Phenomenology of Degenerate Gauginos

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Work done with Stuart Raby and Archana Anandakrishnan

-Motivate degerate gaugino scenarios

-Event topologies

-Existing ATLAS search for very degenerate region

-New work on sensitivity analysis

-Prospects and Conclusions

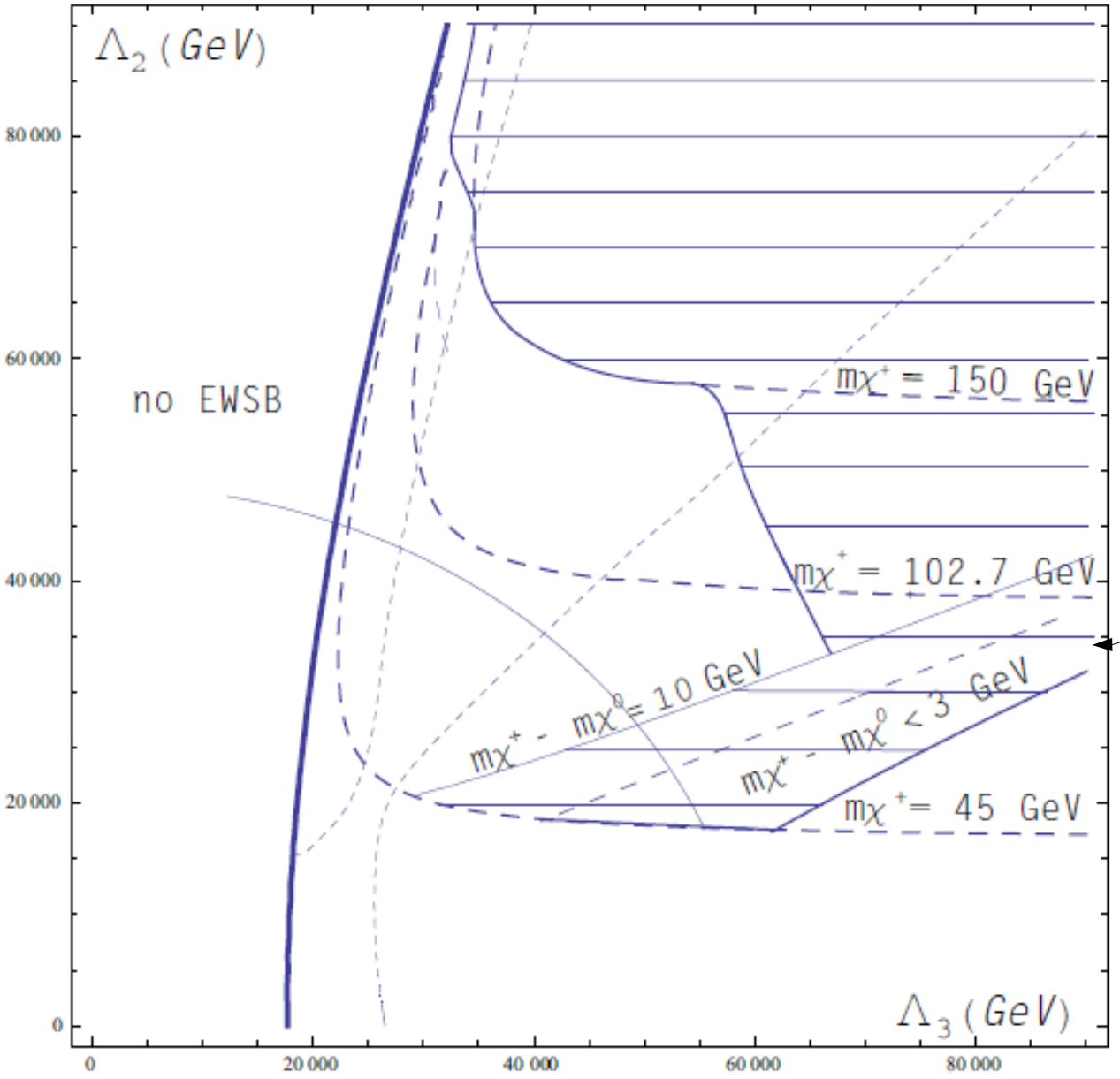
Dengenerate SUSY scenarios

Wino-Like LSP M2 <M1,

Higgino-Like LSP

This feature shows up in many SUSY scenarios: AMSB, Mirage Mediation, General scenarios with non-unified gaugino masses, Higgino world, High Scale Gauge Mediation

