Measurement of Weak Coupling Constant blahblah

1 Introduction

The muon, a fundamental particle produced in the upper atmosphere as a secondary product of cosmic ray collisions, was originally discovered in 1936 []. It decays via the weak interaction with a mean decay lifetime of $2.2\mu s$, longer than every known particle other than the neutron []. With muons comprising 80% of cosmic ray flux at sea level, the muon is a good candidate for the study of the weak force [].

Our experiment consists of two main components: the muon lifetime measurement and the muon mass measurement. We describe the experimental setup which consist of a system of three scintillators and Photomultiplier Tubes (PMTs). Using this system, the cosmic ray muons and their decay products are detected along with their enegy. The muon lifetime and mass results are presented with the relevant statistical analysis of data, and compared to previous experimentally established values. Finally, the muon mass and lifetime values are used to calculate the weak force coupling constant, G_F.

2 Background

The weak decay of the muon is the clearest of all weak interaction phenomena in both its experimental and theoretical aspects. Thus, the muon decay is an effective means of studying the weak force, and specifically finding the weak coupling constant g_w. Negatively charged muons decay weakly into an electron, muon neutrino, and electron antineutrino (Figure):

$$\mu^- \rightarrow e^- \nu_{mu} \overline{\nu_e} \tag{1}$$

with a corresponding antimatter process:

$$\mu^+ \rightarrow e^+ \overline{\nu_{mu}} \nu_e \tag{2}$$