SUPPLEMENTAL MATERIAL
Chirality-induced helical self-propulsion of cholesteric liquid crystal droplets

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I. DENSITY MEASUREMENT OF SURFACTANT SOLUTION AND CHOLESTERIC LIQUID CRYSTAL

Density of TTAB solution at various mixing ratio of D_2O and H_2O by weight and cholesteric liquid crystal doped with 2wt% R811 are shown in Fig. S1. We also show the data for lower surfactant concentration (0wt% and 5wt%) than 13wt%, which is the condition we applied in the main text, as references.

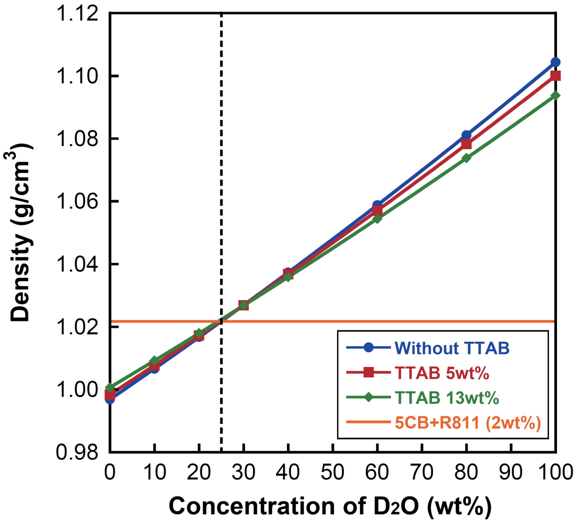

Fig. S1: Density of TTAB solution and 5CB doped with 2wt% R811. The quadratic curves are fits to data. The dashed vertical line indicates 25wt%, which is the condition we applied to eliminate the effect of buoyancy on the swimming behavior of CLC droplets.

II. TRACKING ALGORITHM

We made a python program to track a CLC droplet. The algorithm is as follows. While the detail condition for the image analysis is different for each movie we captured, the basic algorithms applied were common.

1. After enhancing the contrast of the original image by normalizing the intensity values over the range [0, 255] available for 8-bit images (Fig. S2(b)), blur the image to reduce the non-uniformity of the intensity due to the striped pattern (Fig. S2(c)). For the blurring, median filter was performed with scipy.filters.median_filter.

2. Binarize using the function cv2.threshold from openCV library (Fig. S2(d)).

3. Fill holes in a binarized image of a droplet using numpy.ndimage.binary_fill_holes (Fig. S2(e)).

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4. Finally, detect the center of mass of the binarized image of the droplet (Fig. S2(e)). The center of mass of the original image is shown in Fig. S2(f).

