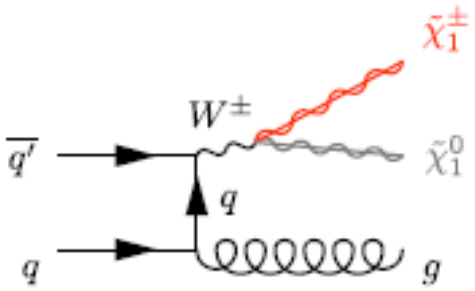
Long-lived Chargino

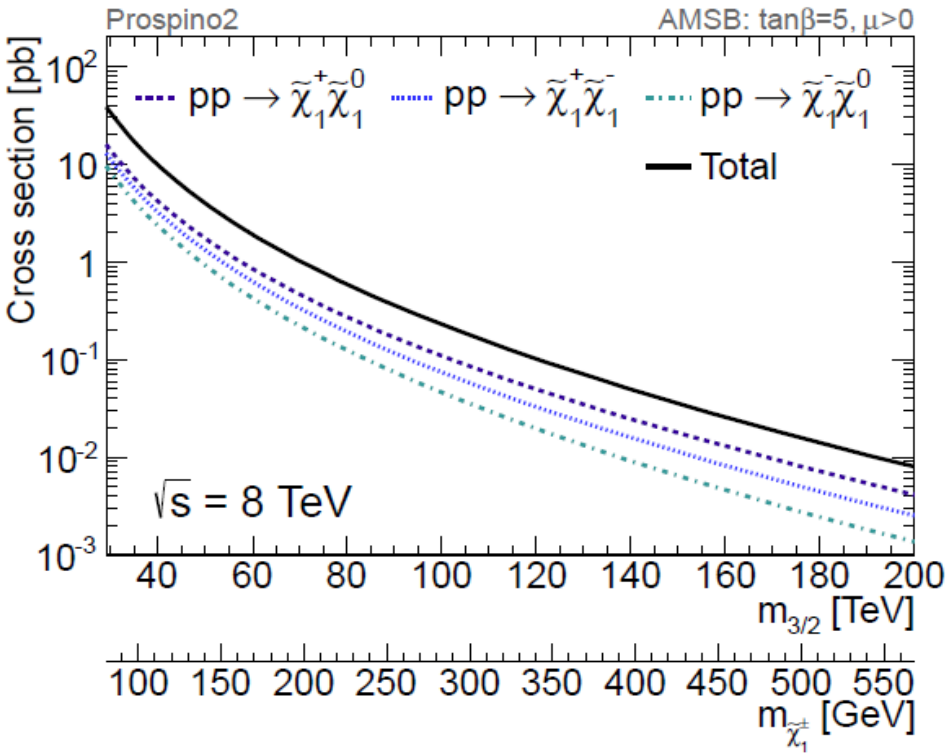
- Chargino becomes long-lived when nearly-degenerate with the LSP

- Light Wino and Bino, heavy Higgsinos, Wino LSP
  - Lifetime ~50 mm, $\Delta m \sim 165$ MeV from EW contribution
- Higgsino LSP, only light Higgsinos
  - Lifetime ~5 mm, $\Delta m = \frac{1}{2}\,\alpha\, m_Z = \sim 355$ MeV

$$pp \to \tilde{\chi}_1^{\pm}\tilde{\chi}_1^0 + \text{jet}\ ,\ pp \to \tilde{\chi}_1^{+}\tilde{\chi}_1^- + \text{jet}$$

