משרד החינוך
המינהל הפדגוגי
האגף למחוננים ולמצטיינים

מכון הנרייטה סאלד
המכון הארצי למחקר במדעי ההתנהגות

Incresing the efficiency of rejecting background when searching for dark matter

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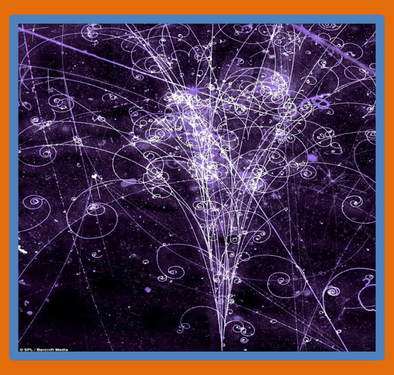
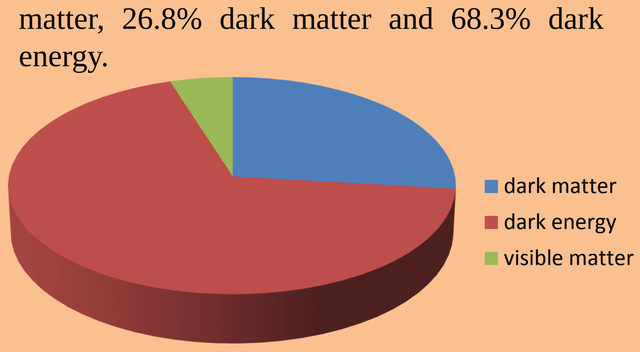


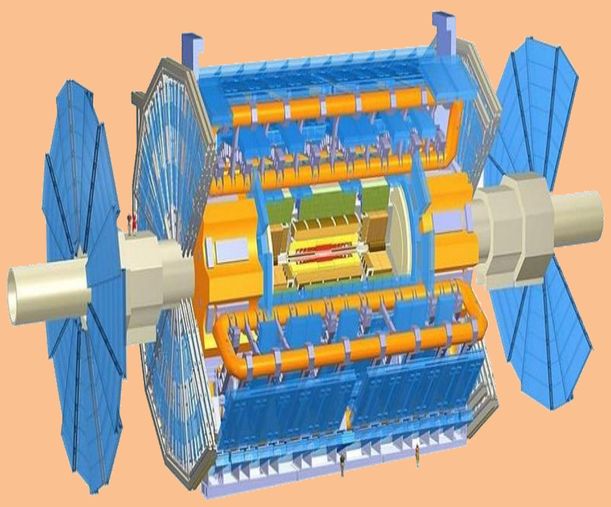
Introduction

Dark matter is a type of matter hypothesized in astronomy and cosmology to account for a large part of the mass that appears to be missing from the universe. Dark matter cannot be seen directly with telescopes; evidently it neither emits nor absorbs light or other electromagnetic radiation at any significant level. It is otherwise hypothesized to simply be matter that is not reactant to light. Instead, the existence and properties of dark matter are inferred from its gravitational effects on visible matte, based on the standard model of cosmology, the total mass–energy of the known universe contains 4.9% ordinary matter, 26.8% dark matter and 68.3% dark energy.



LHC and the ATLAS detector

The Large Hadron Collider is a proton-proton (and ion-ion) accelerator and collider located at CERN, near Geneva. It is a 26.7 km long ring structure built underground.
ATLAS was designed as a general-purpose detector, capable of investigating a wide variety of physics signatures. As such, it consists of several subdetectors which record tracks and energy depositions, allowing the identification and measurement of a large class of different particles.



