Abstract Submitted
for the DFD08 Meeting of
The American Physical Society

The Aerodynamics and Transport Phenomena of Canine Olfaction BRENT CRAVEN, GARY SETTLES, ERIC PATERSON, Penn State University — A high-fidelity computational fluid dynamics (CFD) model of the canine nasal airway, developed from a 3-D reconstruction of high-resolution magnetic resonance imaging (MRI) scans, is used to study the aerodynamics of canine olfaction. Simulation results reveal that a unique olfactory airflow pattern exists within the canine nasal cavity during sniffing that is critical for efficient olfaction. The physics of olfactory mass transport are next considered via a reduced-order numerical model of multi-phase odorant transport in mucus-lined olfactory airways. Calculations show that this novel olfactory airflow pattern provides a crucial residence time for odorant absorption in the sensory region and promotes spatiotemporal fractionation of odorant mixtures along the olfactory epithelium. Consequently, the aerodynamics and transport phenomena of canine olfaction are highly-optimized for odorant transfer and olfactory discrimination, which may largely explain the high olfactory acuity of the canine.

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Date submitted: 25 Jul 2008 Electronic form version 1.4