Projections at 14 TeV for Dark Matter Searches in the monojet final state using the upgraded CMS Detector

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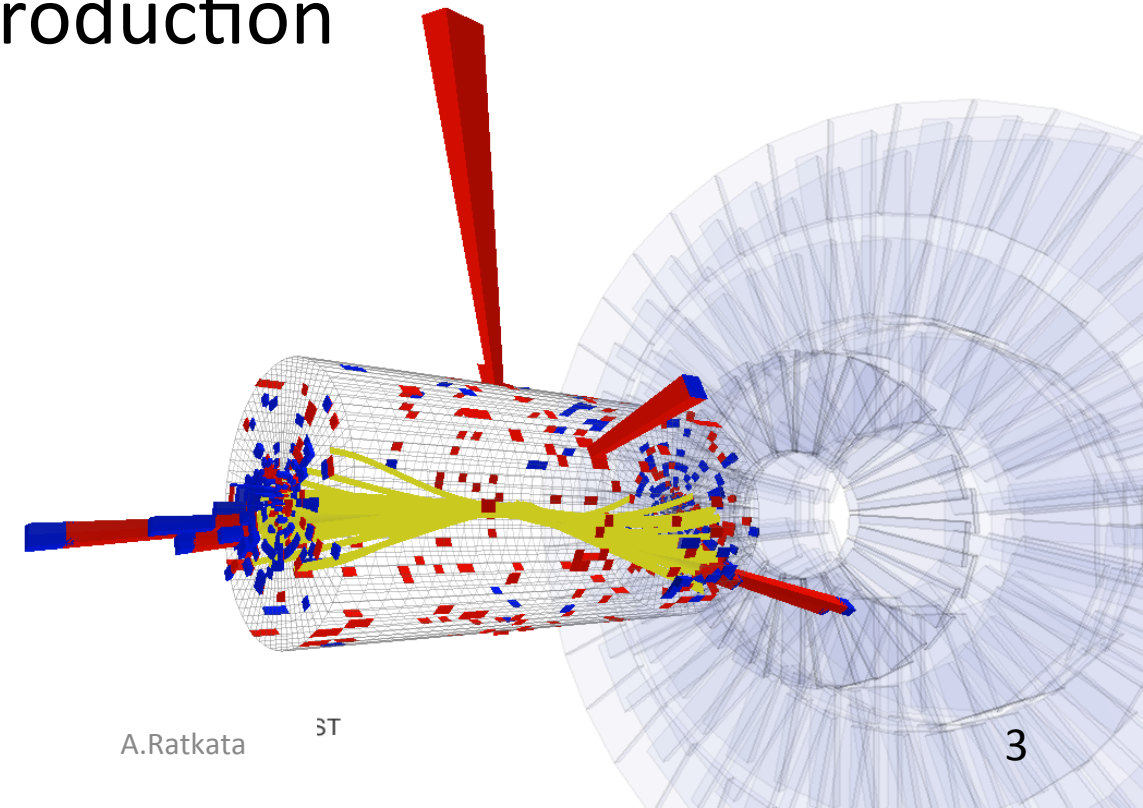
Gratefully Acknowledge

