Abstract Submitted for the MAR09 Meeting of The American Physical Society

Structural Measurements from Images of Noble Gas Diffusion¹ ROBERT V. CADMAN, STEPHEN J. KADLECEK, KIARASH EMAMI, JOHN MACDUFFIE WOODBURN, VAHID VAHDAT, Department of Radiology, University of Pennsylvania, MASARU ISHII, Department of Otolaryngology, Johns Hopkins University, RAHIM R. RIZI, Department of Radiology, University of Pennsylvania — Magnetic resonance imaging of externally polarized noble gases such as ³He has been used for pulmonary imaging for more than a decade. Because gas diffusion is impeded by the alveoli, the diffusion coefficient of gas in the lung, measured on a time scale of milliseconds, is reduced compared to that of the same gas mixture in the absence of restrictions. When the alveolar walls decay, as in emphysema, diffusivity in the lung increases. In this paper, the relationship between diffusion measurements and the size of the restricting structures will be discussed. The simple case of diffusion in an impermeable cylinder, a structure similar to the upper respiratory airways in mammals, has been studied. A procedure will be presented by which airways of order 2 mm in diameter may be accurately measured; demonstration experiments with plastic tubes will also be presented. The additional developments needed before this technique becomes practical will be briefly discussed.

¹Supported by the U.S. NIH through grants P41-RR02305-22, R01-HL077241, and R01-HL064741.

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Date submitted: 20 Nov 2008 Electronic form version 1.4