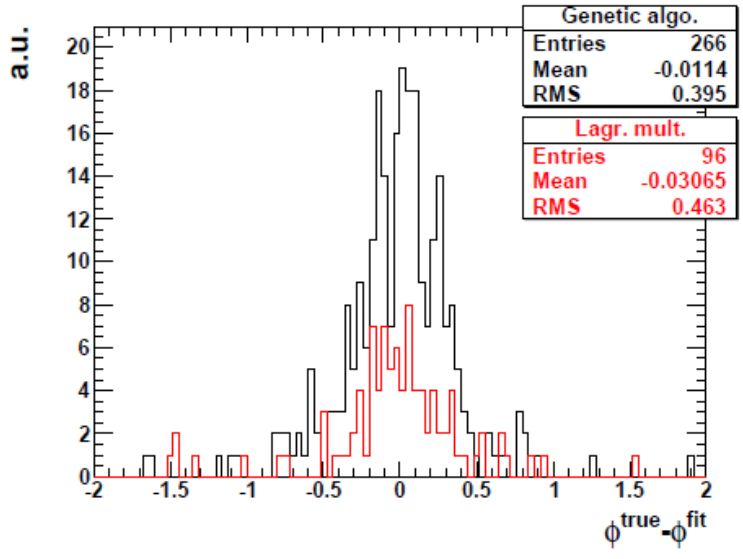


Figure 7: ϕ resolution of reconstructed unmeasured neutralinos

- Better "convergence" rate and resolution for GA
- Fit probability for signal (and signal-like) processes reasonable flat

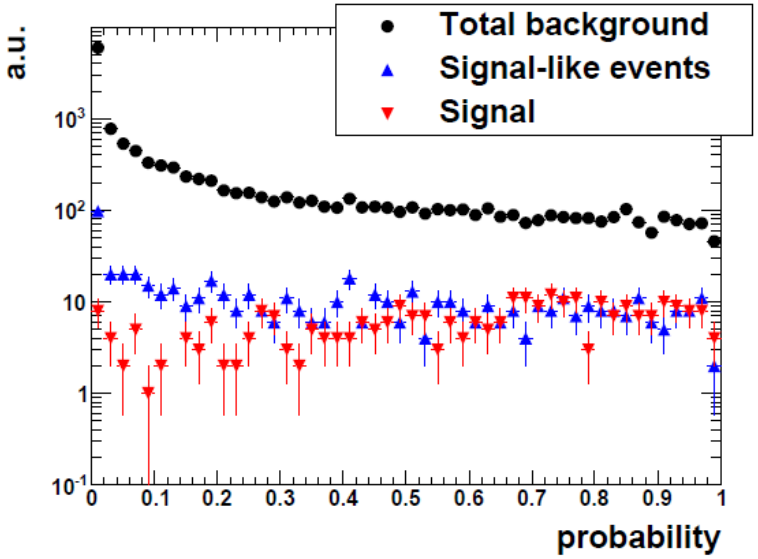


Figure 8: Fit probability for chosen event hypothesis.

Angular Distributions

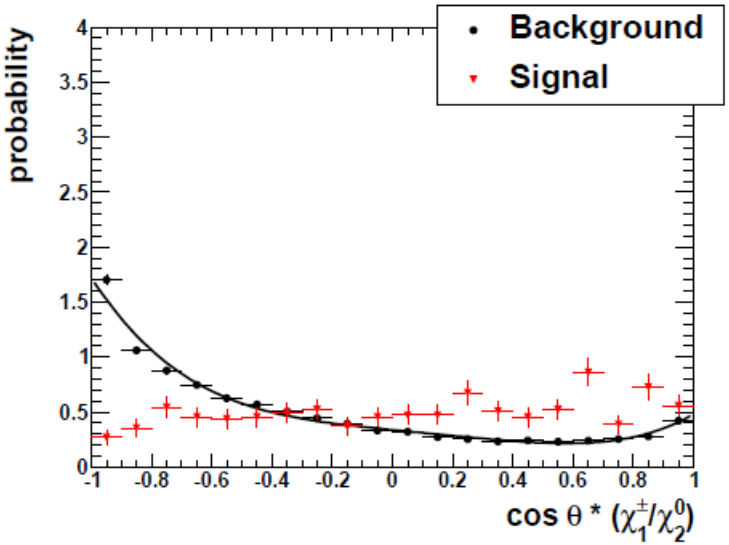


Figure 9: Angular distribution of decay products in rest frame of $\chi_1^{\pm}/\chi_2^0$.

