MICHIGAN STATE UNIVERSITY

Physics at High Energies

Hector de la Torre Perez
Michigan State University

On behalf of the session conveners:
***Hector de la Torre Perez**, Michigan State University*
***Frank Petriello**, Northwestern University, Argonne*
Louise Skinnari, Northeastern University

With many thanks to the organisers (Especially Brendan) and to all of our wonderful speakers that made their way to Florida despite the difficulties!

It was grand!

Five sessions on five topics (very loosely defined and separated)

EIC <-> LHC intersection

Searches for new physics

Higgs Physics

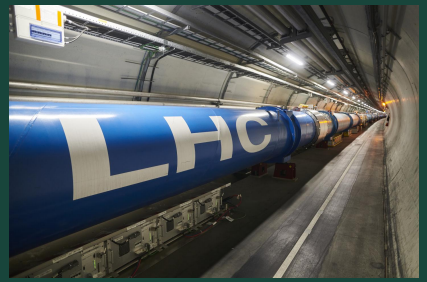
Standard Model physics

Dark matter collider searches

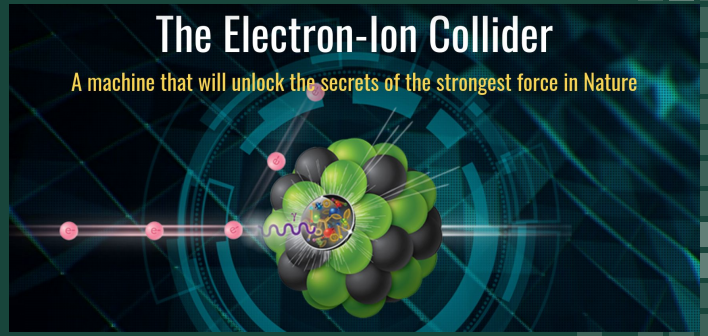
I'll go over a biased selection of personal highlights. All credit goes to the original speakers, mistakes are all mine


Join us at
INTERSECTION
May 30

between


LHC

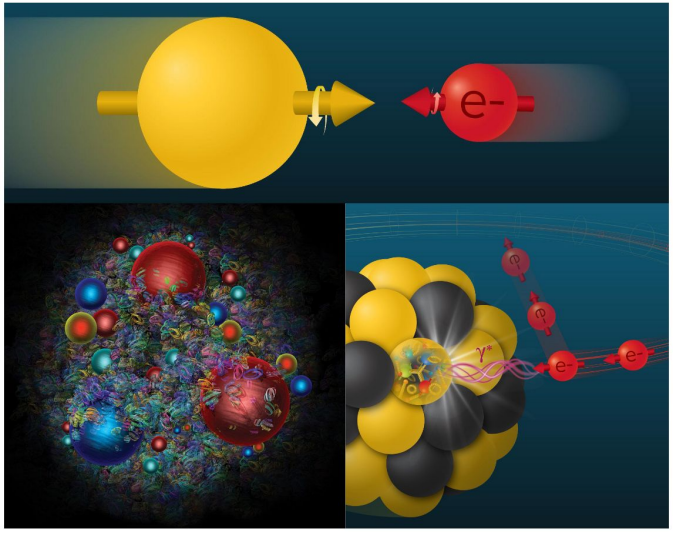
and


The Electron-Ion Collider
A machine that will unlock the secrets of the strongest force in Nature

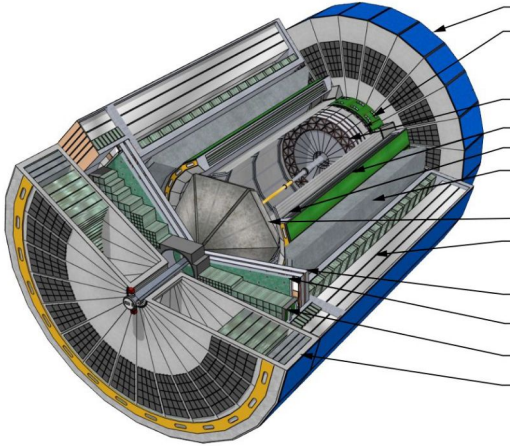
Overview of the EIC experimental programme

Miguel Arratia, UC Riverside

*First-ever accelerator to collide electrons and **polarized** protons (or **polarized** light ions, or heavy nuclei)*



Quantum Tomography of the Nucleon and Nuclei



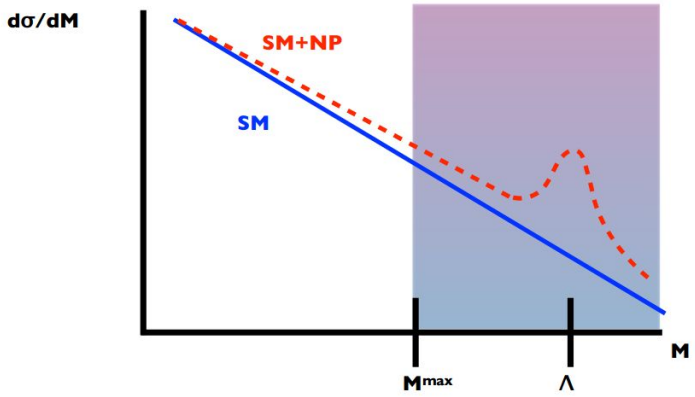
4pi 'collider-like' detectors to go beyond Deep Inelastic Scattering (DIS) measurements

Double helicity asymmetry in DIS, quark helicity PDF, gluon PDF and TMD

H.de la Torre, Michigan State University

The LHC/EIC Synergy in Searches for New Physics

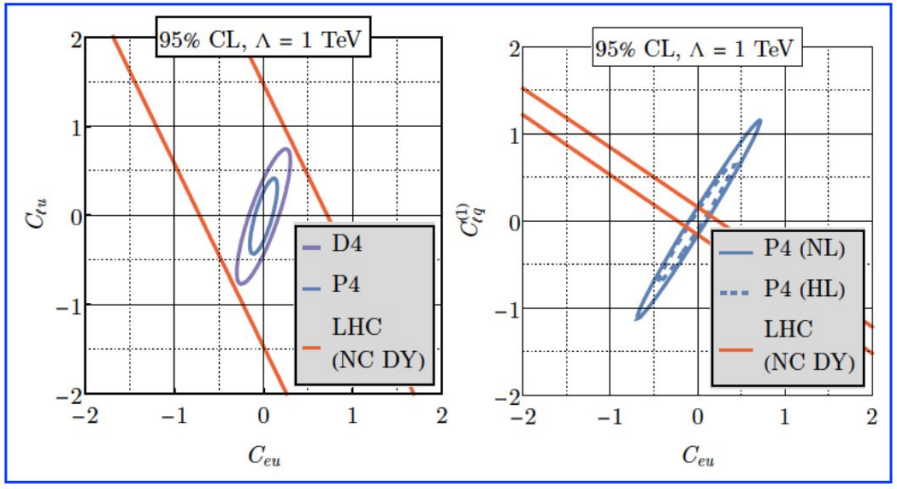
Radja Boughezal, ANL



Lots of parameters to consider and fit to data!

