SEARCHES FOR LONG-LIVED EXOTIC PARTICLES WITH THE ATLAS DETECTOR

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University of Victoria

Three recent ATLAS searches for massive exotic long-lived particles are presented using 2011 data. No new physics has been found but limits have been set and tools for future searches have been developed. New improvements are under way using timing, ionization, displaced vertices, and other unique signatures in several ATLAS sub-detectors and full 2011 data. Searches for new physics will be even more exciting in 2012 as we move to 8 TeV!

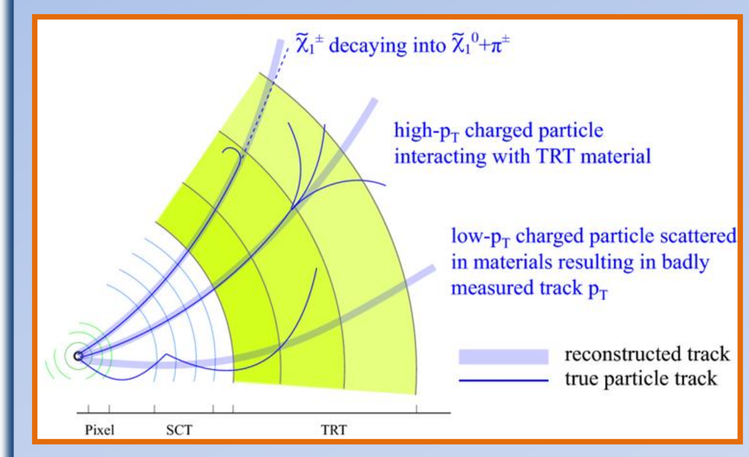
Search for AMSB based on high-Pt disappearing-track signature

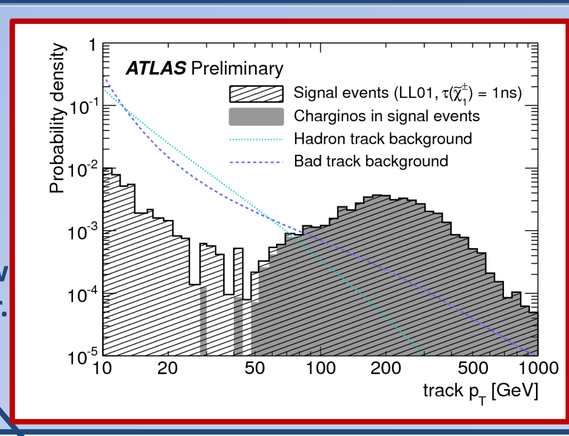
ATLAS-CONF-2012-034

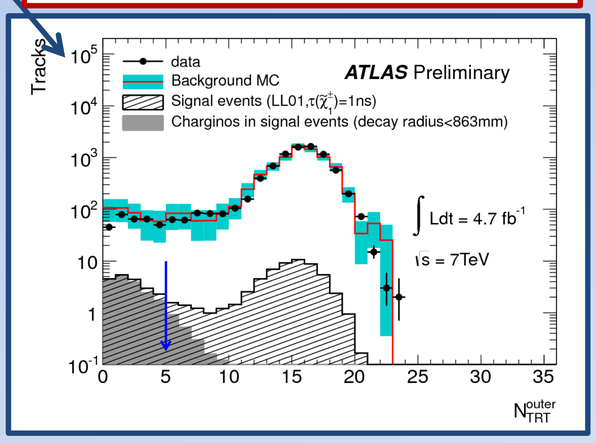
In models of anomaly-mediated supersymmetry breaking (AMSB), the lightest chargino is predicted to have a long lifetime due to a small mass difference. The chargino decays to the LSP neutralino and a low-pT pion. The LSP leaves the detector allowing a trigger on a high-pT jet plus missing energy.

Candidates are identified as high-pT tracks with few hits in the outer part of tracker.

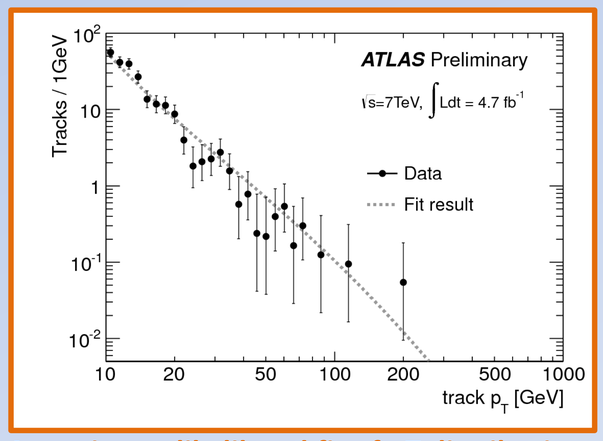
There are two major backgrounds – hadronic interactions and mismeasured tracks.