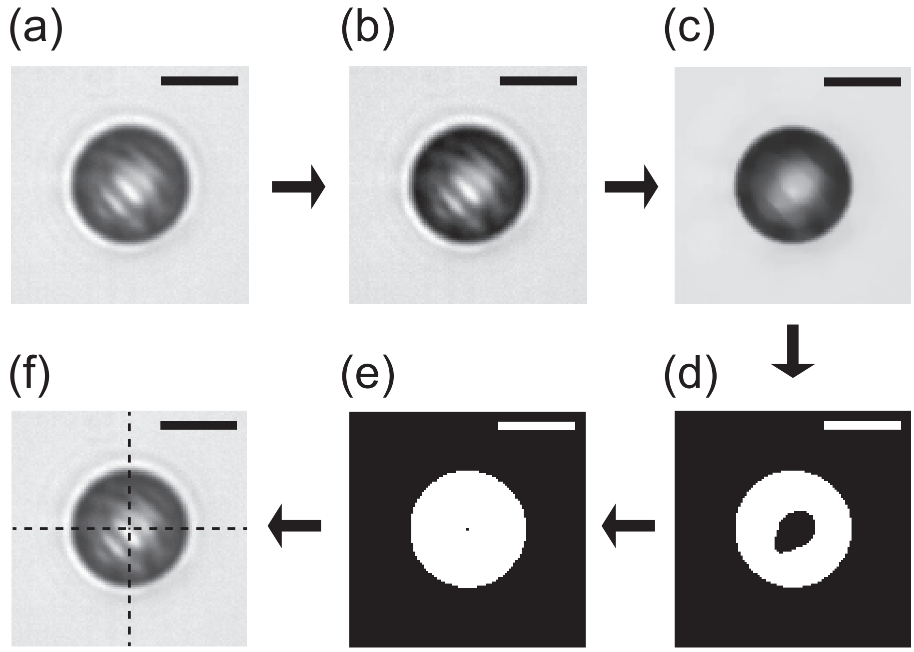

Fig. S2: (a) An original image of a CLC droplet. (b) Enhancing the contrast. (c) Blurring with median filter. (d) Binarization. (e) Filling hole. The black pixel at the center shows the center of mass. (f) The intersection of two dashed lines shows the center of mass in the original image. The scale bars are all 10 μm

III. TIME-EVOLUTION OF XYZ-COORDINATES AND VELOCITY OF CLC DROPLETS

We applied Butterworth filter with the cutoff frequency $f_c = 0.5$ Hz on the recorded coordinates of each CLC droplet before calculating the velocity. Fig. S3 shows the time-evolution of xyz-coordinates and velocity of the CLC droplet shown in Fig. 4 in the main text with and without filtering. Fig. S4 extracts the S-phase in Fig. S3.

