

- characterization of the nematic lyotropic chromonic liquid crystals: Light absorption, birefringence, and scalar order parameter, *Phys. Rev. E* **72**, 041711 (2005).
- [41] D. B. Allan, T. Caswell, N. C. Keim, C. M. van der Wel, and R. W. Verweij, *soft-matter/trackpy*: v0.6.1rc1, Zenodo (2023), doi: [10.5281/zenodo.7669983](https://doi.org/10.5281/zenodo.7669983).
- [42] I. Muševič, *Liquid Crystal Colloids*, Vol. 530 (Springer, 2017).
- [43] A. Martinez, P. J. Collings, and A. G. Yodh, Brownian dynamics of particles ‘dressed’ by chiral director configurations in lyotropic chromonic liquid crystals, *Phys. Rev. Lett.* **121**, 177801 (2018).
- [44] S. Zhou, K. Neupane, Y. A. Nastishin, A. R. Baldwin, S. V. Shiyonovskii, O. D. Lavrentovich, and S. Sprunt, Elasticity, viscosity, and orientational fluctuations of a lyotropic chromonic nematic liquid crystal disodium cromoglycate, *Soft Matter* **10**, 6571 (2014).
- [45] T. Turiv, I. Lazo, A. Brodin, B. I. Lev, V. Reiffenrath, V. G. Nazarenko, and O. D. Lavrentovich, Effect of collective molecular reorientations on brownian motion of colloids in nematic liquid crystal, *Science* **342**, 1351 (2013).
- [46] H. Baza, T. Turiv, B.-X. Li, R. Li, B. M. Yavitt, M. Fukuto, and O. D. Lavrentovich, Shear-induced polydomain structures of nematic lyotropic chromonic liquid crystal disodium cromoglycate, *Soft Matter* **16**, 8565 (2020).
- [47] J. L. Anderson, Colloid transport by interfacial forces, *Annu. Rev. Fluid Mech.* **21**, 61 (1989).
- [48] Y. Ibrahim, R. Golestanian, and T. B. Liverpool, Multiple phoretic mechanisms in the self-propulsion of a PT-insulator Janus swimmer, *J. Fluid Mech.* **828**, 318 (2017).
- [49] R. Golestanian, T. Liverpool, and A. Ajdari, Designing phoretic micro- and nano-swimmers, *New J. Phys.* **9**, 126 (2007).
- [50] T. Bickel, G. Zecua, and A. Würger, Polarization of active Janus particles, *Phys. Rev. E* **89**, 050303(R) (2014).
- [51] X. Wang, M. In, C. Blanc, A. Würger, M. Nobili, and A. Stocco, Janus colloids actively rotating on the surface of water, *Langmuir* **33**, 13766 (2017).
- [52] B. W. Longbottom and S. A. Bon, Improving the engine power of a catalytic Janus-sphere micromotor by roughening its surface, *Sci. Rep.* **8**, 4622 (2018).
- [53] J. S. Lintuvuori, A. Würger, and K. Stratford, Hydrodynamics defines the stable swimming direction of spherical squirmers in a nematic liquid crystal, *Phys. Rev. Lett.* **119**, 068001 (2017).
- [54] R. Golestanian, Anomalous diffusion of symmetric and asymmetric active colloids, *Phys. Rev. Lett.* **102**, 188305 (2009).
- [55] See Supplemental Material at <http://link.aps.org/supplemental/10.1103/PhysRevE.110.054704> for a diagram showing a tangentially anchored active Janus particle inside a planar cell.
- [56] O. P. Pishnyak, S. Tang, J. Kelly, S. V. Shiyonovskii, and O. D. Lavrentovich, Electrically induced dynamics of colloidal particles dispersed in nematic liquid crystal, *Ukr. J. Phys.* **54**, 101 (2009).
- [57] I. I. Smalyukh, O. D. Lavrentovich, A. N. Kuzmin, A. V. Kachynski, and P. N. Prasad, Elasticity-mediated self-organization and colloidal interactions of solid spheres with tangential anchoring in a nematic liquid crystal, *Phys. Rev. Lett.* **95**, 157801 (2005).
- [58] R. W. Ruhwandl and E. M. Terentjev, Long-range forces and aggregation of colloid particles in a nematic liquid crystal, *Phys. Rev. E* **55**, 2958 (1997).
- [59] V. A. R. Sriram Ramaswamy, R. Nityananda and J. Prost, Power-law forces between particles in a nematic, *Mol. Cryst. Liq. Cryst. Sci. Technol. Sect. A* **288**, 175 (1996).
- [60] M. A. Catipovic, P. M. Tyler, J. G. Trapani, and A. R. Carter, Improving the quantification of brownian motion, *Am. J. Phys.* **81**, 485 (2013).