Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Azimuthal diffusion of the large-scale circulation of turbulent Rayleight-Bénard convection[1] XIAOZHOU HE, DENNIS P. M. VAN GILS, EBERHARD BODENSCHATZ, Max Planck Institute for Dynamics and Self-Organization, Göttingen, Germany, GUENTER AHLERS, Department of Physics, University of California Santa Barbara, USA — We present measurements of the azimuthal orientation $\theta_0(t)$ of the large-scale circulation (LSC) of turbulent Rayleight-Bénard convection. The sample was a cylinder with height and diameter equal to 1.12 m. We used compressed SF_6 gas at pressures up to 19 bars as the fluid. The measurements covered the Rayleigh-number range $10^{12} \leq Ra \leq 10^{14}$ at a Prandtl number $Pr \simeq 0.80$. We found that the preferred orientation of the LSC upflow was aligned to the West, consistent with Earth's Coriolis force. The LSC azimuthal dynamics was diffusive, driven by the small-scale turbulent fluctuations. For $Ra \leq 10^{13}$ the Reynolds number $Re^{\dot{\theta}}$ based on the azimuthal diffusivity had a Ra dependence similar to that seen for $10^9 \leq Ra \leq 10^{11}$ and $Pr = 4.38$. The Pr dependence $Re^{\dot{\theta}} \propto Pr^{\alpha}$ with $\alpha \simeq -1.2$ was the same as that found for the Reynolds number based on the root-mean-square fluctuation velocity in the interior bulk flow. For $Ra = Ra_1^* \simeq 2 \times 10^{13}$ $Re^{\dot{\theta}}$ showed the ultimate-state transition and for $Ra \geq Ra_2^* \simeq 8 \times 10^{13}$ it had a Ra dependence with an exponent of 0.40 ± 0.02.

[1]Supported by the Max Planck Society, the Volkswagenstiftung, the DFD Sonderforschungsbereich SFB963, and NSF Grant DMR11-58514.

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Date submitted: 30 Jul 2015 Electronic form version 1.4