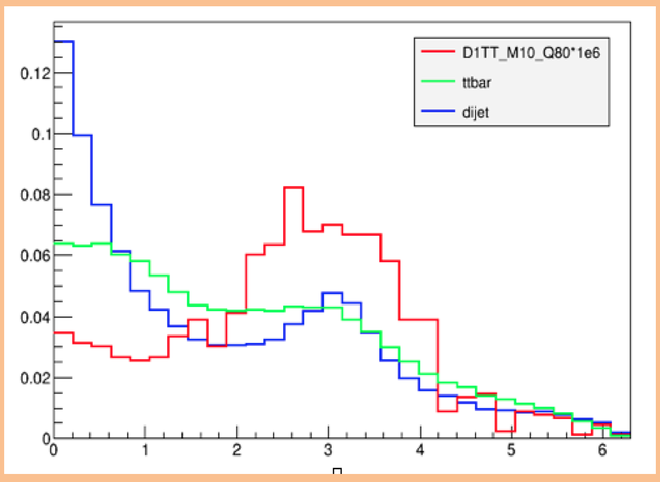
the ATLAS detector

Aim

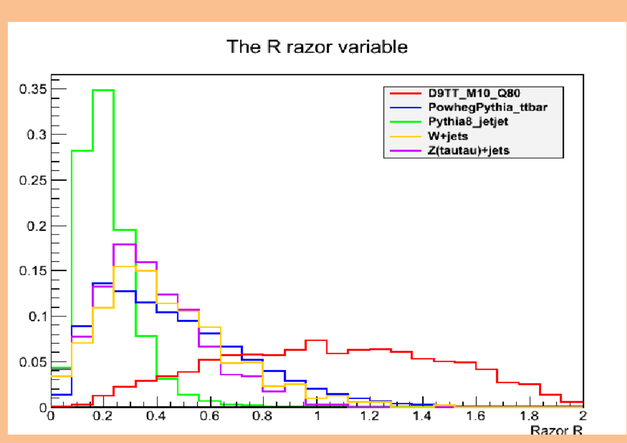
The ATLAS detector produces huge amount of information every second that would take ages to process, thus forcing us to find ways to “purify” the data we receive to locate the the incidents that interest us. Here we are optimizing the variable R by minimizing the background (which represent the data that don't concern our search) and focusing on the Signal that is related to dark matter, this allows us to make a finer cut on the data we have, making the search for dark matter related collisions much more efficient.

Method

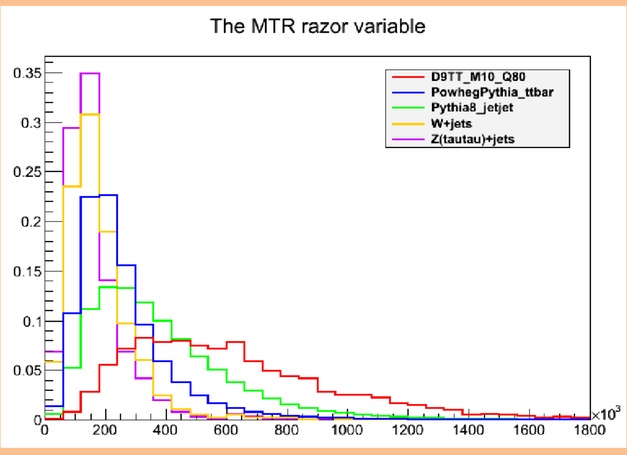
the current method used is to search for large missing transverse energy in association of tt pair. Events are required to have at least five jets. Two of the selected jets are required to be identified as b-jets. These relatively tight requirements are designed primarily to reduce the multi jet background whose cross section falls dramatically with the number of jets. While we do not explicitly cut on ETmiss, we do all the cut optimization on events with ETmiss larger then 200 GeV.



: angular distribution between the leading b-jet and the **E**Tmiss in the transverse plane



R distribution



MRT distribution The

Results

The variable “R” was optimized as follows: In order to maximize the significant, we maximize **S**r^2/**B**r, where Sr is the signal ratio and Br is the background ratio according to the variable “R” as shown in the table below, and the value of “R”>0.7 was selected.

R	Signal-ratio	Background-ratio	(Sr^2)/Br
>0	4115 - 1	1072921 - 1	1
>0.1	4083 - 0.99	964379- 0.89	1.101
>0.2	3833 - 0.93	631008 – 0.58	1.41
>0.3	3383 - 0.82	320775 – 0.29	2.256
>0.4	2794 - 0.67	133509 – 0.12	3.62
>0.5	2077 - 0.50	47294 – 0.044	5.681
>0.6	1445 - 0.35	14780 – 0.013	9.423
>0.7	872 - 0.21	4327 – 0.004	**11.025**
>0.8	422 - 0.10	1225 – 0.001	10.52
>0.9	114 - 0.02	320 – 0.0003	1.33

Once we have the values of the 2 variables we can estimate the Signal and the Background of the process.