Bari Theory Xmas Workshop 2016

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Self-propelled droplets through Marangoni Effect

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What is the Marangoni Effect?

The *Marangoni effect* consists in the rise of a force tangential to an interface due to a gradient of surface tension created by anisotropies of temperature *(J. of Fluid Mech.* ***6****, 3 (1959))* or surfactant *(New J. of Phys.* ***13*** *(2011); Soft Matter* ***10****, 7008 (2014)).*

Surfactants are examples of tensio-active materials which migrate to the interfaces of systems and have the ability to lower the surface tension there

Dynamical equations

$$\mathcal{F}=\int d\boldsymbol{r}\left[\frac{a}{2}\phi^2+\frac{b}{4}\phi^4+\frac{(B_0+B_1c)}{2}(\nabla\phi)^2+clnc\right]$$

*(J. Chem. Phys. **136**, 074904 (2012))*

- *Continuity equation:*

$$\partial_t n+\partial_\alpha(nu_\alpha)=0$$

- *Navier-Stokes equation:*

$$\partial_t(nu_\beta)+\partial_\alpha(nu_\alpha u_\beta)=-\partial_\alpha\left(P_{\alpha\beta}\right)+\partial_\alpha\{\eta\left(\partial_\alpha u_\beta+\partial_\beta u_\alpha-\delta_{\alpha\beta}\partial_\gamma u_\gamma\right)+\zeta\delta_{\alpha\beta}\partial_\gamma u_\gamma\}$$

- *Convection-diffusion equations:*

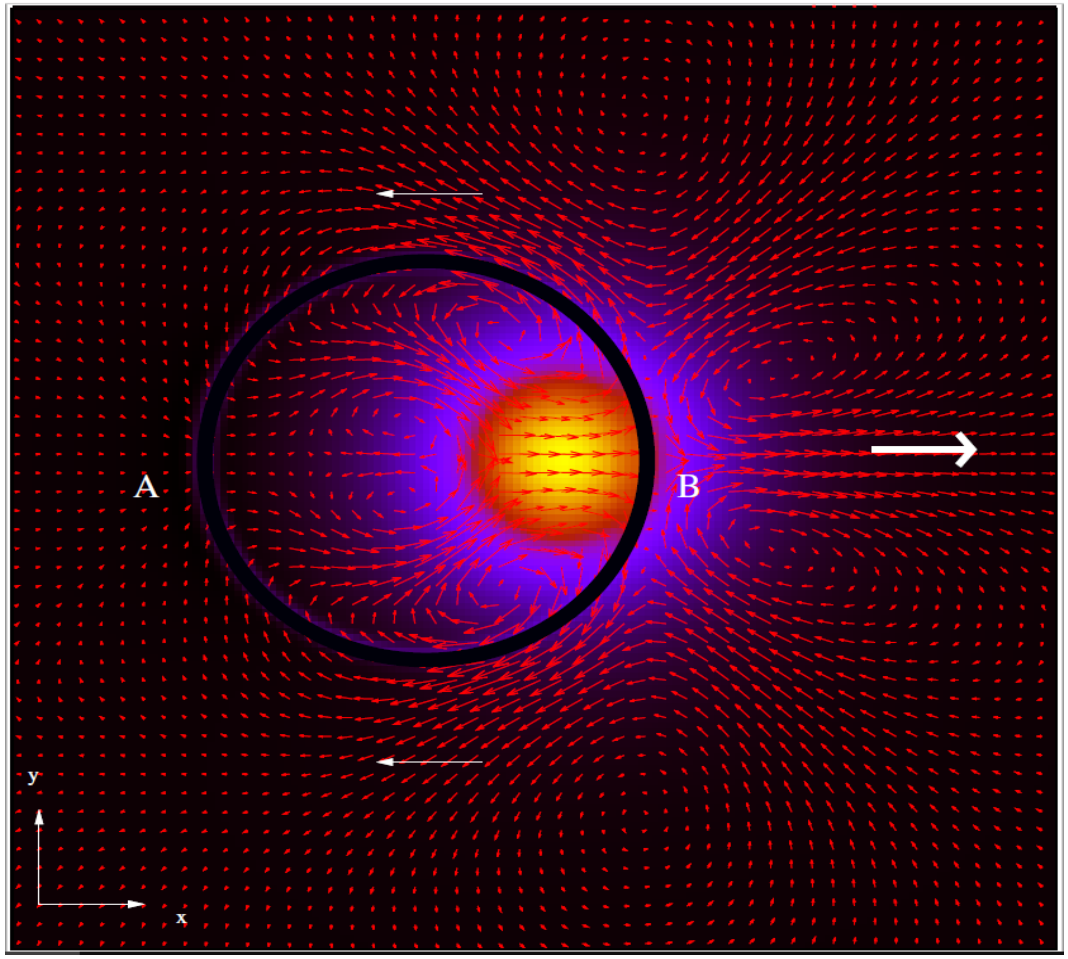
$$\partial_t\phi+\partial_\alpha(u_\alpha\phi)=\nabla^2\mu$$

$$\partial_t c+\partial_\alpha(u_\alpha c)=\nabla\cdot\ [Dc\nabla\mu']-\gamma(c-c_0)+A\Theta(R-|\boldsymbol{r}-\boldsymbol{r}_P|)$$

