SA-CERN 15 and/or A Decade at Wits

Deepak Kar



The Group now!





Sukanya Sinha (PhD 2022), former ECSB member. Won Wits PhD seminar. Currently a postdoc in Manchester



Marvin Flores (Postdoc), currently a faculty in Philippines (Started ATLAS there!)



Danielle Wilson (MSc 2021), currently a PhD student in Manchester



Debarati Roy (Postdoc), currently a CMS faculty in India



Deepak Kar



The book!



Dimbiniaina Soanasolo Rafanoharana (MSc 2019), currently a PhD student at Freiburg Rather than having a top-down model driven approach, let us try a bottomup signature driven approach:

Novel Topologies!

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Events we typically do not look at!

Principle of Social Distancing (in object reconstruction)



Objects reconstructed independently ... double counting or mis-reconstructed object ... overlap removal!

Phys. Lett. B 798 (2019) 134942



Electron in a jet!

In ATLAS electron reconstruction assumed no nearby real jet, and applies implicit isolation requirement. That reduces signal efficiency, and the presence of such a jet affects the electron performance numbers

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Boosted Heavy Neutrino Search



Good Neutrino Mass Reconstruction

JMS well modelled





CR Well Modelled

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Boosted Heavy Neutrino Search



Very small background due to extreme topology



Complementary strength From the resolved analysis

DarkQCD/Strongly Interacting Dark Sector

- A simple replica of standard QCD!
- Hadronisation in hidden sector, off-diagonal dark hadrons, invisible and stable while diagonal ones can decay back to SM quarks.
- The fraction decaying back to SM determines if we get a visible, invisible or semivisible jet!





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ATLAS SVJ Search

Results in jets interpersed with Events with two cronitder topology Events with two cronitder top dark hadrons, with missing

rd (muon veto), and three CRs, 1L, 1L1B, 2L (with muons and b-Defi tagged jets)

Results



Excellent agreement between data and background prediction: HT and MET



 m_{Φ} [TeV]

 ${
m m}_{\Phi}\,[{
m TeV}]$

Lepton Jet from Dark Photon



Lepton Jet from Dark Photon



Lepton Jet from Dark Photon



Summary

• Novel signatures are fun, specially when we have very little guidance from theory ;-)

• Unless we search for them, can't really rule them out, can we?