Pushing the Boundaries 2019
The Standard Model and Beyond

INTRODUCTION

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(IPPP Senior Experimental Fellow 2018/19)

Welcome and Thank You

- **Our warmest welcome goes to all participants and particularly to all our speakers**
  - Thank you for joining us at a busy time of the year

- **A special thank you goes to IPPP**
  - For the excellent organization and hospitality
  - And for their generous financial contribution to the organization of this workshop through my Senior Experimental Fellowship (2018-19) award
    - https://www.ippp.dur.ac.uk/senior-experimental-fellowships2018-2019

Pushing the Boundaries Workshop Series

- This is the third of a series of small-scale workshops organized in 2018 & 2019 with support by IPPP and the University of Sussex
  - To facilitate exchanges between theorists and experimentalists, focusing primarily on BSM physics: --

    - IPPP, July 2018
      - BSM searches – **Status and prospects at the LHC and Beyond**

    - Sussex, November 2018
      - BSM searches – **Taking stocks at the end of the LHC Run2**

    - IPPP, September 2019
      - This workshop – **What now??**

*(**Disclaimer:** This is not a review ☺ -- I work on ATLAS, so I will be showing ATLAS plots to make a few points.)*

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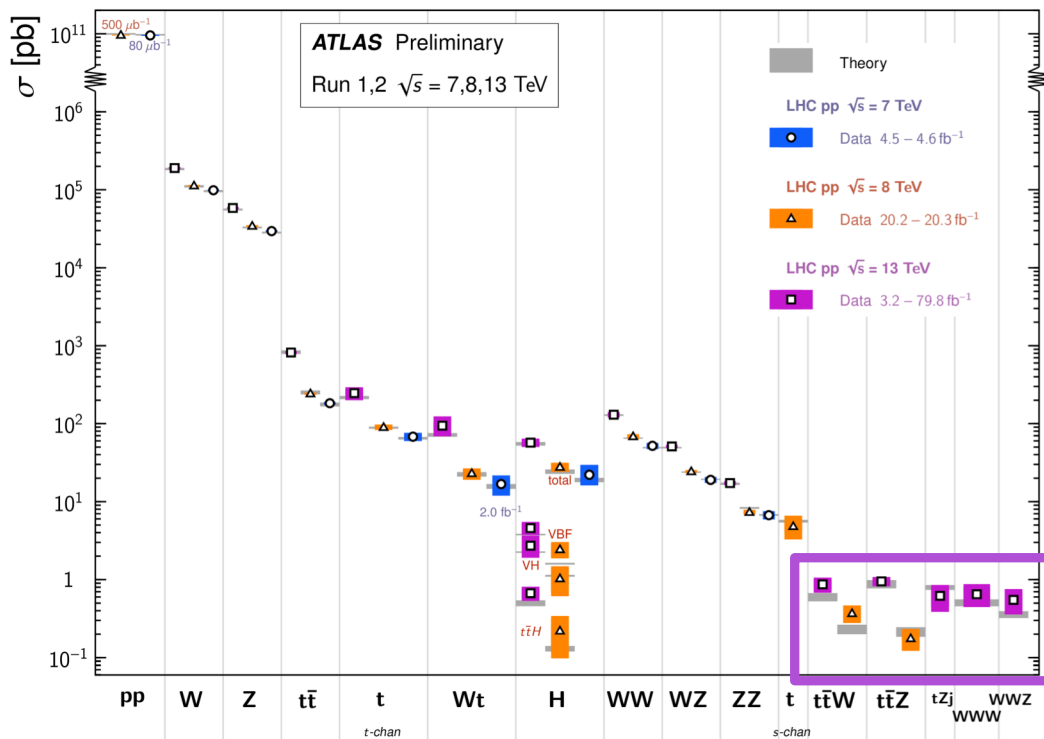
Rationale for this workshop

My, my! Time Flies!

