Abstract ID : **56**

Uncovering the mechanism of chiral three-nucleon force in driving spin-orbit splitting

Content

Three-nucleon systems provide essential information to determine the basic properties of three-nucleon forces (3NFs), such as their strength. In contrast, many-nucleon systems are a key area for studying three-nucleon forces, as seen in phenomena like the spectroscopic properties of light nuclei, the determination of the dripline, and the saturation of nuclear matter.

In this presentation, we examine the relationship between spin-orbit (SO) splitting and 3NFs derived from chiral effective field theory. While the effect of 3NFs on enhancing SO splitting is well-known, the exact mechanisms behind this enhancement have remained unclear. By breaking down the chiral 3NF in detail, our research shows that the rank-1 component plays the main role in increasing SO splitting in light nuclei.

Of particular interest is the antisymmetric nature of the rank-1 3NF, which leads to similarities with phenomena observed in other areas, such as the spin canting caused by the Dzyaloshinsky-Moriya interaction in magnetic ions. We also investigate how this antisymmetry relates to the quantum entanglement of two-nucleon spin states.

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Status: SUBMITTED

Submitted by **FUKUI, Tokuro** on **Tuesday, 18 March 2025**