2-Parameter GGM



Degenerate Gaugino Region

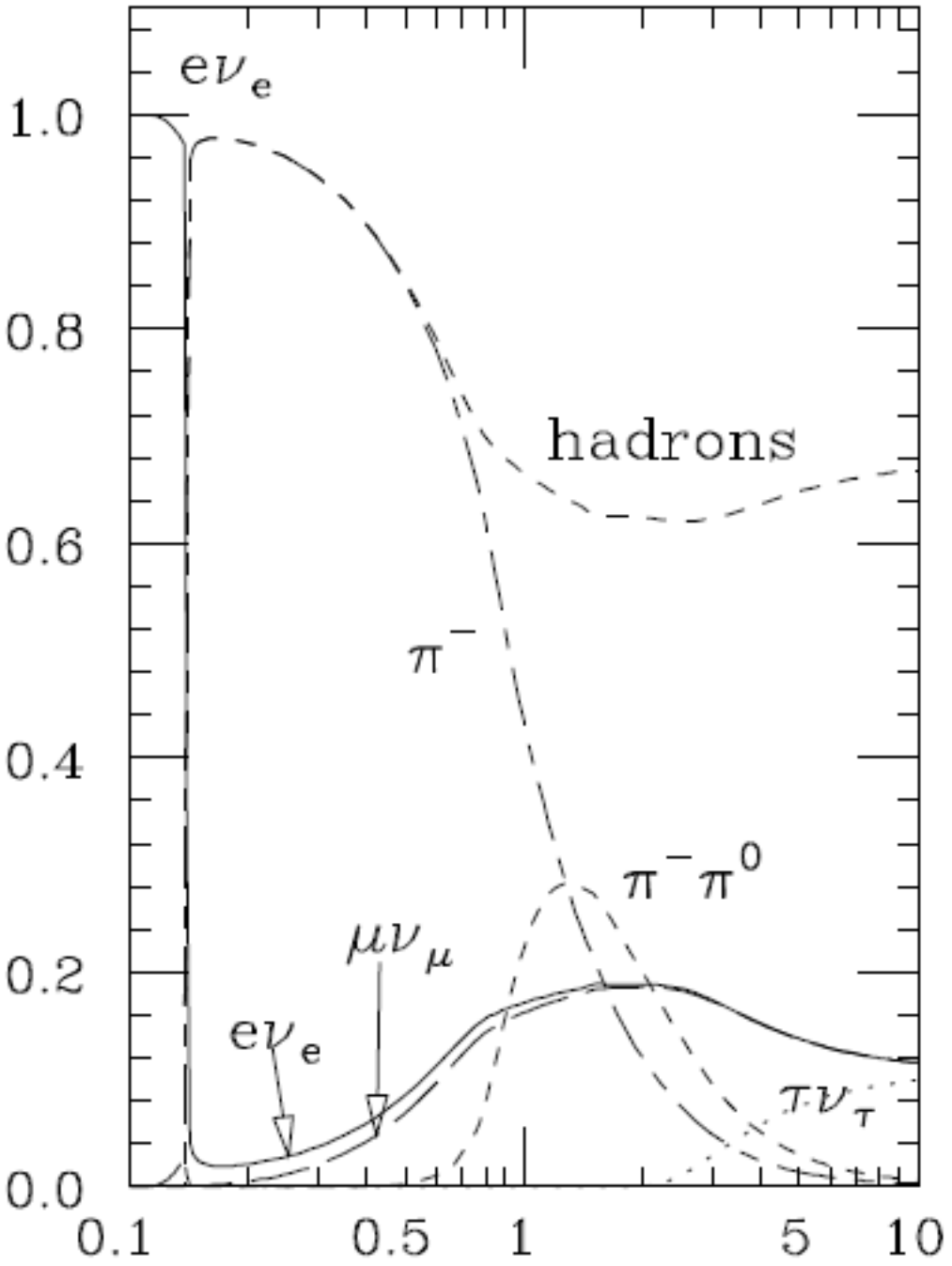
NUHM	"Just-so"	D-term
m_{16}	5000	5000
$\sqrt{D}$	1877	1242
m_{10}	6097	5261
A_0	8074	5593
μ	-615	-1294
$M_{1/2}$	-105	-100
α	11.59	12.00
$M_{CUT} \times 10^{-16}$	4.50	2.38
$1/\alpha_{CUT}$	25.11	25.64
ϵ_3	-0.039	-0.007
λ	0.59	0.56
$\tan\beta$	49.43	48.73
M_A	1558	1237
$m_{\tilde{t}_1}$	1975	2021
$m_{\tilde{b}_1}$	2049	2159
$m_{\tilde{\tau}_1}$	2473	3801
$m_{\tilde{g}}$	4905	5081
$m_{\tilde{u}_L}$	4944	4487
$m_{\tilde{u}_R}$	4947	4477
$m_{\tilde{\chi}_1^0}$	231.98	219.11
$m_{\tilde{\chi}_1^+}$	232.05	219.11
$\Delta M = M_{\chi^+} - M_{\chi^0}$	0.519	0.438
$M_{\tilde{g}}$	882	874

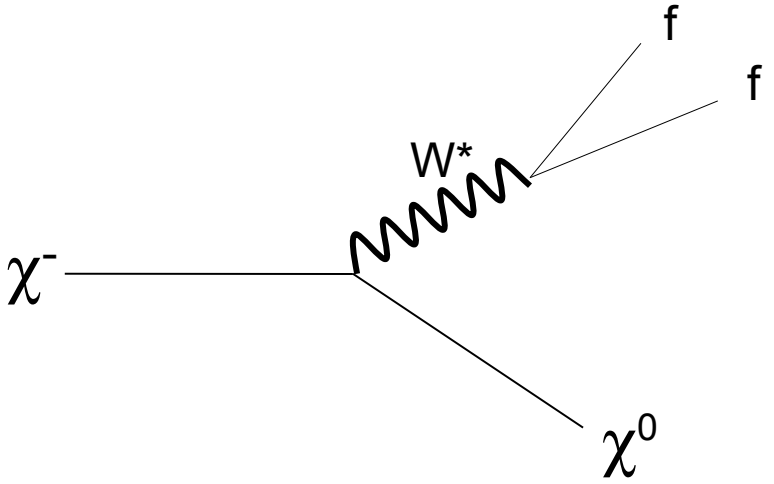
Mirage Mediated Spectrum

There is a limit to the amount of degeneracy between the lightest chargino and neutralino.