You are here
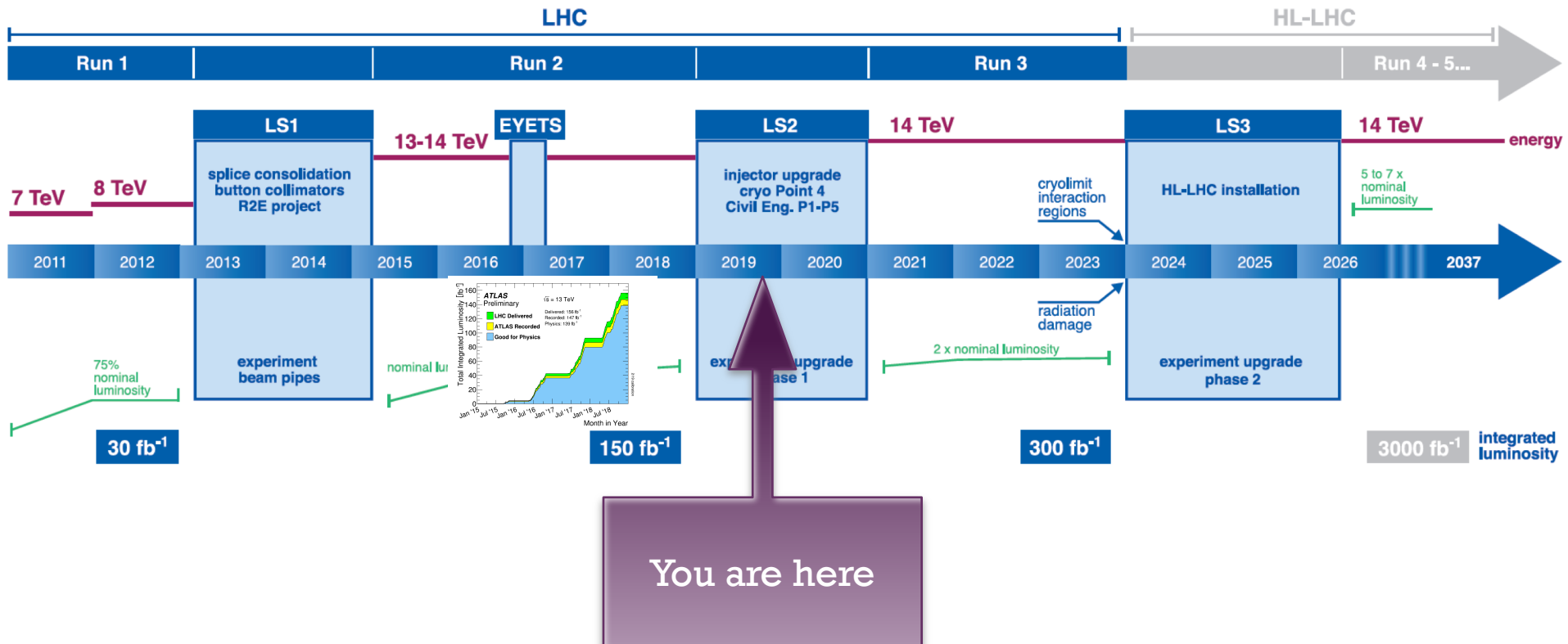
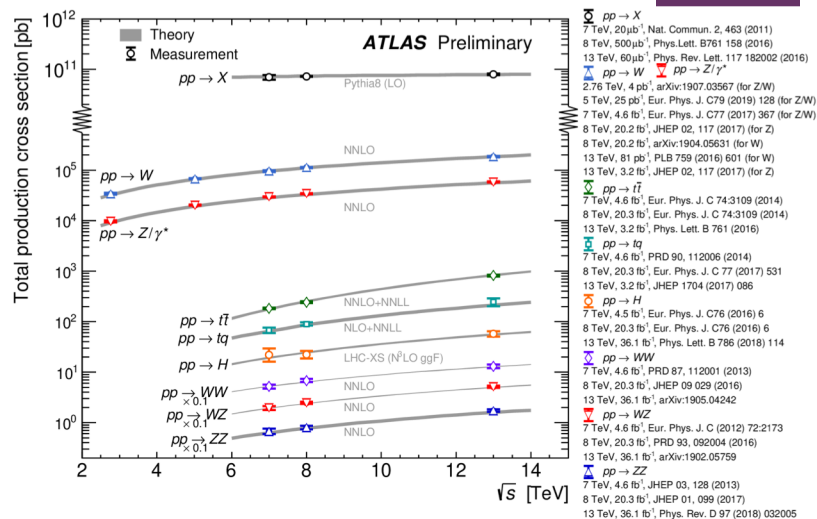# The Standard Model is Alive and Well

