

Seminar on Condensed Matter Theory

Group of Theoretical Physics at the Department of Condensed Matter Physics of Charles University has a pleasure to invite you to attend the seminar

**on 4 November 2020 at 10:00
as an online webinar**

Contact K. Carva (carva@karlov.mff.cuni.cz) for the online access information.



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The properties of isolated chiral skyrmions

Note unusual time of the seminar!

In my talk, I overview the basic physical properties of axisymmetric [1] and non-axisymmetric [2] defect-free skyrmions. In particular, I show that the skyrmions embedded in the saturated phase repel one another, whereas the skyrmions within the conical phase are mutually attractive and so tend to produce clusters. I also report experimental results on attractive magnetic skyrmions in the cubic helimagnet Cu_2OSeO_3 [3] and repulsive skyrmions in PdFe bilayers with induced Dzyaloshinskii-Moriya interactions and strong easy-axis anisotropy [1]. Moreover, the attracting skyrmions were predicted to underlie precursor phenomena (e.g., A-phase in B20 magnets) [4].

Skyrmions may also become oblique with respect to the field. In particular, in Cu_2OSeO_3 due to the competing exchange and cubic anisotropies [5], the conical phase tilts away from the field direction and thus underlies the deviation of skyrmions. As a result, attracting oblique skyrmions may potentially form extended networks in which their axes are not parallel to each other as in previously reported skyrmion clusters. Skyrmion networks with mutually orthogonal isolated skyrmions [6] were directly visualized in thin layers of chiral liquid crystals. We used chiral nematics as a model system for probing the skyrmion behavior due to the similarity of phenomenological models for both condensed-matter systems, chiral magnets and liquid crystals.

Thus, in the present abstract by experimental and theoretical means, I will introduce different classes of non-axisymmetric skyrmions and elucidate the principles of their meshing into a large diversity of extended three-dimensional skyrmionic networks in chiral magnets and liquid crystals.

[1] Leonov A. O., Monchesky T. L., Romming N., Kubetzka A., Bogdanov A. N., Wiesendanger R. (2016). The properties of isolated chiral skyrmions in thin magnetic films. *New J. of Phys.* 18, 065003.

[2] Leonov A. O., Monchesky T. L., Loudon J. C., Bogdanov A. N. (2016). Three-dimensional chiral skyrmions with attractive interparticle interactions. *J. Phys.: Condens. Matter* 28, 35LT01.



For more information follow: theory.kfkl.cz/seminars.php

If you wish to receive regular updates on forthcoming seminars, contact K. Carva (carva@karlov.mff.cuni.cz).

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- [3] J. C. Loudon, A. O. Leonov, A. N. Bogdanov, M. Ciomaga Hatnean, and G. Balakrishnan, Phys. Rev. B 97, 134403 (2018).
- [4] L. J. Bannenberg, H. Wilhelm, R. Cubitt, A. Labh, M. P. Schmidt, E. Lelièvre-Berna, C. Pappas, M. Mostovoy and A. O. Leonov, npj (Nature Partner Journal) Quantum Materials 4, 11 (2019). [5] F. Qian, L. J. Bannenberg, H. Wilhelm, G. Chaboussant, L. M. Debeer-Schmitt, M. P. Schmidt, A. Aqeel, T. T. M. Palstra, E. Brück, A. J. E. Lefering, C. Pappas, M. Mostovoy, A. O. Leonov, Science Advances 4, eaat7323 (2018).
- [6] H. R. O. Sohn, S. M. Vlasov, V. M. Uzdin, A. O. Leonov, and I. I. Smalyukh, Phys. Rev. B 100, 104401 (2019).