Standard model Effective field theory to study low mass effects due to high scale physics

Boughezal et al, 2204.07557



Fits based only on LHC data are blind to certain combinations. This is fixed by adding EIC pseudodata!

Pure Gauge interactions

Gauge-Higgs interactions

Fermion-Higgs-gauge interactions

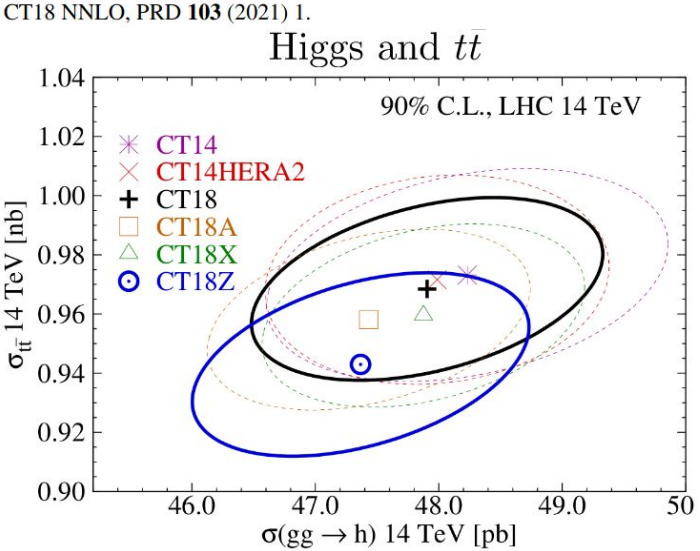
Four-fermion interactions

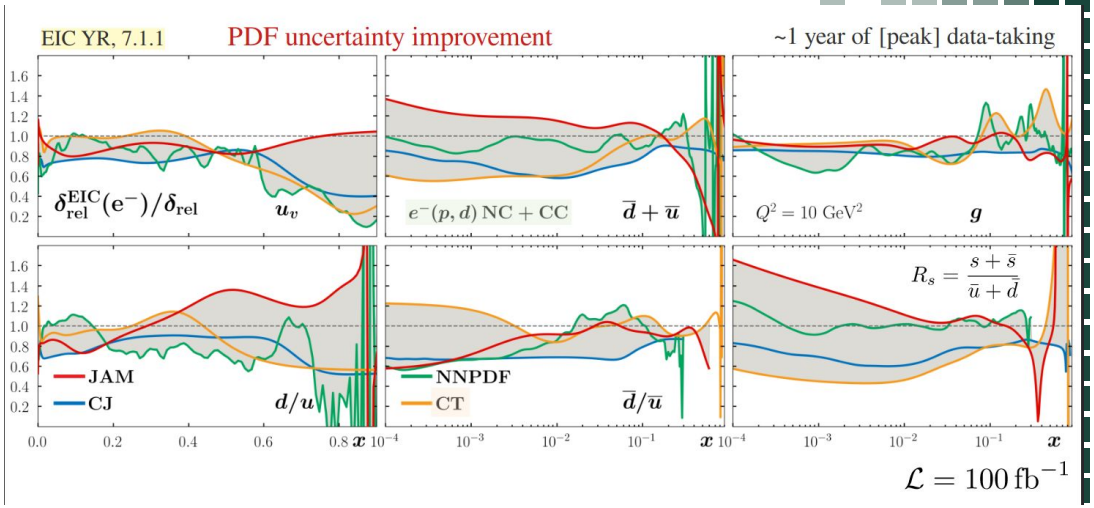
Baryon-number violating interactions (not considered here)

PDFs from EIC, lattice QCD, and the LHC

Tim Hobbs, FNAL

Many HEP analyses suffer from PDF uncertainties. Modelling can also be very relevant for non-resonant searches!





Parallel improvements from lattice and future EIC programme are instrumental

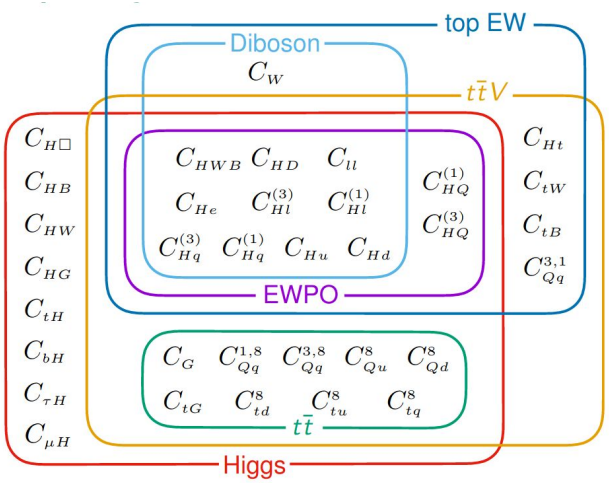
Higgs physics

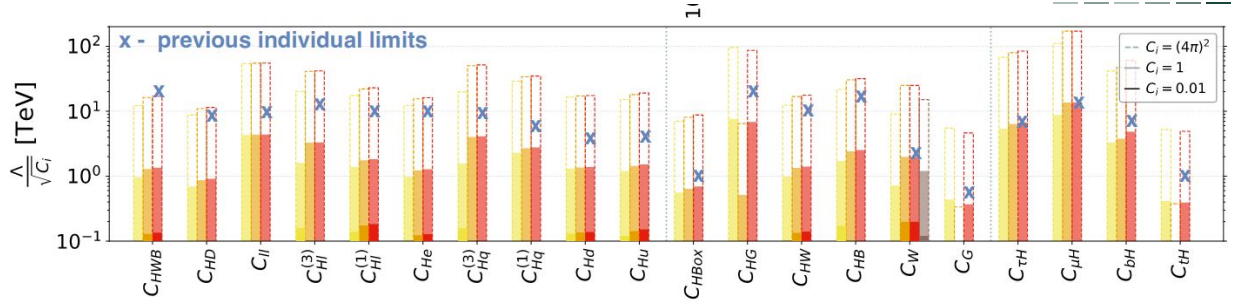
Interpretation of Higgs data within the SMEFT