Standard Model Total Production Cross Section Measurements

https://twiki.cern.ch/twiki/bin/view/AtlasPublic/StandardModelPublicResults

Amazing precision (both theory and experimental) enables unprecedented accurate exploration of SM physics
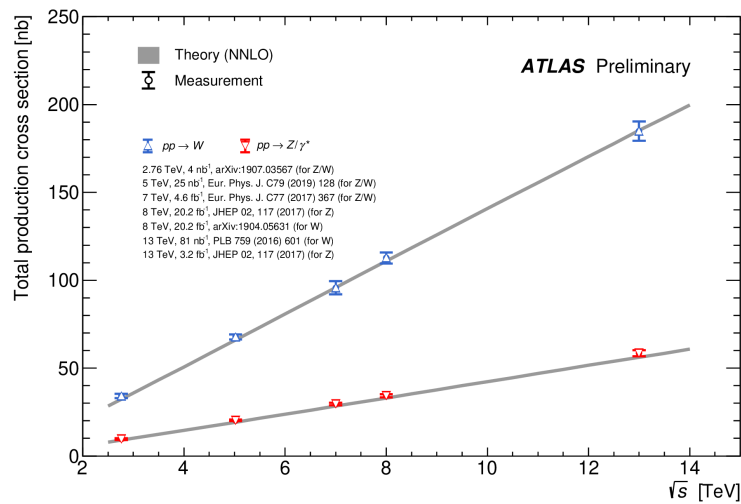
Pinning down the SM Higgs Boson

ATLAS-CONF-2019-025

H(4L)

ATLAS-CONF-2019-029

H(γγ)

ATLAS-CONF-2019-004

ttH(γγ)

