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Self-sustained biphasic catalytic particle turbulence[1] ZIQI WANG[2], Tsinghua University, VARGHESE MATHAI[3], Brown University, CHAO SUN[4], Tsinghua University — Turbulence is known for its ability to vigorously mix fluid and transport heat. While over a century of research for enhancing heat transport, few have exceeded the inherent limits posed by turbulent-mixing. Here we have conceptualized a kind of "active particle" turbulence machine: we find that by adding a minute concentration ($\phi_v \sim 1\%$) of a heavy liquid (hydrofluoroether) to a water-based turbulent convection system, remarkably, high efficient biphasic dynamics is born, which supersedes turbulent heat transport by up to 500%. The system is unique in that it operates on a self-sustained dynamically equilibrated cycle of a "catalyst-like" species, and exploits several heat-carrier agents including pseudo-turbulence, latent heat and bidirectional wake capture. We find that the heat transfer enhancement is dominated by the kinematics of the active elements and their induced-agitation. The present finding opens the door towards a new class of tunable, ultra-high efficiency heat transfer/mixing devices, with potential for major improvements in biochemical, nuclear, and process technologies, as well as in energy usage.

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