University of Sussex

open data ATLAS

DARK MATTER

SEARCHING THE INVISIBLE -ATLAS

The Abdus Salam International Centre for Theoretical Physics Physics Without Frontiers

Royal University of Bhutan

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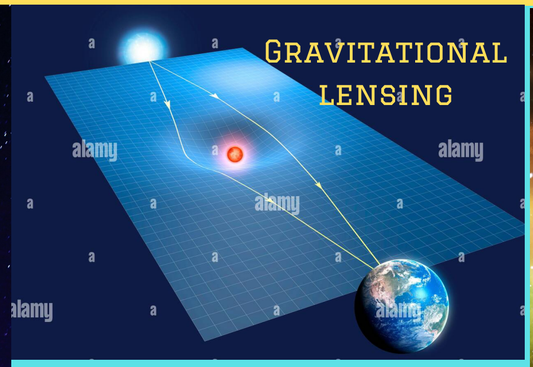
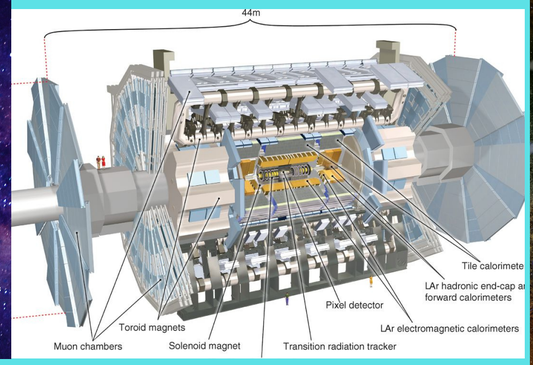
Introduction

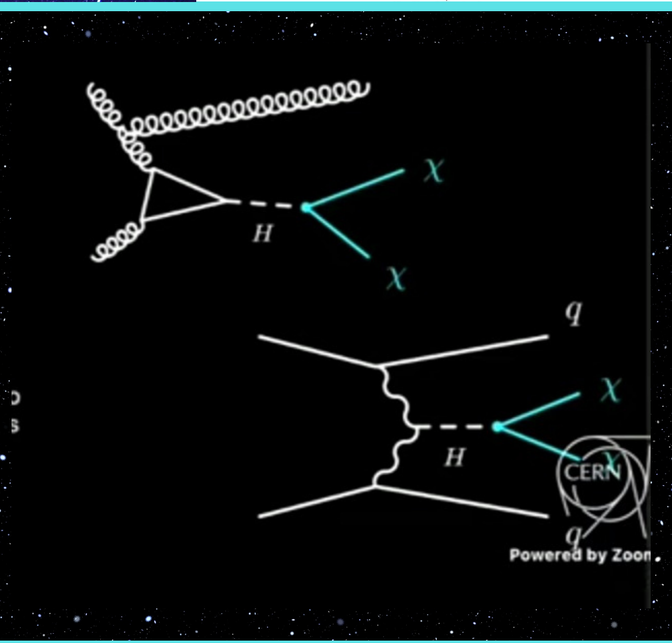
- Dark matter is an invisible matter that do not interact with the electromagnetic force
- Example: Gravitational lensing.
- Though they are common across the universe, it's effect is observable yet difficult to create and observe even using the ATLAS detector.
- So, what we can do to detect dark matter???
- In LHC, we collide protons and observe those collisions producing dark matter particles.



ATLAS detector



- Higgs could decay 'invisibly' that is dark matter
- Several types of experiments are searching for signal from Dark matter and to understand its nature.
- No experiment has the answer for dark matter.

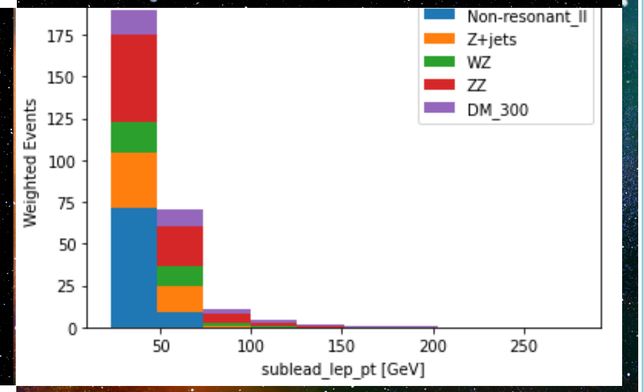


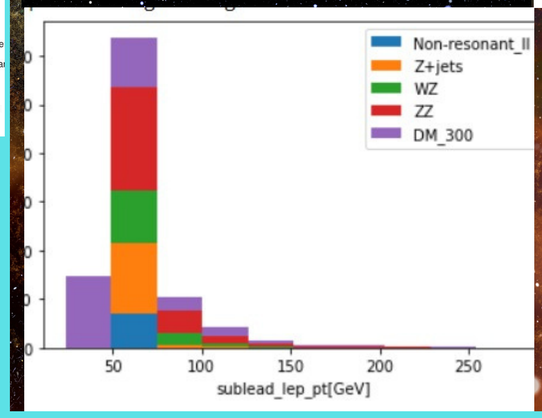

```
data_all['DM_300']['sublead_lep_pt']

0      37.342027
1      31.122283
2      65.336797
3      93.620266
4      40.265805
         ...
486    29.951379
487    45.348254
488    37.106082
489    79.551945
490    50.553152
Name: sublead_lep_pt, Length: 491, dtype: float64
```

- Above data is for DM_300 with column sublead_lept_pt.
- The sublead_lept_pt of various signal such as Non-resonant_ll, Z+jets, WZ, ZZ and DM_300
- The main signsl we use is DM_300

$$\text{significance} = \frac{\text{total signal weights}}{\sqrt{\text{total background weights}}}$$

- Stack graph of sublead_lep_pt of all the data signal such as Non-resonant, Z+jets, WZ, ZZ and DM_300
- The background with maximum weighted events are below 50Gev
- By applying cut we will be able to get better result that has more significance than three.
- In particle physics , we figure out the evidences for dark matter if the significance with more than 3 value





- The graph on the left is new stack graph of sublead_lep_pt of all the signal after applying cut.
- The value of signal weight is 31 and total background is 65
- Where we get the significance above three.

Result

- The significance number after applying the cut is 3.845
- Hence, we conclude that we have evidence for process such as Dark matter in DM_300 signal