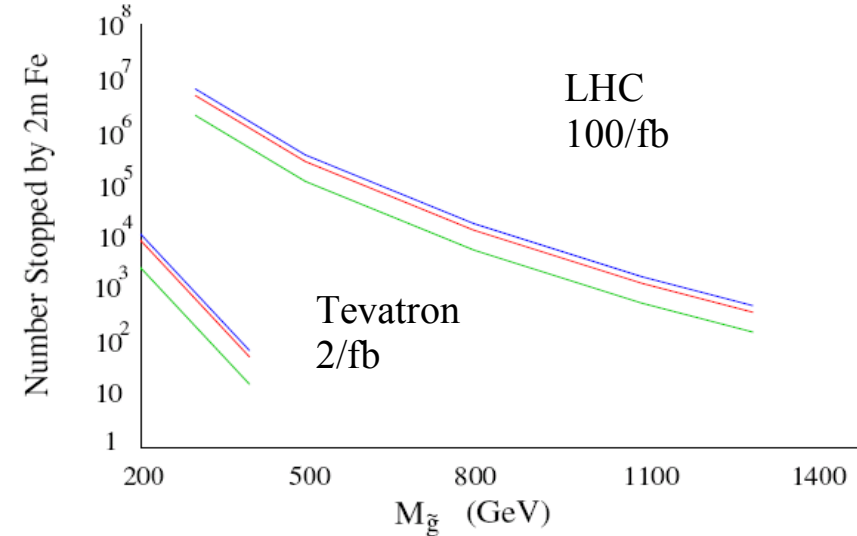


Search for Stopped Gluinos

- Split SUSY -> heavy scalars -> long-lived gluino
- Gluinos hadronize into “R-hadrons”
- Some charged R-hadrons lose enough momentum through ionization to stop in the calorimeters
 - They later decay into jets+MET (LSP)
 - Lifetime < 100 s due to nucleosynthesis constraints, but > 10 ns if $M_{\text{SUSY}} \sim 10^6$ GeV
 - See hep-ph/0506242 – Dimopoulos, et al.
- An interesting “final-state” which has not been carefully explored before experimentally
-
- Generate Z+q (MSEL=13) MC, privately, p14.09.00
 - 1000 events each, with $p_T > 50, 100, 200, 400$
 - $|\eta| < 2$, but then rotated jet to random theta



~ 500 stopped gluinos in 2/fb for $m_g = 300$ GeV
 ~ 5 stopped gluinos in 2/fb for $m_g = 500$ GeV

Signal Efficiency in Data

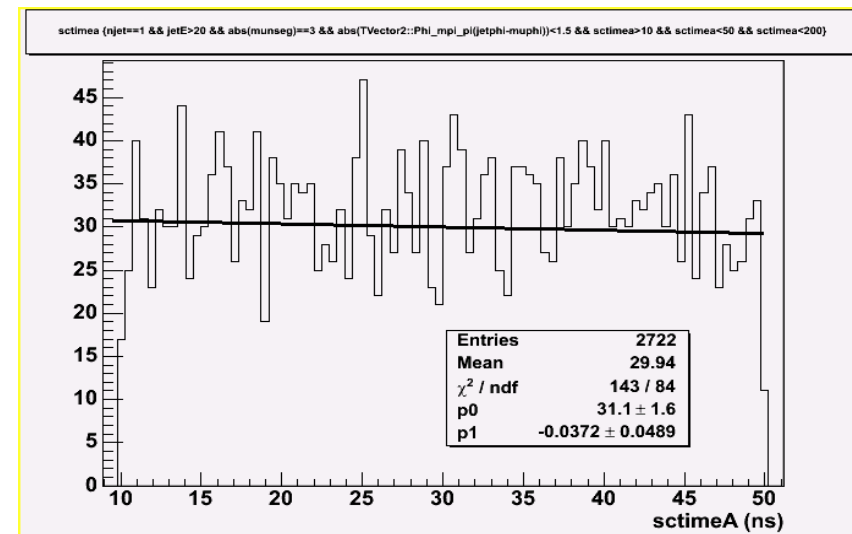
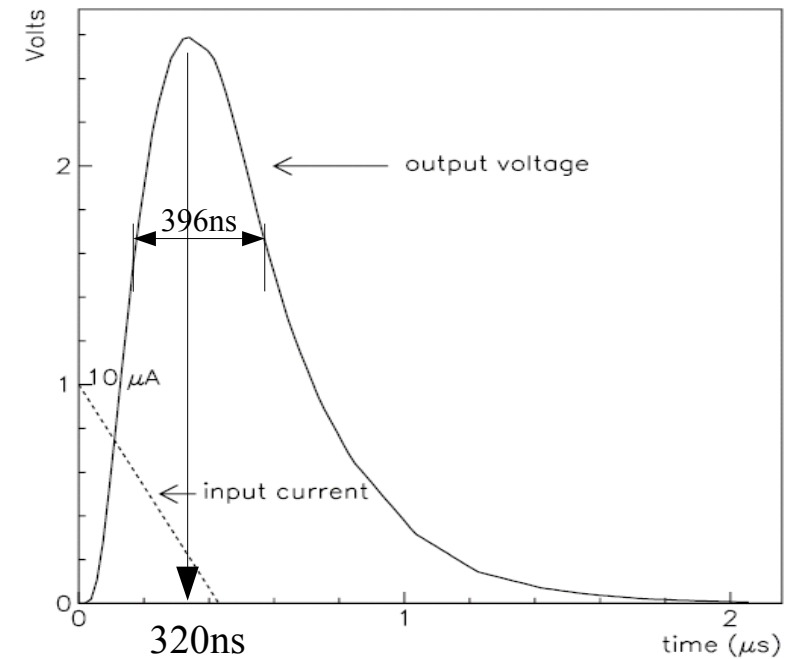
- The events have high energy deposits, trigger eff. = $\sim 100\%$?
 - But we also require a GAPSN... which is dead if there is a min-bias interaction, or we're in a trigger gap
- Also, the energy deposits are often "out of time" !
 - Determine effect to be an average $15 \pm 5\%$ decrease in measured energy, by using muon showers and scintillator timing