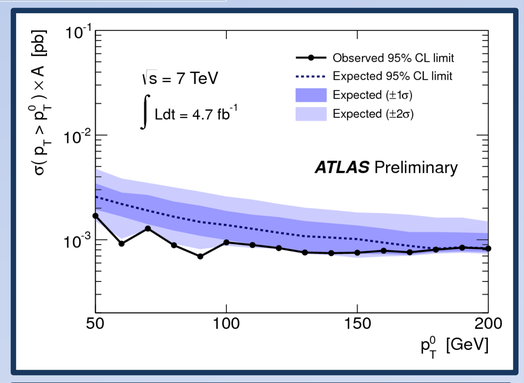


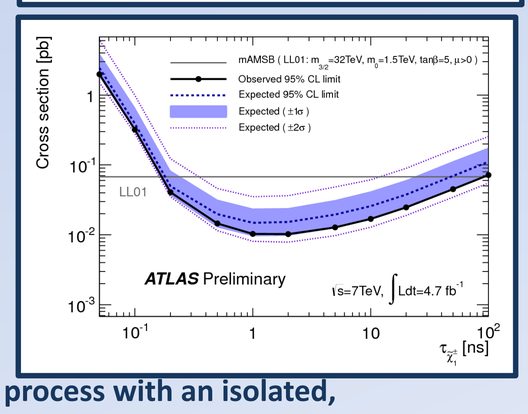


The pT distributions are modeled for the high-pT hadron track (non-disappearing tracks) and for the mismeasured track (no pixel hits, low missing energy) background control samples as well as the signal



A maximum likelihood fit of pT distributions to data shows no signal contribution.



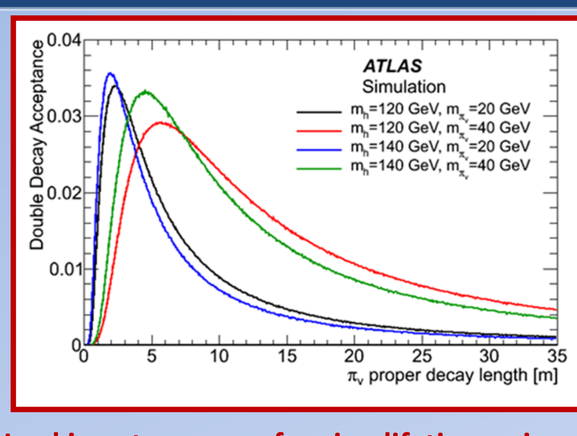


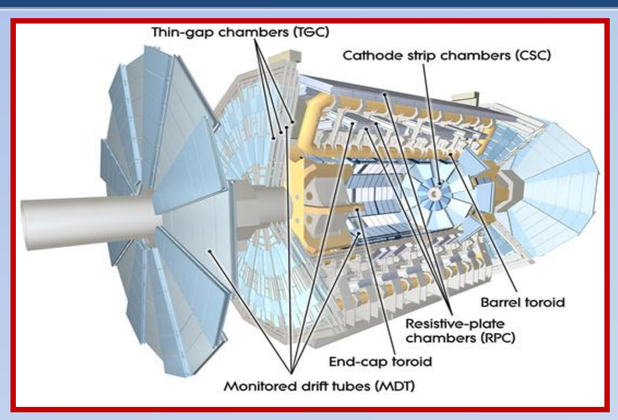
Model-independent limit for a new physics process with an isolated, disappearing track (upper) as well as limits on the signal cross section as a function of chargino lifetime for m(chargino) = 90.2 GeV (lower) are shown.