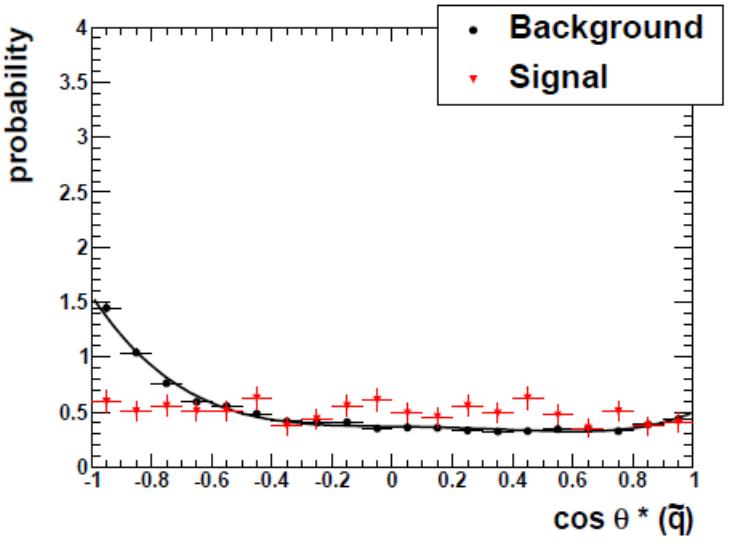


Figure 10: Angular distribution of decay products in rest frame of squark.

$$LR = \prod_{i=1}^{N} \frac{\mathcal{L}_{\mathrm{sig}}(\cos\theta_i^*)}{\mathcal{L}_{\mathrm{sig}}(\cos\theta_i^*) + \mathcal{L}_{\mathrm{bg}}(\cos\theta_i^*)}$$

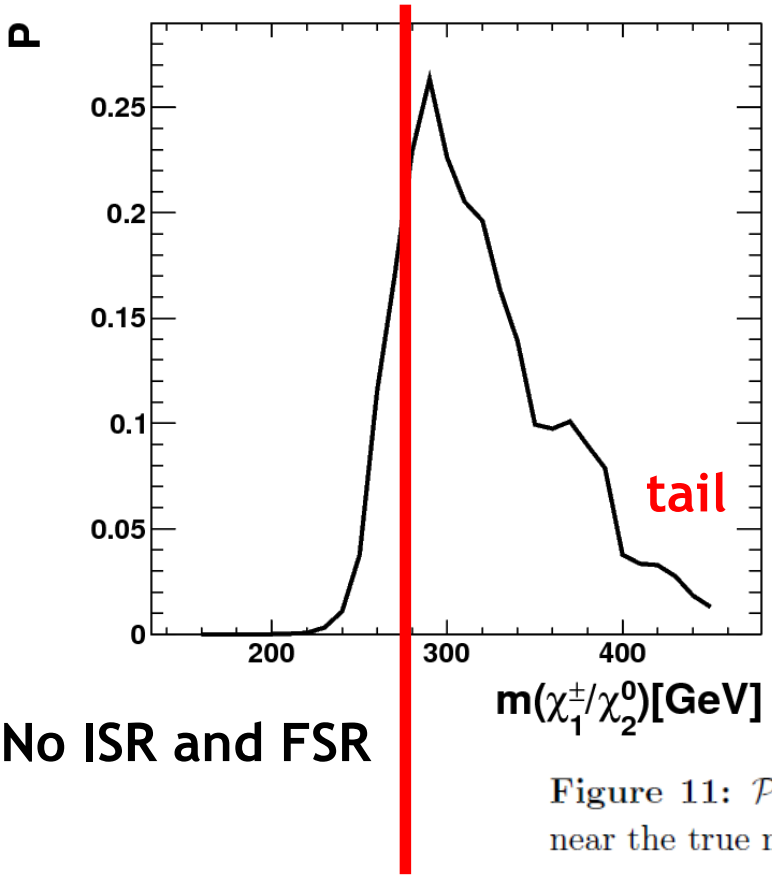
- Introduction of model dependence: identification of bg events
- **In case of bg domination:** use angular distribution of all events?