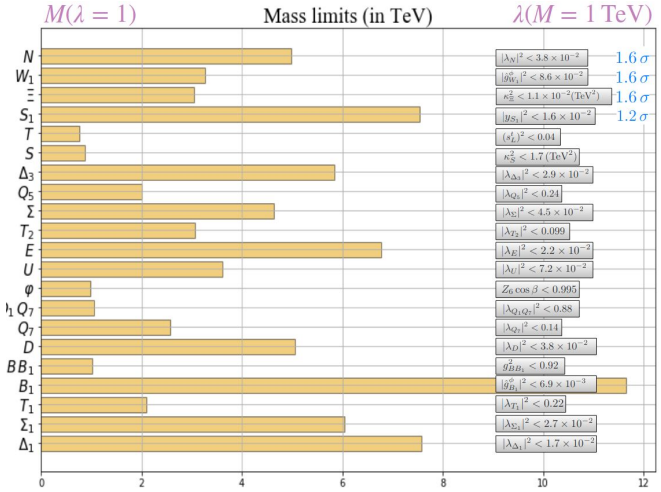
Ken Mimasu, KCL

Fitmaker code

First fit to EWPO, Higgs, diboson and Top results in SMEFT





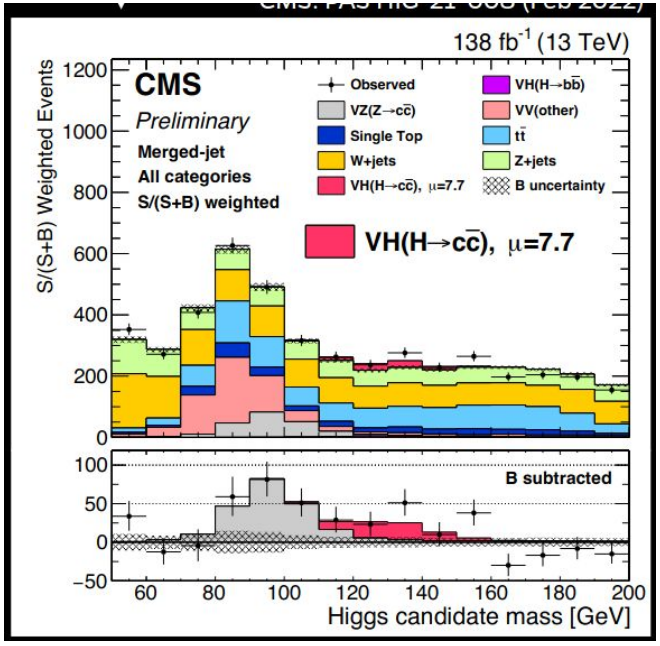


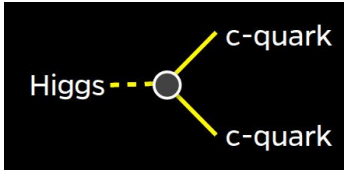
Large interplay
Improvement by a combined fit

Mass limits to a variety of BSM models

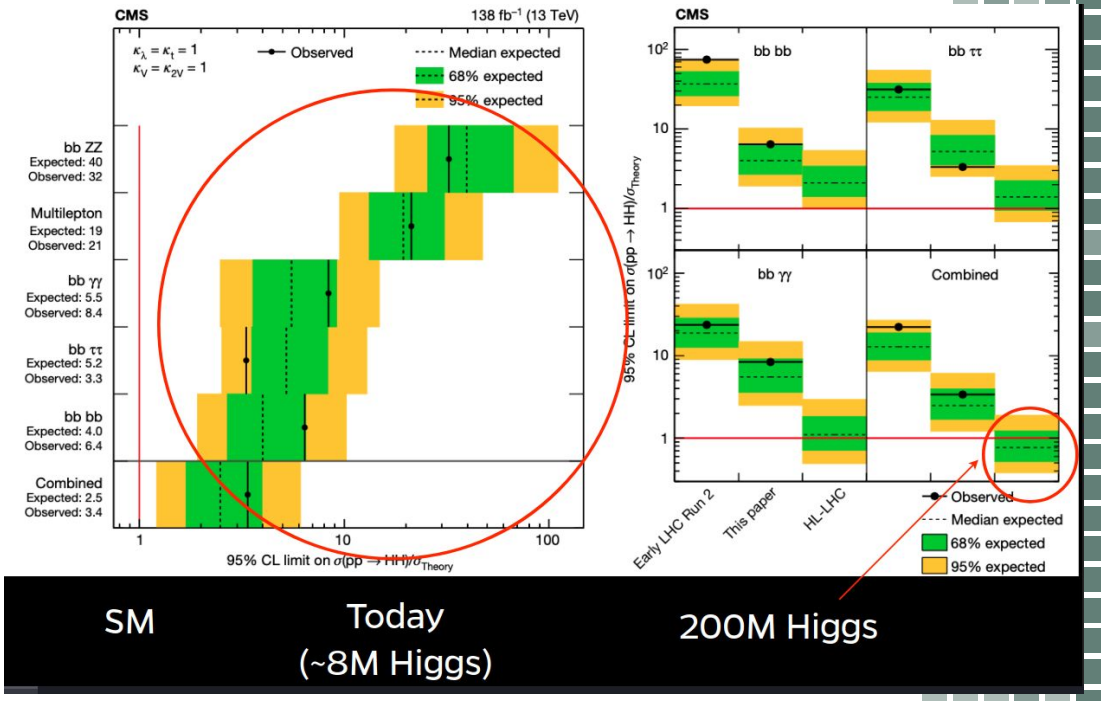
A wide range of new Higgs results from CMS

Philip Chang, UF





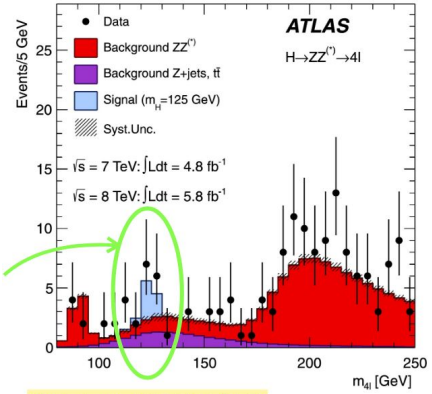
Still lots of things to learn from our newest family member



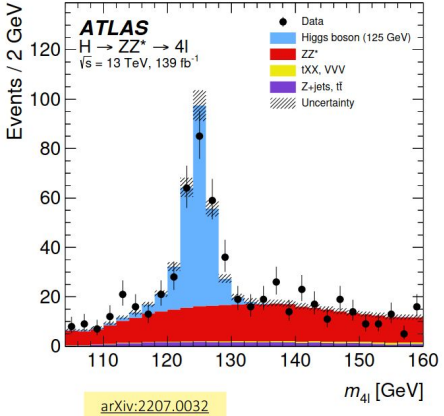
… and from ATLAS

[Ashley McDougall, Nikhef](#)
[Shahzad Ali, Academia Sinica](#)
[Shuo Han, LBNL](#)