Suprevisor

Dr. Norraphat Srimanobhas

Outlines

- Motivation
- Objective
- DM pair production
- My work



Motivation

Upgraded LHC

√S =14 TeV

Motivation

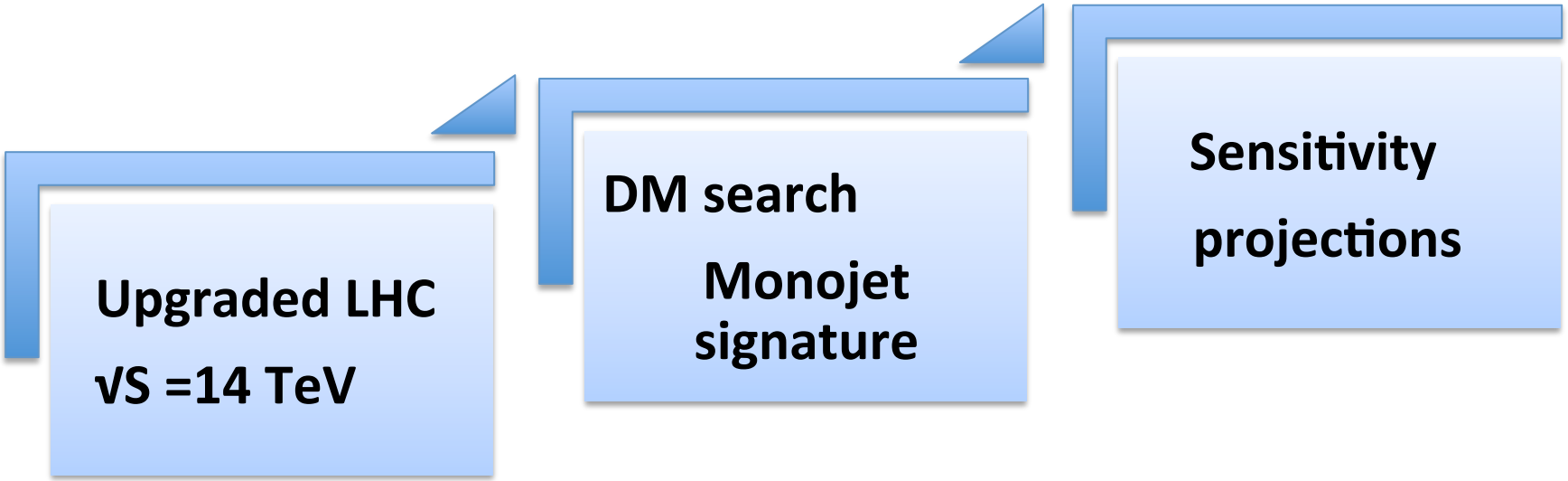
Upgraded LHC

√S =14 TeV

DM search

Monojet signature

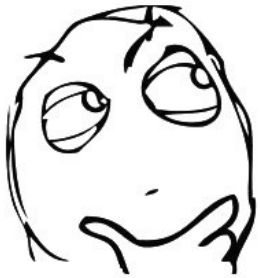
Motivation


Upgraded LHC
√S =14 TeV
DM search
Monojet signature
Sensitivity projections

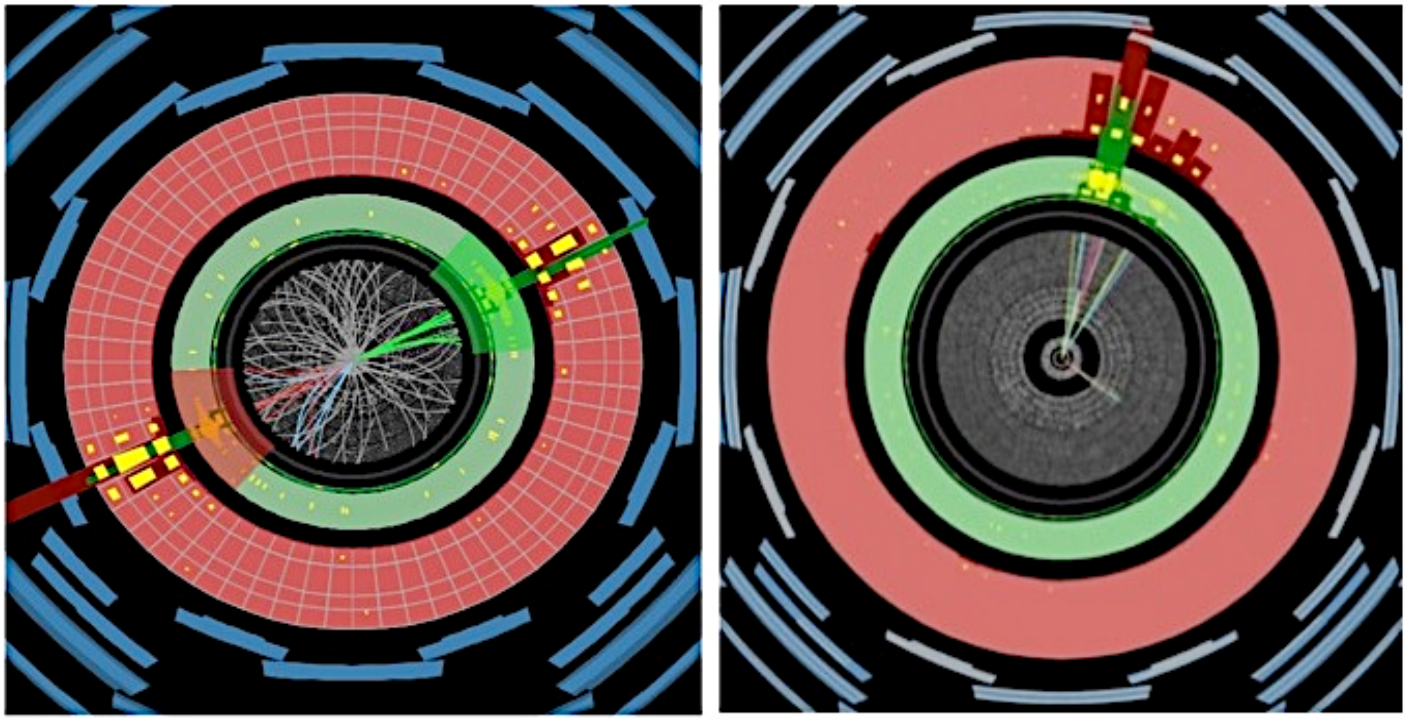
HOW ?

