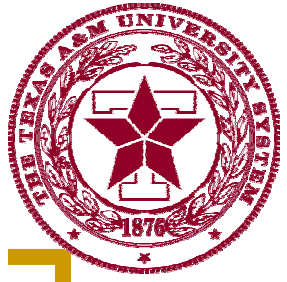


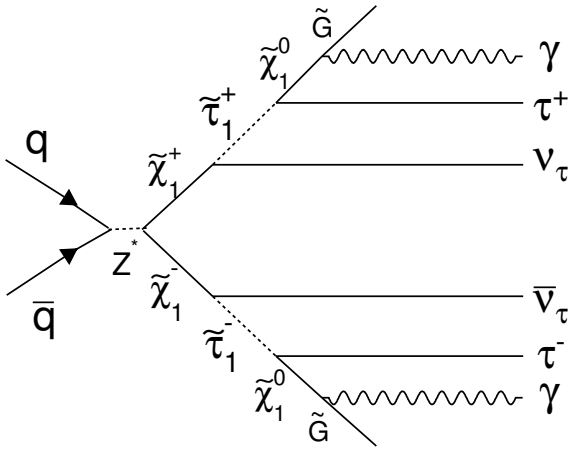
Search for Heavy, Long-Lived Neutralinos that decay via $\tilde{\chi}_1^0 \to \gamma \tilde{G}$

R. Culbertson, **M. Goncharov,** **V. Krutelyov,** ***Eunsin Lee***
A. Pronko, **D. Toback,** **P. Wagner**

Fermilab, Texas A&M University,

University of California at Santa Barbara, University of Pennsylvania

Dominant Signal Process (GMSB)



Looking for $\tilde{\chi}_1^0 \rightarrow \gamma + \tilde{G}$ with any lifetime

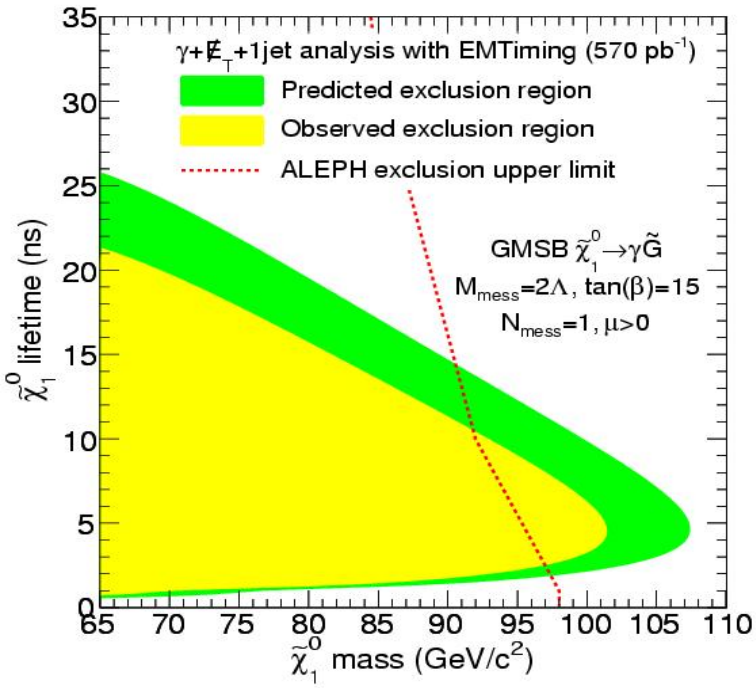
1) Both Neutralinos decay in the detector -> Two Photons

   $\gamma\ \gamma + \not{E}_T$ (Optimal for low lifetimes)

2) One Neutralino decays in the detector -> One Photon

   $\gamma + \not{E}_T + \text{Jets / IsoTrk}$ (Optimal for high lifetimes)

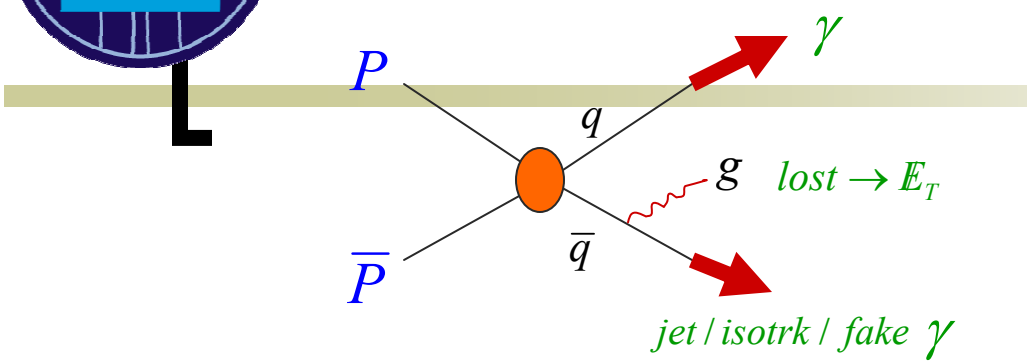
3) No Neutralinos decay in the detector -> No photons



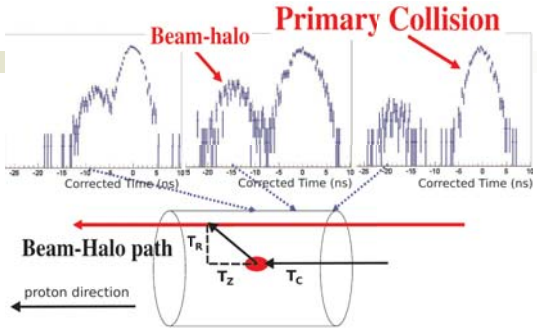
Delayed Photon Analysis
M.Gocharov, V.Krutelyov, E.Lee, D.Toback and P.Wagner
Accepted for Publication in PRL (2007)