Improved individual results

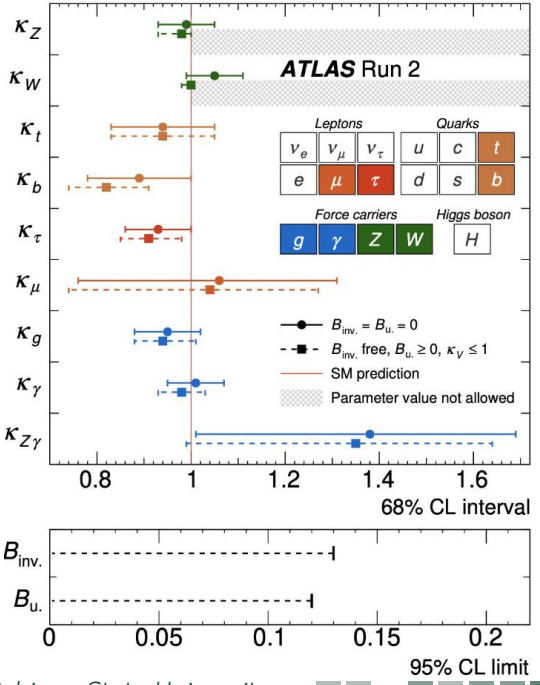


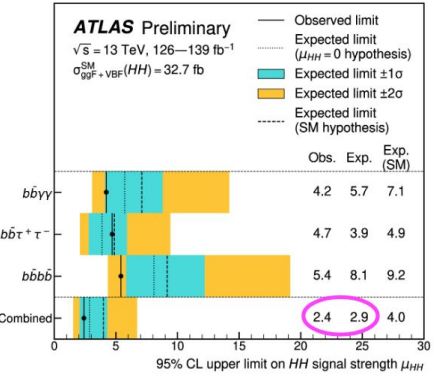
Physics Letters B 716 1 (2012) 1-29

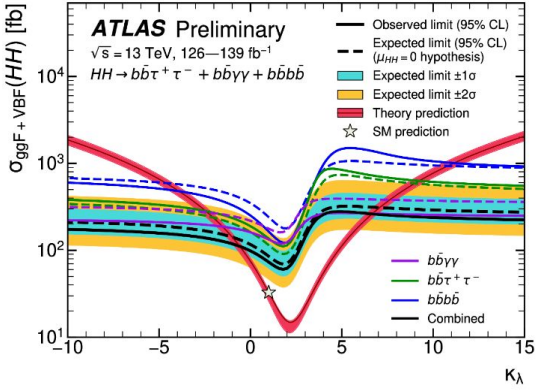


arXiv:2207.0032

Combination bringing new precision. Done using the Simplified template cross section framework

