Dark Matter and Particle Accelerators

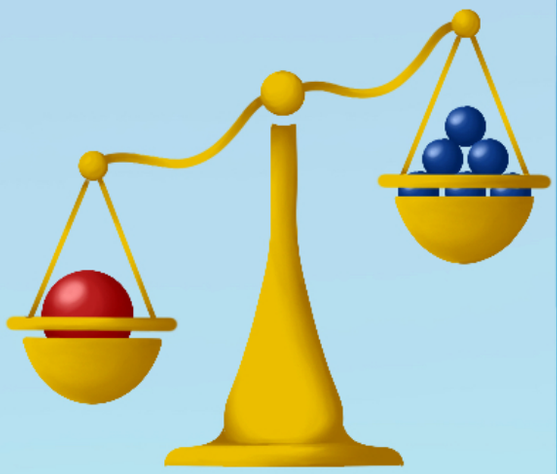
1

For now dark matter searches have not been successful, but we haven't discard its existence yet. We are developing many detection methods that are increasingly accurate and recursive. We're going to talk about the searches of DM in the LHC.

For these searches we must first develop theorethical frameworks, some of them are very complex, these models suggest several dark matter candidates that have theorethical constraints or wich implies collisions with higher energies than the LHC range of energy.

2

There are simplified models that have theoretical frameworks that depend only on the theoretical mass for the dark matter particle and on the mass and type of the particles involved in the collision.



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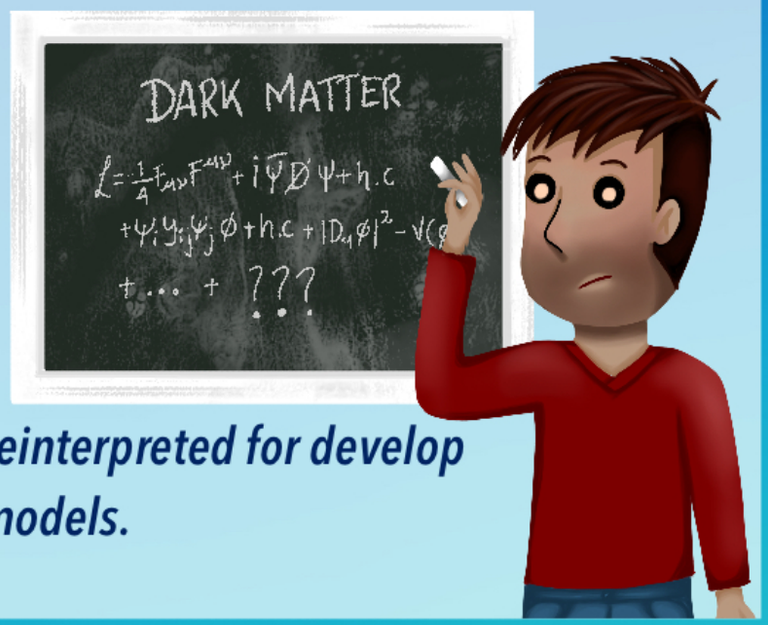
Simplified models help us to analize the results of the experiments and to inspire and design searches in the LHC, also these simplified models can be reinterpreted for develop more complex models.



4

Several computational simulations of dark matter production by particle collisions are being made.
These simulations help us to make searches in the LHC.

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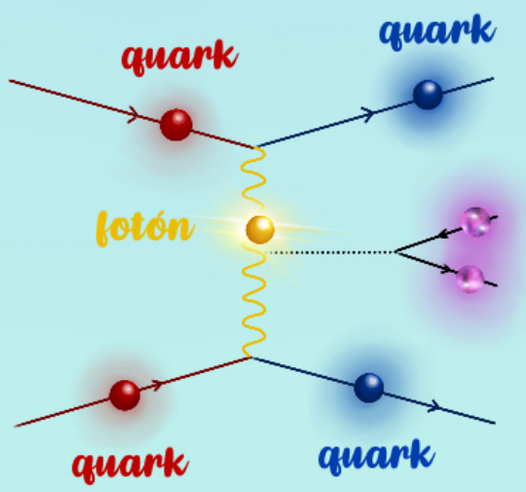

Vector Boson Fusion (VBF) is a mechanism for dark matter production, in these mechanism a pair of quarks collide and with the help of a mediator particle the quarks fuse to form new particles.