- Estimate the upper limits on DM-nucleon scattering cross sections (X-Nσ) using DELPHES simulation compared to generator level analysis

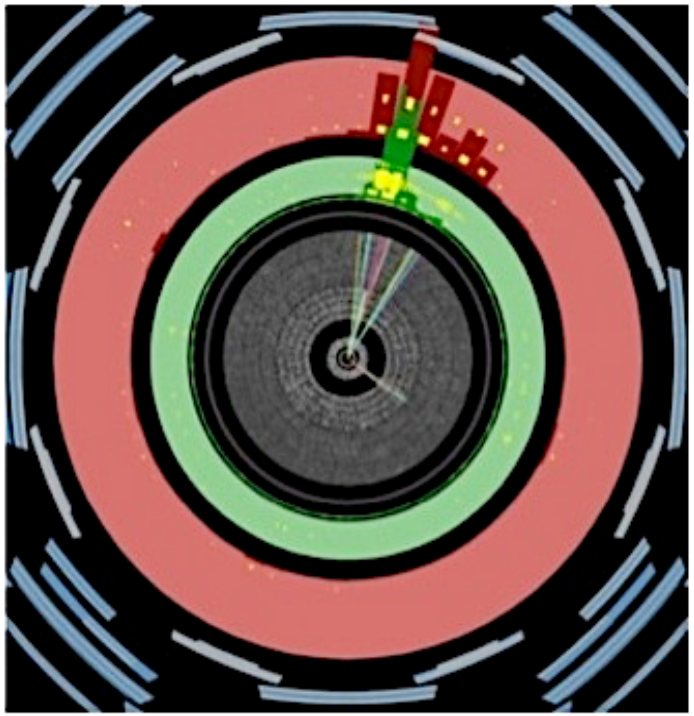
- Scope: At 14 TeV with integrated luminosity 300 fb^{-1}