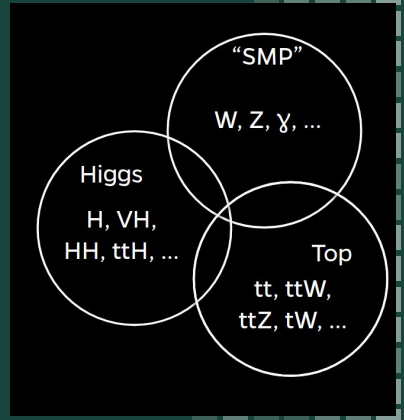






Getting closer to discover rare processes

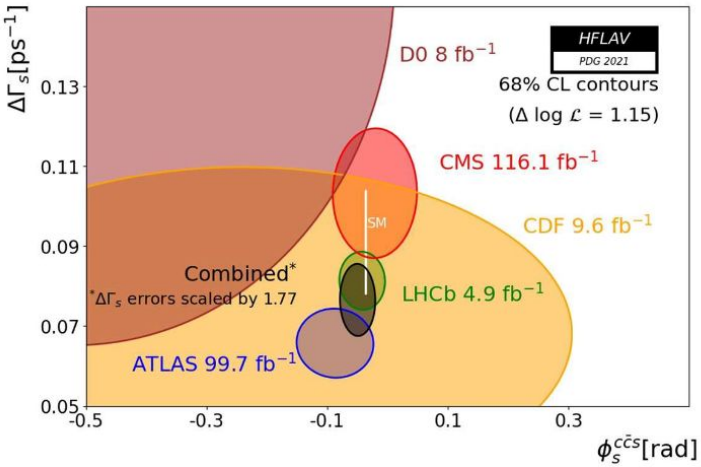
Standard model Physics

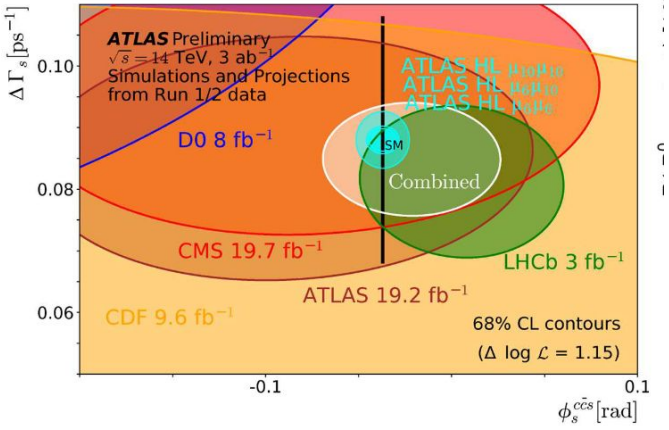


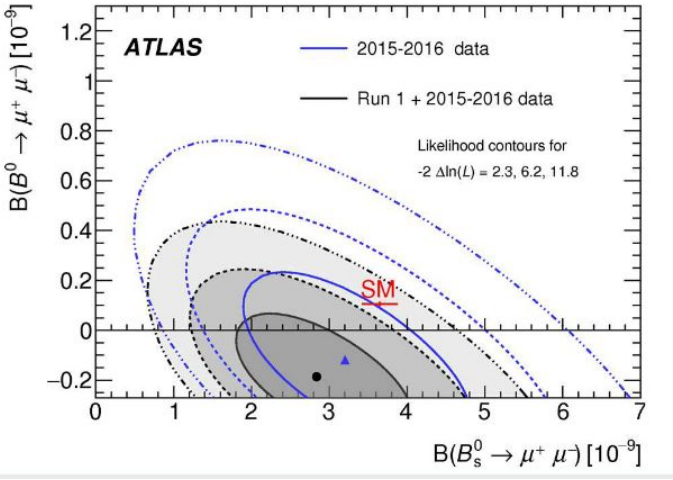
Collider speak translation

‘Neither top nor higgs nor explicit pure-BSM-search’ physics

ATLAS Measurements of CP-Violation and rare decay processes with B-Mesons







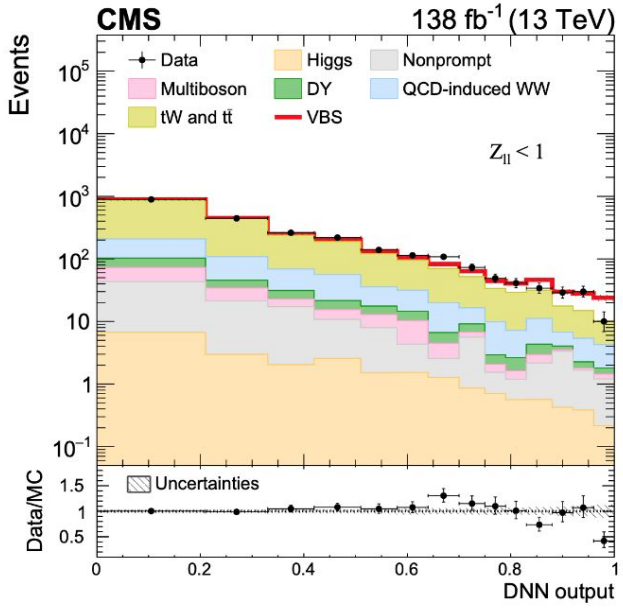
Andy Wharton, Lancaster

Competitive results from ATLAS broadly compatible with the Standard Model

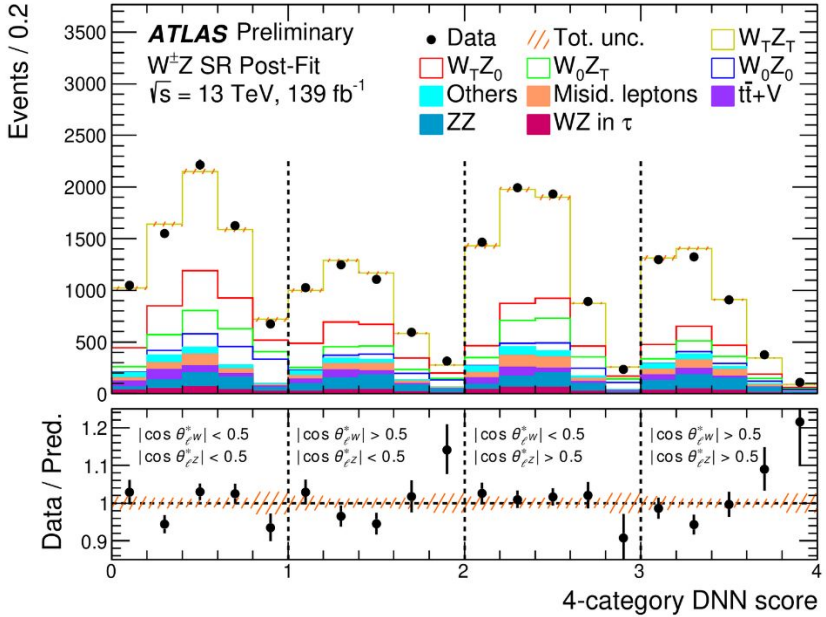
HL-LHC will allow for much tighter constraints

H. de la Torre, Michigan State University

Recent measurements from CMS and ATLAS



First observation of VBS opposite-sign WW 5.6σobs (5.2σexp)



First observation of longitudinal-longitudinal joint-polarisation state in diboson events

Philip Chang, UF
Luka SELEM, LAPP

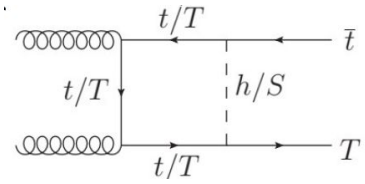
Searches for new physics

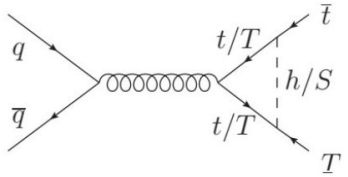
"Roads? Where we're going, we don't need roads"

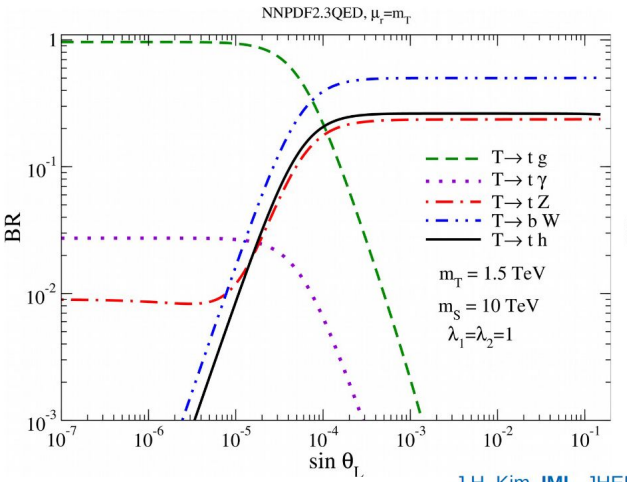
LHC New Physics Searches in the Future

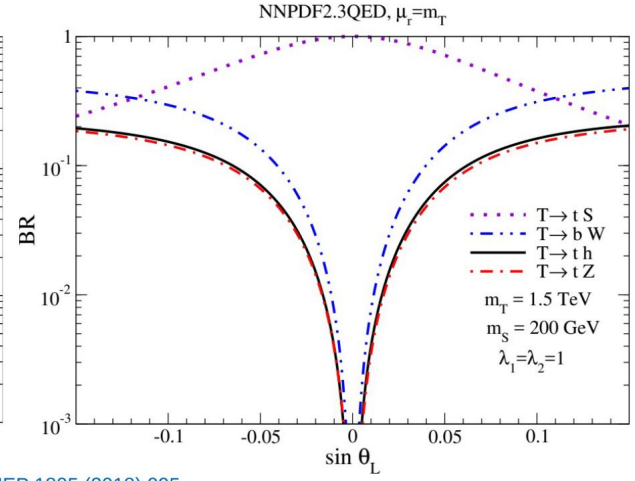
Ian Lewis, University of Kansas

New ideas to look for VLQs coupling to additional scalars

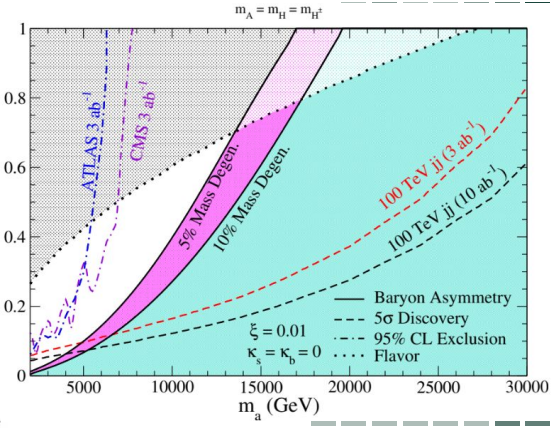




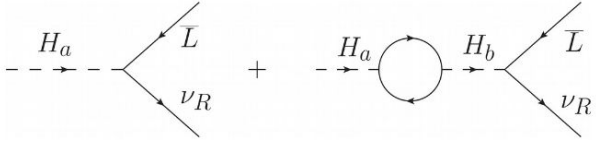




J.H. Kim, **IML**, JHEP 1805 (2018) 095



Models with additional light and heavy scalars to explain baryon asymmetry

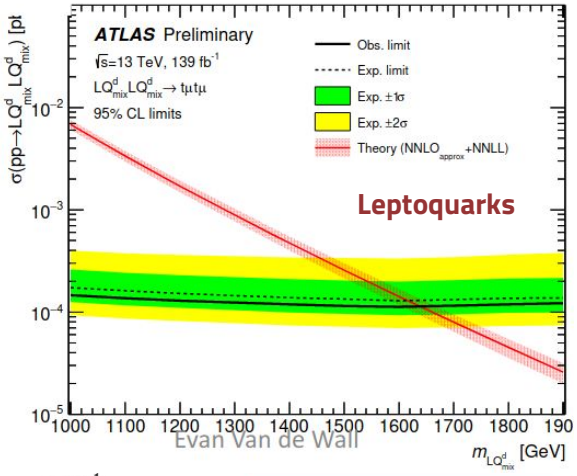


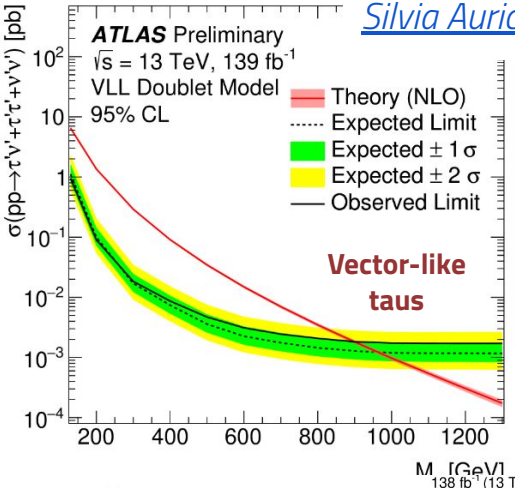
H. de la Torre, Michigan State University

