# Tunable long range forces mediated by self-propelled colloidal hard spheres Supplementary Information

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In the 2D system of active hard spheres, the interaction between particle $i$ and $j$ is modeled with a steep Weeks-Chandler-Andersen (WCA) potential given by

$$\frac{U_{WCA}(r_{ij})}{k_BT} = \begin{cases} 4\epsilon\left[\left(\frac{\sigma}{r_{ij}}\right)^{12} - \left(\frac{\sigma}{r_{ij}}\right)^{6} + \frac{1}{4}\right] & r_{ij}/\sigma \le 2^{1/6}, \\ 0 & r_{ij}/\sigma > 2^{1/6}, \end{cases} \quad (1)$$

where $r_{ij}$ is the center-to-center distance between the two spheres, and $\sigma$ is the diameter of the particles, with $k_B$ and $T$ the Boltzmann constant and the temperature of the system, respectively. Here, the strength of the interaction is set $\epsilon = 40$. Moreover, the interaction between particle $i$ and wall $j$ is given by $U_{wall}(i,j) = U_{WCA}(r_{ij})$, in which $r_{ij}$ is minimal distance between the center of particle $i$ and points on the line segment $j$.

In the quasi-2D system of active hard spheres confined betwen two horizontal walls, the interaction between particle $i$ at $\mathbf{r}_i = (x_i, y_i, z_i)$ and the two horizontal walls is

$$\frac{U_{conf}(\mathbf{r}_i)}{k_BT} = \begin{cases} 0 & 0.5\sigma \le z_i \le H - 0.5\sigma, \\ \infty & otherwise, \end{cases} \quad (2)$$

where $H$ is the height of the confinement.

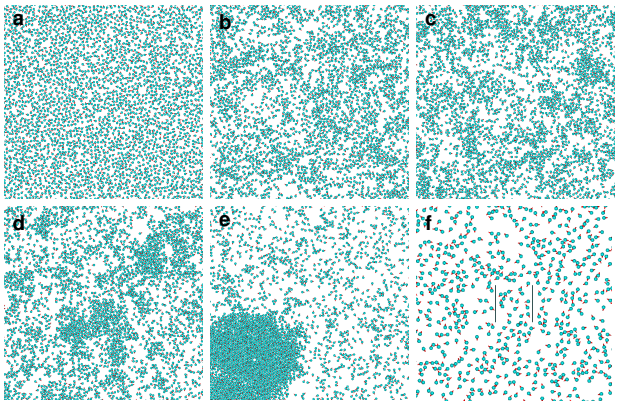


FIG. S1: (a-e) Typical snapshots of 2D systems of self-propelled colloidal hard spheres at density $\rho_{bulk}\sigma^2 = 0.4$ with self-propulsion $f\sigma/k_BT = 0, 20, 40, 60$ and 80, respectively. (f) Illustration of the system to study the interaction mediated by the dynamic clusters of self-propelled colloidal hard spheres, and the two vertical lines indicate the two parallel hard walls. The red arrows indicate the direction of random self-propulsion.

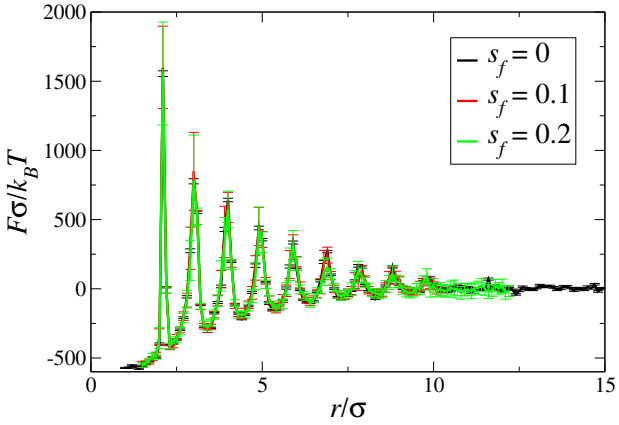


FIG. S2: Effective interaction between two parallel walls $F\sigma/k_BT$ as a function of wall-wall distance $r$ for systems of active hard spheres with different polydisperse active propulsions $s_f$. The density of the system is fixed at $\rho_{bulk}\sigma^2 = 0.4$, and the average self-propulsion is $f\sigma/k_BT = 40$ with $\sigma$ the particle diameter.

The effect of polydispersity of active force on the dynamic wetting force is shown in Fig. S2. The self-propulsion on particle $i$ is given by

$$f_i = f \cdot [1 + \xi(s_f)], \quad (3)$$

where $f$ is average active force in the system, and $\xi(s_f)$ is a Gaussian random number with zero mean and the standard deviation $s_f$.

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