Razor Analysis of Dark Matter Direct Production

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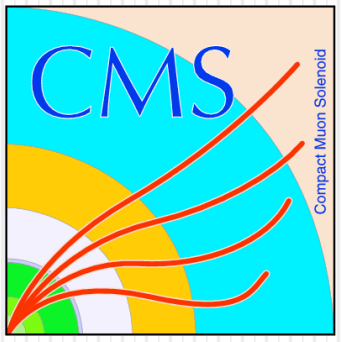
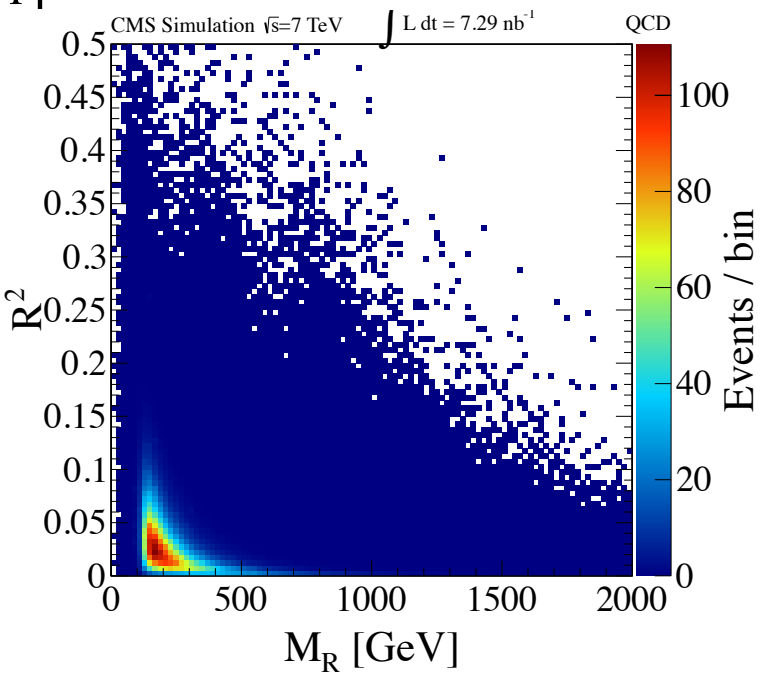


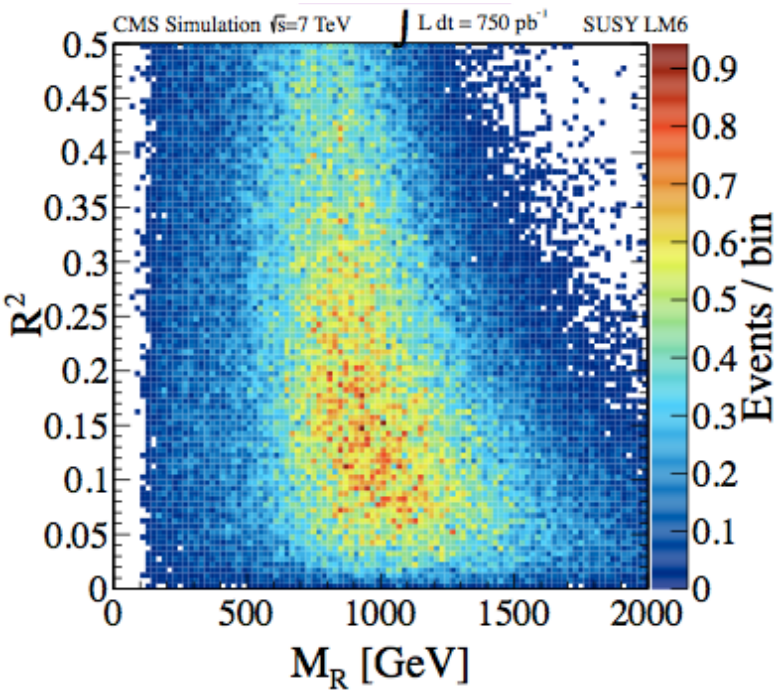
Overview

- Razor Variables (R^2, M_R) :

$$\begin{cases} M_T^R \equiv \sqrt{\frac{1}{2} \cdot \left[\not{E}_T (p_T^{j_1} + p_T^{j_2}) - \vec{\not{E}}_T \cdot (\vec{p}_T^{\,j_1} + \vec{p}_T^{\,j_2}) \right]} \\ M_R \equiv \sqrt{(E_{j_1} + E_{j_2})^2 - (p_z^{j_1} + p_z^{j_2})^2)} \end{cases}$$