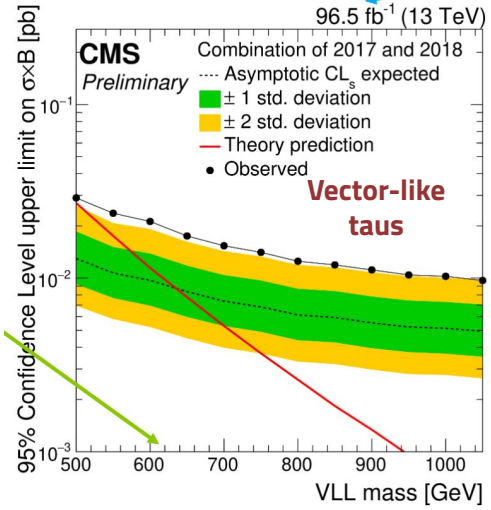
Brand new searches from CMS and ATLAS

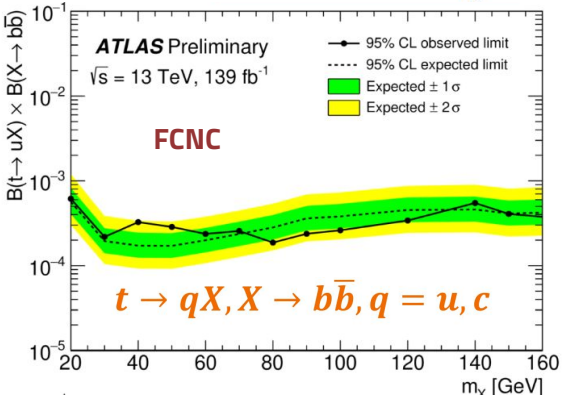
Evan Van de Wall, OSU
Andrej Gorišek, JSI
Silvia Auricchio, Napoli

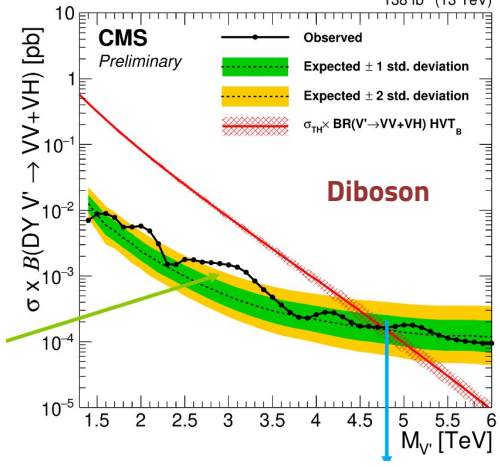
Christian Weber, BNL
Tamás Álmos Vámi, JHU
William Fawcett, Cambridge







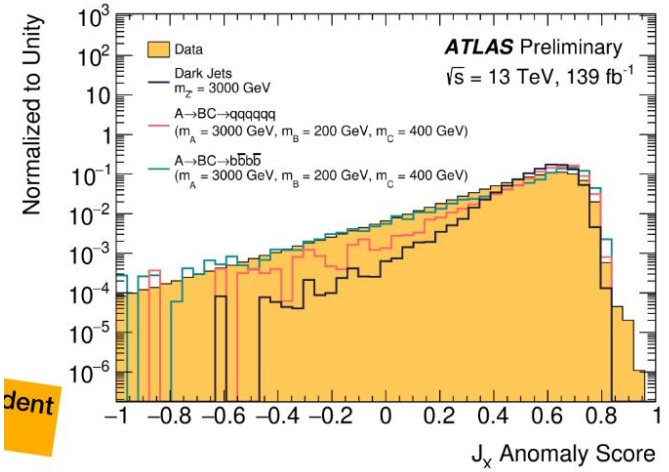


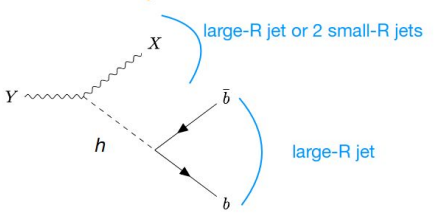


With some very interesting techniques

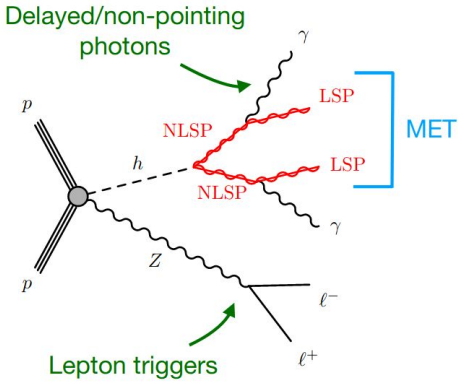
[Evan Van de Wall, OSU](#) [Christian Weber, BNL](#)
[Andrej Gorišek, JSI](#) [Tamás Álmos Vámi, JHU](#)
[Silvia Auricchio, Napoli](#) [William Fawcett, Cambridge](#)

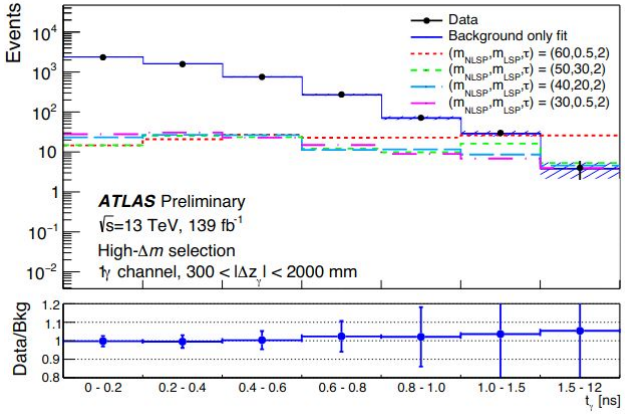
Unsupervised learning used to tag events with a general hadronic resonance