1-loop effects ensure that $\Delta m > \sim 100\text{MeV}$

Branching Fractions

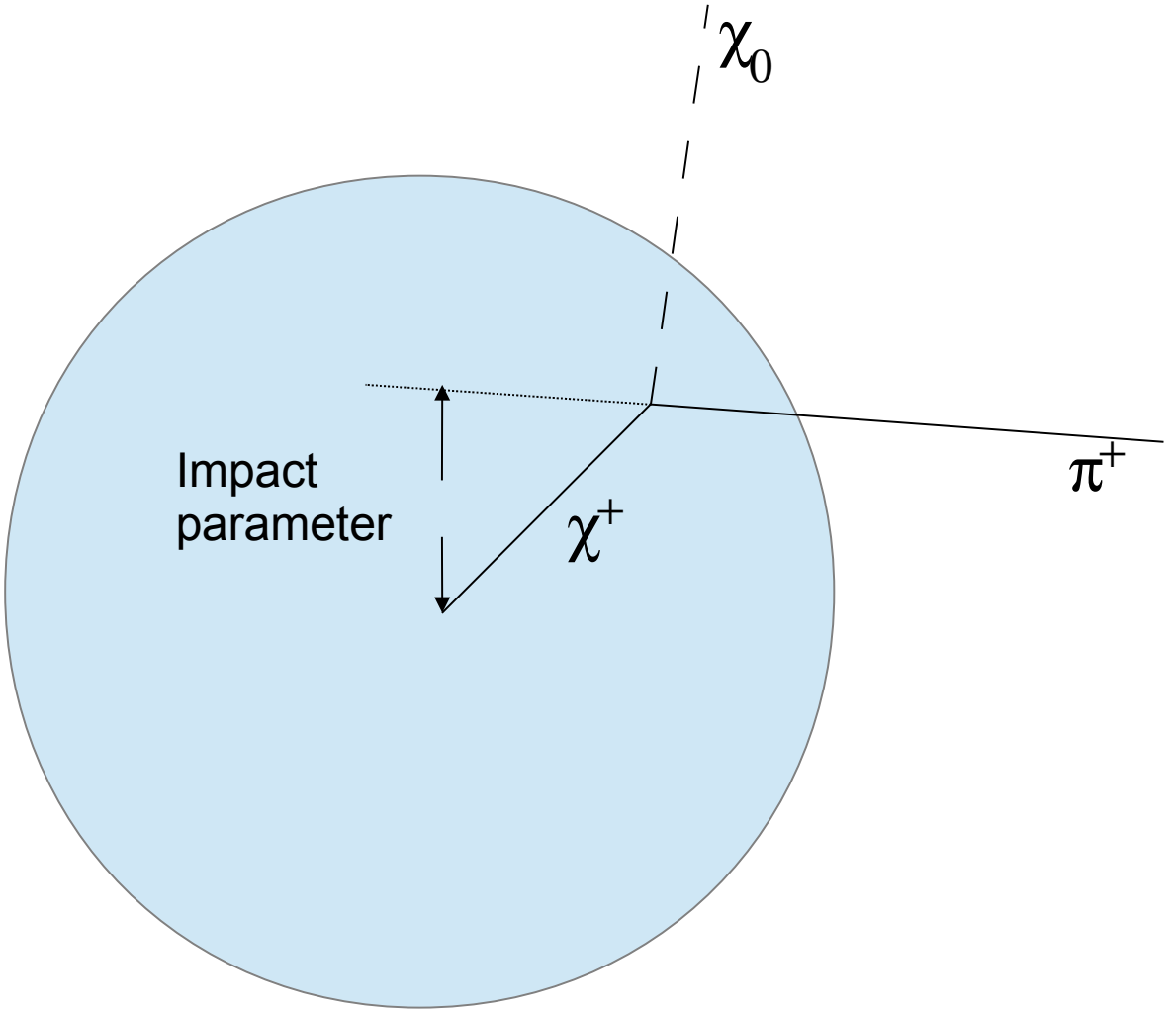




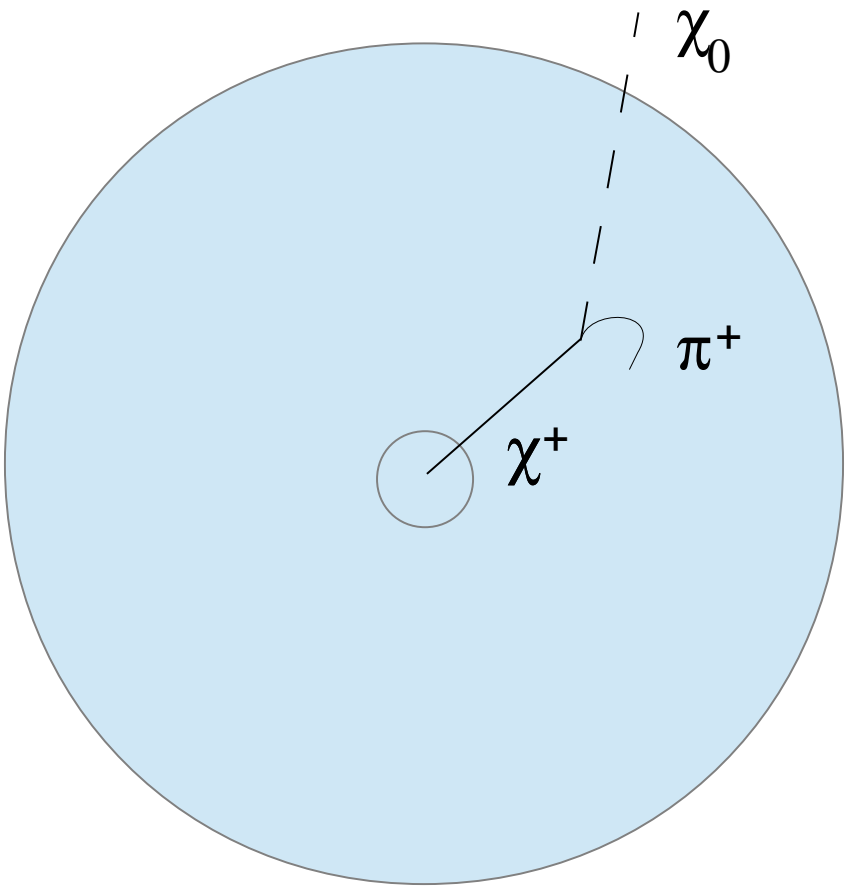
Degenerate case ı m < few GeV, normal search channel is inadequate

The resulting signal becomes non-standard.