https://twiki.cern.ch/twiki/bin/view/AtlasPublic/HiggsPublicResults

ATLAS-CONF-2019-032

arXiv:1909.02845
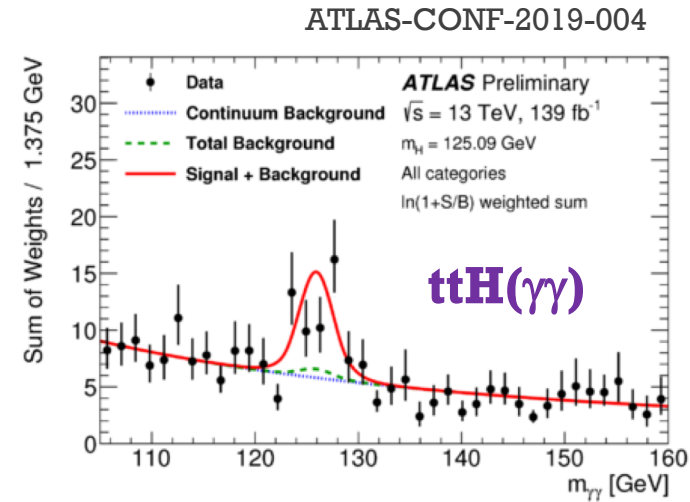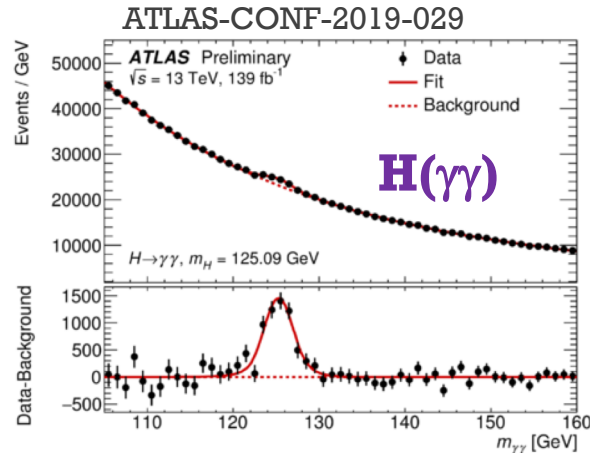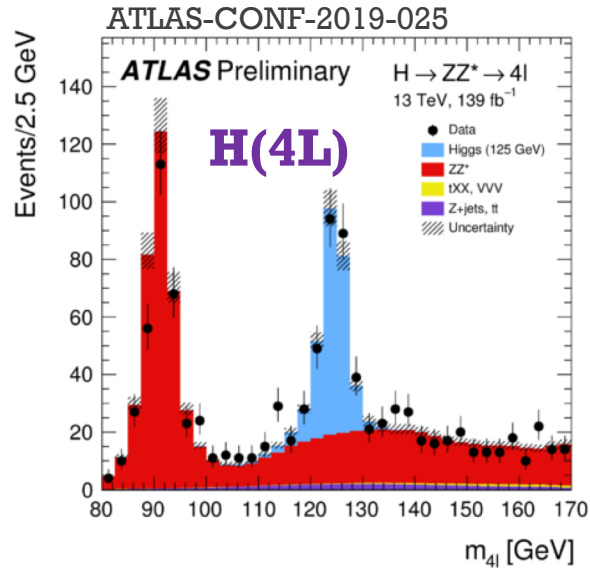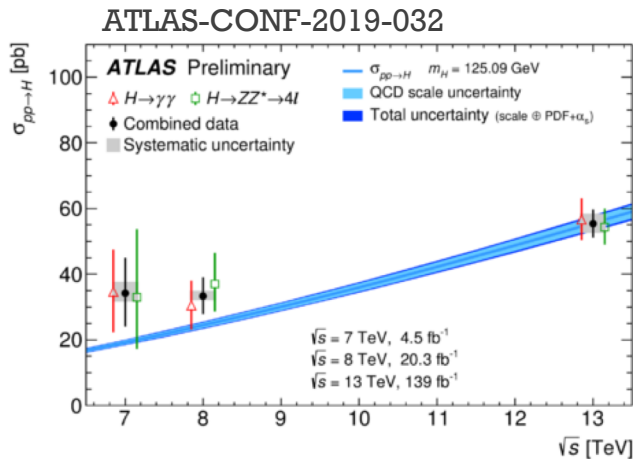
A crucial whole new sector of the SM, which must be explored in its full glory
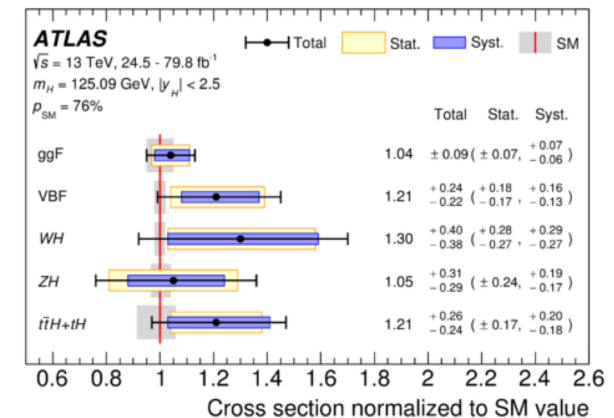
Elusive BSM Physics