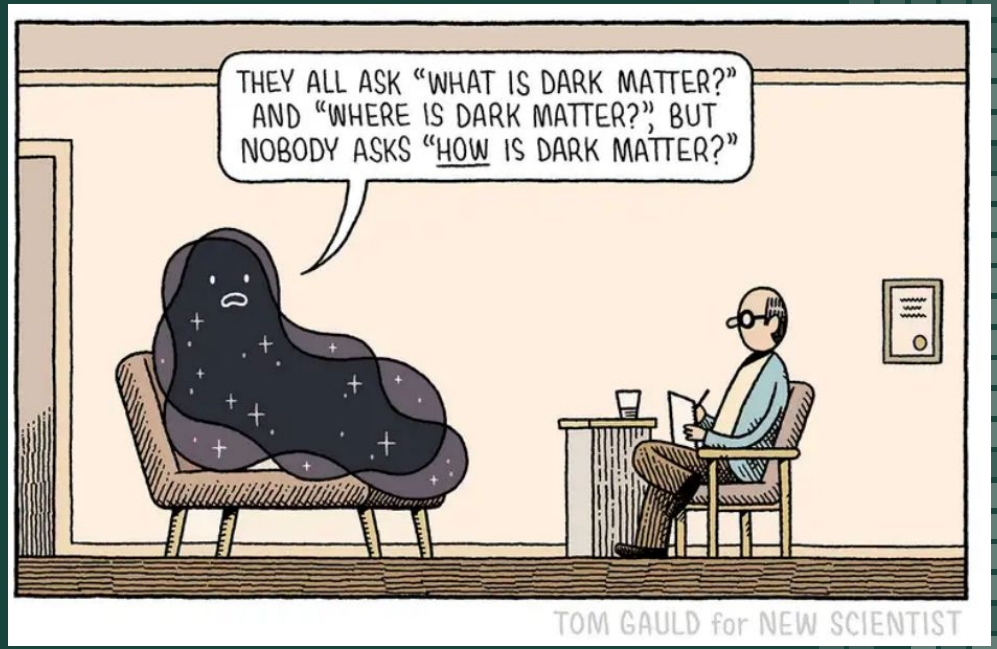
Delayed non pointing photons to look for Long lived particles





Dark Matter collider searches

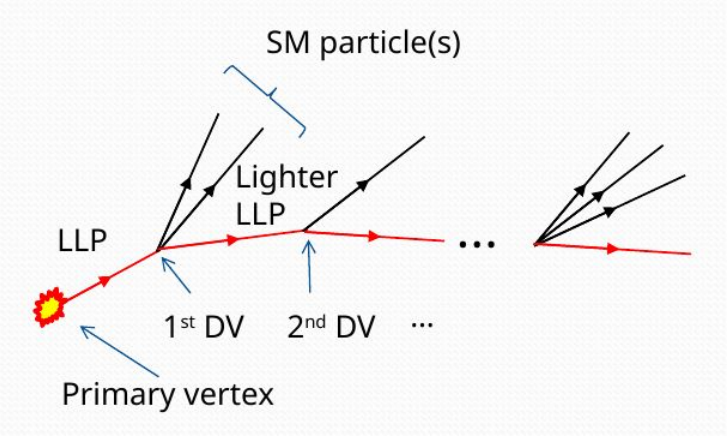
With the help of the DM track conveners
Deborah Pinna, *University of Wisconsin*
Keith Bechtol, *University of Wisconsin*
Bjoern Penning, *University of Michigan*



New ideas to look for dark sectors at the LHC

[Doojin Kim, Texas A&M](#)
[Maíra Dutra, Carleton](#)

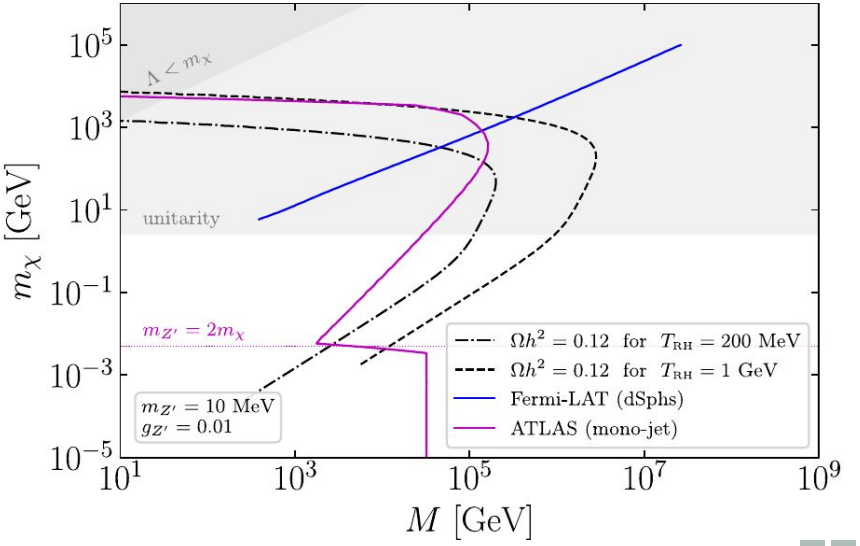
Looking for **tumblers** at the LHC
Series of consecutive displaced vertex



Novel signature from non-minimal dark sectors

Testing **freeze-in** at the LHC using Mono-jet production

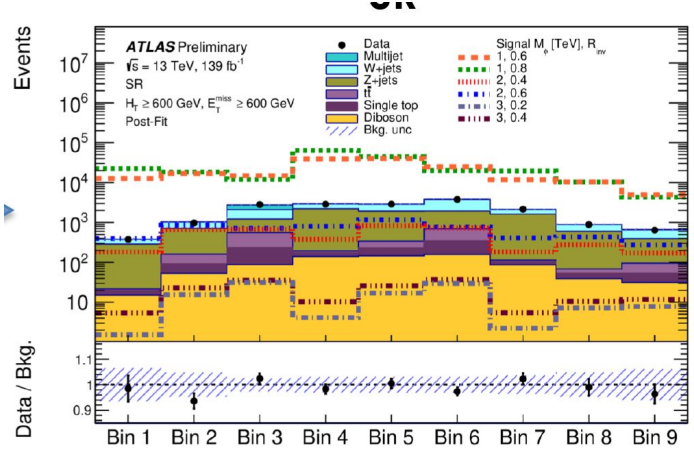
Feebly interacting massive particles (FIMPs) in a **gluophilic Z' portal**

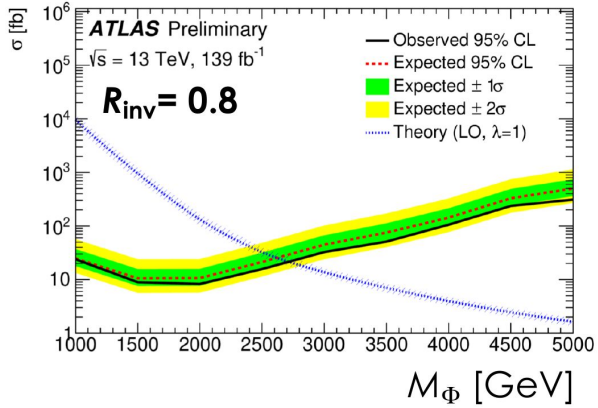


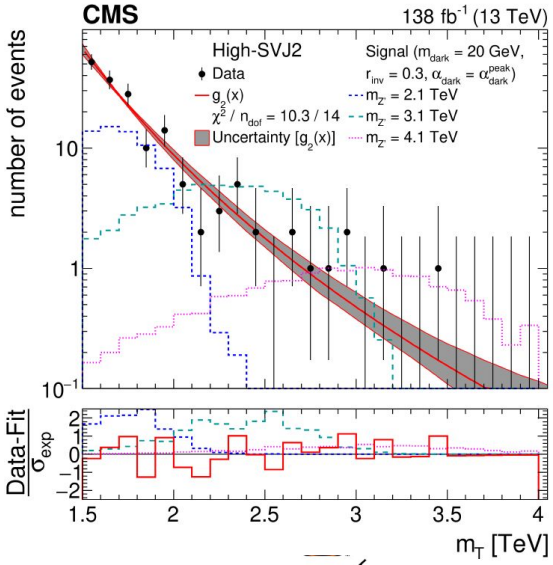
H. de la Torre, Michigan State University