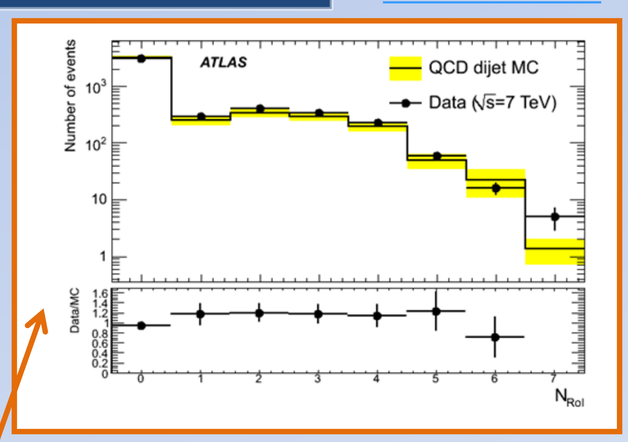
Search for a light Higgs boson decaying to long-lived weakly-interacting particles

arXiv:1203.1303v2

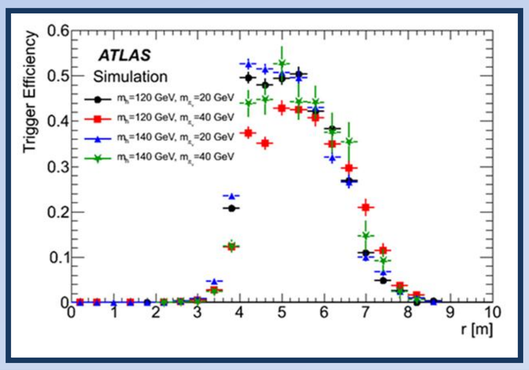
One extension of the standard model is a hidden sector (or v-sector) where a light Higgs communicator interacts with both sectors. The communicator's high mass and weak couplings create a barrier which hides the v-sector and makes production of v-particles very rare at low energies. Some v-particles may be stable (dark matter candidates) while others may decay to Standard Model particles, but their production may be observable at the LHC through displaced vertices.





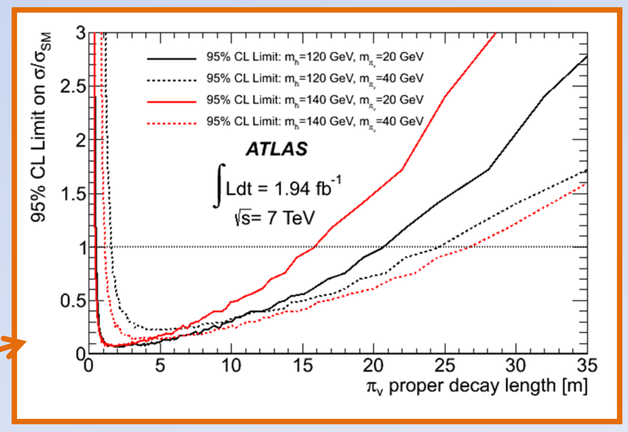


Looking at a range of v-pion lifetimes gives decay signatures throughout the detector. Decays near the muon system (from 4.5-11 m) have been used by searching for vertices of > 3 muon regions of interest (ROIs) not pointing back to the interaction point.



A special trigger has been designed to improve efficiency by about an order of magnitude at high radius.

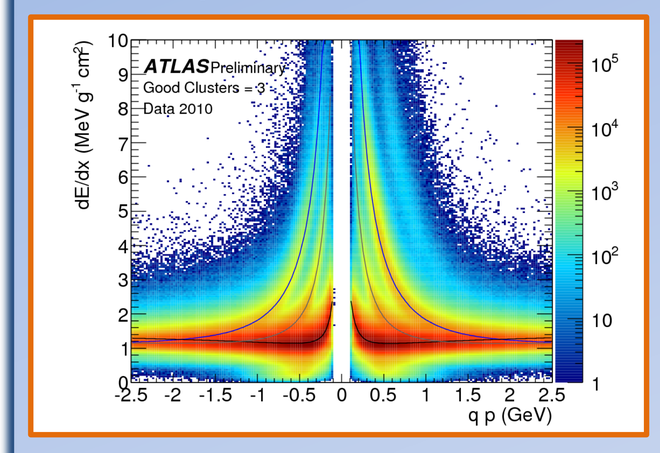
Zero events meeting the analysis selection are observed in 1.94 fb^{-1} of pp collisions. Exclusion limits assume 100% branching ratio for low-mass Higgs to v-pions.