6

Dark matter particle can't be directly detected, so we must measure other properties of the collision. The observed characteristics of the collisions would be anomalous if dark matter particles were produced. We have to minimize the error in our measures for assure that the anomalous characteristics of the collisions are given by the production of dark matter. Mechanisms like VBF help us to minimize this error.

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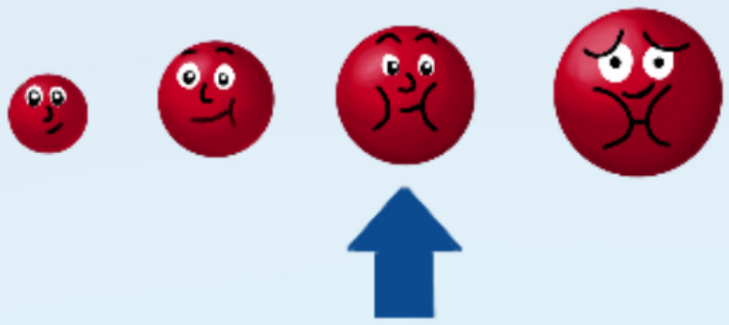
In the computational simulations the masses values for dark matter particle and mediator particle are changed,



and we choose wich events seem to produce a dark matter particle, these events are called signal events.

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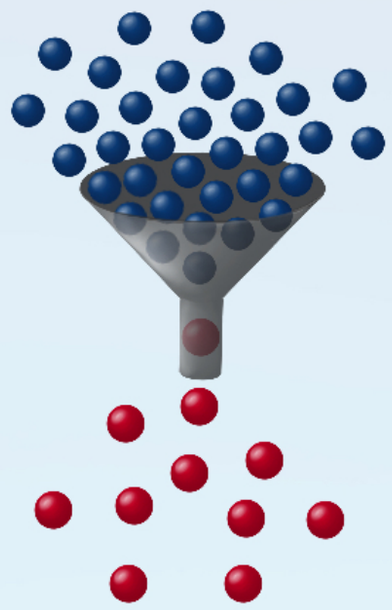

First we must make a selection based on the geometric characteristics and the masses of the particles of the collision. Then we must make other selections to optimize and assure that the anomalous characteristics are real.

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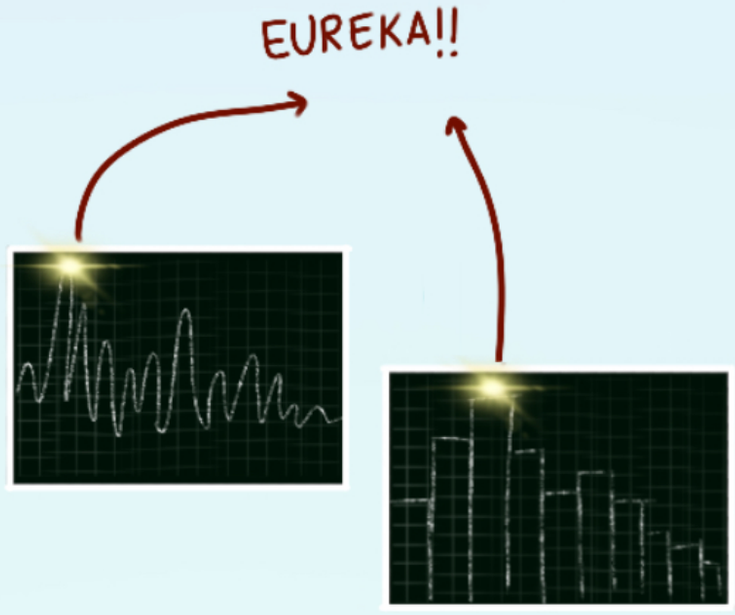
Finally we count the signal events number and we plot the data to see the behavior of this dark matter production. We found a lot of signal events in some plots for some geometric characteristics of the collision.



The results obtained with VBF are compatible and complementary with the results obtained with other mechanisms of dark matter production. Also, this mechanism is innovative and helps us to improve our selection criteria and to design future searches for dark matter in the LHC.

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