

Compton-like scattering with Axions or ALPs

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Content

Among all the dark matter candidates we find axions and axion-like particles, which generally present a coupling with two photons given by the term in its Lagrangian density

$$\mathcal{L}_{a\gamma\gamma} = -\frac{1}{4}ga(x)\mathcal{F}^{\mu\nu}$$

This coupling is key in the experimental search for these particles, since it indicates that if we have an axion (or ALP) it can become photons if it is in the presence of an intense magnetic field. In the present work, the coupling between axions (or ALPs) with photons is used to study their interaction in a different way than usual, since the coupling allows us to study the photon-axion (or ALP) dispersion.

$$\gamma(k, \lambda) + a(p) \longrightarrow \gamma(k', \lambda') + a(p')$$

The process of scattering of a photon by an electron is well known and is called Compton scattering, this process can be studied in the framework of QED. At the tree level, the cross section of the “usual” Compton scattering (CS) can be determined, which is a measure of the probability that this process will occur. Following this idea, Compton-like scattering with axions (or ALP) can be established due to their interaction. Now the axion plays the role of the electron in the scattering, but there are differences with the usual Compton scattering, the general calculation at tree level of the effective section for this process is presented, the differences with respect to the CS and their possible relevance in the stage where the axions (ALPs) are light dark matter.

While the cross section is expected to be too small and cannot be qualitatively compared to the usual CS, what is relevant here is that considering axions (or ALPs) to be dark matter, there must be too many of them in the universe. and although it is very unlikely, this scattering process could be observed, which would have astrophysical implications that could perhaps be observed.

Summary

Among all the dark matter candidates we find axions and axion-like particles, which generally present a coupling with two photons, this coupling allows establishing the dispersion between a photon and an axion (or ALP), the study of this scattering process we have called “Axion-like Compton scattering or ALPs”. This process could be relevant in astrophysical processes due to the great abundance of dark matter that appears to be in the universe.

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