Ξ^- nuclear absorption process in Ξ^--^{14}N atom cascade

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A twin single-hypernuclear production event from Ξ^- atom, $\Xi^- + {}^{14}\mathrm{N} \to {}^{10}_{\Lambda}\mathrm{B} + {}^{5}_{\Lambda}\mathrm{He}$, is newly found in the nuclear emulsion experiment [1]. The binging energy of Ξ^--^{14}N system is estimated to be about 4 MeV (1 MeV) if ${}^{10}_{\Lambda}$B is in the ground (excited) state. In any case, the deduced $B.E.$ is significantly deeper than Ξ^--^{14}N atom 3d-state (0.17 MeV). Thus, it is concluded that Ξ^- is absorbed into nuclei from 2p-state. It is supposed, however, that Ξ^- is mainly captured at 3d-state in ^{14}N and could hardly arrive to 2p-state. In order to check the validity of the experimental interpretation, we have performed the Ξ^--^{14}N atom cascade calculation and estimate Ξ^- 2p-absorption probability.

Our atomic cascade model successfully explains the K^--^{14}N atom x-ray yields [2], which consider the KLL Auger electron emission and the electron refilling process as well as the Ξ^- cascade transition process. As for the (complex) Ξ^--nucleus potential which determine the Ξ^- nuclear absorption rate, the microscopic folding potential is constructed from the ΞN G-matrix interaction derived from Nijmegen hard-core model D (ND)[3], extended soft-core model ESC04d [3] and ESC08c [4].

It is found that the Ξ^- 2p-absorption probability is a few % for ND and the order of 0.1 % for ESC04d (see Fig. 1). The case of ESC08c is located between ND and ESC04d.

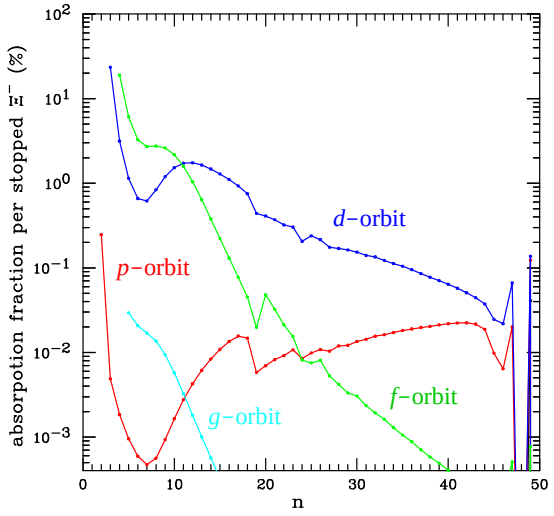

Figure 1: The Ξ^- nuclear absorption probability from each atomic orbit of Ξ^--^{14}N in the case of ESC04d. The Ξ^- cascade starts from $n = 49$.

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[4] M.M. Nagels, Th.A. Rijken and Y. Yamamoto, arXiv:1504.02634 [nucl-th]