Disappearing track constraints on dark sectors

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Based on: A. Belyaev, S. Prestel, F. Rojas-Abatte, JZ, arXiv 2006.vsoon

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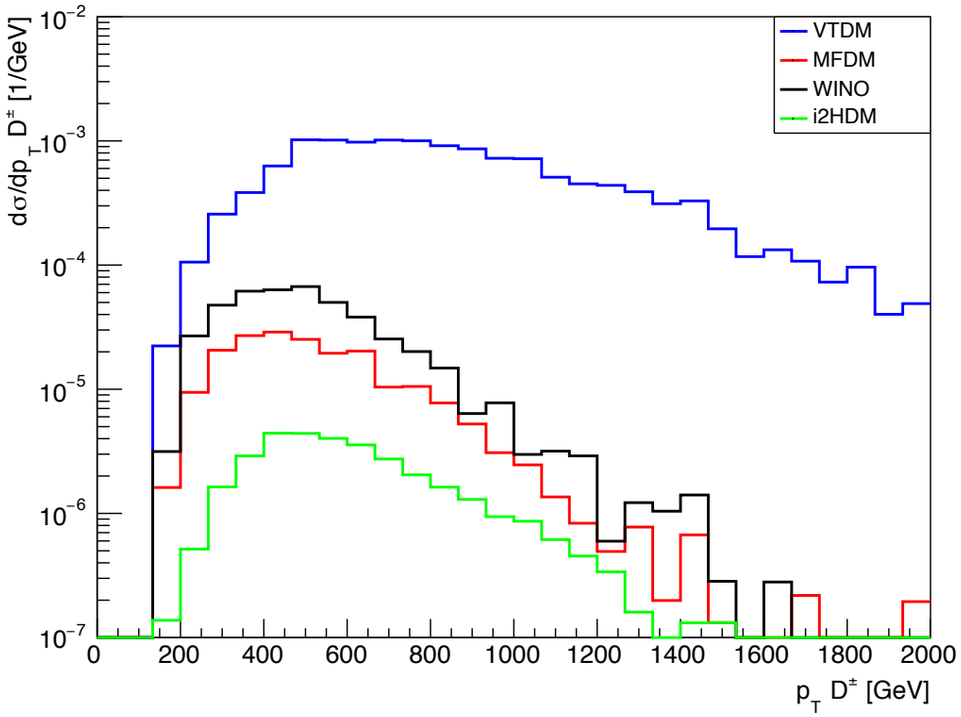
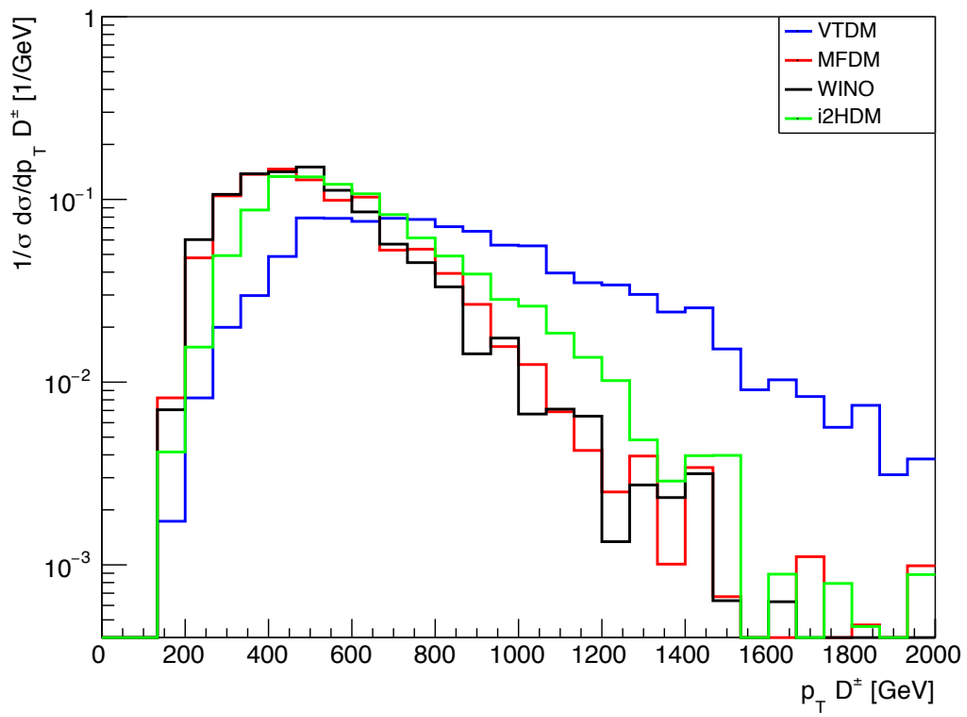
EW multiplets as DM