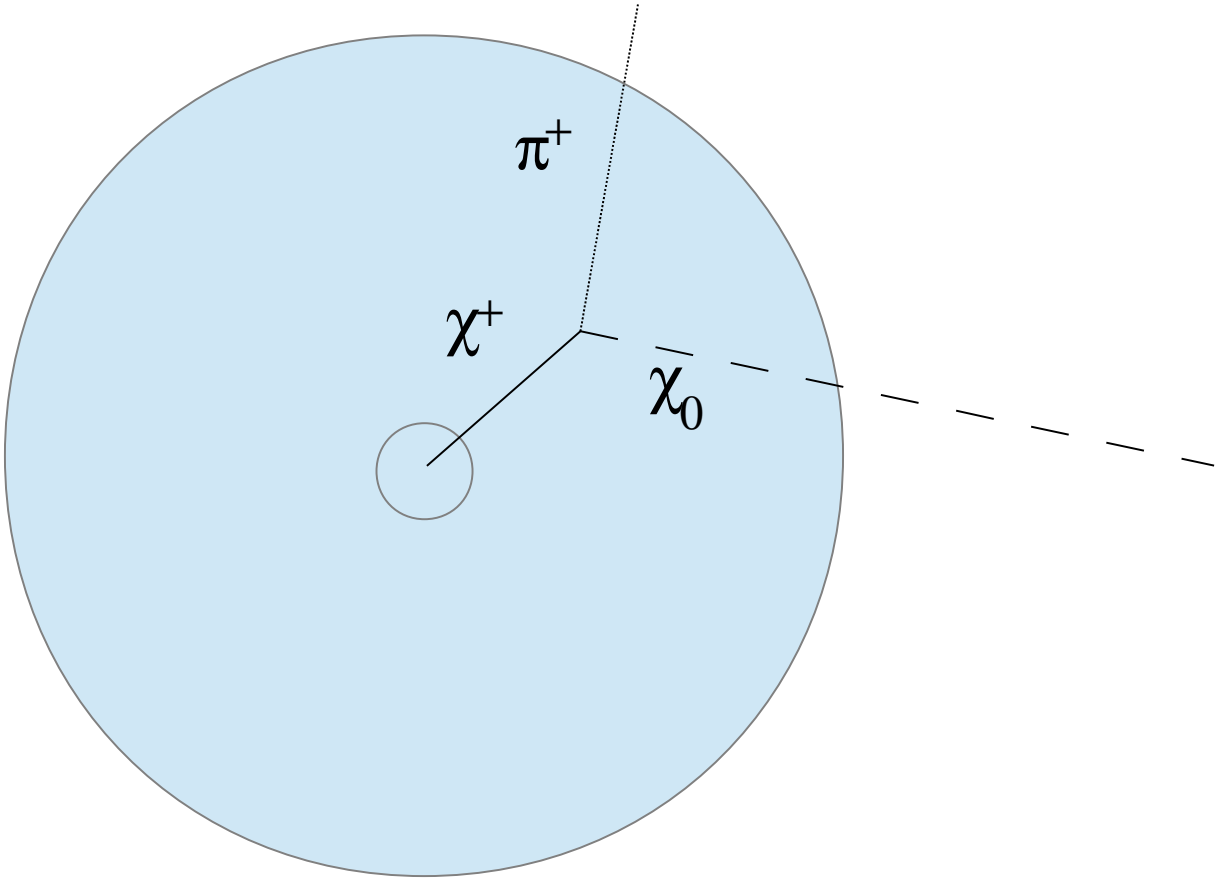
Large impact parameter



Disappearing Track

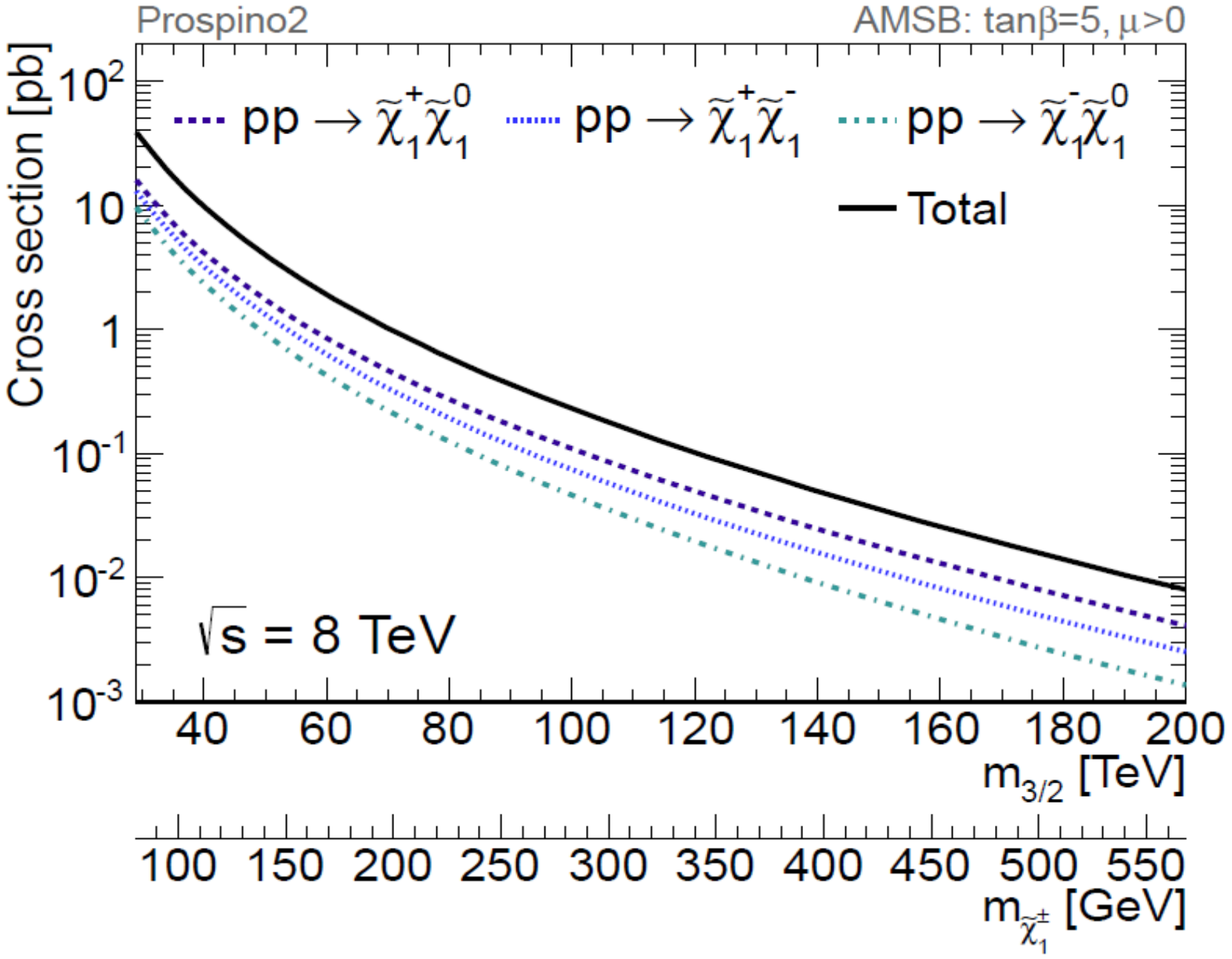


Kink



From ATLAS

Production xsec

