Perspectives of DM Searches With ATLAS and CMS Detectors

DM Searches: Perspectives of DM searches, 22 Oct 2020, JINR, Dubna (Russian Federation)

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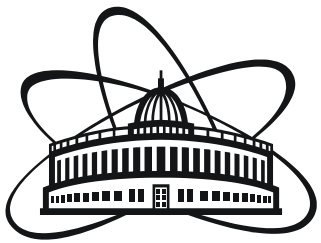
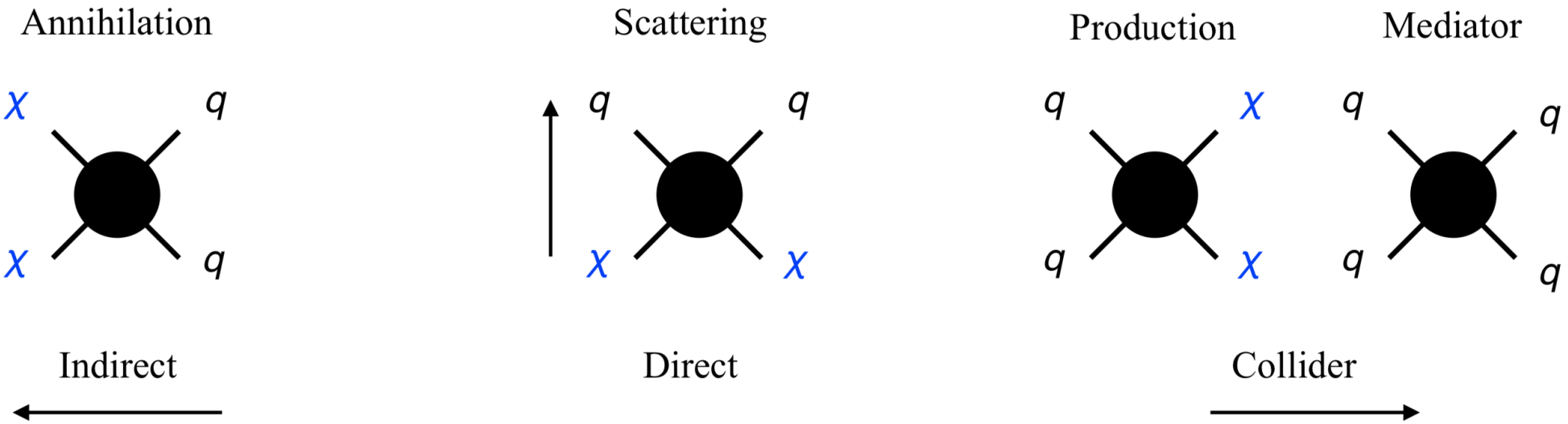
JINR, Dubna

October 22, 2020

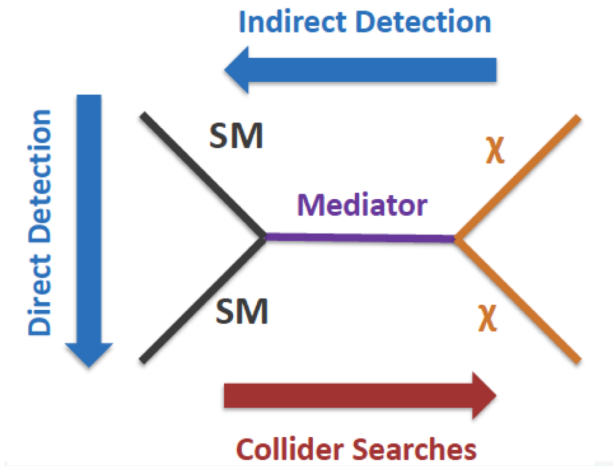


What do ATLAS and CMS Search?

ATLAS (talk at ICHEP)



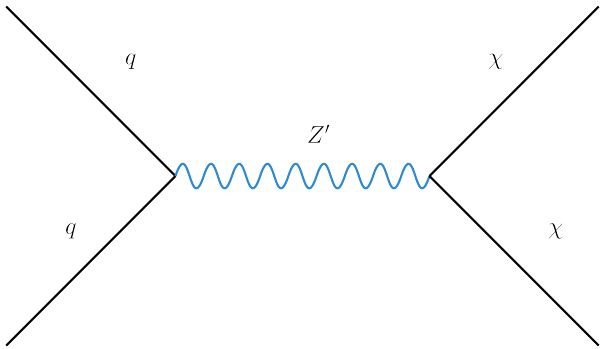
CMS (talk at ICHEP)



