Abstract Submitted
for the DFD11 Meeting of
The American Physical Society

Plume Statistics in Turbulent Rayleigh-Bénard Convection[1]
JAMES HOGG, University of California, Santa Barbara, JOHANNES BOSBACH, DLR, Goettingen Germany, STEPHAN WEISS, GUENTER AHLERS, University of California, Santa Barbara — We report spatial statistics of thermal plumes based on an analysis of shadowgraph images for a cylindrical Rayleigh-Bénard sample of height $L = 9.5$ mm and aspect ratio $\Gamma = 10.6$. The fluids consisted of pure gases with Prandtl- numbers $Pr \approx 0.7$ and gas mixtures with $0.17 \leq Pr < 0.7$. The Rayleigh-number range was $3 \times 10^5 \leq Ra \leq 5 \times 10^6$. We found the plume-length probability-density functions to be well fit by lognormal distributions with fit parameters which revealed a sharp transition from patterns to turbulence. In the turbulent range the mean spacing between plumes was found to scale as $Ra^{-0.33}$, suggesting that the Kolmogorov length η_K is the relevant length scale, rather than the thermal boundary-layer thickness.

[1]Supported by NSF Grant DMR07-02111.

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Date submitted: 01 Aug 2011 Electronic form version 1.4