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Small Ekman number heat transport in low Prandtl number rotating thermal convection ROBERT ECKE, Los Alamos National Laboratory, JOSEPH NIEMELA, International Center for Theoretical Physics — Heat transport in rotating convection is a complex combination of buoyancy, rotation, and fluid nonlinearity. We report experimental measurements of heat transport in rotating convection with cryogenic helium gas having a Prandtl number $Pr = 0.7$. The convection cell is cylindrical with aspect ratio $\Gamma = 1/2$, and the range of explored control parameters, Rayleigh number Ra and Ekman number Ek, is $4 \times 10^9 < Ra < 4 \times 10^{11}$ and $2 \times 10^{-7} < Ek < 3 \times 10^{-5}$ (corresponding to $0.07 < Ro < 5$). We determine the crossover from buoyancy-dominated convection where rotation plays no measurable role in the heat transport to rotation-influenced convection in which the decrease in the heat transport contribution is no greater than 20% of the non-rotating value. We also determine the crossover conditions $Ra_t = 0.5 Ra Ek^{-7/4}$ from the rotation-influenced state to a regime of geostrophic turbulence where normalized heat transport Nu varies roughly linearly in Ra as opposed to the $Ra^{1/3}$ scaling of the rotation-free state. An overall phase diagram of rotating convection in the space of Ra/Ra_c and Ek is proposed for a range of Pr from 0.7 to 6 by combining our results with other data available in the literature.

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