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A new universality class describes Vicsek's flocking phase in physical dimensions

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The Vicsek simulation model of flocking together with its theoretical treatment by Toner and Tu in 1995 were two foundational cornerstones of active matter physics. However, despite the field's tremendous progress, the actual universality class (UC) governing the scaling behavior of Vicsek's "flocking" phase remains elusive. Here, we use nonperturbative, functional renormalization group methods to analyze, numerically and analytically, a simplified version of the Toner-Tu model, and uncover a novel UC with scaling exponents that agree remarkably well with the values obtained in a recent simulation study by Mahault et al. [Phys. Rev. Lett. 123, 218001 (2019)], in both two and three spatial dimensions. We therefore believe that there is strong evidence that the UC uncovered here describes Vicsek's flocking phase.

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