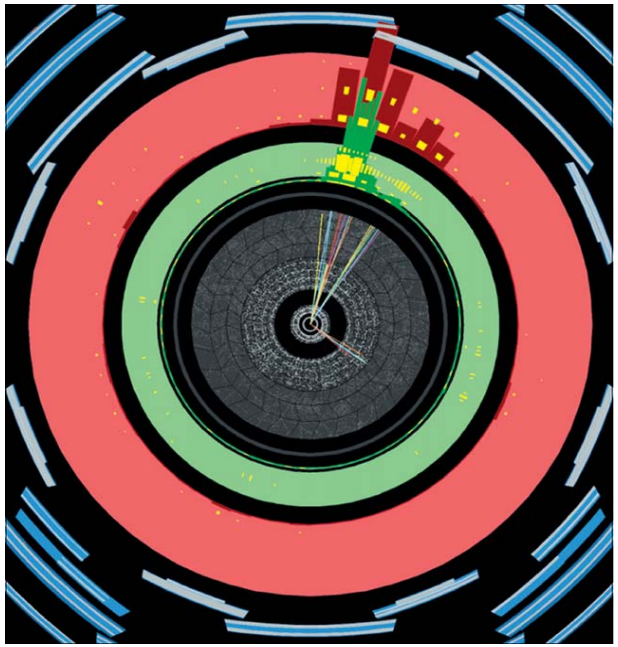
Missing Transverse Energy

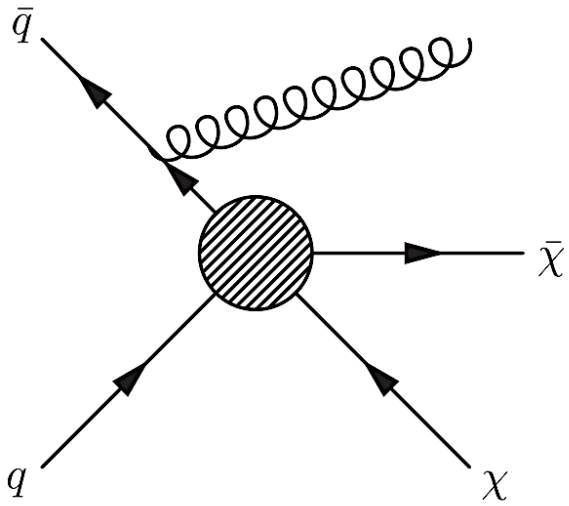


Missing Transverse Energy



Dark matter pair production

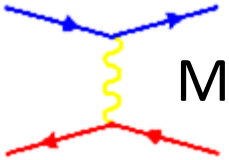




Monojet signature

Process (DELPHES)

Event/signal Generation



MADGRAPH

Detector Simulation → **DELPHES**

Event selection

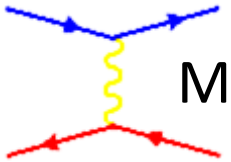
Background Estimation

Invisible Z decays and W(lv)+jets (Dominate)

Acceptances

Upper Limit on $\chi - N\sigma$ (cm^2)

Generator Level analysis



MADGRAPH

Event Generation

~~Detector Simulation~~

Event selection

Background Estimation

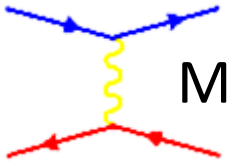
Acceptances

Upper Limit on $\chi - N\sigma$ (cm^2)

Generator Level analysis

Approximation

Event Generation



MADGRAPH

~~Detector Simulation~~

Event selection

Background Estimation

Acceptances

Upper Limit on $\chi - N\sigma$ (cm^2)

