

A New Type Nuclear Reaction with Observation of a Bound Di-Neutron in the Output Channel

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This paper deals with consideration of a new nuclear reaction type on ^{159}Tb with a bound dineutron in the outgoing channel. The dineutron as a particle consisting of the two bound neutrons has been the target of scientific hunt for 70 years, since the very first publication of Colby and Little in Phys. Rev. in 1946. For decades a neutron-only nucleus was considered physically impossible. This paper presents results of experiments that report on the first statistically significant observation of an exotic state of nucleons, the long-sought dineutron, with conclusion that emission of the dineutron takes place in $(p, ^2n+n)$ and $(n, ^2n)$ nuclear reactions on ^{159}Tb and represents a new type nuclear reaction in the output channel. The explanation of these experimental results is based on theoretical paper of Migdal from 1972 when the dineutron was predicted theoretically as a bound state of the two neutrons emitted from the nucleus through the mechanism of binding the two neutrons in one single particle near the surface, but outside a heavy nucleus such as ^{157}Dy or ^{158}Tb . Such a formation is possible due to the strong nuclear force from a heavy nucleus holding the two neutrons in close proximity for certain time. The dineutron is difficult to acquire and detect; therefore this problem has been solved by identifying a residual nucleus in the output channel of corresponding nuclear reaction. The dineutron may be only the very first evidence for existence of low nucleon bound systems composed of two or even three identical nucleons.

Biography:

Prof. Igor Kadenko has completed his PhD from Kiev State University, USSR/Ukraine and lately defended his doctoral thesis in Institute for Nuclear Researches, National Academy of Sciences of Ukraine. He is the Director of International Nuclear Safety Center of Ukraine and Head of Department of Nuclear Physics and Engineering of Taras Shevchenko National University of Kyiv, a leading educational organization in Ukraine. He has published more than 160 papers in reputed journals in fields of nuclear physics, high energy physics and nuclear engineering.