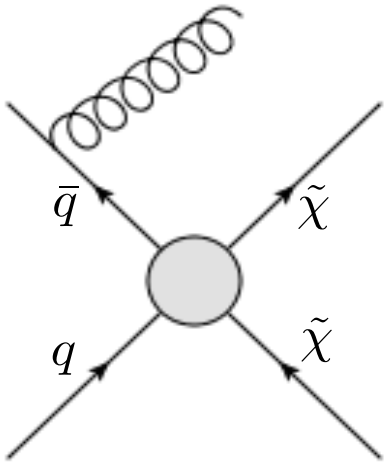
  - Description: Model-independent estimators of mass scale of SUSY decay processes
  - Advantages: QCD Background Peaks at $R^2 \sim 0$; signal peaks at $M_R \sim M_\Delta$ [1]





Overview

- Previous Searches for SUSY
  - Look for the simplest Final State – Monojets/Monophoton Analysis
  - Bounds on DM-nucleon scattering cross-sections



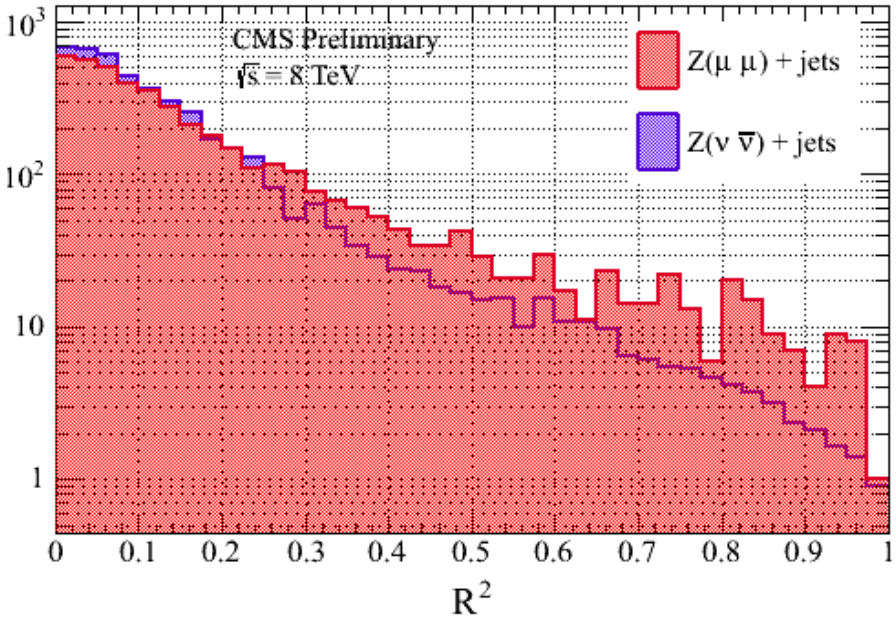
- Project – Consider final-states with double-ISR topology

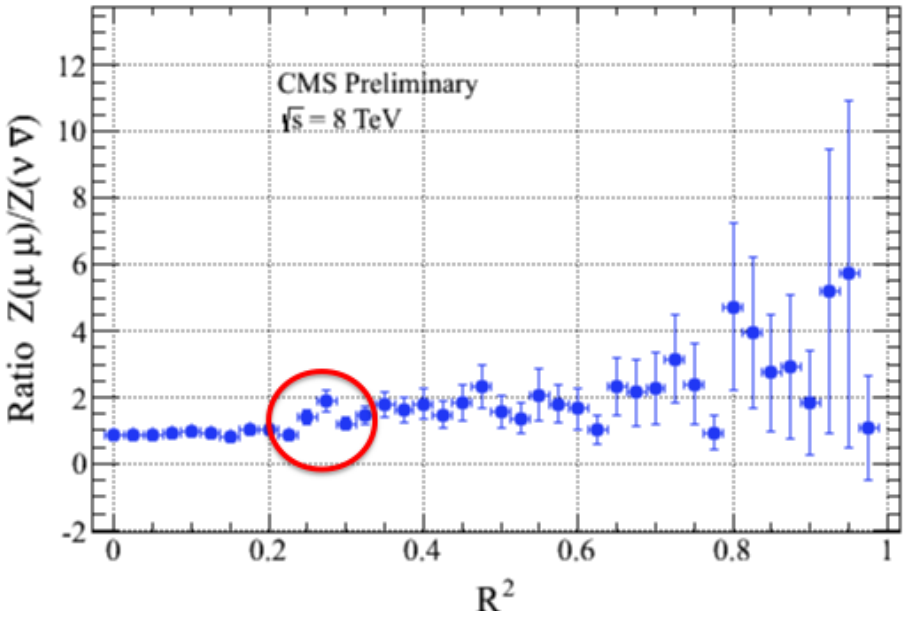
- Motivation: Increase signal efficiency; Possible improvement to background discrimination; Compressed SUSY Spectra