https://twiki.cern.ch/twiki/bin/view/AtlasPublic/ExoticsPublicResults
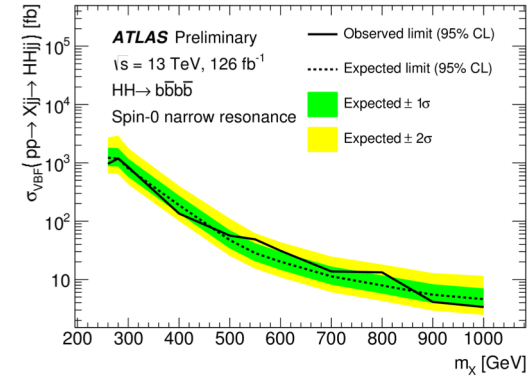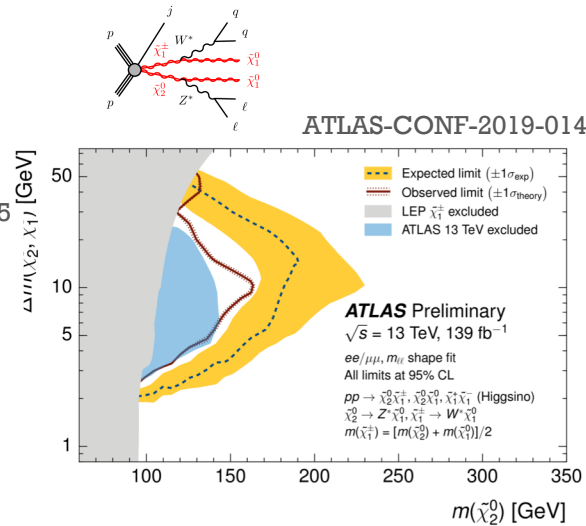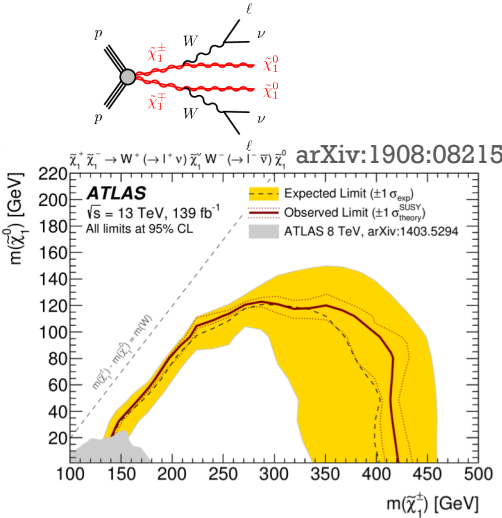
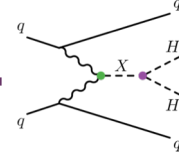https://twiki.cern.ch/twiki/bin/view/AtlasPublic/SupersymmetryPublicResults
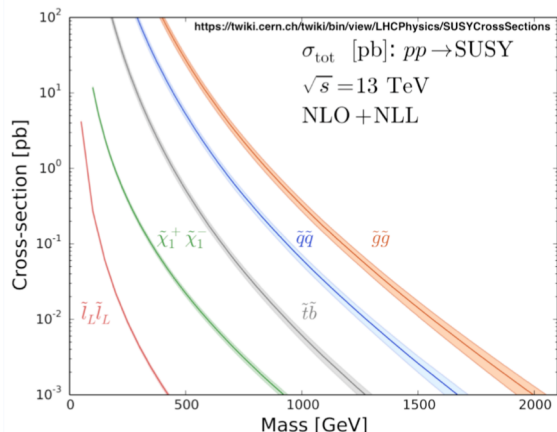
Electroweak SUSY remains a strong BSM contender
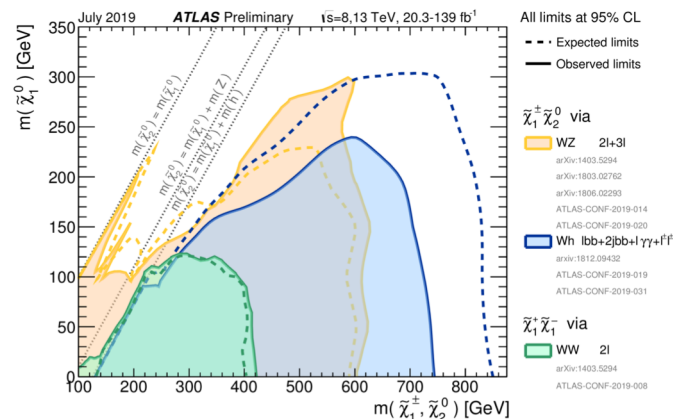
Shifting Some Boundaries Already

