Abstract Submitted
for the DFD10 Meeting of
The American Physical Society

Dependence of the Nusselt number on the Rayleigh number for Prandtl numbers near 0.7[1] JAMES HOGG, GUENTER AHLERS, Department of Physics, University of California, Santa Barbara — We report Nusselt-number measurements for a cylindrical Rayleigh-Bénard sample of height $L = 49.6$ cm and aspect ratio $\Gamma = 0.497$ that were made using three pure gases: helium (Prandtl number Pr=0.67), nitrogen (Pr=0.73), and argon (Pr=0.67-0.70) at pressures up to 47 bars. They cover the Rayleigh number range $9 \times 10^6 < Ra < 2 \times 10^{11}$. The uncorrected results are not well fit by the standard power law $Nu \propto Ra^{\gamma_{eff}}$ and the results for different gases disagree more than can be attributed to any expected Prandtl-number dependence. We find that a correction to the Nusselt number using a model for the non-linear temperature gradient in the side wall brings the results for different gases into agreement in their region of overlap. After the side-wall correction, the Nusselt number results are consistent with a power law, with $\gamma_{eff} \approx 0.32$ for relatively large Ra and $\gamma_{eff} \approx 0.27$ for relatively small Ra.

[1]Supported by NSF Grant DMR07-02111.

James Hogg
Department of Physics, University of California, Santa Barbara

Date submitted: 04 Aug 2010 Electronic form version 1.4