Direct Search for Heavy Quasy-Stable Particles at CMS

FIRST SEARCH ON LHC!

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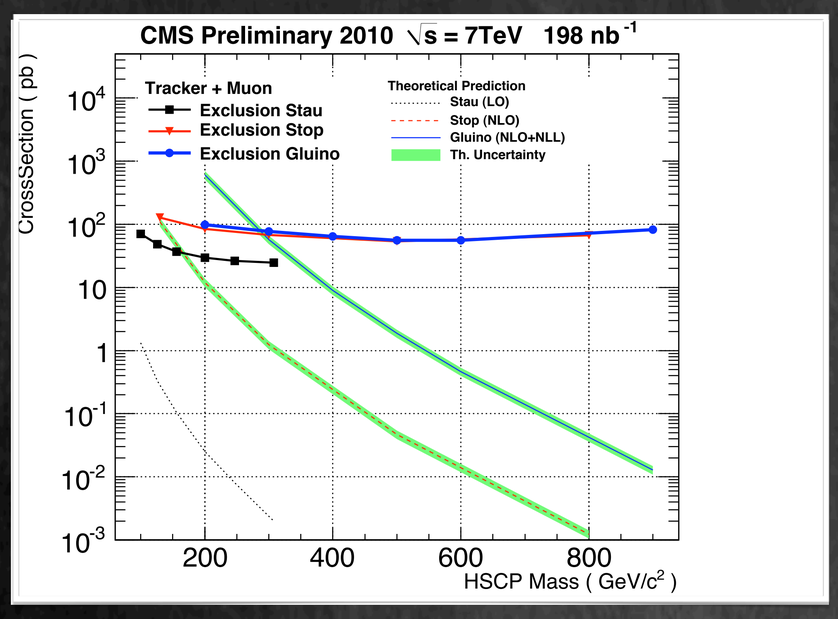
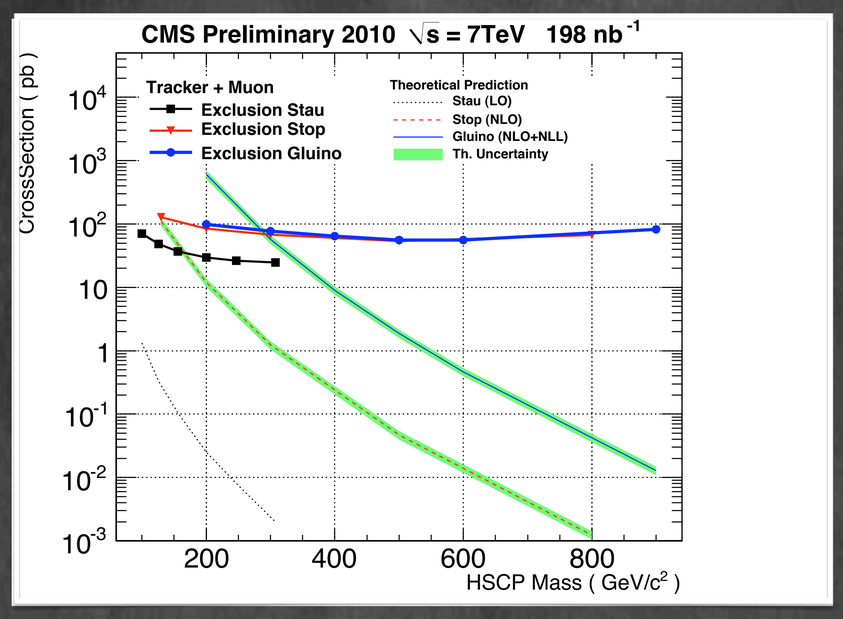
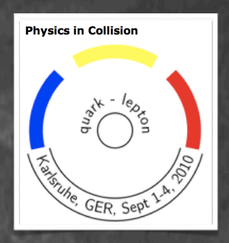
for the CMS Collaboration