Source	Efficiency
GAPSN Trigger	.6
Trigger gaps	.68
Total	0.41

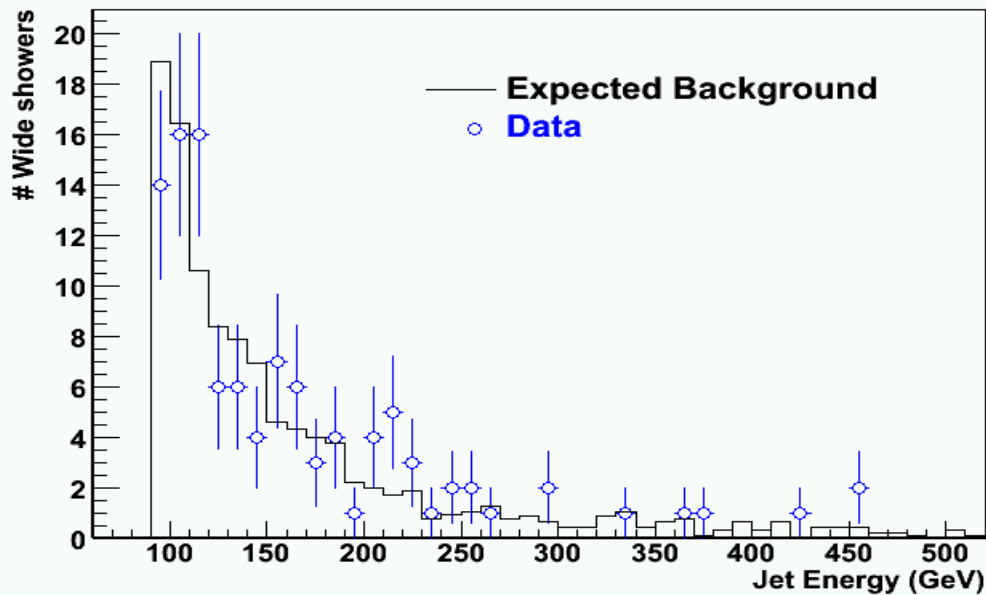
Table 1: The extra signal inefficiencies, and their total product.

Source	Uncertainty
Geometrical/Kinematic Acceptance	0.2
Min-bias Overlap	0.15
Total	0.25

Table 2: The systematic uncertainties, and their total (added in quadrature).



Results



Systematic error on background normalization is 10%, from statistics on fit to wide-show muon background.

Jet E Range (GeV)	Obs.	Exp.	Eff.	Exp. Limit (pb)	Obs. Limit (pb)
90-150	69	77.3	.11	.71	.73
150-200	25	21.9	.14	.42	.53
200-300	20	12.7	.15	.24	.51
300-500	6	9.0	.16	.19	.13

Table 3: The data, background, efficiency, and limits for each jet energy range.

