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Exchanges in the nucleus in the 1930s: Werner Heisenberg and Ettore Majorana

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The discovery of the neutron in 1932, provided the key picklock that allowed quantum mechanics to be applied to the problem of nuclear structure. The first, moderately satisfactory attempt was undertaken by W. Heisenberg, who had already pioneered the introduction of exchange interactions in the quantum mechanics of identical atoms and had first applied them to the helium atom. While Heisenberg took inspiration from a different incarnation of exchange interactions, introduced in molecular physics to explain covalent bonds, E. Majorana went back to the original idea and proposed (at first independently of Heisenberg) his own version, which overtook several drawbacks of Heisenberg's theory and gave results closer to experiments. In this contribution, we reconstruct this story, including a detailed discussion of Majorana's unpublished notes on this subject, which in fact contain much more material than what was published.

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