Abstract

The set-up of the modulation experiment consists of eight NaI(Tl) detectors, which are placed opposite each other in pairs. The first pair measures the background, and the others measure the radioactive decay of respectively the ^{44}Ti,^{60}Co and ^{137}Cs source. The goal of the experiment is to investigate whether there exists a modulation in the measured decay rate, on top of the exponential decay. The temperature, pressure, humidity, magnetic field, high voltage and radon concentration inside the set-up are measured in order to investigate the influence of environmental factors.

The radon concentration and temperature are deliberately changed over a time of respectively ∼300 h and ∼400 h to measure the effect of these variables on the measured rate. A change in temperature of range of 9°C results in a change in measured rate of 0.015±0.022% and a decrease in radon concentration of 80 Bq/m^3 gives a measured rate change of 0.0008±0.0232%. Both rate changes are an order of ten smaller than the 0.1% which is mentioned as the amplitude size of a possible modulation [**?**][**?**][**?**].

A simulation of a daily modulation, with an amplitude of 0.1% added to an exponential decay of a source with a half-lifetime of 5.27 yr and a start activity of 37 Bq, can be retrieved from 150 days of simulated data with a uncertainty of 1% on the frequency and less than 10% on the amplitude and phase using a Fast Fourier transform. In order to retrieve a yearly modulation from simulated data with a measurement time of less than three years, an exponent with an added cosine should be fit to the data. Fitting first an exponent and then a cosine to the residuals leads to an overestimation of the exponential decay slope.

The next step for the modulation experiment is improving the simulations to estimated the needed measurement time to find possible yearly simulations and analysing a long dataset obtained by the experiment.