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Cross-stream migration of active particles WILLIAM USPAL, Max Planck Institute for Intelligent Systems and IV. Institut für Theoretische Physik, Uni. Stuttgart, JAIDEEP KATURI, Institute for Bioengineering of Catalonia and MPI for Intelligent Systems, JULIANE SIMMCHEN, MPI for Intelligent Systems, ALBERT MIGUEL-LOPEZ, Institute for Bioengineering of Catalonia, SAMUEL SANCHEZ, Institute for Bioengineering of Catalonia, Max Planck Institute for Intelligent Systems, and Catalan Institute for Research and Advanced Studies — For natural microswimmers, the interplay of swimming activity and external flow can promote robust directed motion, e.g. propulsion against (upstream rheotaxis) or perpendicular to the direction of flow. These effects are generally attributed to their complex body shapes and flagellar beat patterns. Here, using catalytic Janus particles as a model system, we report on a strong directional response that naturally emerges for spherical active particles in a channel flow. The particles align their propulsion axis to be perpendicular to both the direction of flow and the normal vector of a nearby bounding surface. We develop a deterministic theoretical model that captures this spontaneous transverse orientational order. We show how the directional response emerges from the interplay of external shear flow and swimmer/surface interactions (e.g., hydrodynamic interactions) that originate in swimming activity. Finally, adding the effect of thermal noise, we obtain probability distributions for the swimmer orientation that show good agreement with the experimental probability distributions. Our findings show that the qualitative response of microswimmers to flow is sensitive to the detailed interaction between individual microswimmers and bounding surfaces.

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