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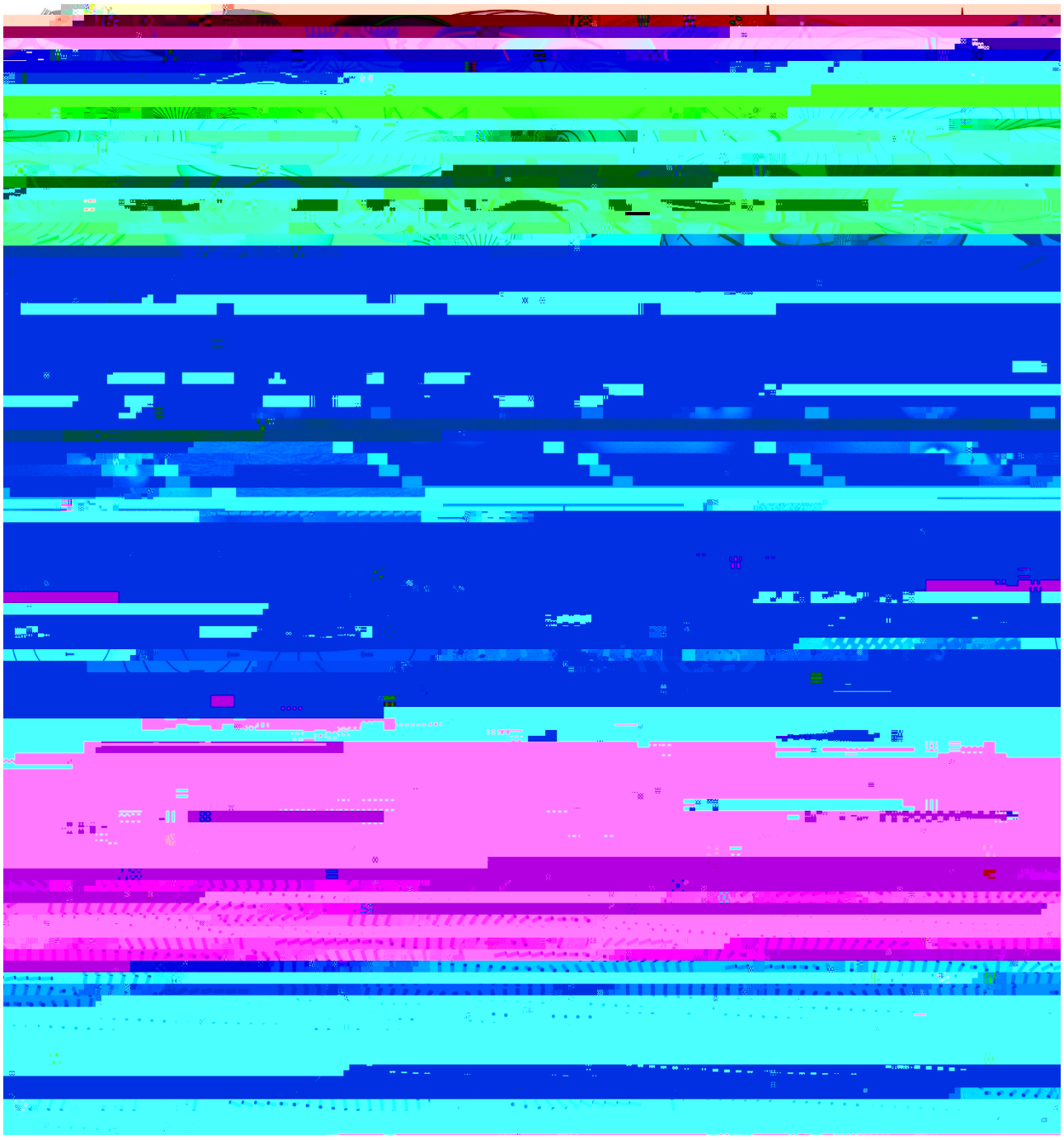

orientation of , favoured by the free-energy term describing its coupling to the field. However, as U

modelling based on the director relaxation method[5,29] of minimizing the CNLC free energy at strong perpendicular boundary conditions on confining plates[1]. Since the half-integer defect lines in , ( ) do not occur in the structures studied in this work, this approach is ideally suitable for 3D modelling of the skyrmionic particles as it accounts for all elastic constants while also allowing for simulations of relatively large sample

U, the elastic interactions gradually transform from isotropic quadrupolar repulsive at low U to strongly anisotropic dipolar-like attractive at relatively high U, giving the origin to different voltage-dependent self-assemblies. Beyond this qualitative picture, quantitative understanding of interactions between skyrmionic particles requires accounting for detailed contributions of twist and dielectric terms associated with the complex 3D structure of the toron–umbilical field configurations at different fields, as well as the short-range interaction effects that cannot be described through the electrostatic analogy, further contributing to the richness and complexity of interactions in cholesteric systems that recently attracted a great deal of attention[41].

interactions. Furthermore, the inter-skyrmion separation in the self-organized structures was tuned by varying applied voltages up to 5 V, giving rise to strong electrostriction. This behaviour bridges markedly different forms of observation of condensed matter defects, ranging from active LCs to thermodynamically stable phases with periodic vortex lattices. The exquisite control of self-assembly of skyrmionic field configurations and singular topological defects may enable their practical uses in diffractive optical elements, singular optics, nanoparticle entrapment into periodic arrays and in fabrication of mesostructured composites.

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