The DCBA/MTD experiments for neutrinoless double beta decay search

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One of the most important problems in elementary particle physics is whether neutrino has Majorana nature or not. If neutrino has Majorana nature, Leptogenesis based on See-saw Mechanism is considered to be a hopeful theory in early universe. Neutrinoless double beta decay (0νββ) experiment is only one practical method to investigate the neutrino Majorana nature. Since the half-life of 0νββ is theoretically expected so long as $10^{26}$ y, the experimental detector has to have not only at least 1000 mol of decay source, but also excellent capabilities to eliminate backgrounds from natural radio activities including decay chains and cosmic rays. And also the excellent energy resolution is required at the Q-value of decay nucleus in order to distinguish 0νββ events from the tough backgrounds of conventional double beta decay (2νββ).

Drift Chamber Beta-ray Analyzer (DCBA) is an R&D for the future experiment temporarily called Magnetic Tracking Detector (MTD) which will realize conditions mentioned above. Both are momentum analyzers using the decay source of $^{100}$Mo and $^{150}$Nd and in progress at KEK. DCBA/MTD can identify β-ray in the backgrounds of α-, γ- and cosmic rays. Since a module of MTD will accommodate 32 kg decay source, we can search for 0νββ events with several ten modules down to about 30 meV neutrino mass, corresponding to the half-life of $10^{26}$ y.