Exclusions for tracker+muon



Exclusions for tracker-only





Motivation

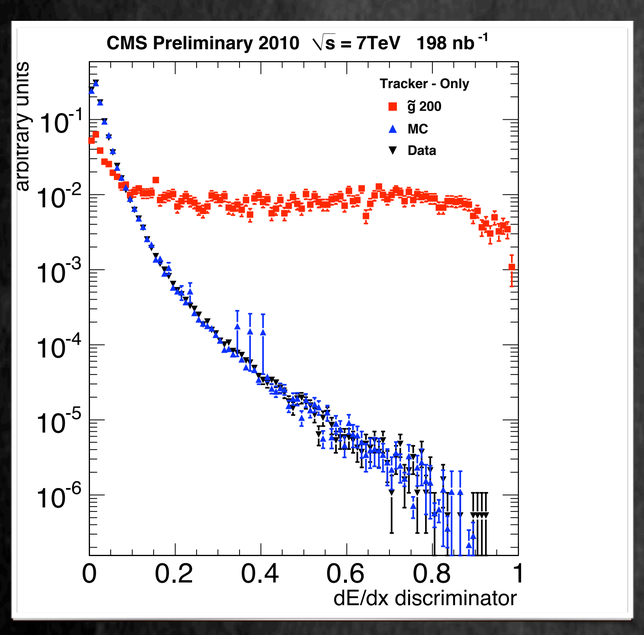
- Inspired by physics scenarios predicting heavy stable charged particles, HSCP
  - some SUSY flavors predict long living gluino, stop, stau...
  - Hidden valley models, certain GUTs
  - Lifetimes $10^2..10^3$s of particular interest by cosmology
    - may explain ^{7}Li and ^{6}Li abundance discrepancy between measurement and conventional nucleosinthesis
- Strongly interacting particles form stable states with quarks/gluons - R-Hadrons
- Distinguishing properties:
  - High momentum
  - High ionization
  - High time of flight (not used in this analysis)
  - Muon-like
    - However R-hadrons may change charge in nuclear interactions

Summary

- Searched for (high-pT, high-dE/dx) tracks with and without muon ID in 198nb^{-1} of data at √s=7TeV
- For masses 130-900 GeV/c^2, gluino/stop x-section limited to ~100 pb
- Track+muon analysis: exclude gluino below 284 GeV/c^2
- Track-only analysis: exclude gluino below 271 GeV/c^2
  - approaching Tevatron limit of ~350 GeV/c^2
- More details in CMS public analysis summary CMS-PAS-EXO-10-004
- http://cdsweb.cern.ch/record/1280690

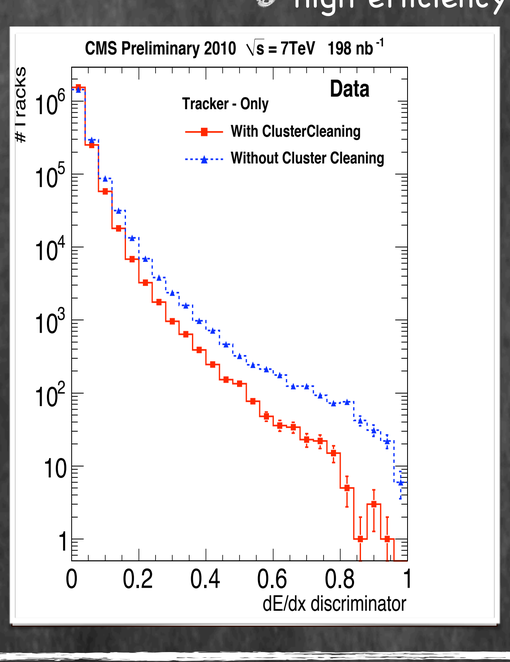
dE/dx descriminator

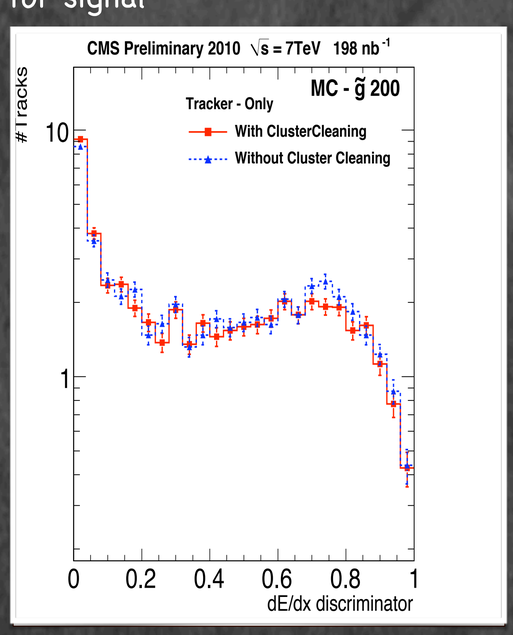
- Based on comparing all charges produced by the track hit in every Si detector with the charge expected from MIP