Need pT>90 GeV ISR for MET trigger:
~15% of cross-section



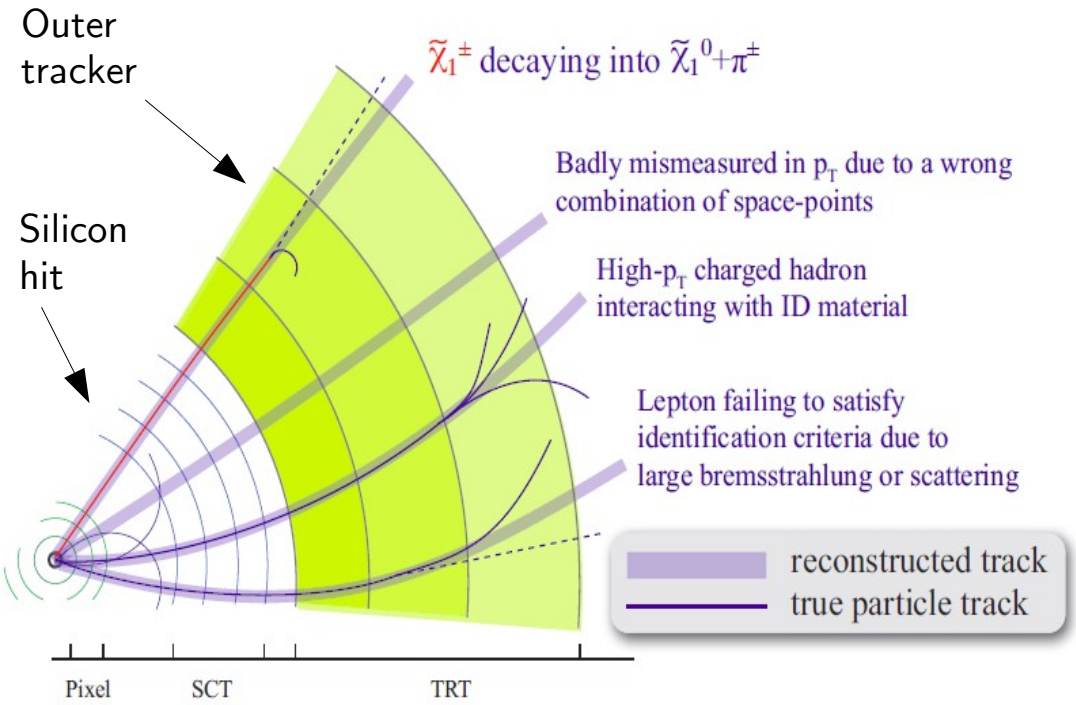


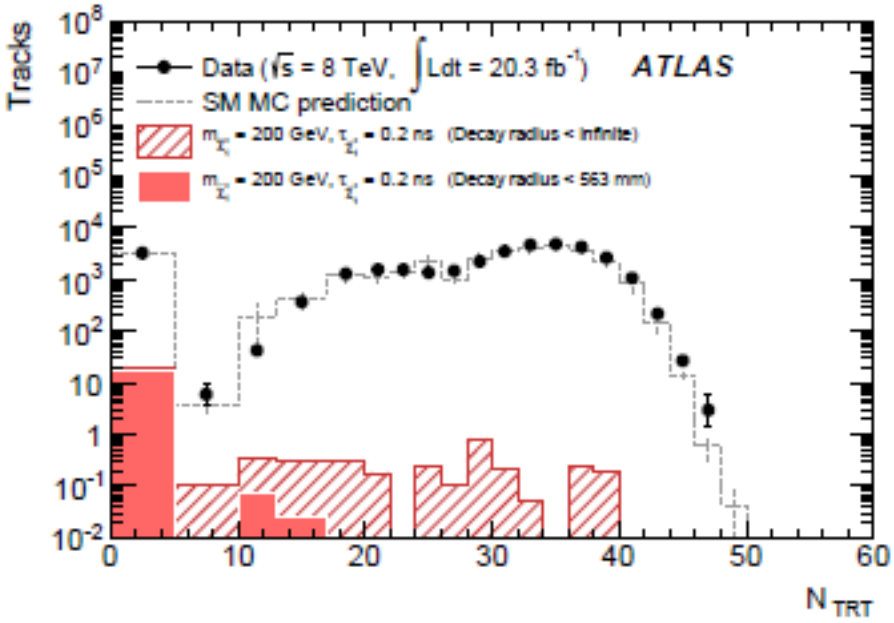
Disappearing track search

arxiv:1310.3675

- Chargino travels through some layers
  then decays to a soft pion (not reconstructed) + MET