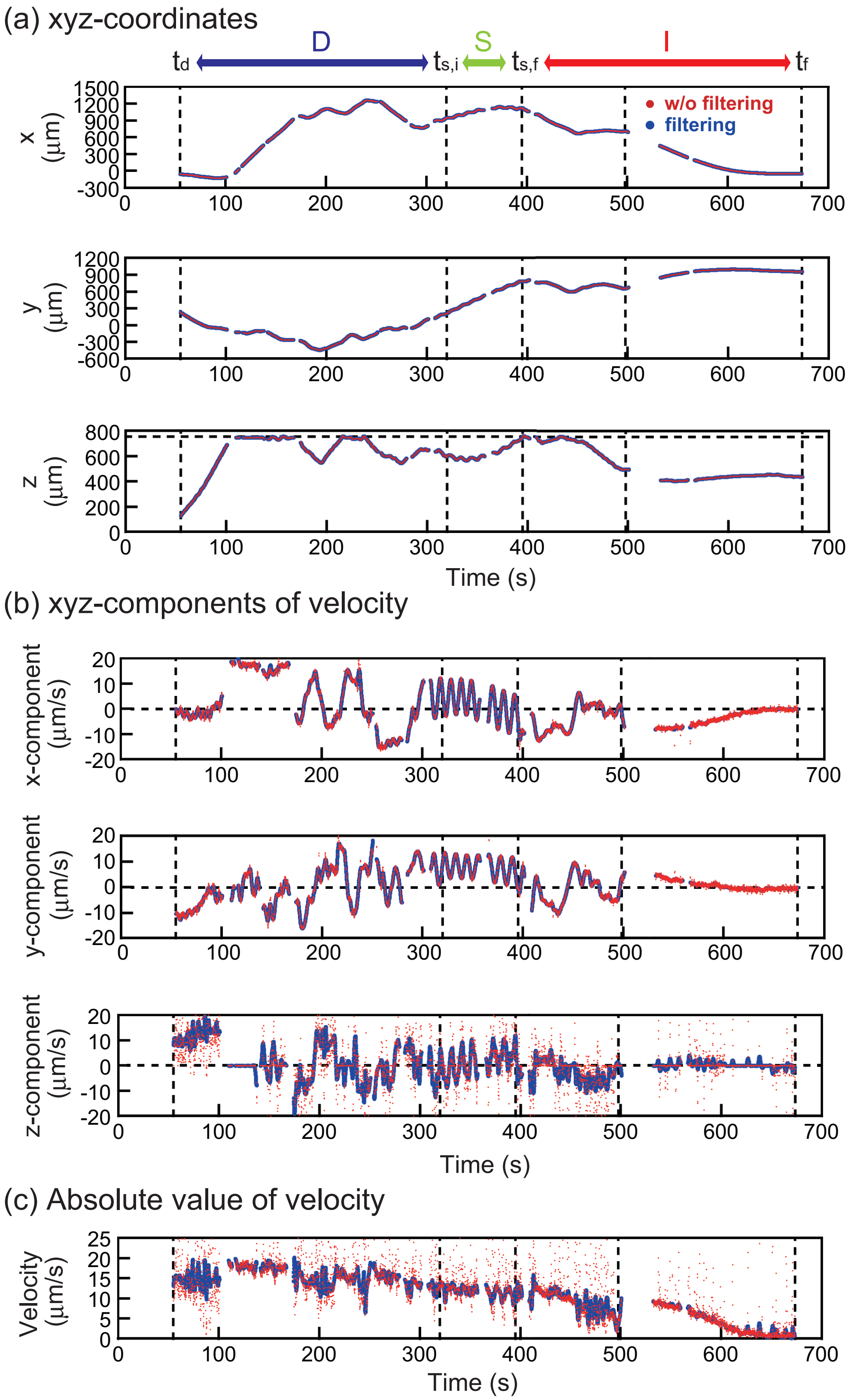

Fig. S3: Time-evolution of (a) xyz-coordinates, (b) xyz-components and (c) absolute value of velocity of the droplet corresponding to Fig. 3 in the main text. The red and blue marker indicate the data without and with filtering, respectively. The vertical lines indicate $t = t_{\rm d}, t_{\rm s,i}, t_{\rm s,f}, t_{\rm iso}, t_{\rm f}$, respectively. The horizontal dashed line in (a) indicates the height of the upper glass ($z = 755$ μm).