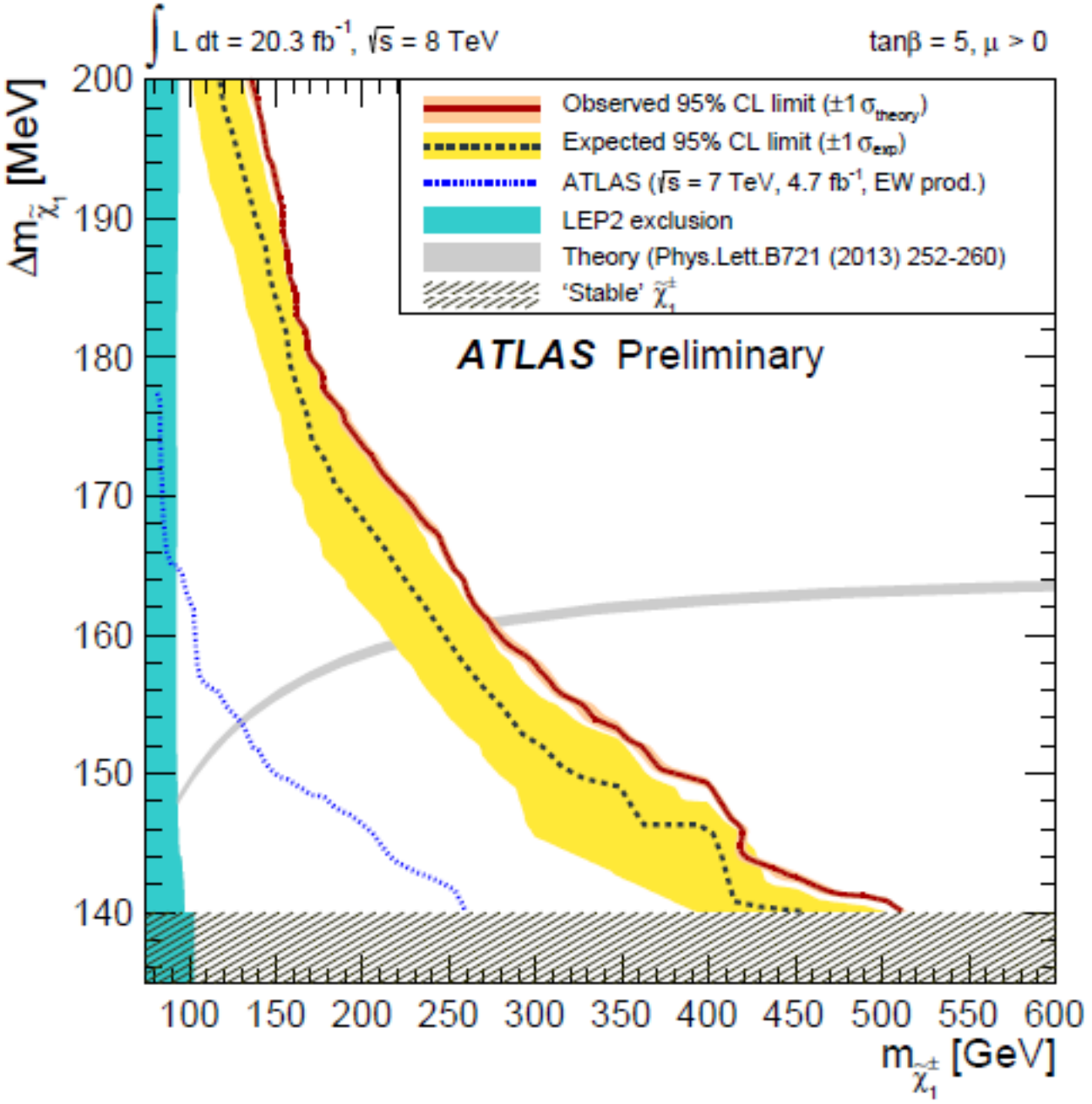


ATLAS Disappearing Track Search

-Isolated track pt > 400 MeV, which makes it through no more than 5 layers of the TRT