Current implementation: Improvement of ~10% (120 → 132: best is correct combination)

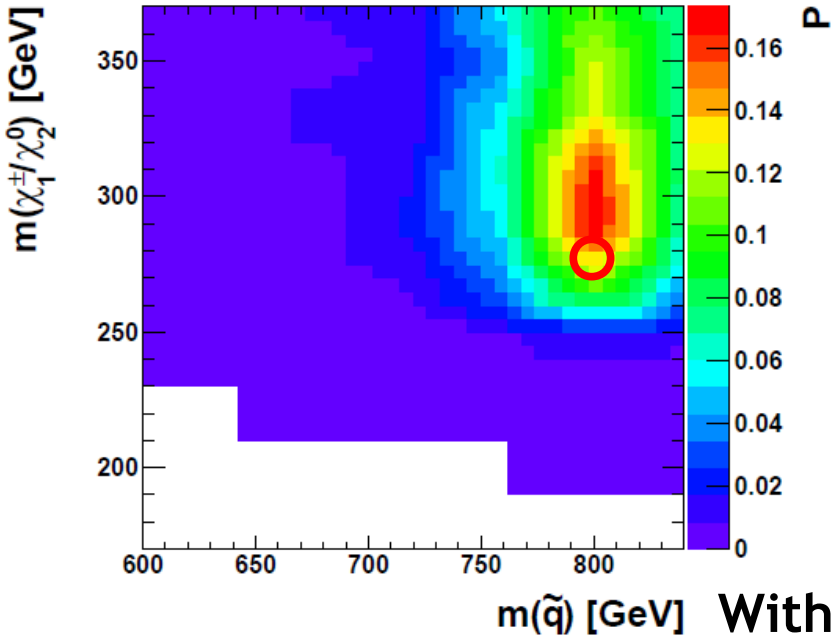
- Only signal events are shown, for which best is correct combination (no combinatorial background)
- Systematic shift / tail of “most likely” region to larger chargino masses

$$L_{\text{all events}} = \left(\prod_{i=1}^{N} p_i\right)^{\frac{1}{N}} = \exp\left(\frac{1}{N}\sum_{i=1}^{N}\log p_i\right)$$

× Fractional event count = P



No ISR and FSR



With ISR and FSR

Figure 11: $\mathcal{P}$ of signal events for which the best hypothesis is the right one. The maximum is near the true masses (see Table 1).

Explanation of Shift / Tail ?

