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ELECTRON DETECTION IN THE SEGMENTED NEUTRINO DETECTOR SUPERFGD

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Electron neutrinos in the T2K experiment are detected through the particles produced when they interact with matter. Charged-current interactions produce an electron, which loses energy through ionization and bremsstrahlung. This work studies the simulated energy deposition of this electron in SuperFGD, the three-dimensionally segmented scintillator detector of the ND280 complex, and examines the photon background.

A sample of 10,000 primary electrons with kinetic energies from 5 to 300 MeV was studied using Geant4. Energy deposits from the primary electron and its associated secondary particles are summed without double counting. The response is defined as the deposited energy, corrected for rest-mass energy, divided by the electron's initial kinetic energy.

When the calculation is extended from the direct electron branch to the full cascade, the mean response increases from 56.8% to 85.9%. Branches initiated by bremsstrahlung photons contribute about one third of the cascade's deposited energy on average. A primary electron stopping inside the detector does not ensure full energy containment: secondary photons can carry energy out of the active volume.

Photon conversion into an electron-positron pair was studied at photon energies of 50, 100 and 200 MeV. Under the simulated conditions, the fraction of photons converting inside SuperFGD increases from about 62% to 84% as the photon energy rises from 50 to 200 MeV. The energy deposited by conversion pairs is similar to that deposited by electrons, so electron-photon separation also requires information on the spatial structure of the event.

These results provide a basis for further development of methods for electron energy reconstruction and electron neutrino event selection. The study describes energy deposition in the active material; light collection, electronics and full neutrino event reconstruction were not included in this analysis.

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