

colloids are often described by the electrostatic analogy and multipole expansion of the interaction potential, this approach cannot be applied directly in our case. Since the symmetry axes of the configurations due to individual colloidal particles are normal to cell substrates, elastic dipoles align perpendicular to confining surfaces, too, and point upward or downward [Fig. 3(a)]. Naively, one would expect attractive interactions for antiparallel dipoles and repulsive interactions for parallel ones at all distances. However, the antiparallel dipoles are found to repel at large distances and attract only at short distances, which can be qualitatively understood by considering the particle-induced $\phi(r)$ [Fig. 3(a)]. Despite the asymmetry in the particle and bulk point defect positions forming a dipolar near-field $\phi(r)$, the structure is seen as a single toron or hoplon from a long distance. The distortions in the exterior are fairly symmetric with respect to the cell midplane [Fig. 3(a)] because the double-twist cylinder loops around the dipole and screens the elastic dipole moment of the overall particle-toron hybrid, making the long-distance interactions quadrupolarlike (although further screened by the cell confinement), i.e., always repulsive in our geometry. At short distances comparable to the size of the particle-toron hybrid, the double-twist portions of the solitons start to interpenetrate, and the symmetry breaking in the interior of this configuration starts playing a role, leading to short-range attractive interactions and the eventual formation of dimers and chains with antiparallel dipoles, in which the particles are found entangled by meanders of the two-dimensional skyrmions (Fig. 3B). This behavior