Abstract Submitted
for the MAR10 Meeting of
The American Physical Society

Using Scale Invariance to Identify Universal Properties of Quantum Systems With Exceptionally Large Nonlinear-Optical Response[1]
MARK KUZYK, Dept. of Physics, Washington State University, Pullman, WA 99164-2814 — The invention of the laser led to the discovery of a broad range of nonlinear-optical phenomena,[1] which have applications in optical computing, high-speed telecommunications, photo-dynamic cancer therapies, optical data storage, 3D photolithography, etc. At the heart of these applications is the requirement of a large nonlinear susceptibility. Intense effort has therefore focused on understanding and optimizing the nonlinearity of organic molecules. Using fundamental limits of the nonlinear-optical response, the scale invariant intrinsic hyperpolarizabilities - which account for size/energy scaling - can be determined. Most molecules measured over three decades of research have remained a factor of 30 below the fundamental limit.[2] Using several theoretical techniques, we have identified the properties required of a quantum system for its response to be at the fundamental limit. Interestingly, while there are many quantum systems with a maximal intrinsic hyperpolarizability, they all share certain universal properties. I will discuss how this may lead to better materials and new physics. [1] www.NLOsource.com [2] M. G. Kuzyk, J. Mater. Chem. 19, 7444 (2009).

[1]NSF ECCS-0756936

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Date submitted: 19 Nov 2009 Electronic form version 1.4