ATLAS-CONF-2019-030

arXiv:1908:08215

ATLAS-CONF-2019-014

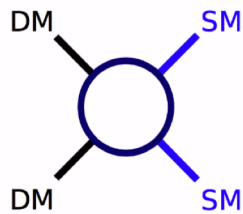ATLAS-CONF-2019-025

ATL-PHYS-PUB-2018-048

HL-LHC projection
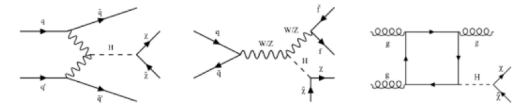
PRL 122 (2019) 231801
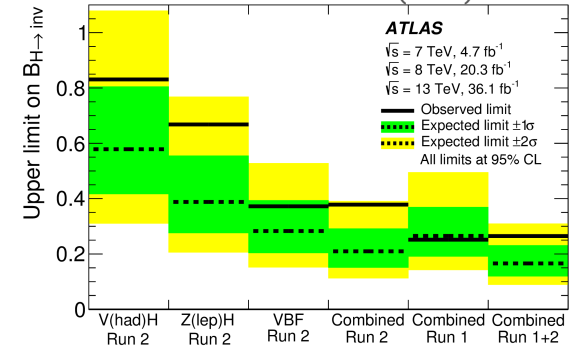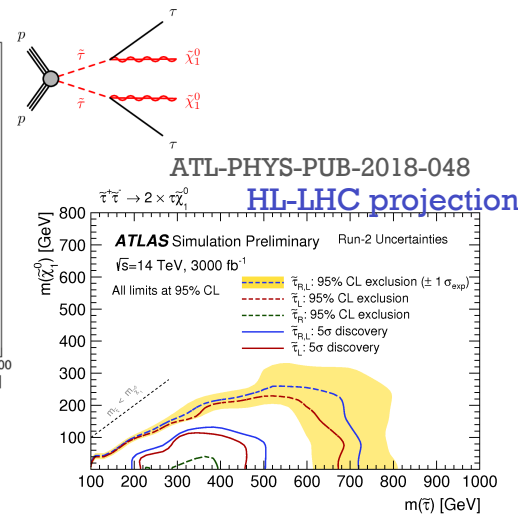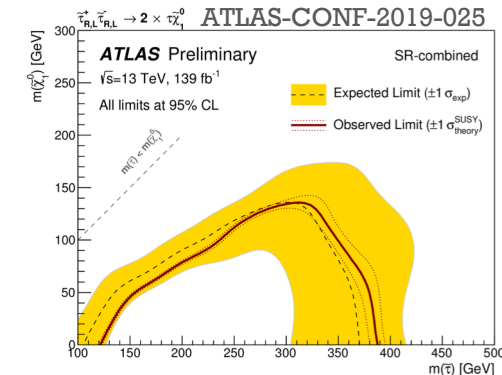
BSM scenarios that had been inaccessible are appearing on the horizon and may be within full reach in the not-so-distant future
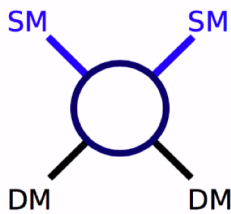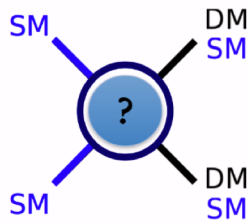
[… and more…]
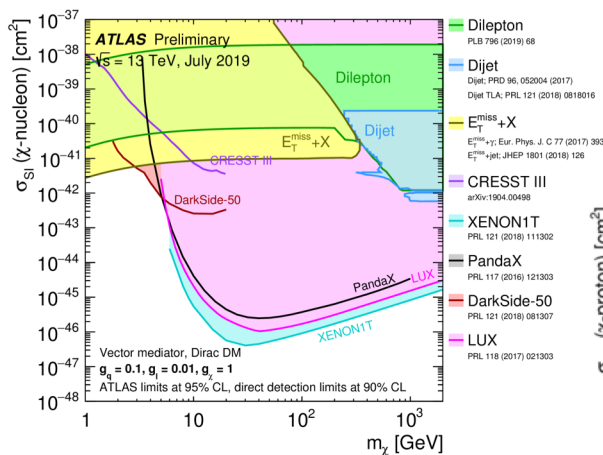
Dark Matter