- DM (X^0) is the electrically neutral component of spin s, SU(2) N-plet X. N=1,2,3,…, ; s = 0,1/2, 1, …
- $X^\pm$ - X^0 splitting is O(0.1 GeV) $m_X > m_Z$: X^+ is naturally long-lived.
- $X^\pm \to X^0 + \pi^\pm$ gives disappearing track (DT) signature at colliders, where $\pi^\pm$ too soft to be reconstructed*.
- Quantum numbers fix Z, W, γ interactions (need to avoid Z-current due to DD bounds).
- Free parameters: DM mass, DM-DM-h. Pure Wino (Higgsino) gives right relic with 2.7 (1.1) TeV.





Belyaev, Cacciapaglia, McKay, Marin, Zerwekh, 1808.10464

Model	N	s
VTDM	3	1
MFDM	2	1/2
WINO	3	1/2
i2HDM	2	0

Belyaev, Cacciapaglia, Ivanov Rojas-Abbate, Thomas, 1612.00511

N=3, s=0, see Chiang, Cottin, Du, Fuyuto, Musolf,.2003.07867

- Kinematic distribution of charged track pT differs considerably z simple models!
- Disappearing tracks have the largest discovery potential, trumping over LEP, jets +MET (+soft).
- This talk: recast of ATLAS DT study, CERN-EP-2017-179. CMS-EXO-19-010-pas has no reinterpretation material

* In a clean collider environment, like e-p, the pion CAN be reconstructed, see Curtin, Deshpande, Fischer, JZ, 1712.07135

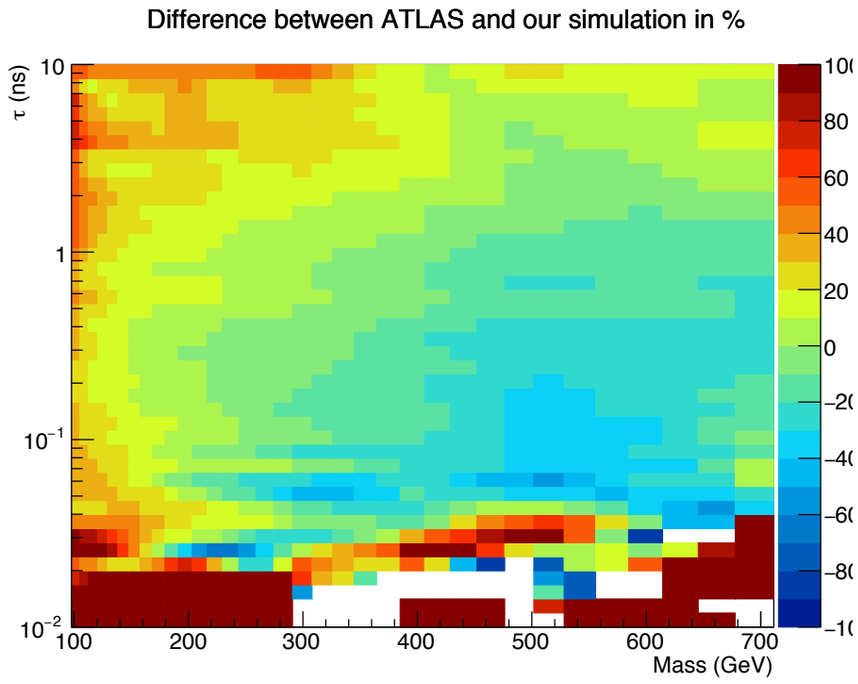
Recasting ATLAS DT study

Detailed efficiencies and acceptances at gen- and reco- level, with 2D heat-maps (mass-lifetime). 😀😀😀