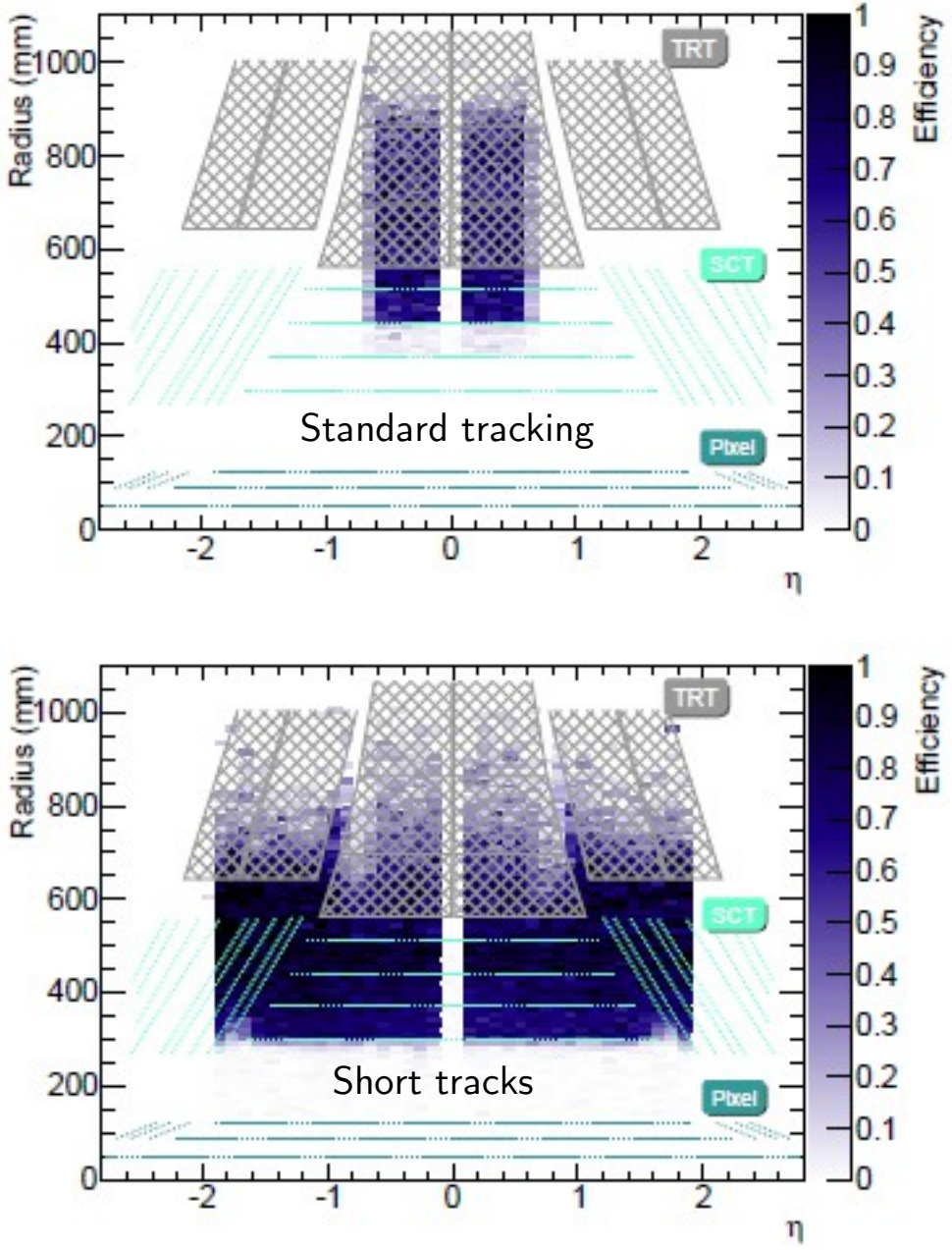
- Look for high-pt isolated track with few hits in outer tracking layer
  - Track needs at least 3 inner pixel hits and 1 silicon strip hit
  - Require <5 outer-tracker (TRT) hits