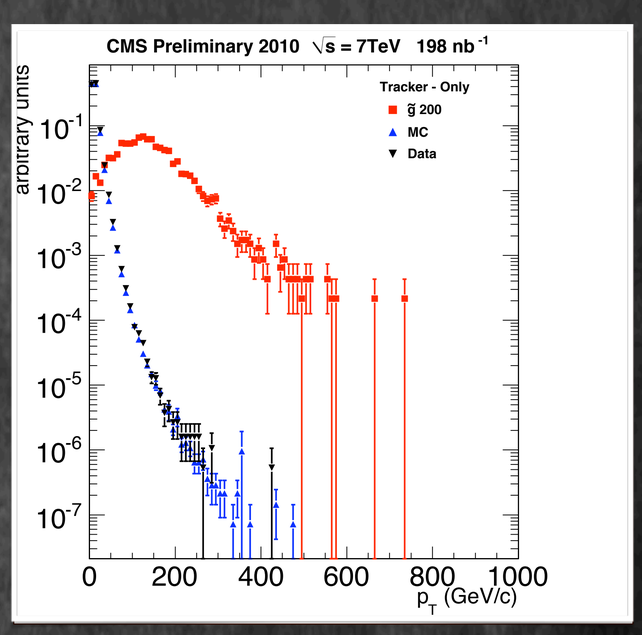
Si cluster cleanup

- Remove clusters with abnormal spatial energy profile
  - effectively suppress backgrounds
    - high efficiency for signal

