The Study of Inner Bremsstrahling

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Abstract

The "inner" bremsstrahlung (also known as "internal bremsstrahlung") arises from the creation of the electron and its loss of energy (due to the strong electric field in the region of the nucleus undergoing decay) as it leaves the nucleus. Such radiation is a feature of beta decay in nuclei, but it is occasionally (less commonly) seen in the beta decay of free neutrons to protons, where it is created as the beta electron leaves the proton.

In electron and positron emission by beta decay the photon's energy comes from the electron-nucleon pair, with the spectrum of the bremsstrahlung decreasing continuously with increasing energy of the beta particle. In electron capture, the energy comes at the expense of the neutrino, and the spectrum is greatest at about one third of the normal neutrino energy, decreasing to zero electromagnetic energy at normal neutrino energy. Note that in the case of electron capture, bremsstrahlung is emitted even though no charged particle is emitted. Instead, the bremsstrahlung radiation may be thought of as being created as the captured electron is accelerated toward being absorbed. Such radiation may be at frequencies that are the same as soft gamma radiation, but it exhibits none of the sharp spectral lines of gamma decay, and thus is not technically gamma radiation.

General Aspect

A measurement of inner bremsstrahlung in muon decay has been made using spark chambers, scintillates and fast oscilloscopes. The electron range distribution in graphite and the absolute rates were determined for electron-gamma-ray angles between 130 and 180 deg. For the electron and gamma-ray energies studied, the branching ratio of $\mu \rightarrow e+\gamma+\nu+\bar{\nu}$ to $\mu \rightarrow e+\nu+\bar{\nu}$ is predicted to be about 10^{-4} over this angular range. The total number of inner bremsstrahlung events observed was 1805 ± 43, which is in agreement with an expected number of 1889 ± 283. The data were found to be in accord with the predictions given by

electromagnetic corrections applied to the weak interaction.

Reference

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