C.Doglioni, Grenada 2019
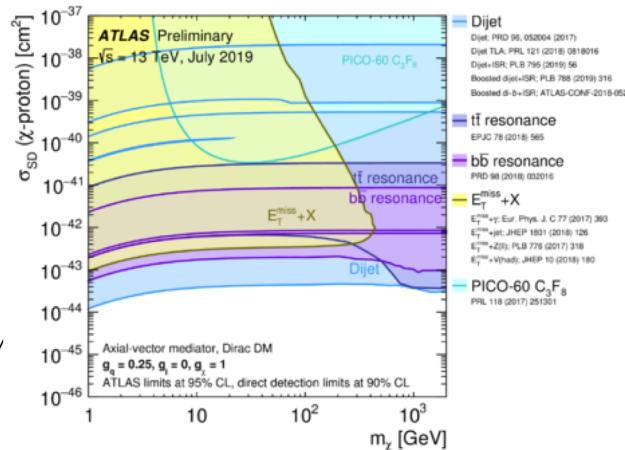
| Indirect Detection | Direct Detection | Particle Colliders |

PDG 2018

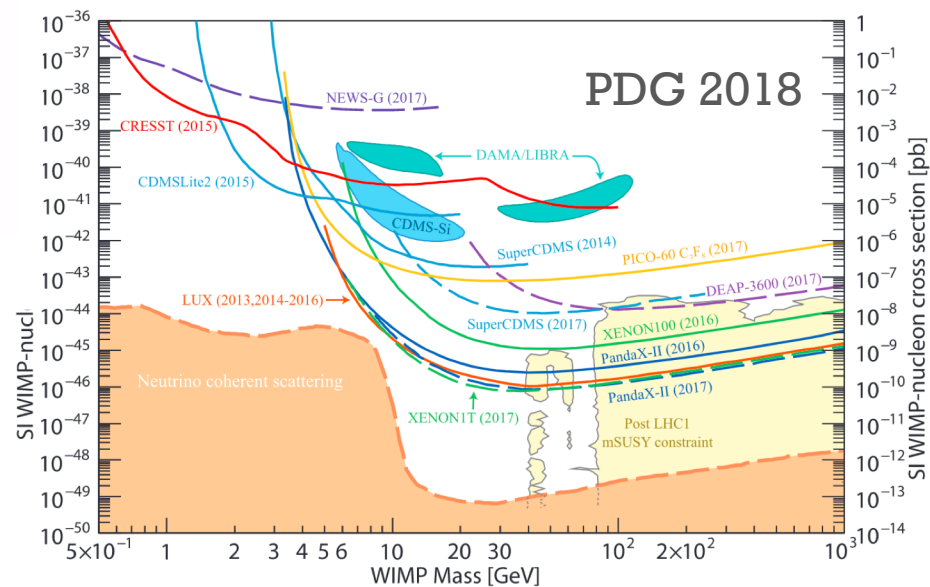https://atlas.web.cern.ch/Atlas/GROUPS/PHYSICS/
CombinedSummaryPlots/EXOTICS/
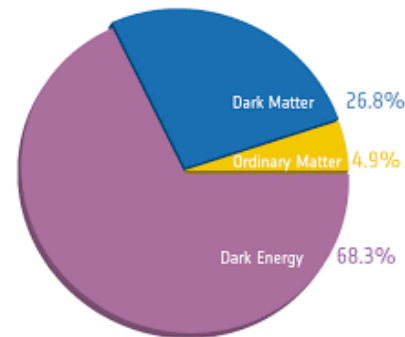
Complementarity must be exploited between direct and indirect DM searches, at colliders and elsewhere

tails
"It's the ~~economy~~, stupid"

