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Non-equilibrium transport and enhanced diffusion near biological active carpets[1] ARNOLD JTM MATHIJSSEN, Stanford University, FRANCISCA GUZMAN-LASTRA, Universidad Mayor, Santiago, Chile, MANU PRAKASH, Stanford University, HARTMUT LOEWEN, Heinrich Heine University Duesseldorf — Biological activity is highly concentrated on surfaces, from molecular motors and ciliary arrays to sessile suspension feeders and biofilms together they form the class of 'active carpets'. While the physics of active suspensions has raised considerable interest, it remains unclear how energy and momentum injection from active surfaces can drive living systems out of equilibrium. Here we demonstrate that active carpets generate coherent flows towards the substrate, which provides an efficient pathway for replenishing nutrients that feed back into activity. A full theory is developed in terms of gradients in the active matter density and velocity, and applied to bacterial turbulence, topological defects and clustering. Active carpets can also enhance diffusion, which we describe by generalising Fick's laws for this non-equilibrium living system. Our findings show that diversity in carpet architecture is essential to maintain biofunctionality.

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