-Must trigger on hard ISR jet pt > 90 GeV

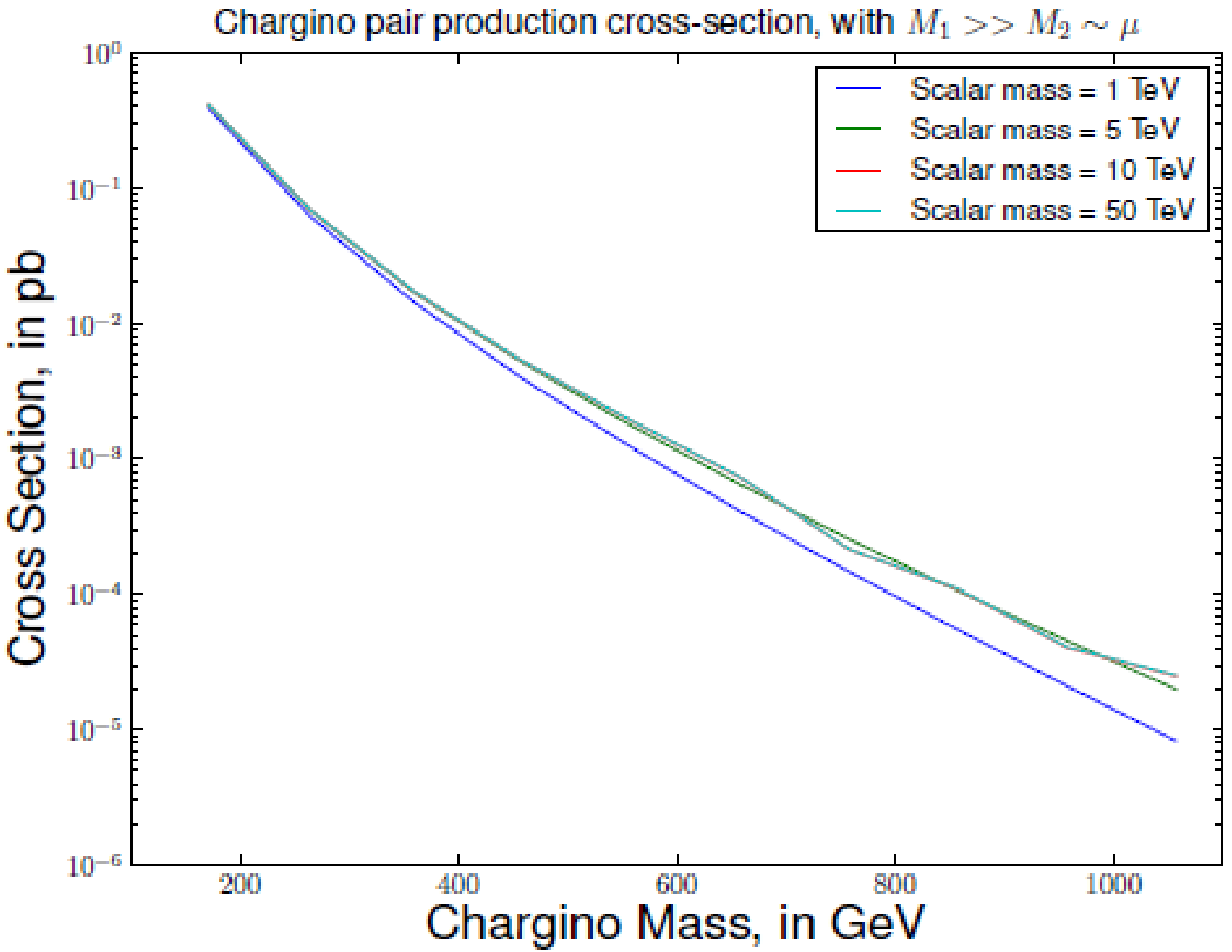
- missing E_T > 90 GeV


∫ L dt = 20.3 fb-1, √s = 8 TeV
tanβ = 5, μ > 0
Observed 95% CL limit (±1 σtheory)
Expected 95% CL limit (±1 σexp)
ATLAS (√s = 7 TeV, 4.7 fb-1, EW prod.)
LEP2 exclusion
Theory (Phys.Lett.B721 (2013) 252-260)