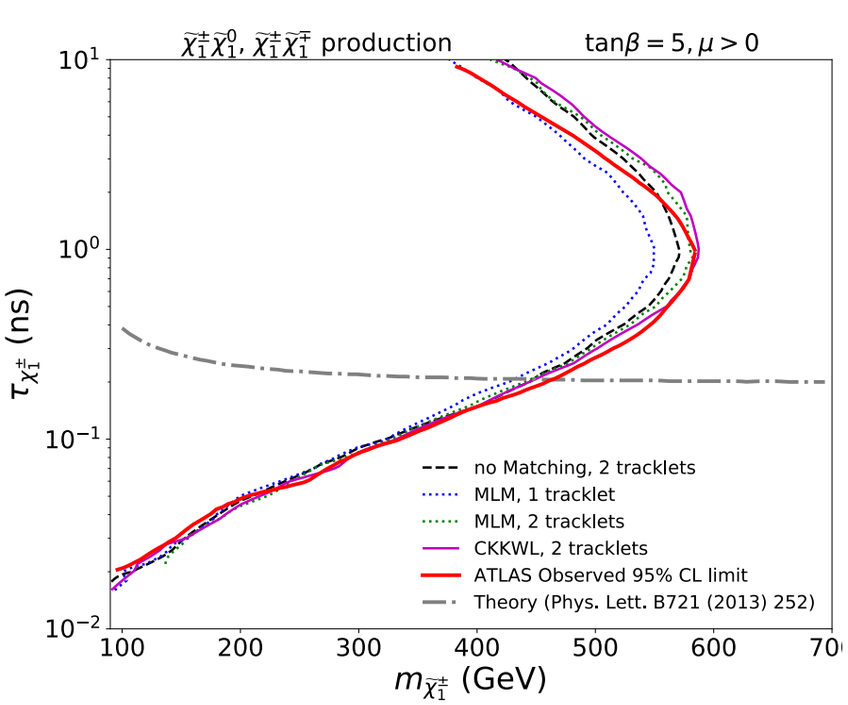
Benchmark on Wino, also later Higgsino reinterpretation in ATL-PHYS-PUB-2017-019.

If more than one DT candidate is present, only the hardest is kept (please don't do that, see arXiv:2003.07868)

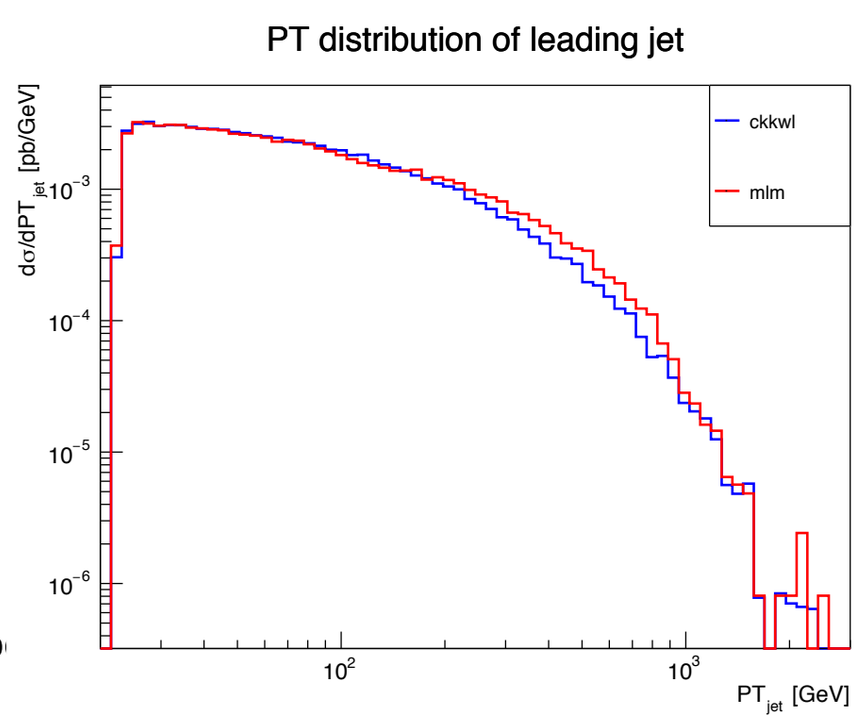
Sometimes hard to decipher what exactly "efficiency" and "acceptance" mean (defined only in words!)