Improved disappearing track search

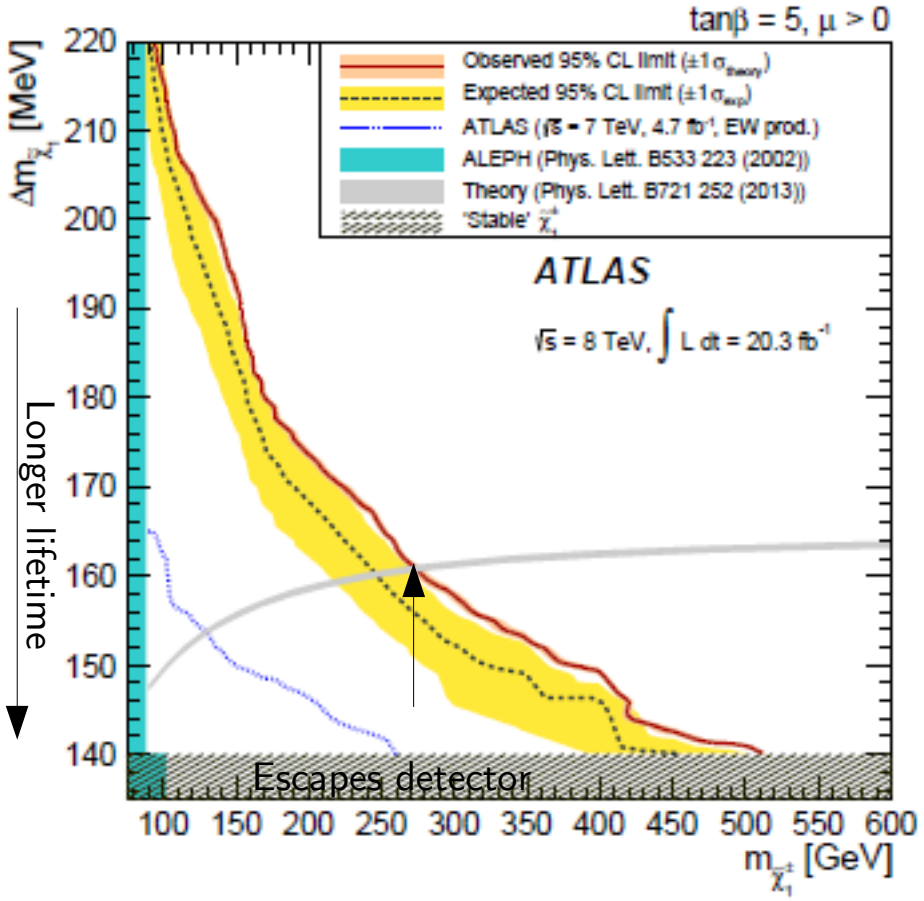
- Large improvement from customized track reconstruction
  - *(Needs access to data with all tracker hits saved...)*
- Require just 1 Si strip layer (instead of 3) and no TRT
  - Decay volume moves to r>~300 mm and widens
  - Efficiency 100x larger for cτ=50mm (165 MeV)

