

## Proposed experiment to measure $\gamma$ -rays in high resolution hadron beam experiments $O(p, p')X$ and $O(^3He, t)X$ and the detection of $\gamma$ -rays in $\nu - ^{16}O$ reactions

The  $\gamma$ -rays produced from excited nuclei in neutral-current (NC) neutrino-oxygen (even charged-current (CC)  $\nu - O$ ) interactions have not been measured at  $E_\nu = 10 - 100$  MeV. They are very important, since they will add extra signals or become unexpected background in Supernova neutrino detection. Neutrinos at  $E_\nu = 20 - 100$  MeV are expected to excite  $1^-$ ,  $1^+$  and  $2^-$  (giant resonances) in NC reactions  $O(\nu, \nu')O^*$ , which decay to  $^{15}N^* + p$  and  $^{15}O^* + n$ ; the  $\gamma$ -rays are produced from  $^{15}N^*$  and  $^{15}O^*$ . But, no previous experiments have checked such expectations. We show a proposed experiment to measure the  $\gamma$ -ray spectrum produced in the hadron beam experiments  $O(p, p')X$  ( $\Delta T=0,1$ ) and  $O(^3He, t)X$  ( $\Delta T=1$ ) at RCNP(Osaka). They will give the information on the Fermi and Gamov-Teller transition strength from the ground state to the excited states of the oxygen, associated with the  $\gamma$ -ray production. Such experiment will further develop an initial measurement of the  $\gamma$ -ray spectrum in  $O(p, 2p)N$  reaction at RCNP (K.Kobayashi et al., nucl-ex/0604006).

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