Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Effect of weak rotation on the large-scale circulation in turbulent convection with a Prandtl number $Pr = 12.3$[1] PING WEI, GUENTER AHLERS, University of California, Santa Barbara, CA — We report measurements of large-scale circulation properties for high-Rayleigh-number convection in a rotating cylindrical sample with aspect ratio $\Gamma = D/L = 1.00$ (D is the diameter and L the height). The Prandtl number was $Pr = 12.3$. The measurements covered the Rayleigh-number range $2 \times 10^{10} \leq Ra \leq 4 \times 10^{11}$ and the inverse Rossby-number range $0 \leq 1/Ro \leq 1/Ro_c = 0.28$ where the LSC was present. The azimuthal orientation θ_0 of the LSC circulation plane remained fixed in the frame of the rotating sample for $Ra < Ra_0 \simeq 5 \times 10^{10}$. The sloshing motion of the LSC showed oscillations with a short time period τ^{pl} of several tens of seconds. The temperature amplitude $< \delta >$ of the LSC increased as $1/Ro$ approached $1/Ro_c$, and decreased rapidly beyond it. For $Ra > Ra_0$, the circulation plane underwent retrograde rotation and hence caused time-periodic temperature oscillations near the side wall with a large period τ_{ac} of hundreds of seconds. Remarkably, τ_{ac} persisted without a discontinuity even for $1/Ro > 1/Ro_c$ where the LSC ceased to exist, indicating that vortex structures in that regime undergo the same retrograde rotation as the LSC.

[1]Supported by NSF Grant DMR11-58514

Ping Wei
University of California, Santa Barbara, CA

Date submitted: 30 Jul 2015 Electronic form version 1.4