Background Sources

Collision (SM) Background



Non-Collision Background : Cosmic and Beam Halo



Triggers, Data Sets and Final Objects with Preselection requirements

$\gamma + \not\!\!E_T + Jets$

Luminosity $= 2\ fb^{-1}$

(update with more luminosity)

$E_T^{\gamma} > 30\ GeV$

$|\eta_{Pho}| < 1.0$

$E_T^{jet} > 30\ GeV$

$|\eta_{Jet}| < 2.0$

$\not\!\!E_T > 30\ GeV$

W_NOTRACK trigger

$\gamma + \not\!\!E_T + IsoTrk$

Luminosity $= 2\ fb^{-1}$

(New idea)

$E_T^{\gamma} > 30\ GeV$

$|\eta_{Pho}| < 1.0$

$P_T^{trk} > 10\ GeV$

$|\eta_{IsoTrk}| < 1.0$

$\not\!\!E_T > 30\ GeV$

W_NOTRACK trigger

$\gamma\ \gamma + \not\!\!E_T$

Luminosity $= 2\ fb^{-1}$

(same)

$E_T^{\gamma} > 13\ GeV$

$|\eta_{Pho}| < 1.0$

$\not\!\!E_T > 20\ GeV$

DIPHOTON_12(iso) or DIPHOTON_18(no iso) trigger

Analysis Style and Current Dominant Analysis Issues

1) $\gamma + \not\!\!E_T + Jets$

-Following $\gamma + \not\!\!E_T + Jets$ Analysis Style from Goncharov, Krutelyov, Lee, Wagner and Toback

-Adding More Data

- Starting with Reproducing Max/Peter's numbers
- Same Background Estimation Techniques with more data
- GMSB Simulation (Acceptance)
- Full Optimization

2) $\gamma + \not\!\!E_T + IsoTrk$

-This is NEW and Promising idea (complimentary to g+Met+jets where jets are mostly leptons and no isotrks in dominant bkg)

- Background Estimation
- GMSB Simulation (Acceptance)
- Full Optimization

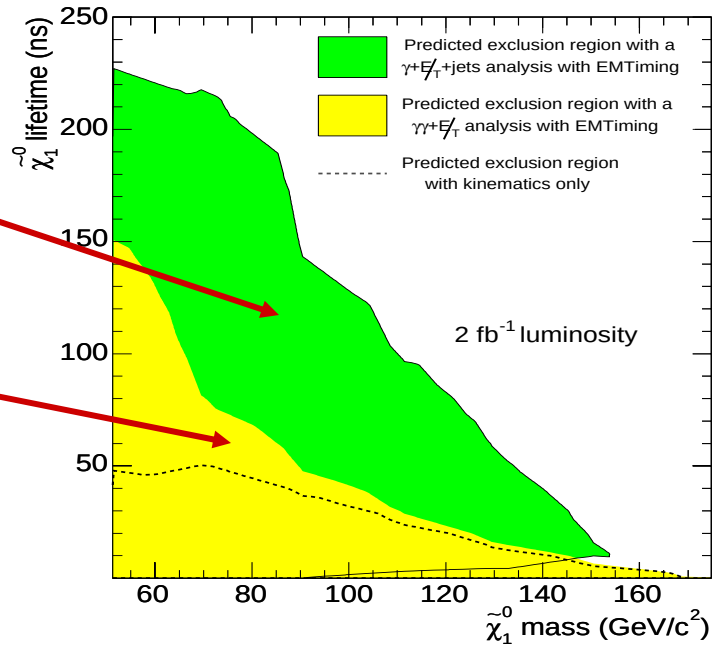
3) $\gamma\ \gamma + \not\!\!E_T$

- Following $\gamma\ \gamma + \not\!\!E_T$ Analysis Style from Culbertson, SW Lee, MS Kim and Toback (new data with Culbertson, Pronko and Toback)
- Checking if its optimized
- GMSB Simulation (Acceptance)
- Full Optimization

Combine All Three Analyses -Sensitivity at low AND high neutralino lifetimes

Expected Sensitivity from $\gamma + \not\!\!E_T$ + Jets / IsoTrk

Expected Sensitivity from $\gamma\ \gamma + \not\!\!E_T$



The prospective sensitivity D.Toback and P.Wagner, Phys. Rev. D 70, 114032 (2004)

Documentation

1) $\gamma + \not\!\!E_T + Jets$ 2) $\gamma + \not\!\!E_T + IsoTrk$ 3) $\gamma\ \gamma + \not\!\!E_T$

CDF note
8016, 8015, 7960, 7929,
7928, 7918, 7915
Accepted for Publication in PRL

A new CDF note
In progress

CDF note
6389, 6317, 6310
Phys. Rev. D 71 031104(R) (2005)
with $200\ pb^{-1}$
Blessed with $2\ fb^{-1}$
A new CDF note In progress

Journals to be submitted to

$\gamma + \not\!\!E_T + IsoTrk$ **To PRL**

$\gamma\ \gamma + \not\!\!E_T$ **To PRL**

→ **Combined To PRL**

Future Plan

- **Next Talk Schedule in Two Weeks**
- **Next Steps : Getting Preliminary Results and Preblessing**