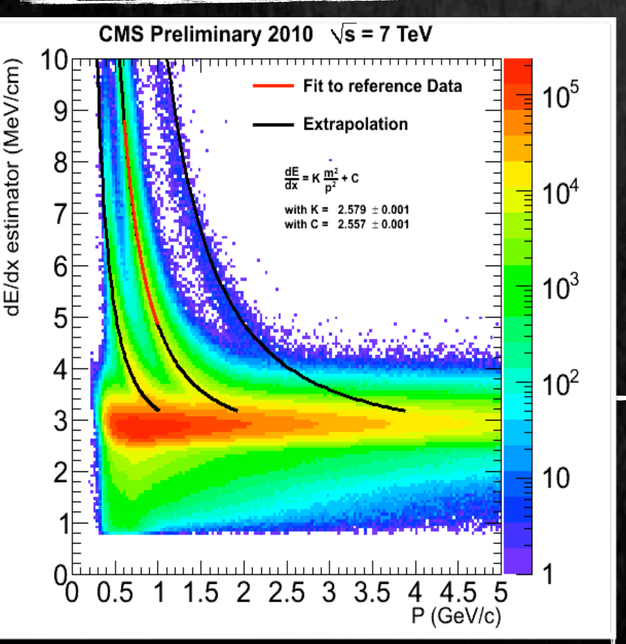




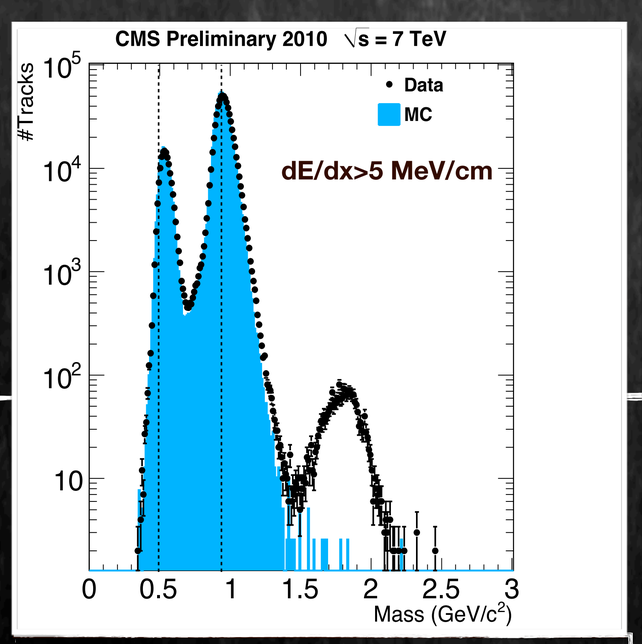
pT descriminator



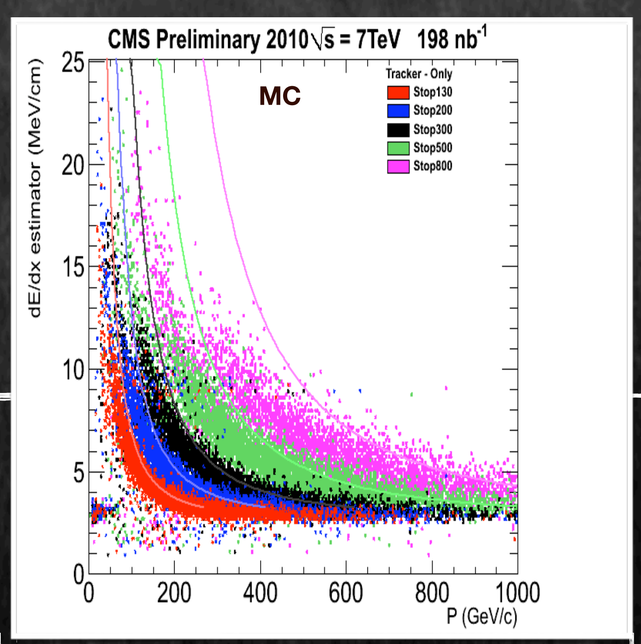
Mass reconstruction: Converts (p, dE/dx) → Mass



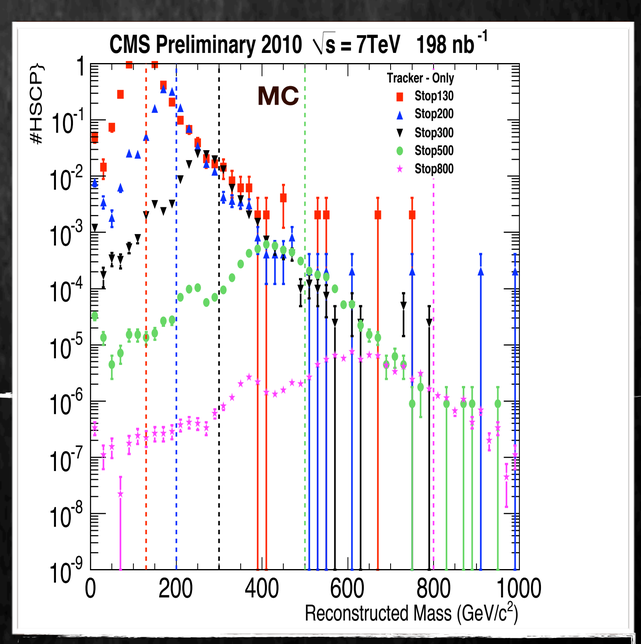
dE/dx vs momentum in data



K, p, d (not in MC) mass reconstruction



dE/dx vs momentum for HSCP



HSCP mass reconstruction

Cuts optimization

- Select tracks with reconstructed mass in [75,1200] GeV/c2
- Consider tracker+muon and tracker-only tracks separately
- Estimate background from data using ABCD in dE/dx descriminator : p_T plane
- Optimize cut parameters separately on 2D grid
  - tracks with different N_{hits}
  - tracks in different |η| ranges:0-0.5-1.-1.5-2.-2.5
- Keep background suppression equal for all grid cells
  - (pT,dE/dx discriminator) cuts: (10^{-3},10^{-3}) for track+muon, (10^{-4},$10^{-3.5}$) for track-only

Systematic uncertainties

- Background - 40%(tracker+muon), 36% (tracker-only)
- Luminosity - 11%
- Signal acceptance - 20%
- Theoretical cross section - 15%

Counting experiments

- Tracker+muon:
  - Expected - 0.153±0.061, observed - 0
- Tracker-only:
  - Expected - 0.060±0.021, observed - 0
- Set Bayesian 95% C.L. exclusion limit