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Orbital Angular Momentum Generation in the Neutron-Nucleus Weak Interaction

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During the 1970s parity non-conserving spin rotations where first observed in the neutron nucleus weak interaction [1]. In these experiments transversally polarized neutrons were passed through certain nuclear targets, upon which the neutron spin was rotated around the flight direction. Due to the conservation of total angular momentum this spin rotation has to be compensated in some manner. In contrast to the magnetic interaction, where total angular momentum is conserved by transferring some angular momentum to the magnet, the formalism of the neutron nucleus weak interaction [2] seems to indicate total angular momentum is conserved by imprinting orbital angular momentum (OAM) on the neutron. In the proposed talk arguments for neutron orbital OAM generation are derived from the formalism of the neutron nucleus weak interaction. Furthermore, we present an experimental scheme by which this OAM can be observed in a polarized neutron diffractometer. Finally, preliminary experimental evidence is shown in which a spin-OAM coupled neutron state [3] is passed through a Lanthanum target. The data appears to confirm conservation of the total neutron angular momentum within experimental accuracy.

[1]: M. Forte et al., PRL, 45 2088-2092, 1980.
[2]: F.C. Michel. Phys Rev., 133 329-349, 1964.
[3]: J. Nsofini et al., Phys. Rev. A 94, 013605 2016.

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