

Supplementary information

for

Island hopping of active colloids

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1 Instantaneous velocity of active colloids

As shown in **Figure S1**, the calculated instantaneous velocity, based on the JP trajectory displayed in **Figure 3a** of the main text, reveals no significant change within the observed time interval. This implicates that the particle velocity is retained upon interaction with cluster islands as demonstrated for all events occurring within the 400 s time interval. We observe no pronounced drop in the instantaneous velocity during collisions of the active colloids and the particle velocity only fluctuates around the average.

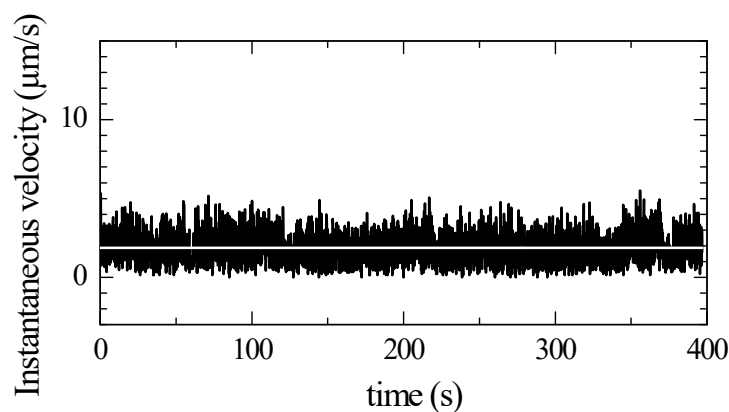


Figure S1. JP moving in a silica passive particle environment. Instantaneous velocity calculated from the active particle trajectory in presence of silica cluster self-assembled in aqueous environments at constant electric field ($E = 0.066 \text{ V}\mu\text{m}^{-1}$). Within the observed time interval of $\Delta t = 400 \text{ s}$, the particle velocity fluctuates around its mean value ($1.86 \pm 0.95 \text{ }\mu\text{m/s}$) represented by the horizontal line. The error is given by the corresponding standard deviation. Corresponding microscopic images were taken at a framerate of 10 fps.

2 Statistics of backscattering events

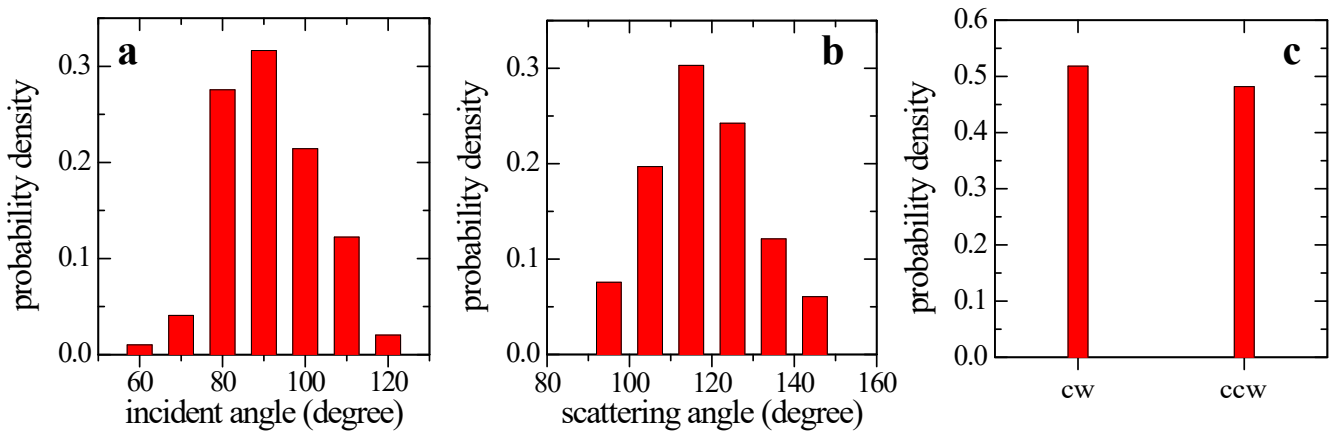


Figure S2. JP-island collisions. (a) Probability density for the incident angle. (b) Probability density for the “scattering angle”, i.e., the angle between the incoming and outgoing velocity vectors. (c) Probability density for the clockwise (cw) and counterclockwise (ccw) rotational direction of JP upon collision with islands.

3 Supporting video information

Supporting video SV1: Island-formation by self-assembly of silica passive particles upon applying AC electric fields ($E = 0.066 \text{ V}/\mu\text{m}$). The field switching frequency was kept constant at $f = 1.5 \text{ kHz}$. The video was recorded at $40 \times$ magnification, where the scale bar corresponds to $5 \mu\text{m}$. The recording speed was set to 100 FPS rendered at $5 \times$ speed up.

Supporting video SV2: Dissolution of islands when turning off the AC electric field ($E = 0 \text{ V}/\mu\text{m}$) and fluid phase recovery by thermal diffusion. The video was recorded at $20 \times$ magnification, where the scale bar corresponds to $10 \mu\text{m}$. The recording speed was set to 2 FPS rendered at $10 \times$ speed up.

Supporting video SV3: Island-microswimmer interaction and gold-cap orientation at applied AC electric field ($E = 0.066 \text{ V}/\mu\text{m}$ at constant frequency $f = 1.5 \text{ kHz}$). The video was recorded at $40 \times$ magnification, where the scale bar corresponds to $5 \mu\text{m}$. The recording speed was set to 100 FPS rendered at $5 \times$ speed up.