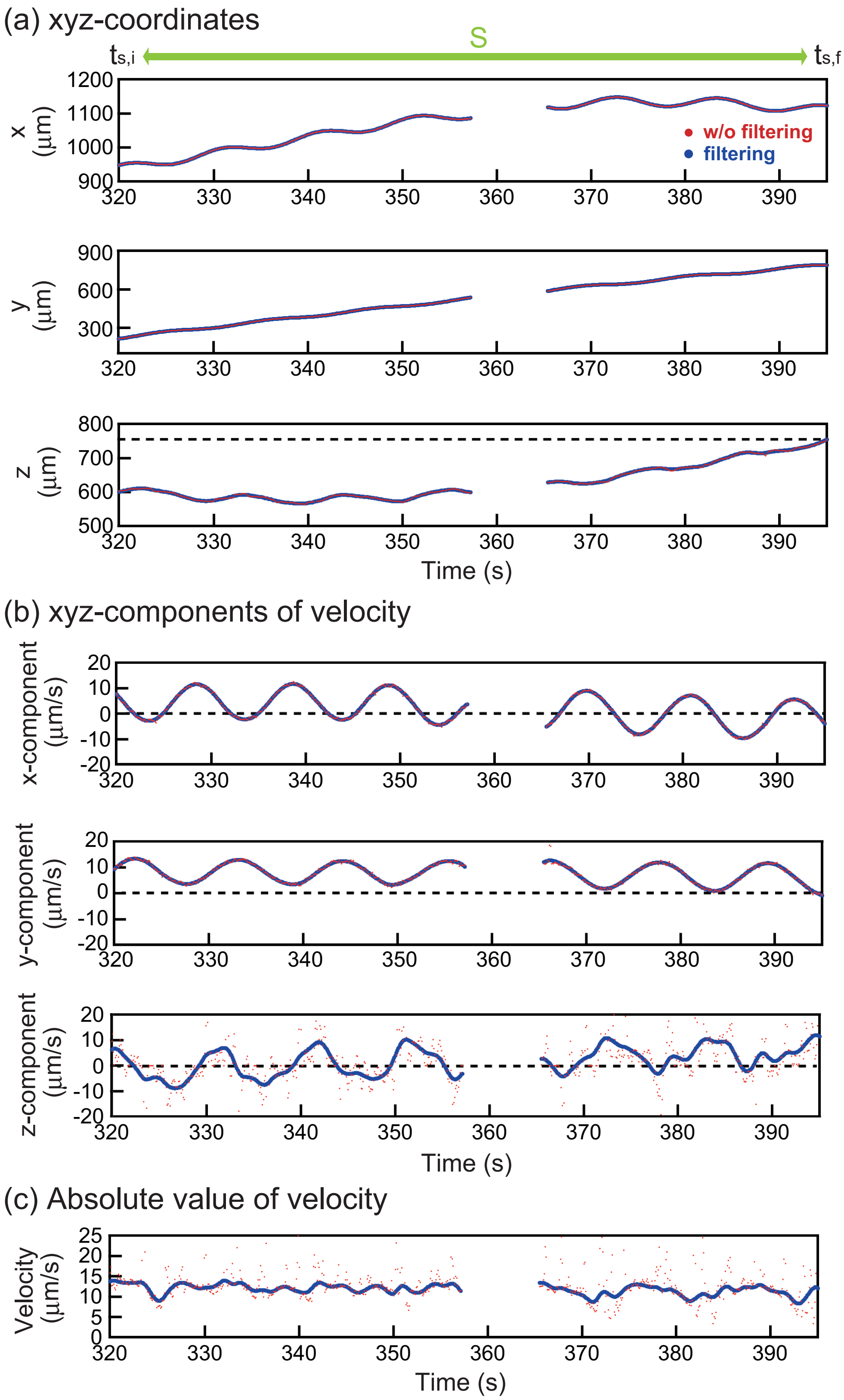

Fig. S4: Time-evolution (S-phase) of (a) xyz-coordinates, (b) xyz-components and (c) absolute value of velocity of the droplet corresponding to Fig. 3 in the main text. The red and blue marker indicate the data without and with filtering, respectively. The horizontal dashed line in (a) indicates the height of the upper glass ($z = 755$ μm).

IV. ISOTROPY OF THE DROPLET IN THE I-PHASE

The isotropy of the CLC droplet in Fig. 3(a-3) in the main text was checked using crossed polarizers as shown in Fig. S5. Note that the dark image under crossed polarizers corresponds to isotropic structure of the droplet.

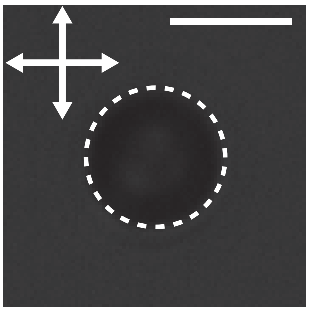

Fig. S5: The image of the CLC droplet in the I-phase observed with crossed polarizers. The image was captured at $t = 518.5$ s in the trajectory in Fig. 3(a), just after the image in Fig. 3(a-3) was captured. The white dashed circle indicates the contour of the droplet. The white double-headed arrows show the directions of the polarizations of two polarizers. The scale bar is 10 μm.

V. ISOTROPIC TRANSITION TEMPERATURE OF CHOLESTERIC LIQUID CRYSTAL

The isotropic transition temperature T_{iso} of CLC at various concentration of R811 is shown in Fig. S6. We estimated $T_{\text{iso}} = 26.4°\text{C}$ at $c(t_{\text{iso}}) = 14.2\text{wt}\%$ in the main text by linearly interpolating the experimental data in Fig. S6. We determined the transition temperatures T_{iso} by observing the texture of the CLC while we controlled the temperature of the samples in units of 0.1 K with a hot stage (HCS402, Instec, Inc.).

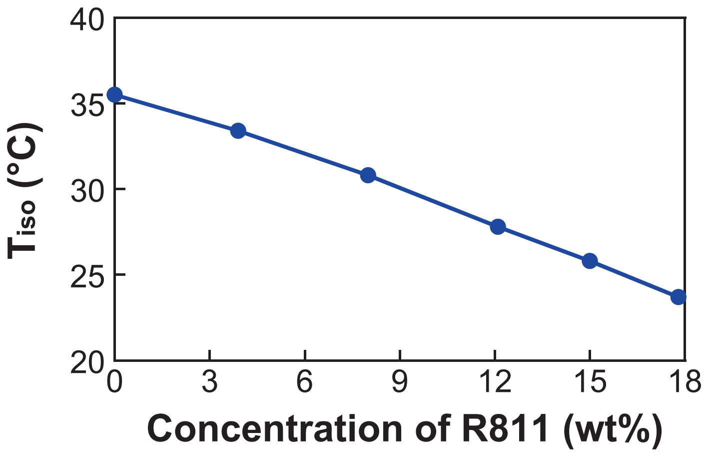

Fig. S6: Isotropic transition temperature T_{iso} of CLC at various concentrations of R811.