Simulations performed with hybrid LBM method with cell D_2Q_9

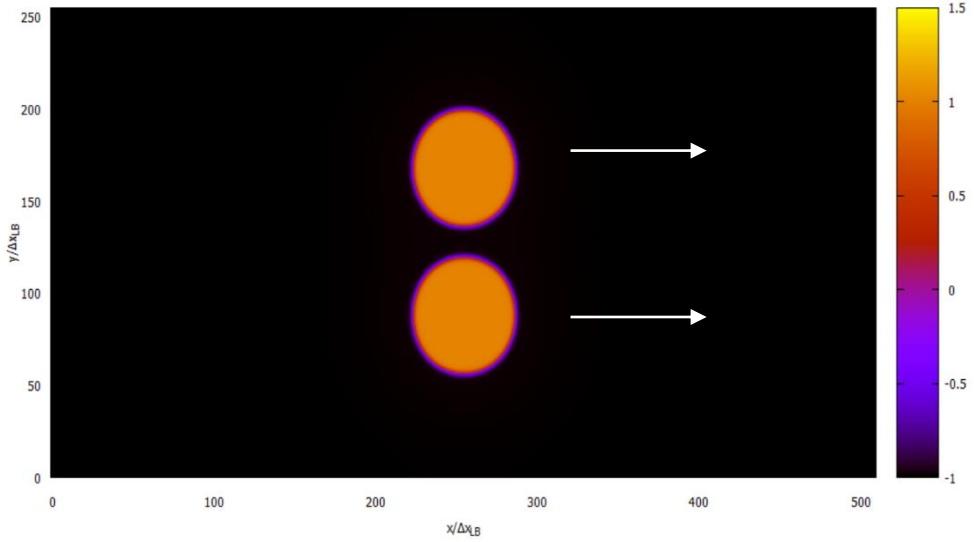
Single self-propelled droplet

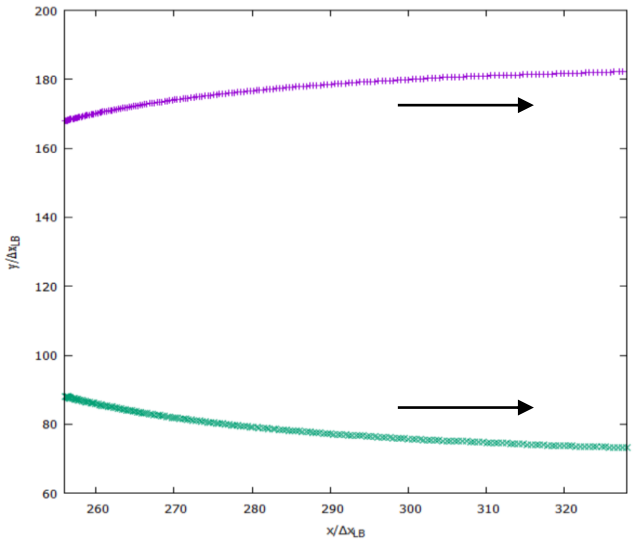
*(Soft Matter **10**, 7008-7022 (2014))*

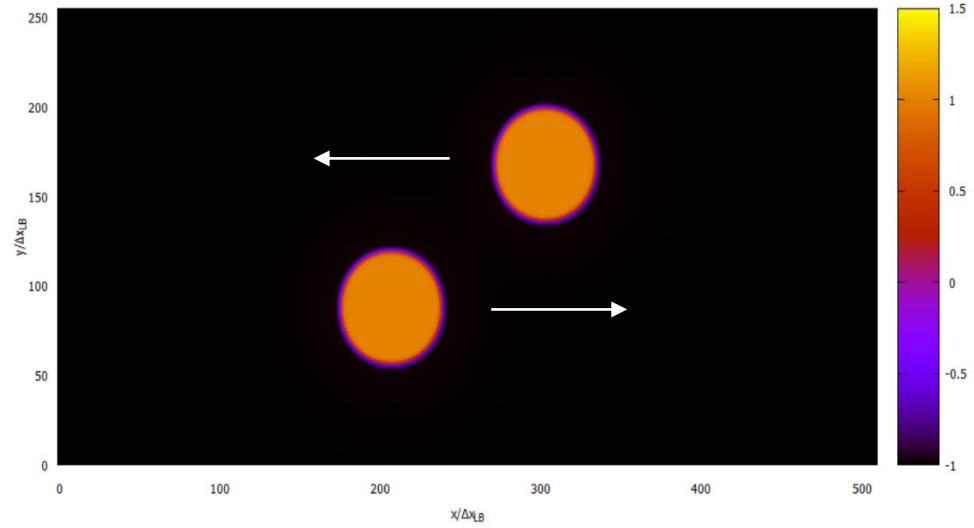


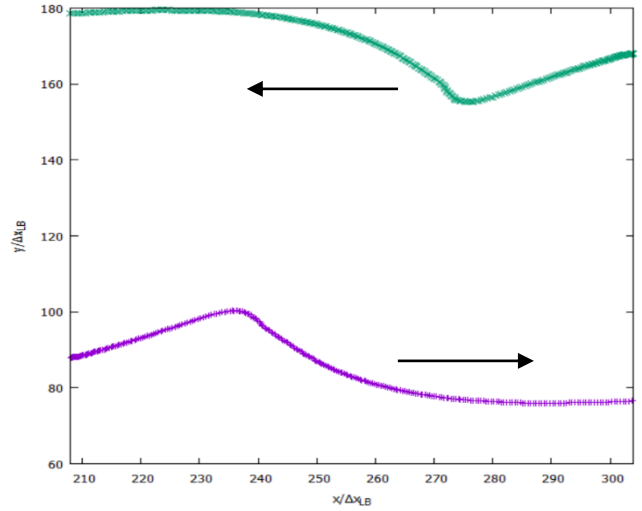
Two interacting self-propelled droplets

*(J. Fluid Mech. (2016), vol. **806**, pp. 205-233)*









Thanks for the attention!!!

Merry Christmas

and

Happy New Year to everybody!!!