CMS Monojet analysis

- Event selection

  - $p_T(j_1) > 100$ GeV in $|\eta|<2.4$, MET > 200 GeV

  - $N_{jets} \leq 2$, jets with $p_T > 60$ GeV, $\delta\Phi(j_1,j_2) < 2.5$

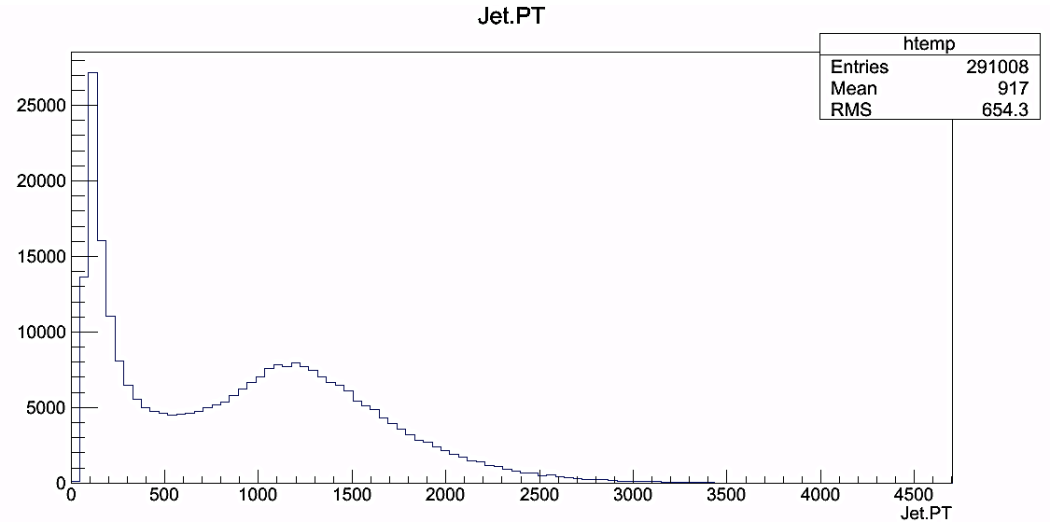
  - e, μ, hadronic vetoes

  - MET > 1000, 1100, … , 1500 GeV & $p_T(j_1) > 500$ GeV

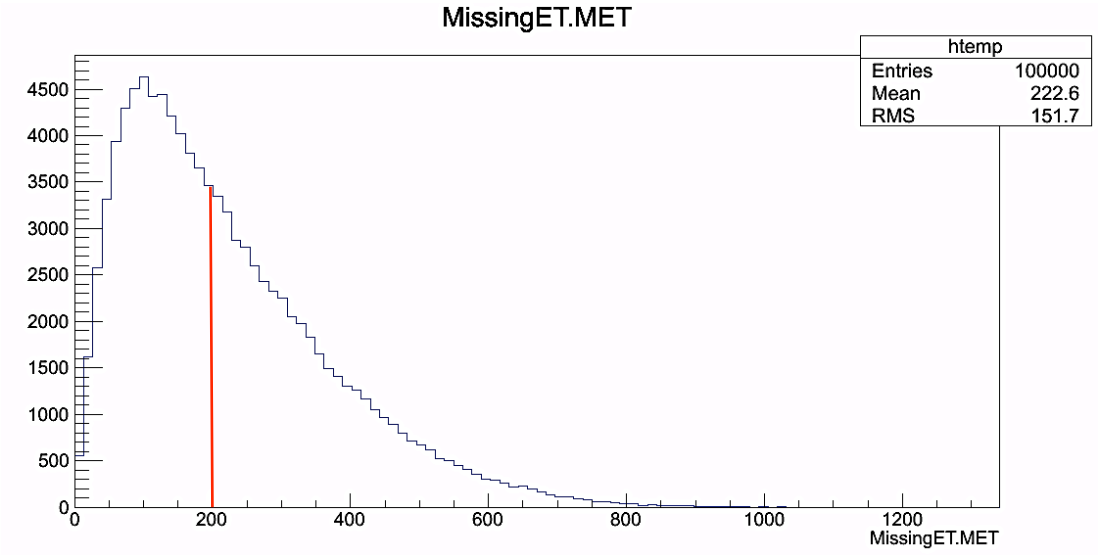
- Upper limit on production cross section

  - Projection of 90% CL spin dependent for the DM-nucleon cross section as a function of DM mass