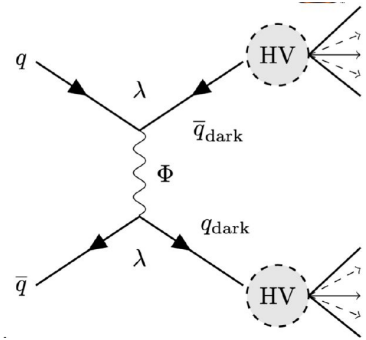
Semi-visible jets at the LHC

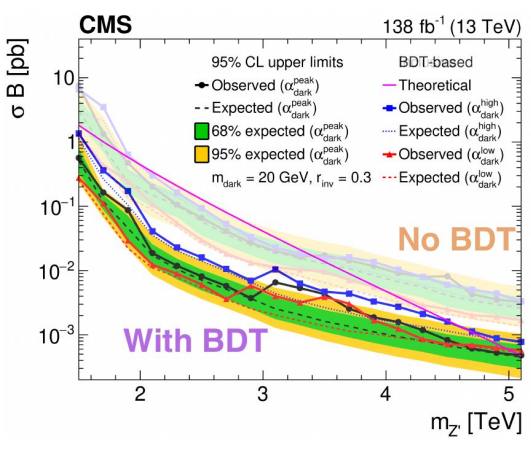
[Joe Haley, OSU](#)
[Thomas Klijnsma, Fermilab](#)

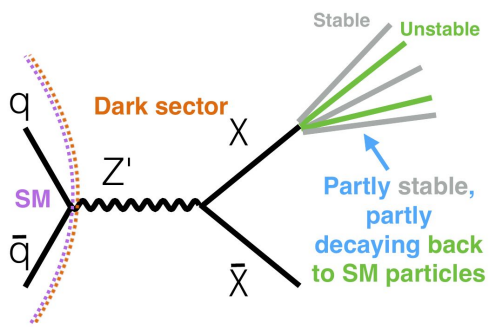












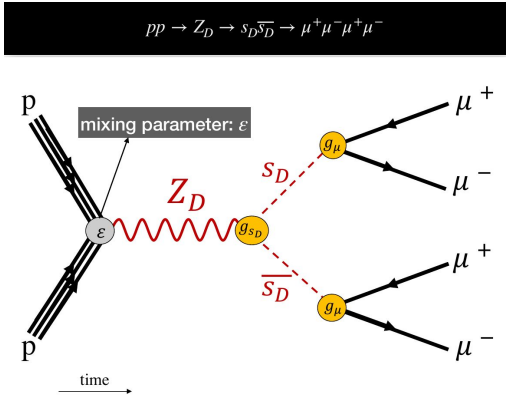
H. de la Torre,

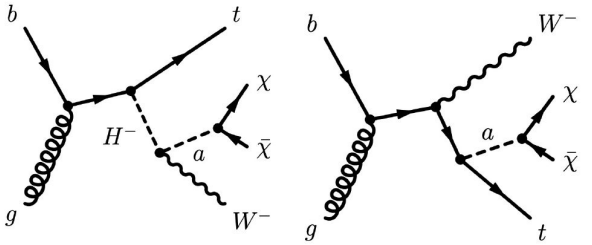
And many other DM results

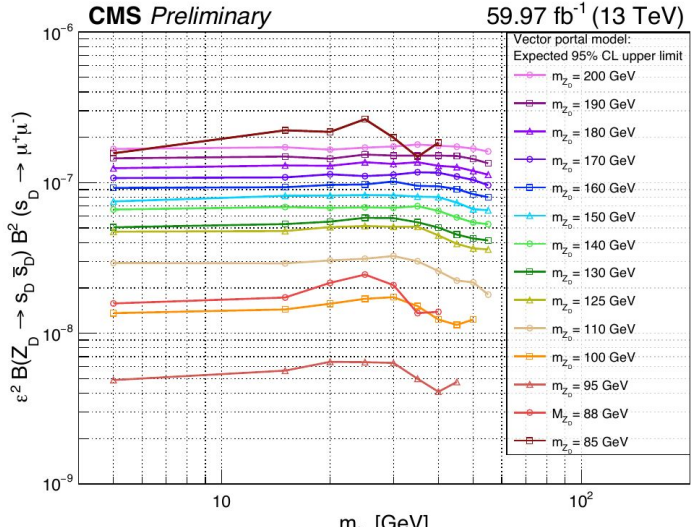
[Joe Haley, OSU](#)
[Mehdi Rahmani, Florida Tech](#)

Vector portal model

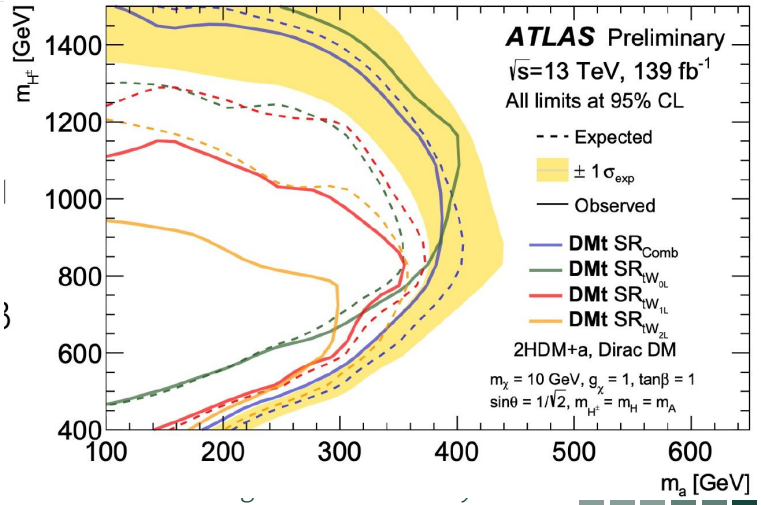
Model independent upper limits on kinetic mixing parameter, cross-section branching ratio and acceptance at CMS







Many new Mono-X searches



Summary

- 23 talks from 22 speakers on a variety of topics
- Good mixture between theory and experimental talks
- Lots of nice discussion!

Thank you again to all of our speakers! Have a safe trip back home and see you soon