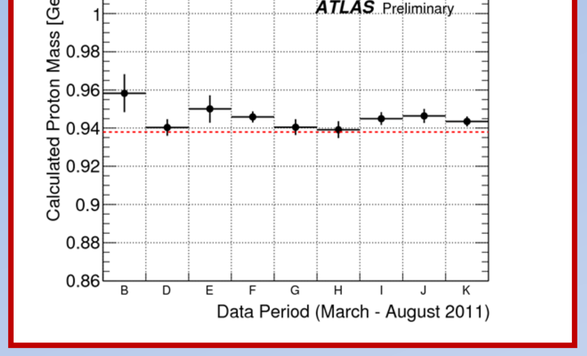
Search for charged long-lived heavy particles with the ATLAS Experiment at the LHC

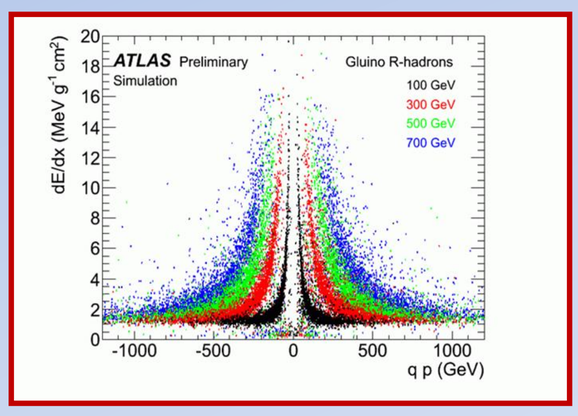
ATLAS-CONF-2012-022

R-hadrons are SUSY particles with color charge which can become neutral through hadronic interactions inside the detector. They are charged, long-lived heavy particles which have β < 1, resulting in high ionization.

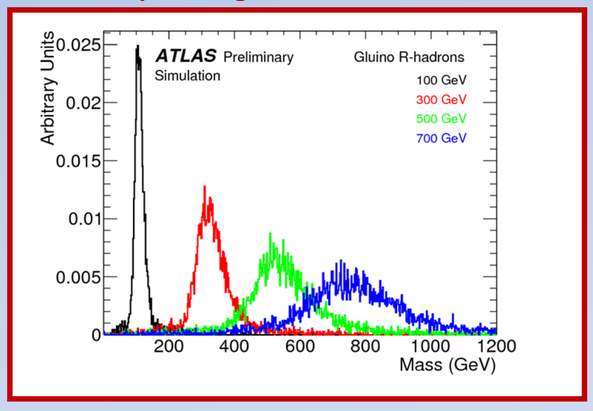


The Pixel sub-detector provides an indicator for high ionization close to the interaction point. It uses minimum bias events to calibrate a dE/dx measurement.

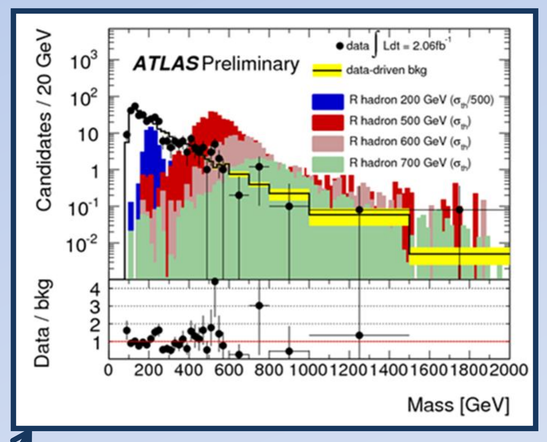


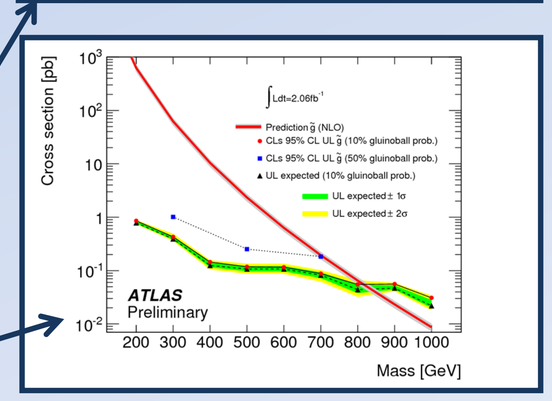


dE/dx is used to determine a β via Bethe-Bloch and then a mass using momentum. This conversion is calibrated using protons and extrapolating to R-hadrons.



Candidates are isolated, high momentum tracks. 333 are observed in data as is consistent with data-driven background estimation. With some model dependent assumptions, this can be interpreted as excluding gluino R-hadrons with masses smaller than 810 GeV.





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CHRISTOPHER MARINO, University of Victoria, ON BEHALF OF THE ATLAS COLLABORATION