Double beta decay study of ^{48}Ca by CaF_2 scintillator

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A CaF_2 scintillation detector system (ELEGANT VI) is developed to search for neutrinoless double beta decay (0νDBD) of ^{48}Ca and spin coupled dark matter. ^{48}Ca is the most favorable isotope among other potential DBD nuclei because it has the largest Q-value (4.27 MeV) of the decay $^{48}\mathrm{Ca} \rightarrow^{48}$ Ti then the possibility of the occurrence is highest and little background is expected. CsI(Tl) scintillators and active lightguides (pure CaF_2 crystals) which are on both sides of the central CaF_2(Eu) crystal act as 4π active shields. The whole system is in operation at the underground laboratory located in Nara (Oto Cosmo Observatory) which has effectively 1.4 km water equivalent shield.

The obtained energy spectrum after all cut for the measurement of 5567 hours of live time at Oto Cosmo Observatory is shown in Figure 1. There are no events in the 0νDBD energy window, then we can preliminarily derive the lower limit of the half life of 0νDBD of ^{48}Ca as

$$T^{0\nu}_{1/2} \geq 1.0 \times 10^{22} \text{ year (90 \% C.L.)}$$

which is compared with the previous data[1,2]

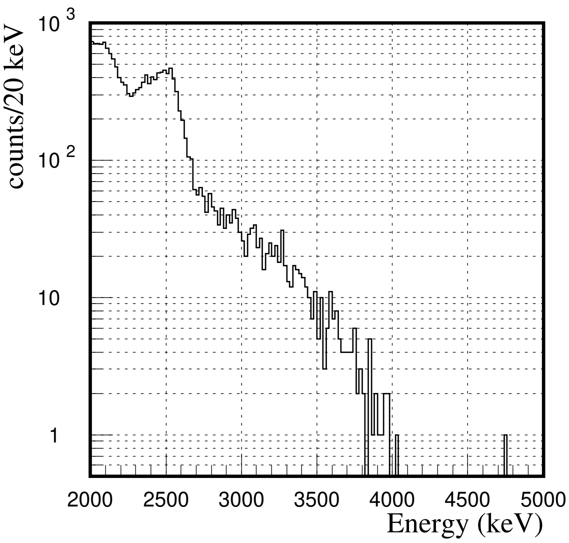

Figure 1 : Summed energy spectrum.

References

[1] K. You et al., Phys. Lett. B **265** (1991) 53.
[2] V.B. Brudanin et al., Phys. Lett. B **495** (2000) 63.