'Stable' χ̃1±
ATLAS Preliminary
Δm(χ̃1±) [MeV]
200
190
180
170
160
150
140
100 150 200 250 300 350 400 450 500 550 600
m(χ̃1±) [GeV]

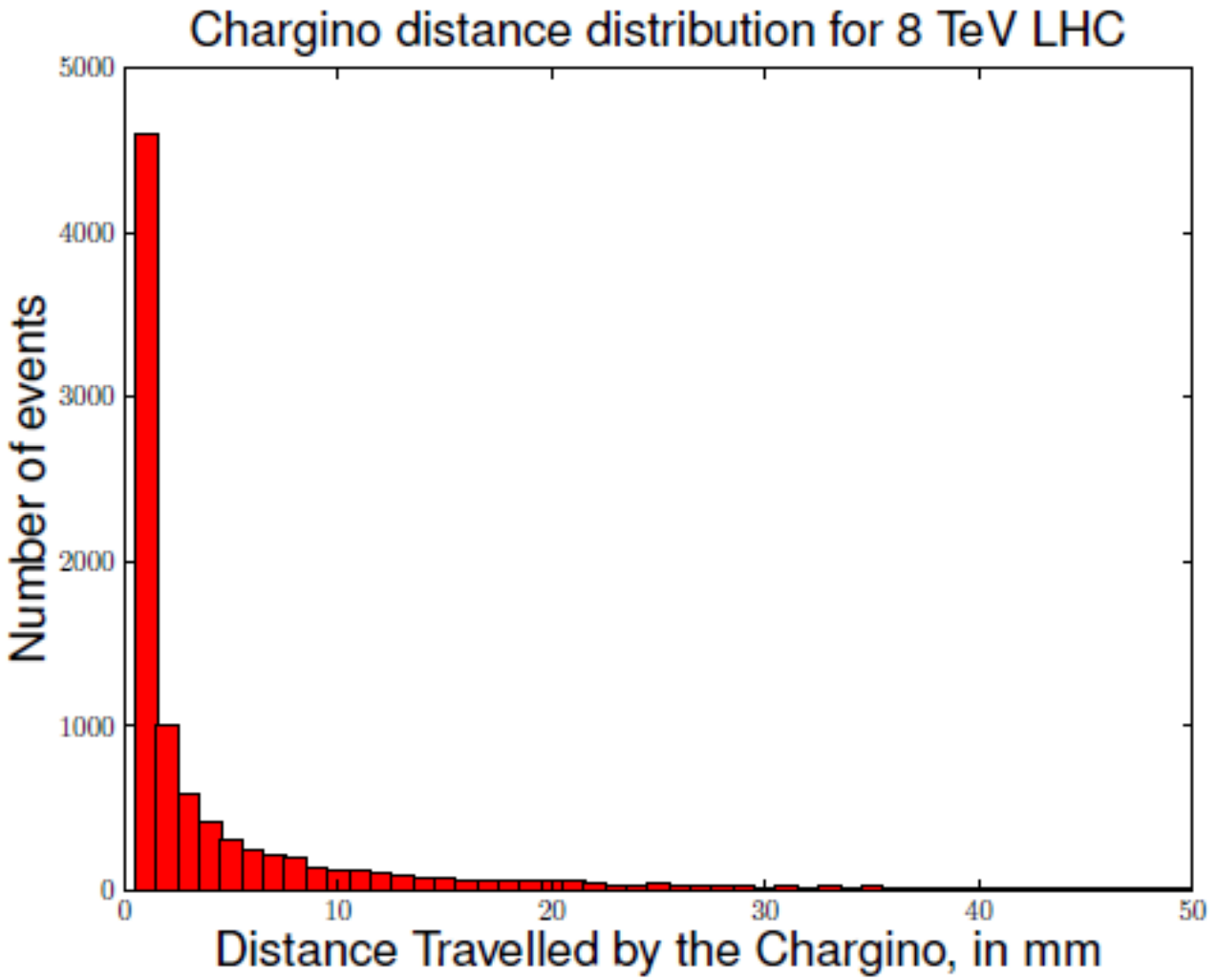
Δm ~150 GeV, pion will be extremely soft, its track will not propogate deeply into the vertex detector-- dissapearing track search