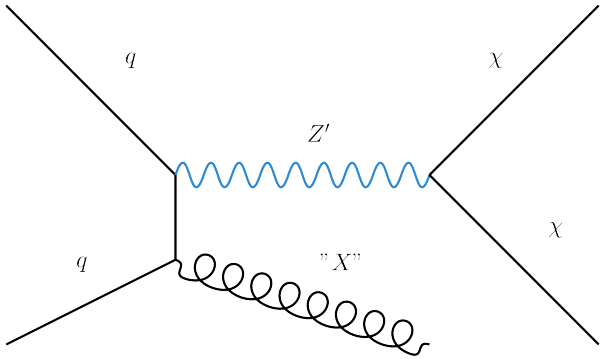
- DM interacts gravitationally and electrically neutral
- Collider searches compliment evidence from direct and indirect searches
- WIMPs are one of the most favourite DM candidates

How do ATLAS and CMS Search?

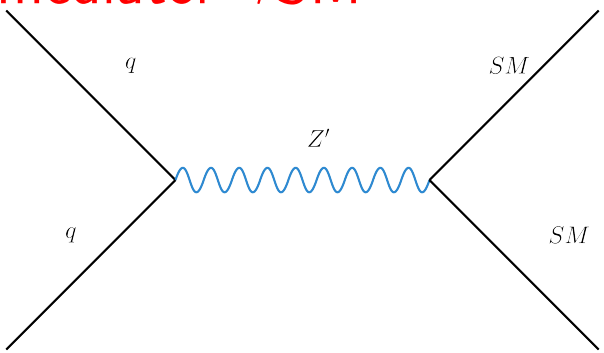
mediator→DM



mediator→DM+"X"



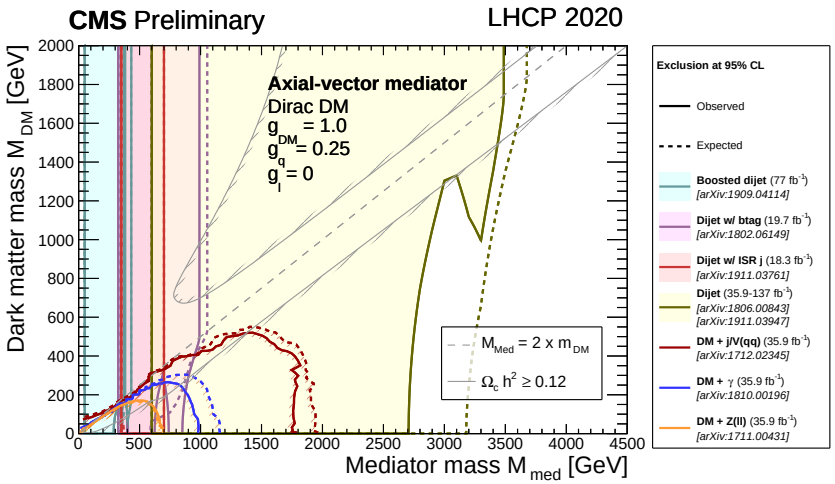
mediator→SM



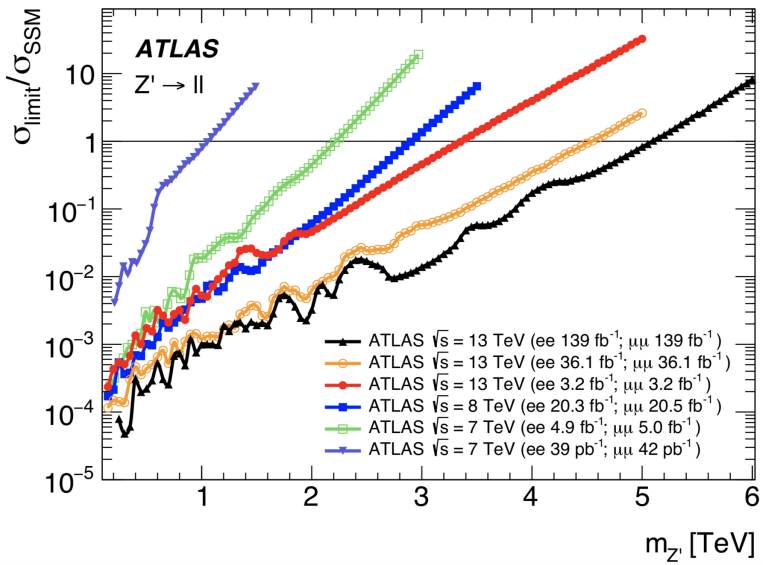
- Look for stable dark matter candidate by requiring that the system recoil against a visible "X"
- A wide range of models for different "X"
  - Jet, Photon, W/Z
  - Higgs boson
  - Heavy flavors
- Direct mediator searches: dijet (dilepton) resonances