direct searches   "UV" !   SM   E

"UV" ?   EFT   SM   global fits   E $E > E_{LHC}$

Higgs: HH, ggF, BR_H, VH/VBF, VBS, ttH

Top: tt, FCNC, single top, tt+V, t+H/Z

EW: EWPO, TGC
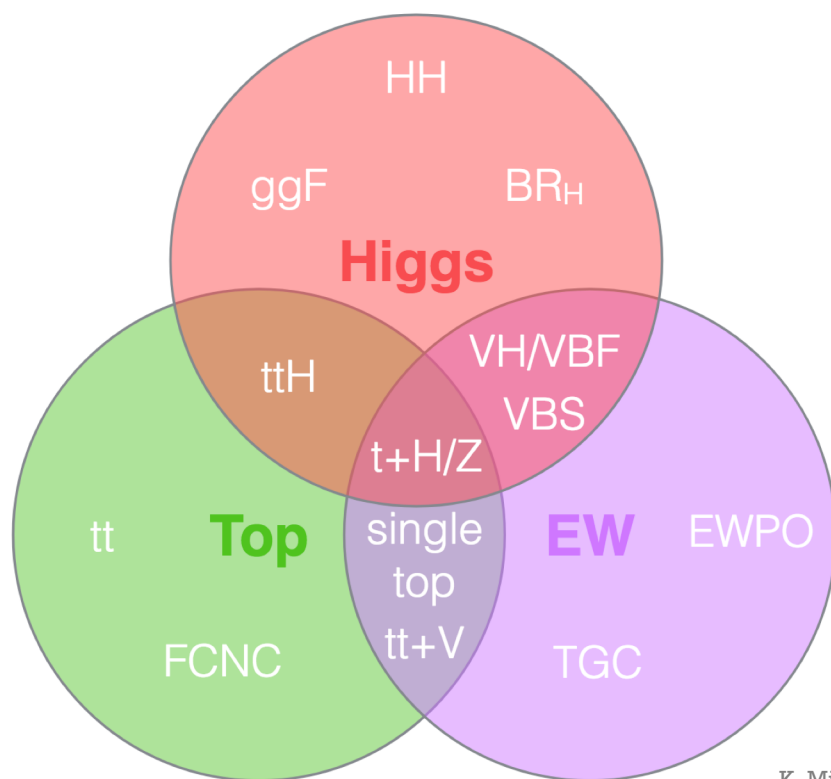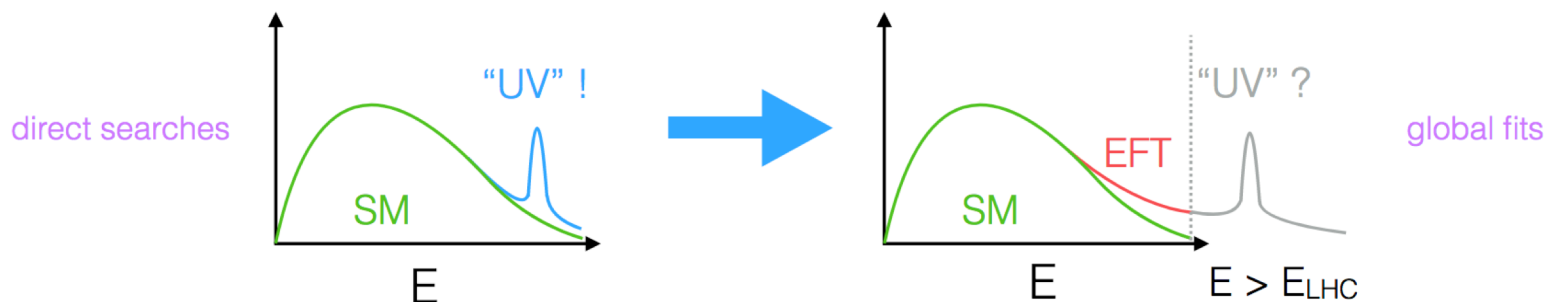
Decays

Flavor

CPV

New physics may be just beyond the energy limit of the LHC and may manifest itself as deviations from SM predictions in the tails of key distributions

Precision SM measurements may hold the key to finding evidence for BSM physics at colliders

K. Mimasu,

+ Workshop Structure

Day 1

- This Intro
- **Status and Outlook**
- ECR session #1

Day 2

- **Direct BSM Searches (at colliders and beyond) – with focus on EWK signals**
- ECR session #2

Day 3

- **BSM searches and EFT**
- Conclusions

The Elephant(s) in the Room

- It was a deliberate decision to keep a narrow focus for this workshop, and lots of exciting stuff had to be left out
  - Non-SUSY BSM searches at the LHC (BSM Higgs, exotica)
  - Flavour physics (anomalies, etc)
  - Future colliders
  - Neutrinos and astroparticle physics
  - Other future experiments
  - etc...

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- **We'll need a bit more Pushing the Boundaries in the future...**

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Thank you and Enjoy!