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The dipole approximation for droplets in Hele-Shaw flows YOAV GREEN, Ben-Gurion University of the Negev — For the past decade, the interaction between two droplets flowing in a Hele-Shaw cell has been modelled as a dipolar force. On one hand, the correspondence between experiments and the dipole model is remarkable. On the other hand, the dipole model doesn't satisfy the required no-flux boundary condition at the droplet interfaces. Despite of this contradiction, the dipole model remained popular. In an attempt to bridge this gap, Sarig et al[1] derived an exact analytical solution, for a two-droplet system satisfying zero-flux at both droplet interfaces, that showed remarkable correspondence to experiments. However, their solution was given in terms of infinite Fourier series, which didn't allow for the desired resolution of the contradiction. By deriving approximations for their Fourier series, for the cases of small and large droplet spacing, we resolved the contradiction [2]. We showed that the large spacing approximation reduces to the expected dipole-like solution. We extended our solution to arbitrary droplet numbers. Our infinite lattice solution includes a corrections term relative to the dipole model. Finally, our small spacing solution also provides a novel lower limit. [1] Sarig et al, J. Fluid Mech. 800, 264 (2016) [2] Y. Green, J. Fluid Mech. 853, 253 (2018)

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