Dark matter search associated with monotop production via leptonic decay to top quark in pp collision at $\sqrt{s} = 14$ TeV using MADGRAPH5

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**Introduction to DM**

Dark matter is a kind of matter hypothesized in astronomy and cosmology. Dark matter (DM) is a leading candidate to explain gravitational effects observed in galactic rotational curves, galaxy clusters, and large scale structure formation, etc.

**Current experiment for DM**

The considered objects are electron (muon), b-quark and missing E_T (DM particle + neutrino).

**Feynman diagram**

In the plots, interesting point is fermionic DM particle's plot shape. The shape has two bumps because of a fermionic process has two different propagators: they are charged vector and charged scalar. The each particles have different mass by definition. So fermionic process represent two bump. Another interesting point is missing transverse energy plot. This is the value about neutrino + DM, so that plot has mass dependent shape.

**Strategy**

Vector DM process

Scalar DM process

Fermionic DM process

Non-Thermal DM process

**Introduction to Mono top**

**Cross-section**

The considered mass of X2 is 4000 GeV. Assumed Mass of X1 is 1000 GeV. The shape has two bump because of fermionic process has two different propagator: they are charged vector and charged scalar. The each particles have different mass by definition. So fermionic process represent two bump. Another interesting point is missing transverse energy plot. This is the value about neutrino + DM, so that plot has mass dependent shape.

**Transverse Energy**

**Transverse Momentum**

**Transverse Mass**

In the process, neutrino mass can not contribute to transverse mass on this result. So contribution of DM particle mass is dominant about transverse mass. The plots show that blue line has different shape on each plot. Result report LUX experiment is the one of Non-thermal DM.

**Conclusions**

The underground experiment measured DM particle(Wimps) at the weak scale (around 100 fb at 100 GeV) recently, while CMS at LHC expected around 1 pb at 7 and 8 TeV. According to this measurement, LHC running at 14 TeV may search it around 100 fb area. In this condition, we can consider not only vector and scalar DM particle but also fermionic DM particle. Non thermal DM particle is a kind of fermionic DM particle with a difference in incoming parton and propagator mass. Since non-thermal DM process allows b quark as incoming particle, the process requires very high energy to produce them and the propagator be heavy. Then fermionic process includes charged vector propagator, while non-thermal has not. Due to this difference, two processes have different results.

**Plan**

Background study (e.g. single top quark process,...etc)

DM particle Mass $\leq$ 25 GeV region analysis

DM particle Mass $\gg$ top quark mass region analysis

Study for Mono top production by propagator mass variation