Monochromatic Neutrinos from Dark Matter Annihilation.

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Dark Matter Evidences.

- Rotation Curves of Galaxies: Following Newton dynamics there should be more mass in order to predict what we observe.

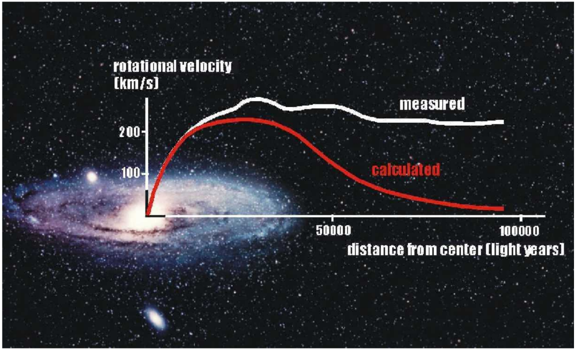


Figure 1: Calculated and Observed Rotation Curve of Andromeda Galaxy [4].

Dark Matter Evidences.

- Gravitational Lensing: Following General Relativity there should be more mass in order to predict the amount of gravitational lensing that we observe.

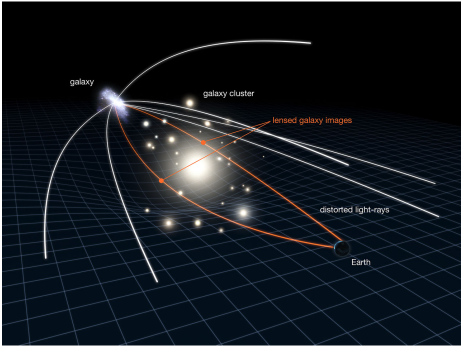


Figure 2: Scheme of a gravitational lense [3].

Dark Matter Evidences.

- Structure Formation: If there were only ordinary matter in the universe, there would not have been enough time for density perturbations to grow.
- CMB:

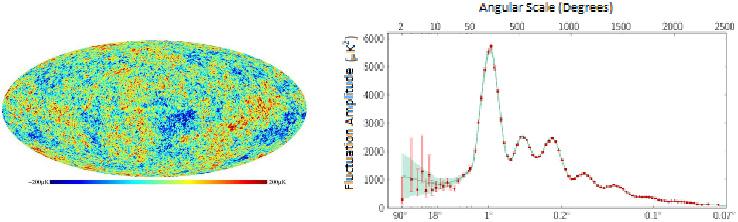


Figure 3: Cosmic Microwave Background [1].

We expect that 27% percent of the energy content of the universe is due to Dark Matter.

Thermal Freeze Out

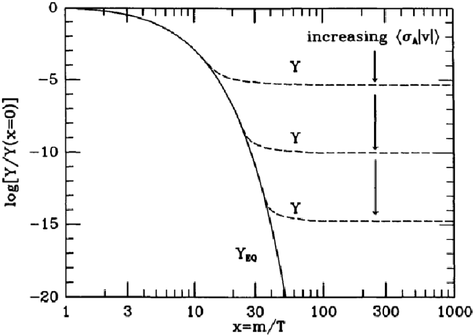


Figure 4: Freeze Out of a massive particle. The dashed line is the actual abundance, and the solid line is the equilibrium abundance [2].

$$\frac{dY}{dx} = -\frac{x < \sigma|v| > s}{H(m)} \left(Y^2 - Y_{EQ}^2\right) \quad , \quad Y = \frac{n}{s} \quad , \quad x = \frac{m}{T} \qquad (1)$$

Higgs Portal.

The two lowest order operators connecting fermionic Dark Matter χ and Standard Model particles will be [5]:

$$\mathcal{H}_{eff} = \frac{1}{\Lambda_1}\left(\bar{\chi}\chi\right)\left(H^\dagger H\right) + \frac{\mathrm{i}}{\Lambda_5}\left(\bar{\chi}\gamma_5\chi\right)\left(H^\dagger H\right) \tag{2}$$

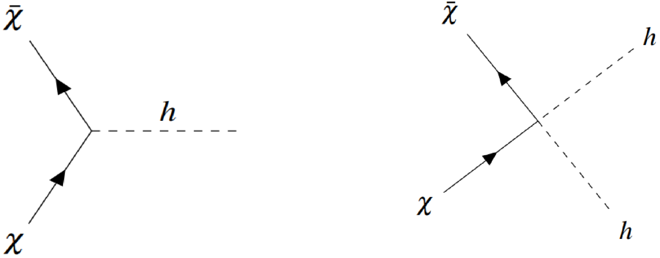


Figure 5: Predicted vertices between Dark Matter and the Higgs.

A New Annihilation Channel.

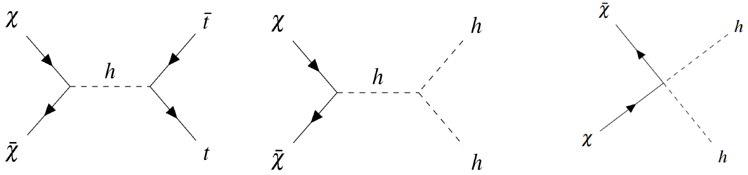
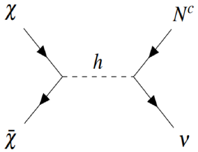


Figure 6: Most significant Feynman diagrams with Higgs Portal.

