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"Casimir effect" with active swimmers DIPANJAN RAY, LENA LOPATINA, CYNTHIA OLSON REICHHARDT, CHARLES REICHHARDT, Los Alamos National Laboratory — In recent years, active matter has increasingly found applications in nanoengineering.[1] Here we show using molecular dynamics simulations that the natural motion of "run-and-tumble" bacteria will push together two parallel walls arranged in a Casimir geometry. This effect is robust as long as the wall separation is comparable to or smaller than the bacterial run-length, so that the bacterial motion is not Brownian on the length scale of the walls. The magnitude of the attractive force between the walls exhibits an unusual exponential dependence on the wall separation. The attraction arises from a depleted concentration of bacteria in the region between the plates; this is caused by the tendency of the bacteria to slide along the walls, which breaks time-reversal symmetry and allows a density difference to develop. The same mechanism was used recently to explain bacterial rectification.[2] The inclusion of steric interactions between the bacteria reduces the attraction between the plates but does not eliminate it.

[1]R. DiLeonardo et al, Proc. Natl. Acad. Sci. U.S.A. 107, 9541 (2010); B. Kaehr and J. B. Shear, Lab on a Chip, 9, 2632 (2009).
[2]M. B. Wan et al, Phys. Rev. Lett., 101, 018102 (2008); J. Tailleur and M. E. Cates, Europhys. Lett. 86, 60002 (2009).

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