Gluino Results

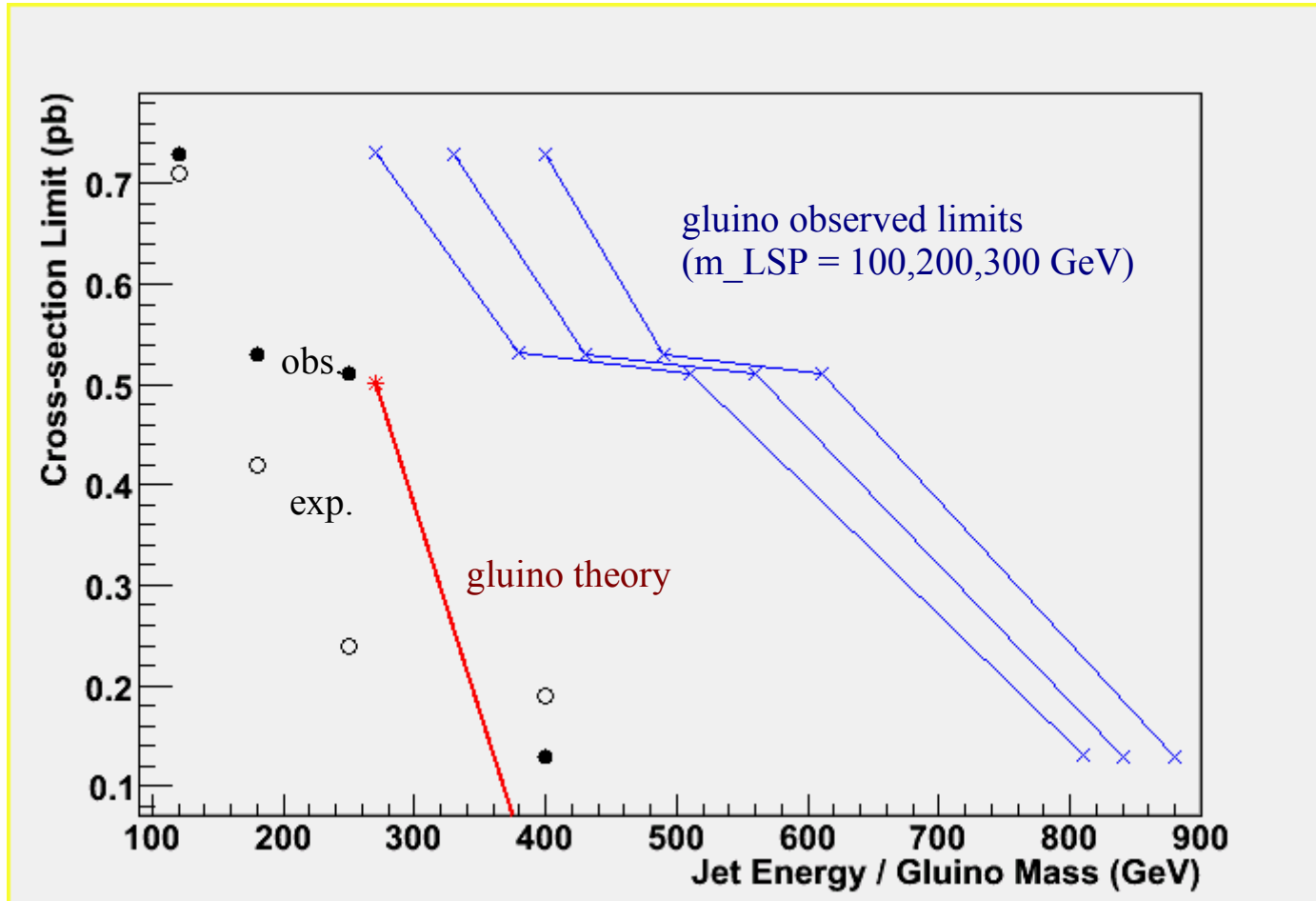
- Extrapolate from the model-independent results to the “gluino” results based on the formula:
- $$E(\text{jet}) = (M_g^2 - M_{LSP}^2)/2M_g$$
-
-
- Thus for each LSP mass, and a jet E range, we can determine the gluino mass that would correspond to this energy range
 - Shown is for $m_{LSP} = 100$ GeV
 - Also did 200 and 300 GeV LSP mass... but results are even worse

Jet E (GeV)	Gluino Mass (GeV)	Observed Limit (pb)	Theoretical CS (pb)
120	270	.73	.5
180	380	.53	.05
250	510	.51	.001
400	810	.13	-

Table 4: The gluino mass, observed cross-section limit, and the theoretical cross-section for each jet energy, assuming an LSP mass of 100 GeV.

Limit Plot

- Can combine all these results together, on a single wonderful plot...



Conclusions / Future

- Aiming for a conference note for this winter, based on p14 PASS2 data
- Note is almost done... I'll send a draft to the conveners today!
-
- Unfortunately, we can't exclude any stopped gluino mass yet
 - Over half of the gluino energy goes into the LSP
 - Too much background from cosmics at low energy
 - Our muon rejection is 90%... they can come in at large angles outside the muon acceptance
 - Further background reduction would have to be done based on the jet shape / direction somehow
 - I made some attempts, but didn't make much progress... gave up for now
- Hopefully, people will still find it to be an interesting analysis
 - It should be able to exclude some light gluino masses with more luminosity and further analysis optimization
 - It sets the stage for a powerful LHC analysis
 - Much lower cosmic background (underground!)
 - Higher instantaneous luminosity (the background does NOT scale with luminosity!)
 - Higher energy beam

DØNote XXXX - Draft v0.00

DØ Search for Stopped Gluinos using p14 Data

Andrew Haas¹

1. Columbia University – USA

January 25, 2006

Abstract

A long-lived gluino is a generic prediction of many models of beyond the Standard Model physics, such as Split-SUSY. Some fraction of the hadronized gluinos (R-hadrons) can lose enough momentum to come to rest in the calorimeters. About 350 pb⁻¹ of Run II data reconstructed with p14 software is analyzed in search of stopped gluinos decaying into a jet and a neutralino. No excess is observed above the expected background from cosmic-muon induced showers, and limits are placed on the stopped gluino cross-section as a function of the gluino and neutralino masses.

