Bead model calculation of effective diffusion

The effective diffusion coefficient $D_{\text{eff}}$ of a rigid structure defined by a set of beads or spheres with positions $\mathbf{r}_i$ can be obtained from the following expression

$$D_{\text{eff}}(q) = \frac{1}{q^2 S(q)} \sum_{j,k} b_j b_k e^{-i q \cdot \mathbf{r}_j} \left( \frac{q}{q \times \mathbf{r}_j} \right) D \left( \frac{q}{q \times \mathbf{r}_k} \right) e^{i q \cdot \mathbf{r}_k}$$

(S4-1)

where $D$ is the diffusion matrix, $S(q)$ is the static form factor, and $b_j$ is the scattering length of particle $j$. A bead model of the discocyte can be constructed by taking a volume occupied by a hcp-lattice of particles with a radius $r_b$ and removing all particles outside the discocyte volume. The diffusion matrix has been calculated based on the discocyte-shaped set of particles using the software HYDRO++ \cite{48,49}. In this program, hydrodynamic interactions between the beads from the set are introduced using the Kirkwood-Riseman approximation with a volume correction for the calculation of rotational properties \cite{48}. The hydrodynamic radius of the particles takes the values $5a$, $3a$, $2a$, and $1.5a$. $D_{\text{eff}}$ converges nicely below $r = 2a$, and it changes by less than 0.5\% when $r \approx 1.5a$, which corresponds to the data set in Fig. 6 of the main text. There is a good agreement between both translational and rotational diffusion coefficients in comparison with MPC and DPD simulations. The orientational average was taken over 2500 $q$-vectors.