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Collisional low velocity phase of concentrated rod-shaped bacteria[1] LUIS CISNEROS, JOHN KESSLER, University of Arizona, SUJOY GANGULY, RAYMOND GOLDSTEIN, University of Cambridge — Suspensions of self propelled wild-type Bacillus subtilis exhibit a transition from independent motion at low concentration to a complex collective dynamics at large concentrations, as a consequence of steric and hydrodynamic interactions. The collective phase displays domains with velocities higher than those of individual swimming cells, correlated with strong co-directionality, termed Zooming BioNematic (ZBN) phase. At intermediate concentrations we find a regime where intercellular collisions, characterized by stopping followed by reconstitution of the propulsion mechanism, produce reduction of mean swimming speeds considerably below those observed for free individual cells. This transitional phase is termed "the jamming phase" by analogy with concentrated automobile or pedestrian traffic. In this regime cell to cell separations are sufficiently small to produce a high frequency of collisions, but not small enough to trigger collective organization. A basic model that considers the typical acceleration of bacteria after collisions and the associated mean free time as a function of cell concentration is shown to yield the observed reduction of swimming speed in the jamming phase.

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