29 April 2026 **Quiz number 8**

Phenomenology of Physics Beyond the Standard Model

FS 2026

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Searching for SUSY at the LHC

- Consider a high-energy proton-proton collider such as the LHC. What are the main steps for designing a search for BSM physics?
- Focus on RPC SUSY. What is the type of signature that you expect?
- Consider the m jets + MET signature. Draw an example diagram for a SUSY production process leading to such a signature.
- Consider Figure 1, describing the subdivision of the analysis phase space of an *inclusive* m jets + MET SUSY search. This achieves two goals, pertaining the SUSY signal and the SM background, respectively. To explain the former, think about what "inclusive" means in this context, and how this split can make the analysis more flexible. The latter aspect is more subtle: try to reason about how dividing events into different categories can enhance the sensitivity even to an individual signal by looking at how the background fractions change across categories.
- Can you identify the main backgrounds? How does MET arise in each of them? Would you expect large MET from QCD events? How can it still occur and why is this case especially complicated to handle?
- Still considering Figure 1, can you explain why W/Z + jets dominates all the categories with 1 jets almost independently on the number of b-jets, and why does the picture changes when requiring larger multiplicities of jets in the event?
- Consider Figure 2: which part of the analysis does it pertain to? Explain why it is crucial do design the entire analysis without looking ad real data in the signal regions before the final fit. Consider now the case in which an excess in data is observed compared to the expected background: how can we assess its statistical relevance?

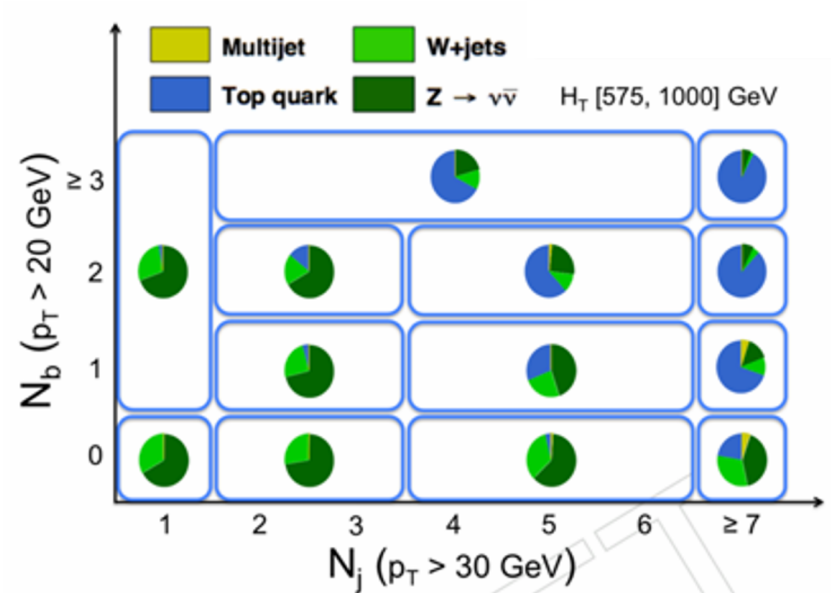


Figure 1: Categorization in a typical m jets + MET SUSY search.

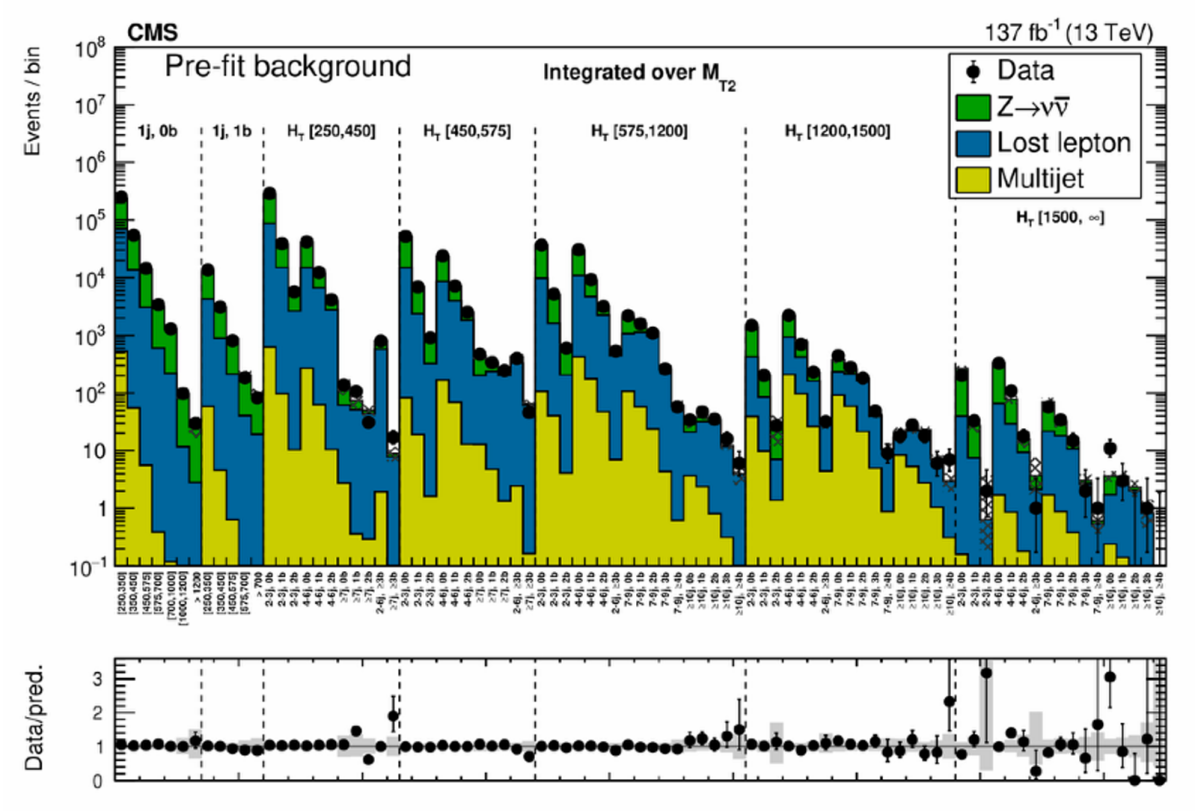


Figure 2: Number of observed events compared to the prediction from simulation of the background in each category of the m jets + MET search.