For larger Δm pion track is harder and propogates through the TRT disappearing track search is insufficient, must rely on other topologies

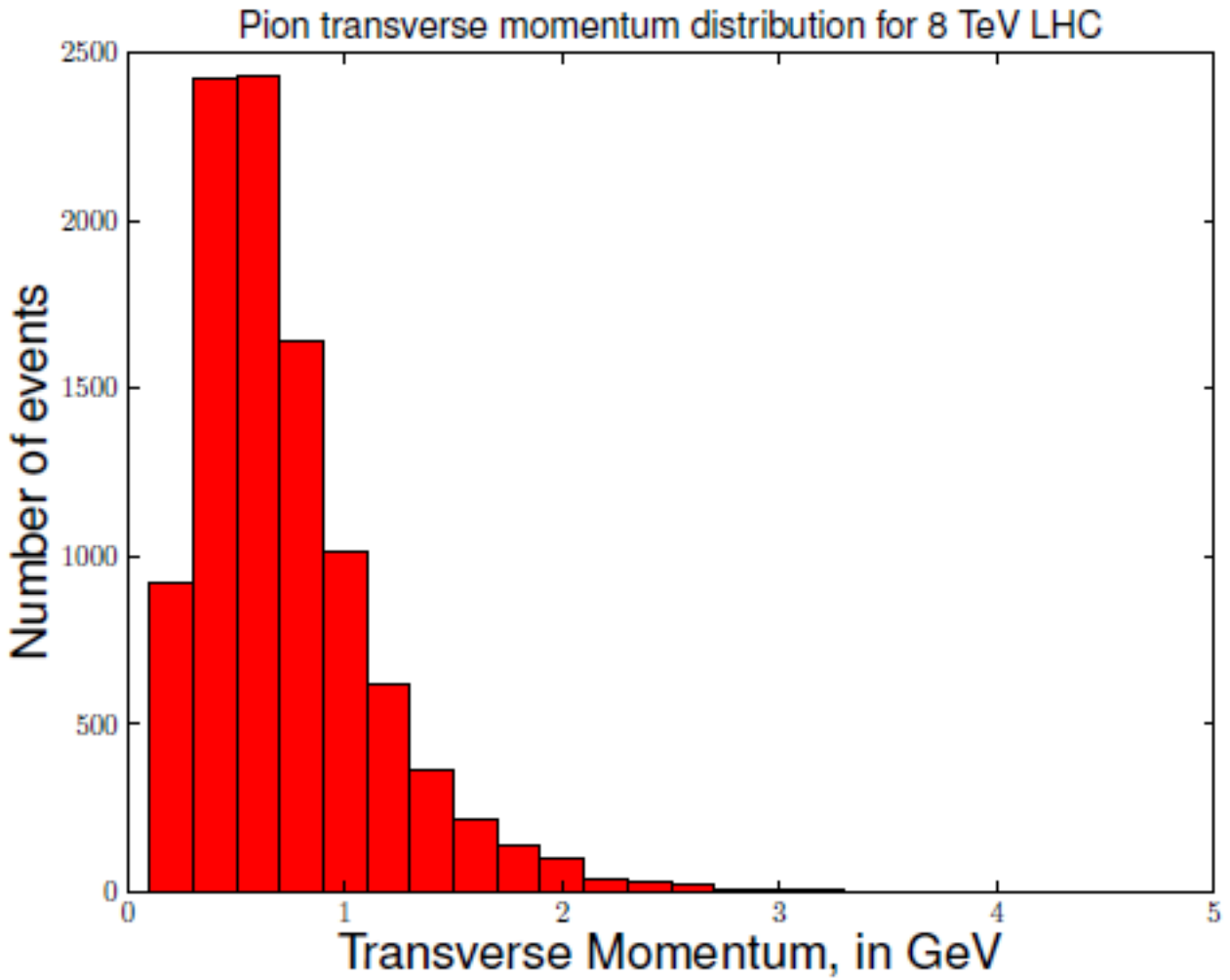
Production xsec varies with scalar masses



Distance Traveled



Pion Momentum Distribution



-General Phenomenology of degenerate gaugino scenarios contains many interesting event topologies

-develope a sensitivity search for kinks and large impact parameters to a general class of Mirage Mediation Models

- Attempt a sensitivity search attempting to trigger on isolated intermediate energy pions,and EW boson ISR