ATLAS and CMS Results

CMS



ATLAS



- A wide variety of dark matter search analyses have already been performed
- Many exclusion limits and summary plots available
- Broad range of techniques
  - Rich set of experimental tools
  - Rich phenomenological landscape
- Constraints the production of DM at LHC
- Many full Run-2 DM analyses are still in progress

Perspectives

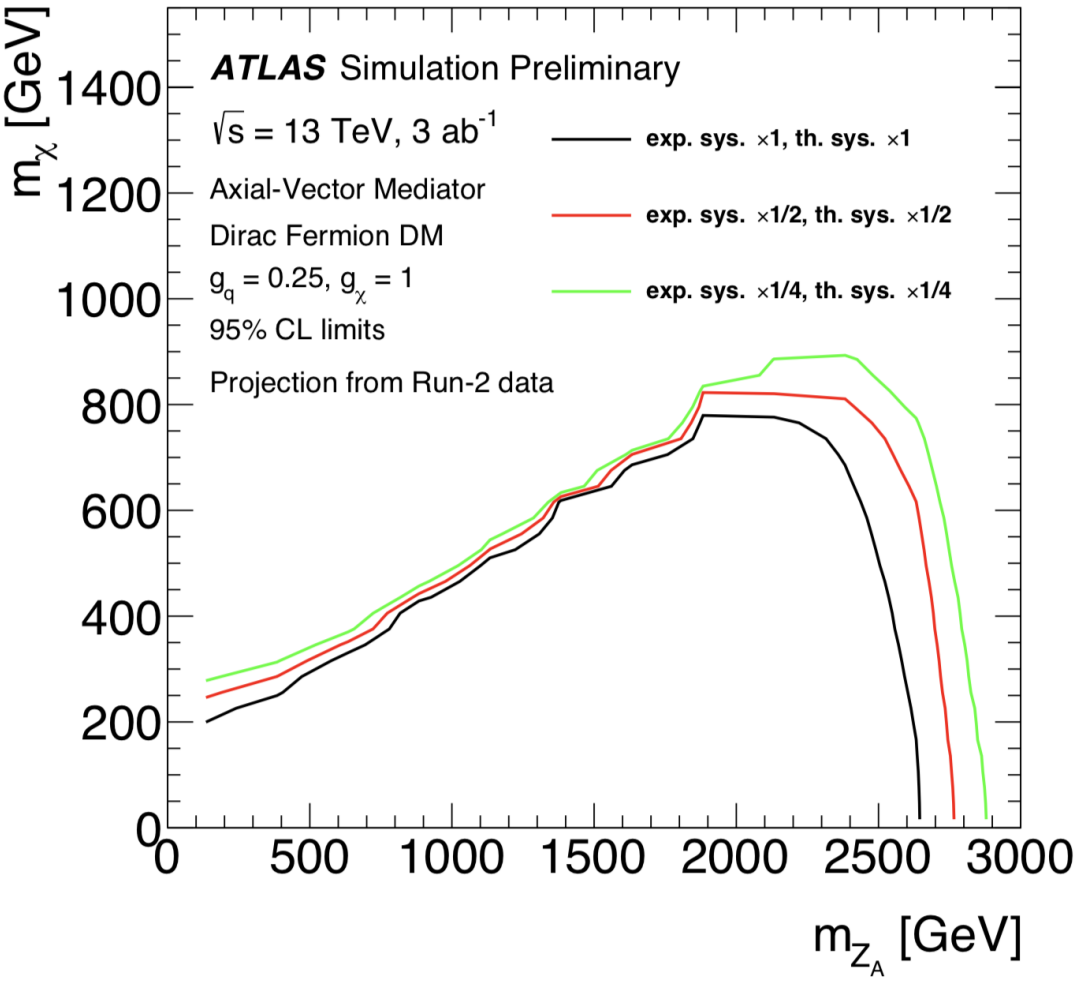
Short Term

- Finalise full Run-2 analyses
- New signatures
- More statistics during Run-3

Long Term

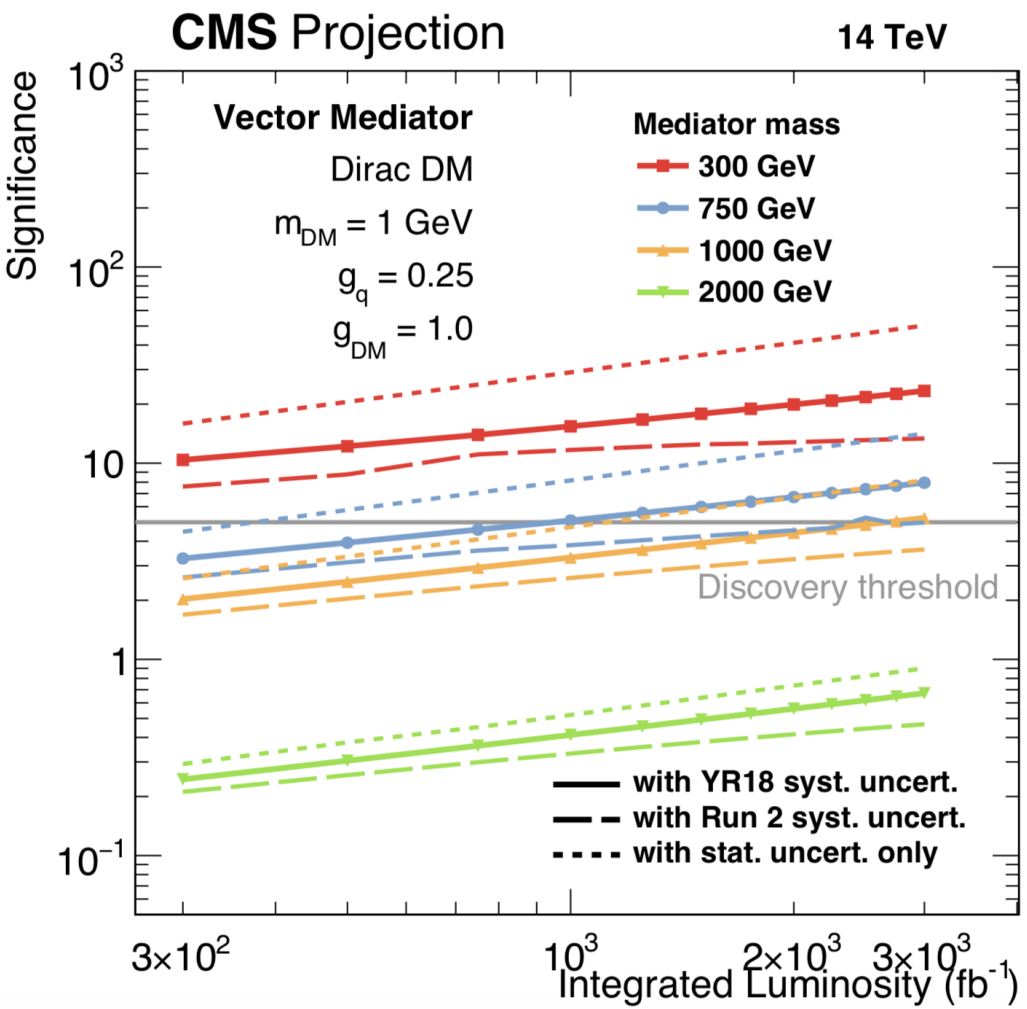
- Physics potential of the high-luminosity phase of the LHC (HL-LHC) and the perspectives for a possible future high-energy LHC (HE-LHC)
- Studies summarised in Report on the Physics at the HL-LHC, and Perspectives for the HE-LHC, CERN-2019-007
- Detectors will be upgraded
- Sensitivity will be improved
- New regions of the parameter space

Dark Matter and Jets



- Study on the sensitivity to Dark Matter of the monojet channel at HL-LHC
- Large statistics allows to increase the number of E_T^{miss} bins – improvement of about 100 GeV in the projected mediator mass reach
- Experimental uncertainties will be reduced due to detector upgrade
- χ is the WIMP DM and Z_A the axial-vector mediator

Dark Matter and Electroweak Bosons



- Dark matter produced in association with a Z boson at HL-LHC
- Z boson reconstructed from an e^+e^- or $\mu^+\mu^-$ pair (well reconstructible signature)
- Signal is determined from a maximum-likelihood fit of the missing transverse momentum
- A signal with a mediator of mass $m_{med} = 750$ GeV could be discovered with $L_{int} = 1$ ab^{-1}, $m_{med} = 1$ TeV with $L_{int} = 3$ ab^{-1}

Conclusion

- ATLAS and CMS search principles
  - Search for mediator
  - Search for the recoiling DM
  - Use the Higgs boson
- A wide variety of dark matter search analyses have already been performed
- Many full Run-2 DM analyses are still in progress
- At the time of HL-LHC detectors will be upgraded (improved uncertainties)
- Up to 3 ab^{-1} of data will be available for analysis after HL-LHC