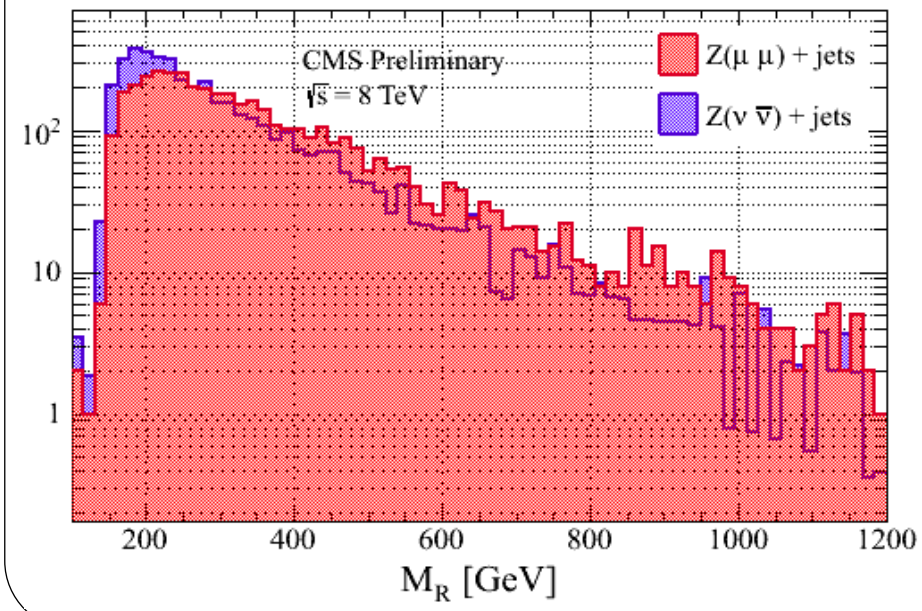
Background Characterization

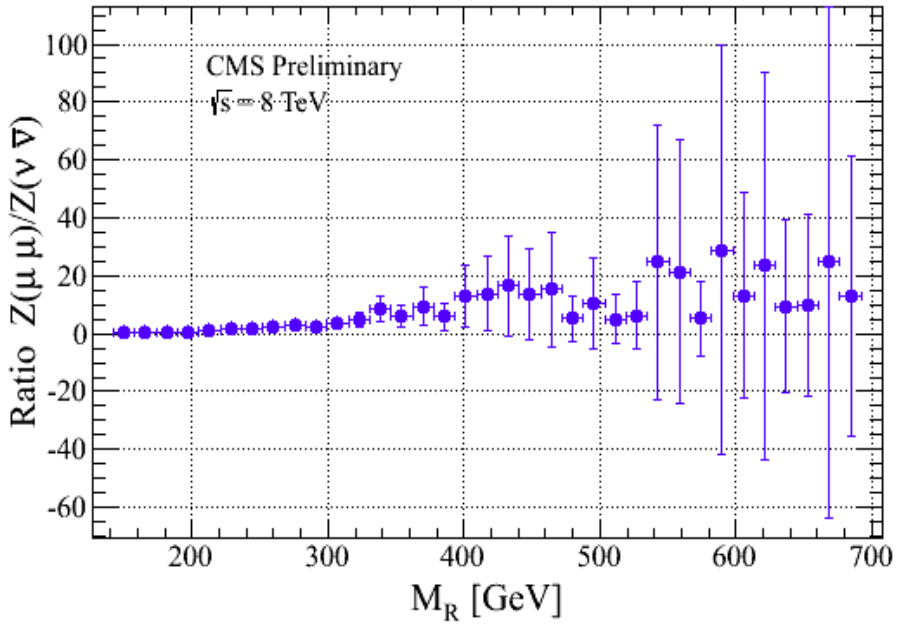
- Require two jets in the final state with $p_T > 70$ GeV, $|\eta| \leq 3$
- Background Sources: $Z(\rightarrow \ell\ell)$ + jets, $W(\rightarrow \ell\nu)$ + jets, $t\bar{t}$
- $Z(\rightarrow \nu\bar{\nu})$ + jets
  - Use $Z(\rightarrow \mu\mu)$ + jets to predict $Z(\rightarrow \nu\bar{\nu})$ + jets background
  - Modify muon isolation criterion for > 30 GeV muons
- $W(\rightarrow \ell\nu)$ + jets
  - Indirect vs. Direct lepton veto
- $t\bar{t}$
  - B-tagging Algorithm