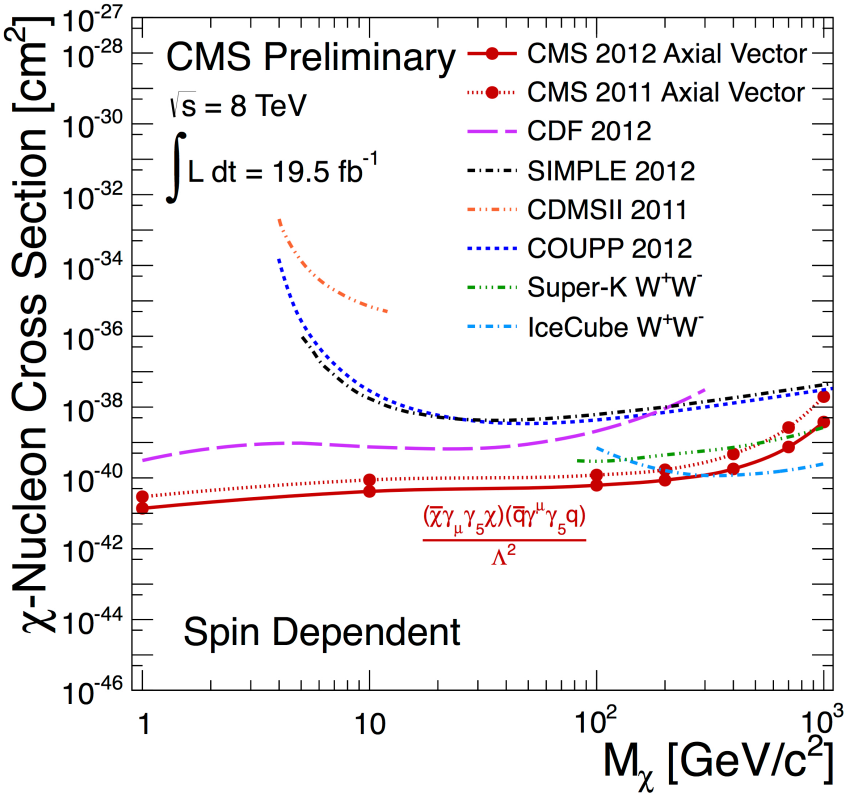
Distributions of Jet & MET



For DM mass = 1000 GeV
Jet transverse momentum

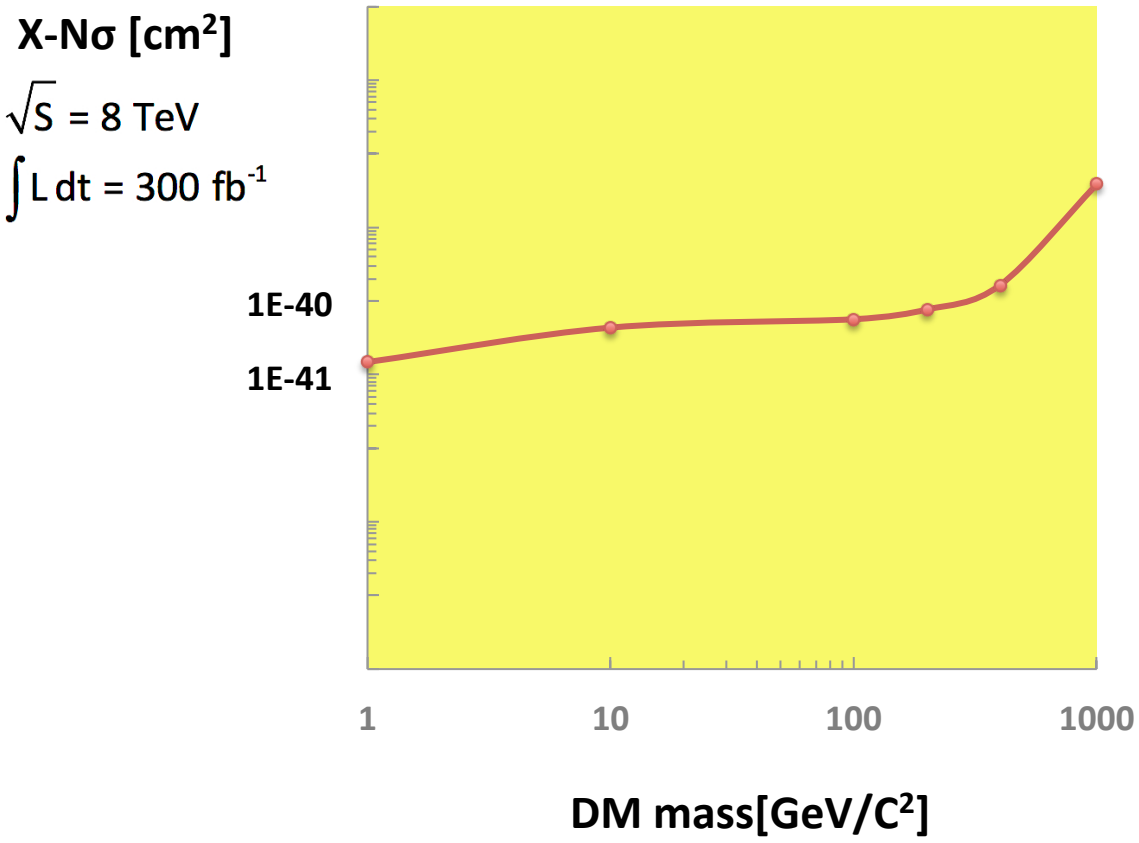


Upper limit on DM-nucleon scattering cross section



[CMS-PAS-EXO-12-048]

DM-nucleon scattering cross section (GL)



Work in progress

- DELPHES

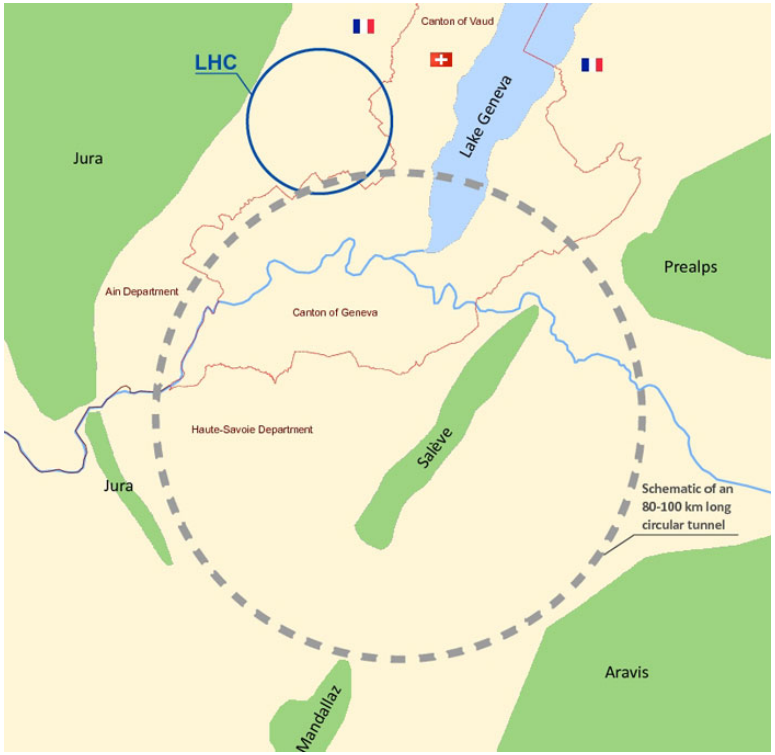
  - total background event yeilds from Z(vv), W+jets

- Generator Level

  - Find event yields for the signal and backgrounds estimated from 8 TeV

Next step

Analysis for upgraded LHC at 33 TeV, 100 TeV



It’s time to unviel
the mysterious universe.

Thank you

References

[1] CMS Analysis Note, Projection at 14 TeV for Dark Matter Searches in the monojet FinalState Using the Upgraded CMS Detector

[2] Patrick J. Fox et al., “Missing energy signatures of dark matter at the LHC”, PhysRevD.85.056011.

[3] CMS Search for dark matter and large extra dimensions in monojet events in pp collisions at s = 7 TeV, arXiv:1206.5663v1.

[4] "Snowmass Energy Frontier Simulations", arXiv:1309.1057, Sept. 2013

[5] "Methods and Results for Standard Model Event Generation at sqrt(S) = 14 TeV, 33 TeV and 100 TeV Proton Colliders (A Snowmass Whitepaper)", arXiv:1308.1636, Aug. 2013