Reply to "Comment on 'Temperature-dependent orientational ordering on a spherical surface modeled with a lattice spin model' "

Article

Published Version

www.reading.ac.uk/centaur

CentAUR

Central Archive at the University of Reading

Reading's research outputs online

Reply to 'Comment on Orientational ordering on a spherical surface modeled by the Lebwohl-Lasher model'

Alan Luo,[1] Stefan Wenk,[1] and Patrick Ilg[1, 2]

[1]ETH Zürich, Department of Materials, Polymer Physics, HCI H529, CH-8093 Zürich, Switzerland
[2]School of Mathematical and Physical Sciences, University of Reading, Reading, RG6 6AX, United Kingdom

In his comment [1], the author provides some remarks and critics to Sec. II of our paper [2] concerning the nature of the two-dimensional ordering transition. He claims that some of our results do not agree with mathematical results. Here, we argue that our simulation results are not in conflict with mathematical results and that the critics raised in [1] are due to a misunderstanding or wordings.

Our study is concerned – as the title and abstract state clearly – with ordering on the surface of a sphere. We were motivated by recent experiments, where droplets with nematic shells were prepared with a radius of about $50 \mu m$ [3]. Due to topological reasons, no perfect order exists on a spherical surface even for zero temperature. Therefore, we follow earlier work [4] and focus instead on the local orientational ordering (see Eq. (15) and corresponding Fig. 4 in [2]).

From computer simulations, we find that the local orientational order increases smoothly with decreasing temperature, see Fig. 3 in [2]. The planar case, that we treat in Sec. II of [2] merely serves as reference for the spherical surface. We use comparable system sizes as in the spherical case and we are explicitly *not* interested in the limit of infinite system size. From standard Monte-Carlo simulations we find that not only the local but also the usual Maier-Saupe orientational order parameter (Eq. (3) in

[2]) increases around the same temperature for this finite-size model. Therefore, we believe, the orientational ordering found in the planar model is helpful to understand the local ordering in the spherical case. Our numerical findings concerning the orientational order in the planar model are in agreement with earlier simulations [5].

It is worth to note that the length-scale dependent spatial fluctuations obtained in our simulations allow us to extract a consistent value of the corresponding Frank elastic constant, see Fig. 2 and theoretical estimate, Eq. (18), in [2]. There, we take the long-wave length limit by considering fluctuations on the size of the system, again without taking the infinite system size limit.

We fully agree with the comment made in [1] that no true long-range order exists in the planar Lebwohl-Lasher model in the thermodynamic limit and the transition we observe is more appropriately referred to as pseudo-transition. We apologize if wordings or headings were misleading. But nowhere we made claims concerning the thermodynamic limit. Since the available mathematical results only deal with the thermodynamic limit, we are therefore not in conflict with those results about this transition. Instead, we merely stated numerical results for finite systems of sizes comparable to that of the spherical case.

[1] S. Romano. This comment.
[2] A.M. Luo, S. Wenk, and P. Ilg, Phys. Rev. E **90**, 022502 (2014).
[3] T. Lopez-Leon, V. Koning, K. B. S. Devaiah, V. Vitelli, and A. Fernandez-Nieves, Nat. Phys **7**, 391 (2011).
[4] M. J. Bowick, H. Shin, and X. Xing, Phys. Rev. Lett **101**, 037802 (2008).
[5] J.Y.Denham, G.R. Luckhurst, C.Zannoni, and J.W.Lewis, Mol. Cryst. Liq. Cryst. **60**, 185 (1980).