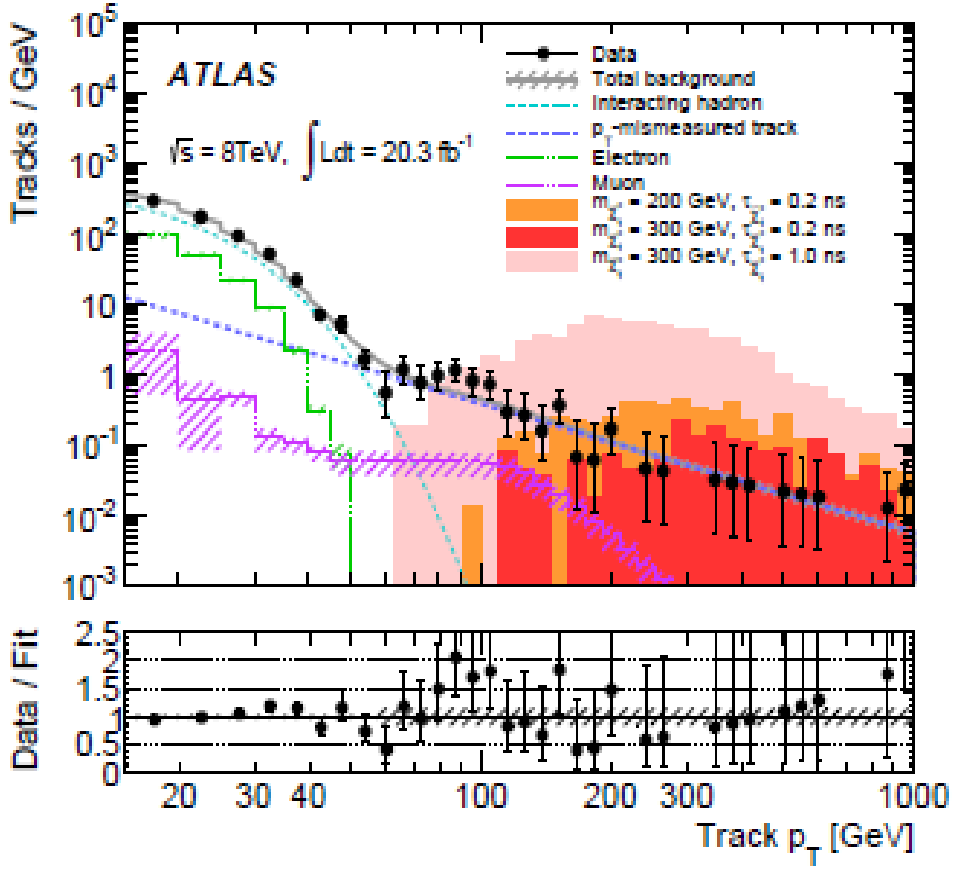


Disappearing track search

- Background track pT shapes fit to data
  - No excess seen at high pT :(

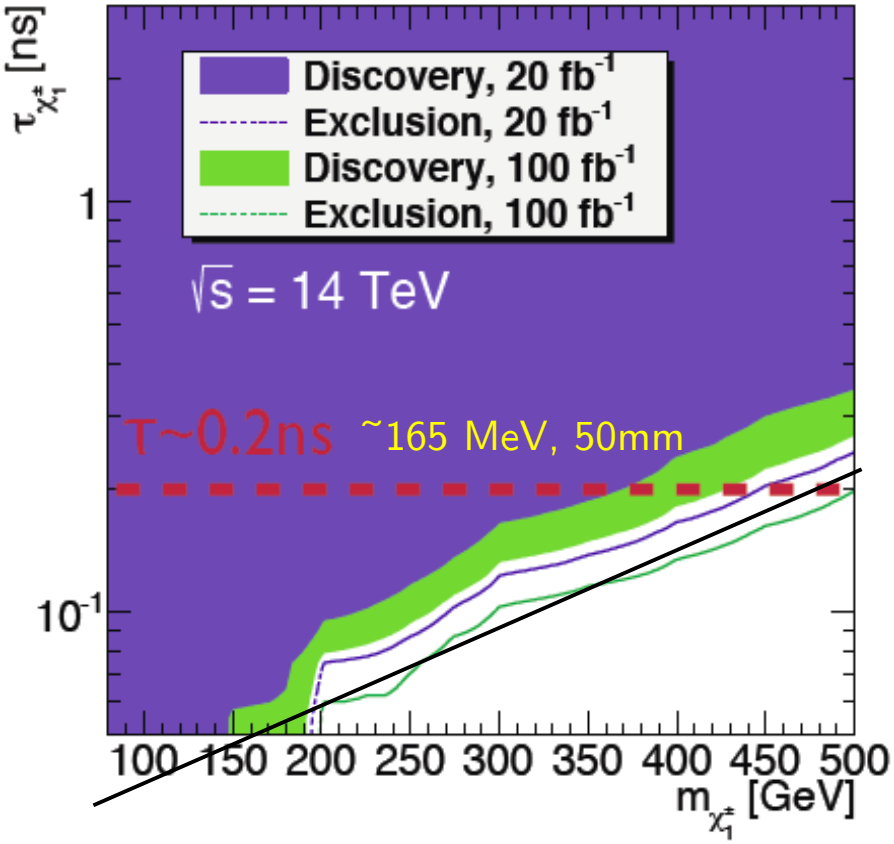
- Exclude chargino <270 GeV in AMSB with Δm~165 MeV





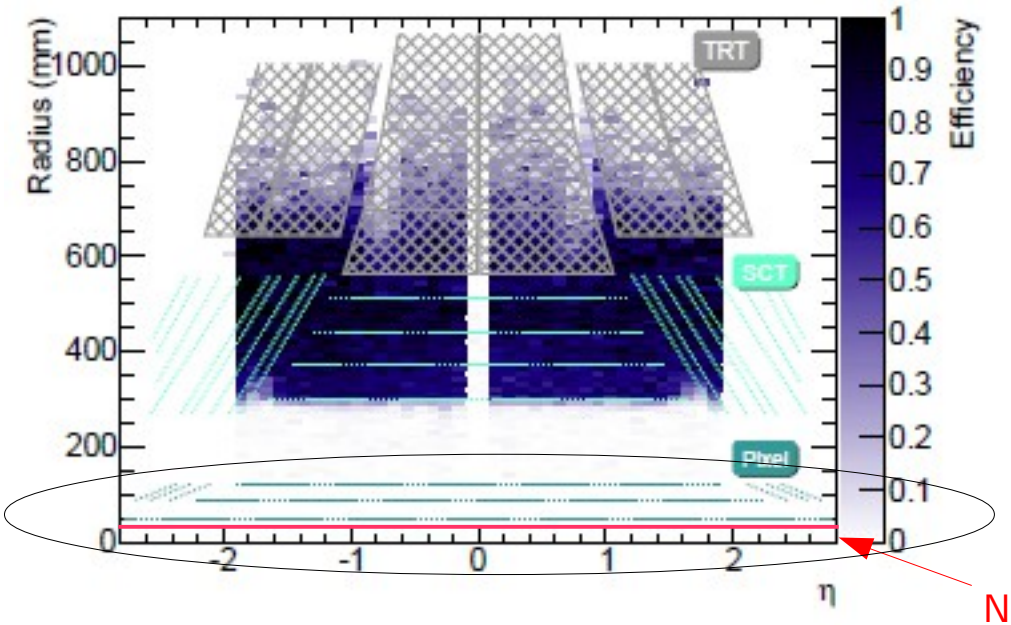
Improved disappearing track search

- Eventual sensitivity with 14 TeV and *same short-track analysis* ~500 GeV for Δm~165 MeV
- Going to need even shorter tracks to reach the ~5 mm lifetime case...