Background Characterization $Z(\rightarrow \nu\bar{\nu})$



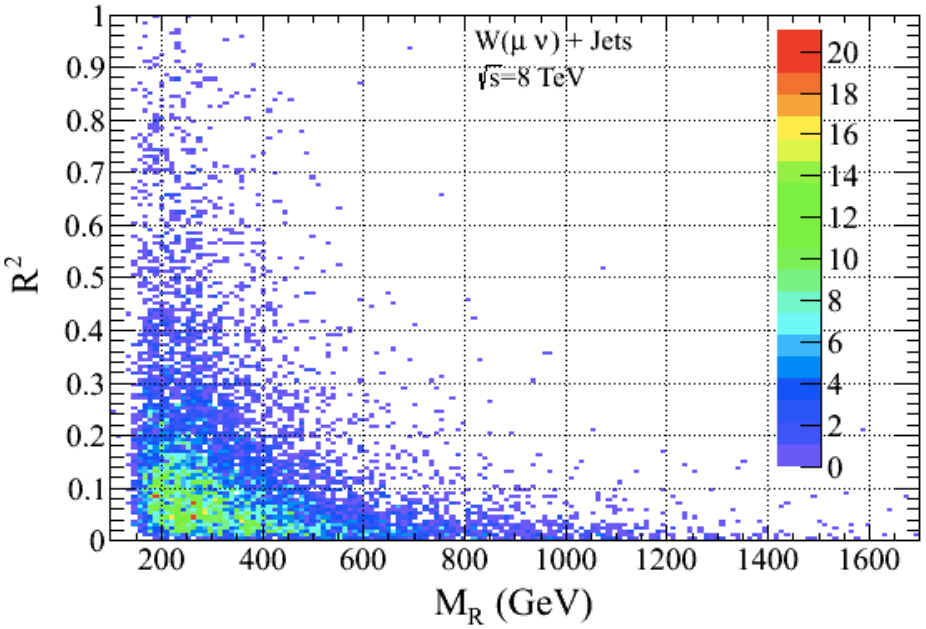


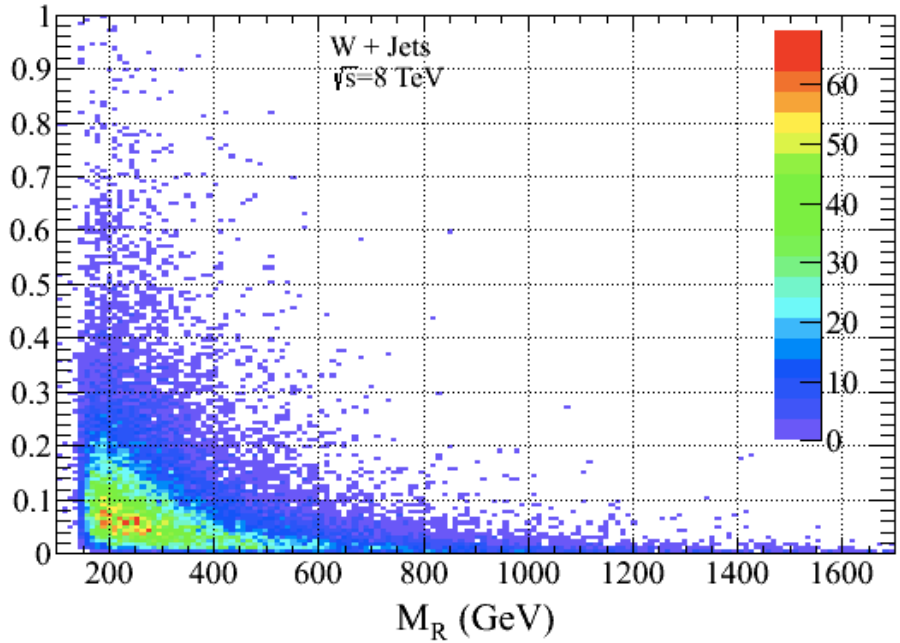




Background Characterization $W(\rightarrow \ell\nu)$

- Razor parameter-space in the 0μ and 1μ boxes





What Next?

- Current Work
  - Analyzing generator-level leptons in Monte Carlo samples
  - Determining sensitivity to p_T cuts

- Future Work
  - Implement Additional Cuts on Inter-jet Angle
  - Run on Data with 0, 1, and 2-muon Control Samples, Hypothesis Testing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References

[1] Duarte, J.M. “Search for New Physics Using Razor Variables at CMS.”, Powerpoint Presentation. Erice, Sicily. 27 June 2012.