Could have been worst…

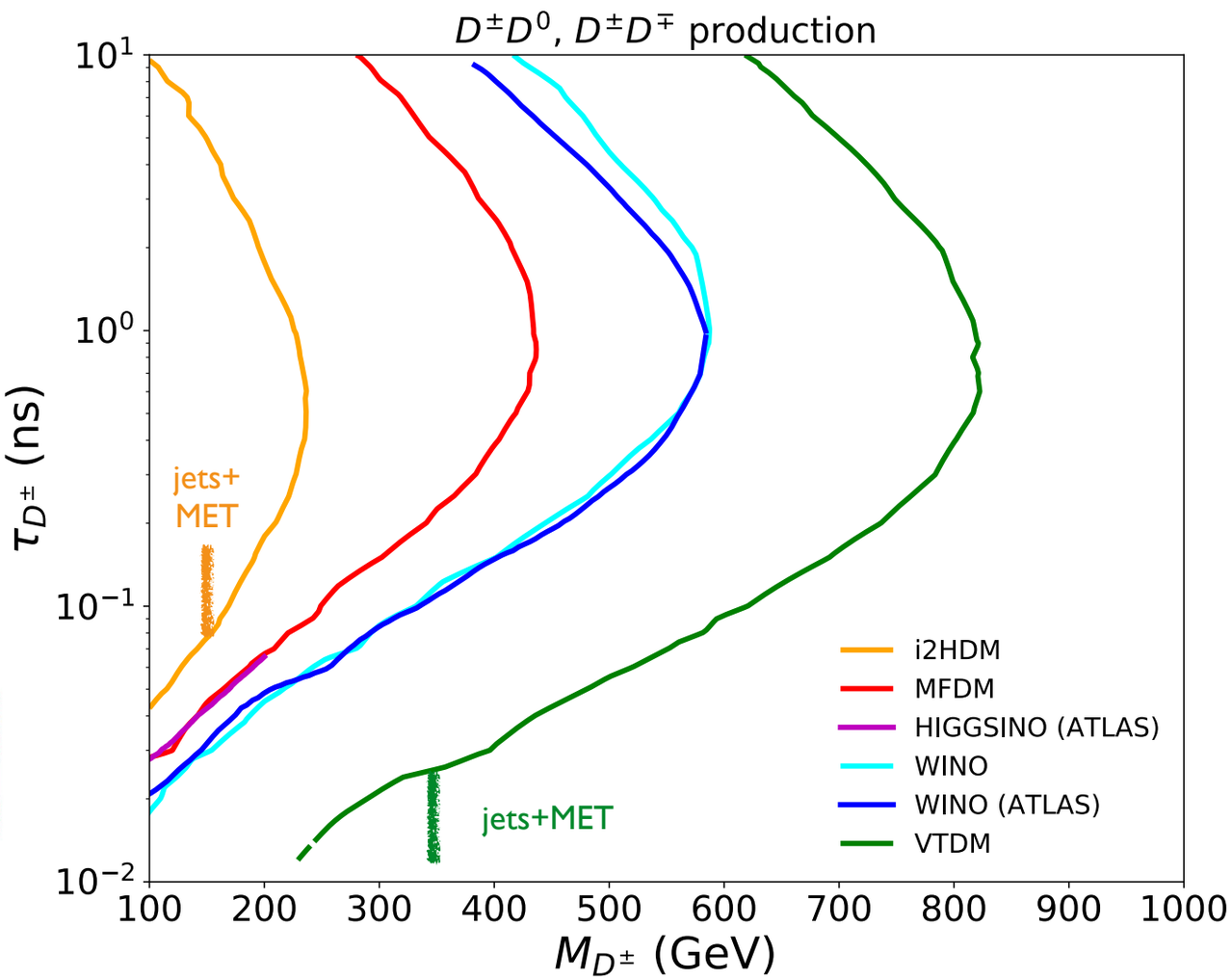


Good agreement on Winos / Higgsinos (latter not shown).



Careful with your matching scheme!
CKKW-L vs ATLAS: few %
MLM < CKKW-L by 10-20 %.

Recasting other models



DT gives the strongest constraints on these models: great discovery prospects!

Public reinterpretation material reproduces the published limits within 10%.

We will provide efficiency maps for our models (VTDM, i2HDM) in the mass-lifetime plane.

Our interest: extend this study for HL-LHC and FCC (backgrounds???).

LoI to be submitted after paper migrates to arXiv.