CANDLES for the Study of double beta decay and dark matters

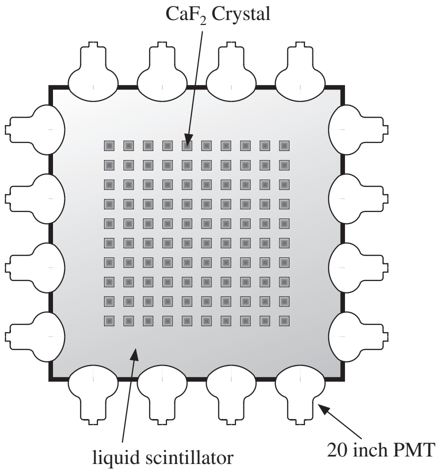
T. Kishimoto[a], I. Ogawa[a], S. Ajimura[a], K. Matsuoka[a], S. Yoshida[a], S. Umehara[a], D. Yokoyama[a], K. Mukaida[a], R. Hazama[b], K. Fushimi[c], and H. Ohsumi[d]

[a] *Department of Physics, Osaka University*
[b] *Deaprtment of Physics, University of Washington*
[c] *Faculty of Integrated Arts and Sciences, The University of Tokushima*
[d] *Saga University*

Recently neutrino oscillation becomes evident. It was first indicated by the deficit of atmospheric ν_μ [1]. It is then supported by an acclerator experiment (K2K) from KEK to Kamioka[2]. The neutrino oscillation is shown to be a solution of the Solar neutrino problem[3].

The neutrino oscillation observed transformation of neutrinos from one type to another type which is possible only when there are mass differences and mixing between different types of neutrinos. The mass can be either of Majorana type or Dirac type. Majorana mass connects particle to its antiparticle. Therefore if the neutrinos have the Majorana mass, lepton number is violated. Since only neutrinos could have the Majorana mass, it is particularly important and interesting to study the neutrino mass. Study of double beta decay is almost only way to approach such problem.

We carried out study of $\beta\beta$ decay of ^{48}Ca by ELEGANT VI which consists of 25 CaF_2(Eu) crystals with a dimension of 45 mm cube at the center and other detectors and shields to reduce backgrounds. We gave the current best lifetime of ^{48}Ca [4]. Mass region suggested by the oscillation exeriments is $\Delta m^2 \sim 10^{-3}(\mathrm{eV})^2$ for which we need to develop detector sensitive to lifetime of 10^{-26} year for $\beta\beta$ decay of the ^{48}Ca.



We propose CANDLES which stands for CAlcium floride for the study of Neutrinos and Dark matters by Low Energy Spectrometer. Conceputual design of the detector is schematically shown in figure. Pure CaF_2 crystals with a dimension of ~10cm cube are immersed in a liquid scintillator. Scintillation light is viewed by the large PMT's. Liquid scintillator acts as an active shield to veto backgrounds. The CaF_2 crystal gives scintillation of $\sim 3\mu$sec width although liquid scintillator has a width of ~10 nsec. Thus by observing pulse shape one can seperate the signal from the backgrounds.

References

[1] Y. Fukuda et al., Phys. Rev. Lett. 81 (1998) 1562.
[2] S. H. Ahn et al., Phys. Lett. B511 (2001) 178.
[3] Q. R. Ahmad et al., Phys. Rev. Lett. 87 (2001) 071301.
[4] I. Ogawa et al., in this volume.