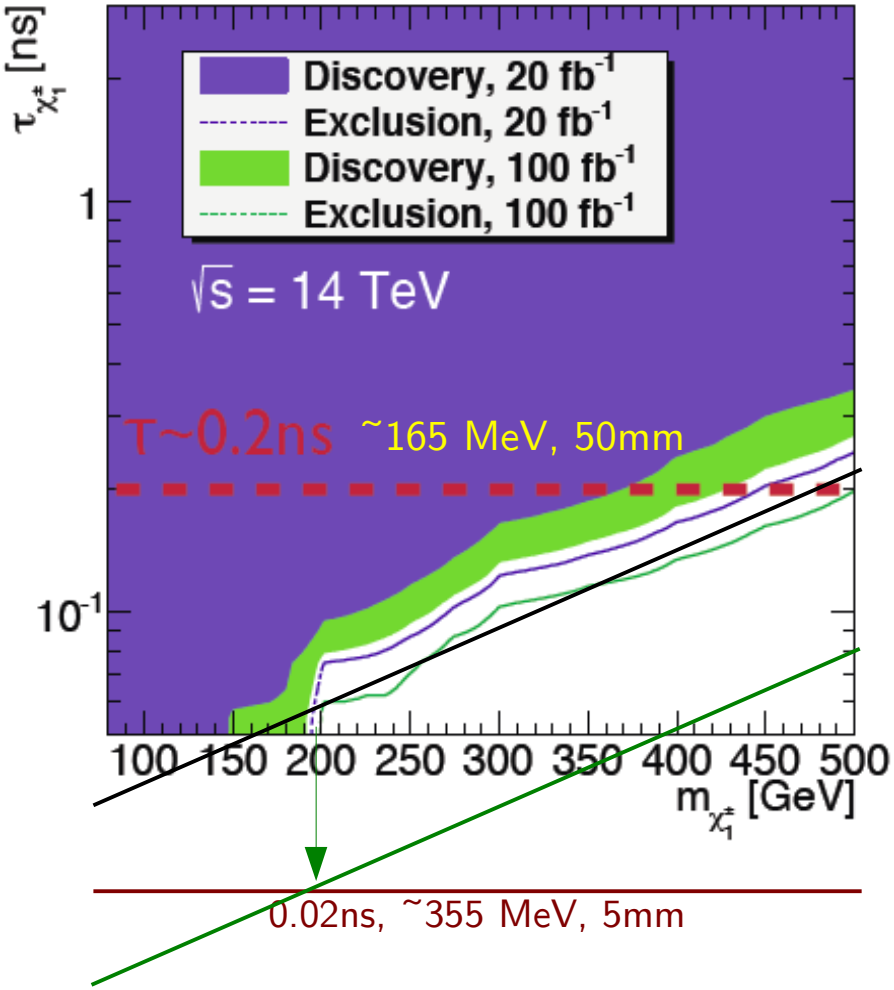


Improved disappearing track search

- Eventual sensitivity with 14 TeV and *same short-track analysis* ~500 GeV for Δm~165 MeV
- Going to need even shorter tracks to reach the ~5 mm lifetime case
  - Insertable B-Layer (IBL) added
  - Could have r>150 mm tracks using just 4 pixel hits?!



New IBL pixel layer at radius of ~26mm



Sensitive up to ~800 GeV for 50mm and ~200 GeV for 5mm lifetime using 4-pixel IBL tracks?

Improved disappearing track search

- **How to find even shorter tracks?**
- 150 mm $\rightarrow$ 50 mm tracks gives ~25 times larger efficiency
  - Sensitivity for chargino of 5mm lifetime goes from ~200 to ~400 GeV
- New tracking layers at small radii?
  - Most important in central eta region
- Need to maintain ~10% momentum resolution at pT=~50 GeV ...
  - High resolution pixels (in r-phi), small scattering
- Any other ways? Boosted in forward direction? Pixel disks?
  - Asymmetric collisions ala BaBar?