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RUB

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Beyond ferromagnets and antiferromagnets: type-III collinear magnets with d/g/i-wave alternating spin-momentum interaction

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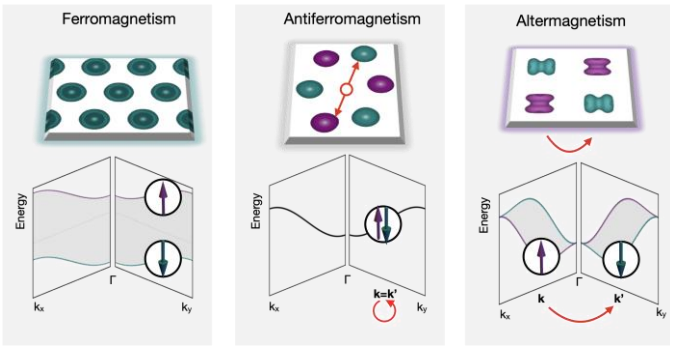

Fig.1. Three types of spin groups and collinear magnets.

Magnetically ordered solids are commonly divided into ferromagnets and antiferromagnets according to whether their magnetic symmetry allows magnetization. Magnetic symmetries intertwine the effects of relativistic and non-relativistic magnetic origins because they act simultaneously in crystal and spin space. In this talk, we will discuss distinct non-relativistic spin symmetries that act separately in crystallographic and spin space, and thus we can categorize the non-relativistic magnetic interactions and the shape of the spin density and collinearity[1]. Using spin symmetries, we classify all possible collinear magnetic arrangements into three types depending on the relationship between the opposite spin sublattices. The first two types are conventional ferromagnets (Fe) and antiferromagnets (CuMnAs [2]). The third type describes unconventional magnets with the opposite spin sublattices coupled by rotational symmetry *(marked by curved arrow in Fig. 1)*. They exhibit a characteristic time-reversal symmetry breaking in the form of (d/g/i-wave like) alternating spin-momentum interaction in momentum space (see Fig. 1) [1,3-6], and are therefore also called altermagnets[1,6,7]. We show that altermagnetism provides a unifying explanation for recently described effects previously considered to be antiferromagnetic anomalies (see Refs. 1,4-7 and Refs therein). These include also effects predicted in RuO_2, such as the anomalous Hall response[3,4,6,7], colossal non-relativistic electric spin splitting[1,3-6,7] or giant magnetoresistance[5,7].

References

[1] LŠ., J. Sinova, and T. Jungwirth, arXiv:2105.05820v2
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[4] I. I. Mazin, et al., PNAS 118 (42) e2108924118 (2021)
[5] LŠ et al., Phys. Rev. X, 12, 011028 (2022)
[6] LŠ, A. H. MacDonald, J. Sinova, S. Nakatsuji, and T. Jungwirth, Nature Review Materials (2022), https://doi.org/10.1038/s41578-022-00430-3
[7] LŠ., J. Sinova, and T. Jungwirth, arXiv:2204.10844 (2022)

Einführung: Prof. Dr. Anna Böhmer

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