We have added a new possible annihilation into a SM neutrino and a Heavy Neutrino by the Yukawa term $yLHN^c \subset \mathcal{L}$:



A New Annihilation Channel.

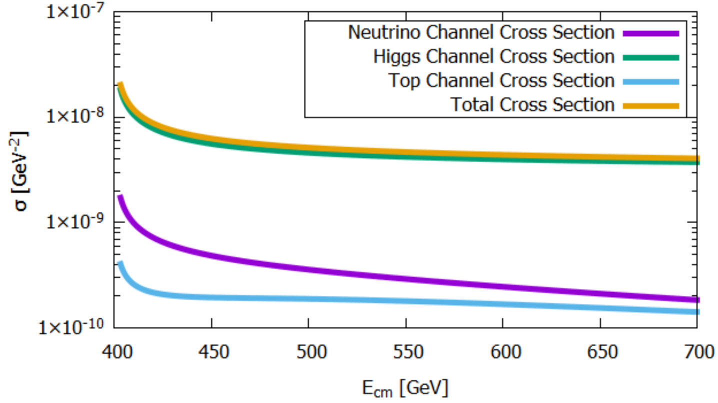


Figure 7: Different cross sections due to each channel. We have set $y = 1$, $\Lambda_1 = 7000 = \Lambda_5$, $m_\chi = 200\,\text{GeV} = m_N$, so we obtain $E_\nu = 150 GeV$.

Predicted Relic Abundance.

We adjust our parameters in order to predict the actual relic abundance that we observe today.

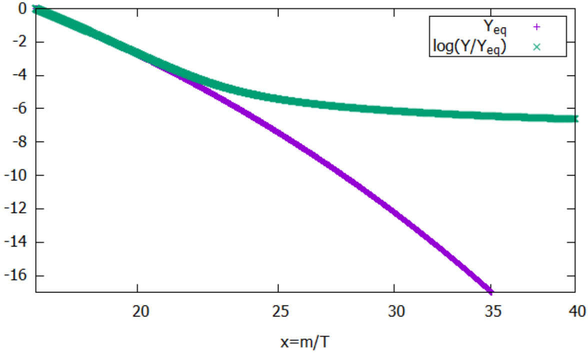


Figure 8: Evolution of the abundance of Dark Matter in comparison with the equilibrium abundance.

Capture of Dark Matter by the Sun.

We expect a wind of Dark Matter.

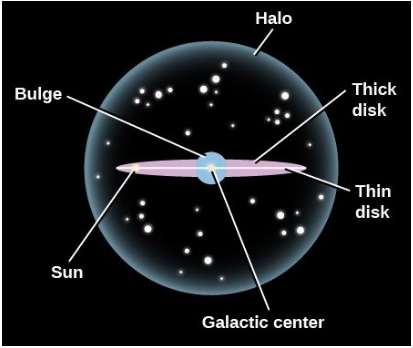


Figure 9: Scheme of the sun rotating around the DM halo [3].

Detection of the Signal at a Neutrino Telescope.

We will look for an optimal signal at KM3Net neutrino detector.

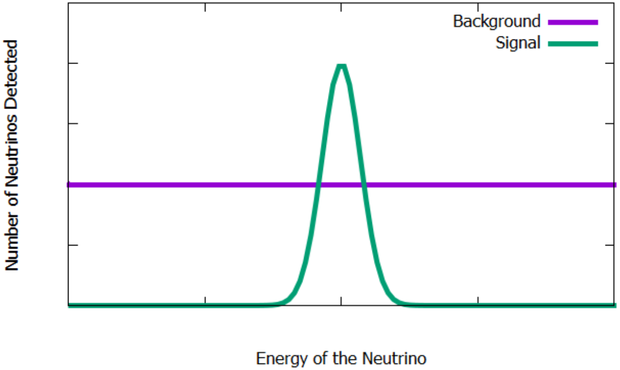


Figure 10: Scheme of what we expect to find, an optimal signal over the background.

Referencias

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[2] M. S. Turner E. W. Kolb. *The Early Universe*. Addison-Wesley Publishing Company, 1990.

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[4] B. Hubert and P. Alan. "Modeling Wave Dark Matter in Dwarf Spheroidal Galaxies". In: *Journal of Physics: Conference Series* 2 (Jan. 2013). DOI: 10.1088/1742-6596/615/1/012001.

[5] Laura Lopez-Honorez, Thomas Schwetz, and Jure Zupan. "Higgs portal, fermionic dark matter, and a Standard Model like Higgs at 125 GeV". In: *Physics Letters B* 716.1 (Sept. 2012), pp. 179–185. DOI: 10.1016/j.physletb.2012.07.017. URL: https://doi.org/10.1016%2Fj.physletb.2012.07.017.