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Production of a 4.4-MeV gamma ray from NC neutrino-oxygen reaction in a water Cherenkov detector for supernova neutrino bursts and the isospin mixing of the 2^- states (12.97 MeV and 12.53 MeV) of O

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We first discuss and determine the isospin mixing of the two 2^- states (12.53 MeV and 12.97 MeV) of ^{16}O nucleus using the inelastic electron scattering data. We then evaluate the cross section of 4.4-MeV γ rays produced in the neutrino neutral-current (NC) reaction ^{16}O(ν, ν')^{16}O$(12.97\mathrm{MeV}, 2^-)$ with a water Cherenkov detector at the low energy below 100 MeV. We have made the shell-model calculation of this NC neutrino-^{16}O$(12.97\mathrm{MeV}, 2^-)$ cross section as accurate as possible by calibrating both the vector form factor (or spin g-factor g_s) and the axial coupling constant (g_A), using real data of the (e,e') cross section, muon-capture of ^{16}O(12.97MeV,2^-), and ^{16}N β-decay from the 2^- analogue state to the ^{16}O ground state. We compare the γ-ray production rate from this process with that from the excited states (E_x>16 MeV), which was discussed previously by many authors. In this talk, we discuss a new NC reaction channel from ^{16}O(12.97 $\mathrm{MeV}, 2^-$) producing a 4.4-MeV γ ray, the cross section of which is more robust and even larger at the low energy (E_ν <25 MeV) than the NC cross section from ^{16}O($E_x > 16$ MeV$, T = 1$). We also evaluate the number of such events induced by neutrinos from supernova explosion which can be observed by the Super-Kamiokande, a 32 kton water Cherenkov detector in the Earth.

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