Comments on neutrino-less double beta decays

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Comments on the present and future 0νββ) experiments are given below.

1. Spectroscopic (tracking) measurements of individual ββ rays for ββ nuclei with Q >3 MeV. They make it possible to get low-background spectra and energy and angular correlations of the ββ rays, which are used to identify/confirm 0νββ events and the ν-mass 0νββ mechanism.

MOON (Molybdenum Observatory Of Neutrinos), which an extension of ELEGANT V, aims to measure individual ββ rays from ^{100}Mo to study the Majorana ν−masses in the 50–25 meV region [1.2.3]. Energy and angular correlations of 0νββ to both the ground and the 1.132 MeV excited 0+ states are studied to confirm the 0νββ events and the 0νββ mechanism.

Detectors under developement is a super-module of multi-layer PL plate and fiber scintillators. One module consists of a plate (PL) scintillator for the β energy and two sets of X-Y fiber scintillator planes for the vertex identification, between which a thin ^{100}Mo film is interleaved. The half-life (mass) sensitivity is 3 10^{26} y (50 meV) by 2 ton-year run.

The multi-layer system leads to the realistic compact detector of around 10 m^3 for 100 kg ^{100}Mo isotopes. A prototype detector was built. It showed the energy resolution of σ=2.2% as required to reduce the 2νββ tail [3]. Enriched ^{100}Mo isotopes were shown to be obtained by centrifugal separation of MoF_6 gas.

2. Experimental studies of 0νββ nuclear matrix elements $M^{0\nu}$.

$M^{0\nu}$ is indispensable for designing 0νββ detectors and extracting the ν mass from 0νββ data. It is so sensitive to nuclear structures and medium effects that the theoretical calculation is hard. Thus experimental studies of $M^{0\nu}$ are important [1,4,5]. High energy resolution studies of charge exchange reactions for $M^{2\nu}$ have been carried out at RCNP Osaka [6], and currently extensive programs for $M^{0\nu}$ are under progress [1,4].

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