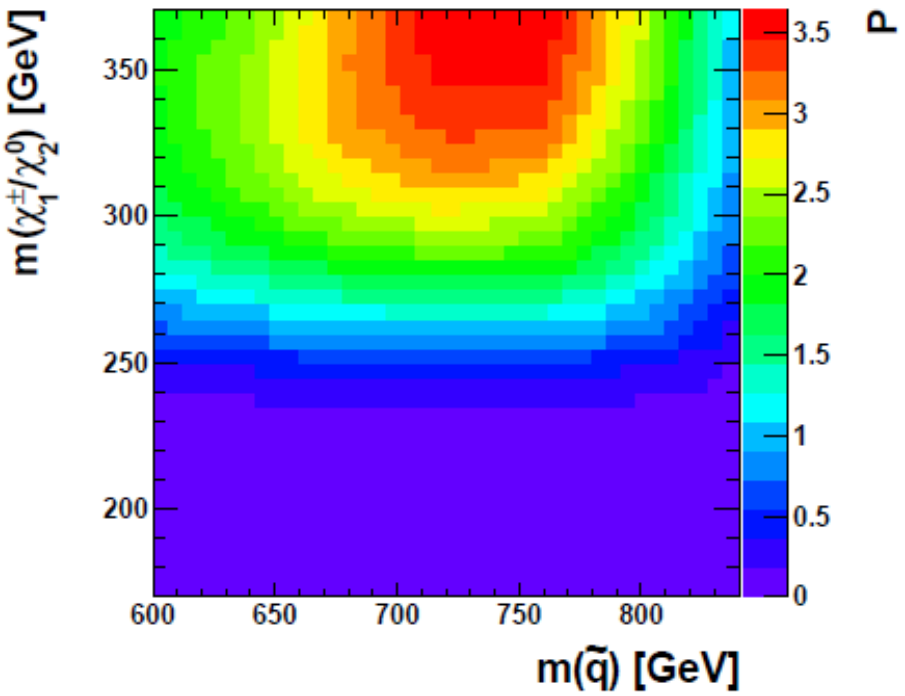


Figure 12: $\mathcal{P}$ of all events. This distribution is dominated by background and its maximum is shifted away from the true masses.

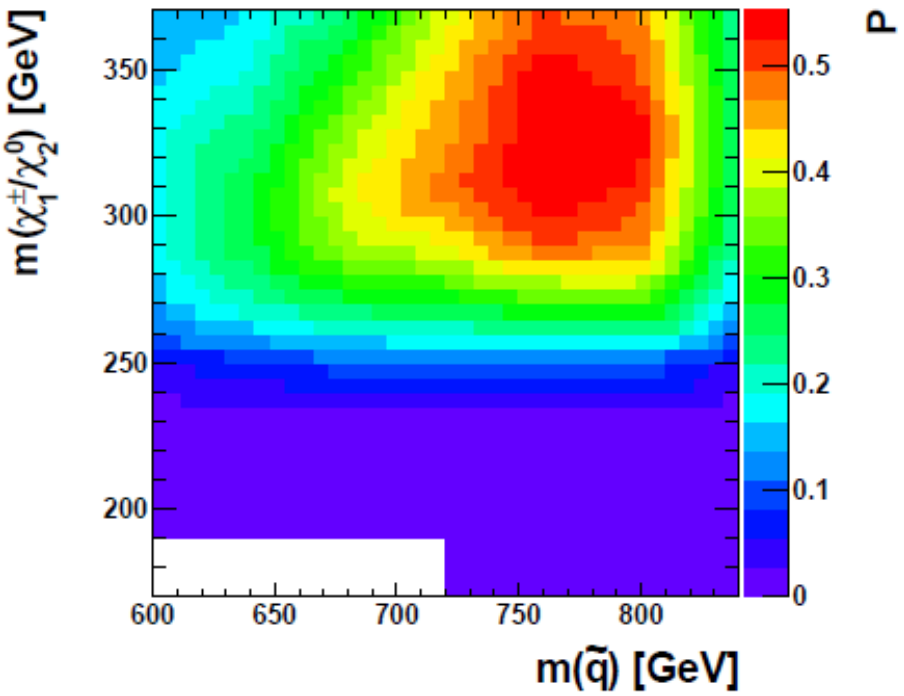


Figure 13: Same distribution but with the background reduced by a factor of 50.

If the combinatorial and SUSY background is included, the maximum of $\mathcal{P}$ is shifted towards significantly larger $\tilde{\chi}_1^{\pm}/\tilde{\chi}_2^0$ masses, as can be seen in Figure 12. Similar decay topologies with heavier intermediate SUSY particles, e.g. $\tilde{\chi}_3^0$, $\tilde{\chi}_4^0$ or $\tilde{\chi}_2^{\pm}$, can account for this. Another reason is, that for heavier mass hypotheses it easier to find a combination, which fulfill the constraints, since the phase space of allowed solutions is larger.