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Centrifugal Buoyancy and Non-Boussinesq Heat Transfer in Rotating Rayleigh-Bénard Convection[1] JONATHAN CHENG, University of Rochester, SIETZE OOSTVEEN, MATTEO MADONIA, RUDIE KUNNEN, Eindhoven University of Technology — In laboratory experiments of rotating Rayleigh-Bénard convection, conditions differ from the idealized problem in several significant ways. Important among these differences are the presence of centrifugal buoyancy – which causes colder fluid to be driven radially outward and is characterized by the Froude number (Fr) – and non-Boussinesq effects – where variations in the fluid properties break the vertical symmetry of the temperature field. Here, we present a suite of rotating convection simulations under fixed heat flux and Coriolis influence, but with varying centrifugal forcing. The heat transfer is suppressed as Fr increases, with the transition occurring in agreement with the force balance arguments of Horn & Aurnou, Phys. Rev. Lett. 120:204502, 2018. We compare the influence of centrifugation with that of non-Boussinesq effects by examining sidewall temperature gradients in the TROCONVEX rotating convection lab setup. At the sidewall, we expect these two effects to compete against one another. When the Rayleigh number is increased we observe the expected positive shift in the midplane temperature (Ahlers et al., J. Fluid Mech. 596:409-445, 2006), and when Fr is increased, the positive shift is present but reduced.

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Jonathan Cheng
University of Rochester

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