The strong CP problem

The theory of quantum chromodynamics has an infinite number of possible vacuum states, which generally violate the discrete symmetry of parity (P) and time-reversal (T) transformations. In the standard model of particle physics, the vacuum is determined by the spontaneous breaking of a global symmetry, leading to the formation of a non-zero vacuum expectation value for the Higgs field. This process is known as the electroweak transition, and it is responsible for the masses of the weak force gauge bosons.

The vacuum is a classical field configuration, and it is determined by the balance of energy terms in the field equations. In the case of the QCD vacuum, the energy density is dominated by the contributions of the quark and gluon fields, which are coupled to the strong force. The QCD vacuum is a non-perturbative entity, and it is determined by the balance of the energy density terms in the field equations.

The QCD vacuum energy density actually depends on the temperature. At high temperatures, it does not depend on the QCD parameters and therefore whenever the initial conditions of the hot quantum bath could not have had any preference for any of the vacua. At low temperatures (below the QCD scale, QCD instantons contribute to the energy density:

\[ E_{\text{QCD}} = \frac{\alpha_s}{4\pi} L^4 \]

and the P and T conserving vacuum, \( \Theta = 0 \) is favored. Note that transitions from one vacuum to another happen on a timescale.

Axions

The Goldbach-Pethick-Rubakov (GPR) model is based on the assumption that the axion is a hypothetical particle that is predicted by the electroweak theory. The axion is a pseudo-scalar particle, and it is predicted to be extremely light and very weakly interacting. The GPR model is based on the assumption that the axion is a hypothetical particle that is predicted by the electroweak theory. The axion is a pseudo-scalar particle, and it is predicted to be extremely light and very weakly interacting.

The search for axions

The search for axions is a major frontier in experimental physics, and it is a key component of efforts to understand the nature of dark matter. Axions are predicted to be produced in a variety of astrophysical processes, and they could be detected in a laboratory experiment by measuring their coupling to other particles.

One of the most promising approaches to search for axions is the use of a solar axion telescope. The CERN solar axion telescope CAST is the most powerful of such telescopes ever built. It is primary goal was to test hadronic axions in the sub eV range which are only disfavored by the SN1987A and SN1987B helioscopes ever built. It is primary goal was to test hadronic axions in the sub eV range which are only disfavored by the SN1987A and SN1987B helioscopes ever built.

The idea of an helioscope is to exploit the two photon coupling to design the magnetic field and other mechanisms that can be used to detect axions. The concept of an helioscope experiment is to use gamma-ray background in the 30 MeV range to search for axions. The idea of an helioscope is to exploit the two photon coupling to design the magnetic field and other mechanisms that can be used to detect axions.

Detecting the DSB?!

Detecting these axions is extremely challenging. They would interact more weakly than neutrinos of comparable energy. DSB would produce a much smaller signal. Our attempts to detect DSB in large-supercritical astrophysical magnetic fields fail to provide a detectable signal. It should exceed the different parameters of the DSB in the 30 MeV range as measured by \( \epsilon_{\text{DSB}} < 10^{-6} \) (1/\( \alpha \)). The conversion probability would have to be of order 10^-5.

Axion-like particles (ALPs), in contrast, might have much smaller mass for the same coupling strength to large that conventional axions and astrophysical signatures are essential. Of course, they don’t solve the strong CP problem.

Next galactic sin

The next galactic SN will provide a high-gamma-ray signal of 10 MeV neutrino signature. The DSB would be detected in the compatible energy range of 10 MeV. The next galactic SN will provide a high-gamma-ray signal of 10 MeV neutrino signature.