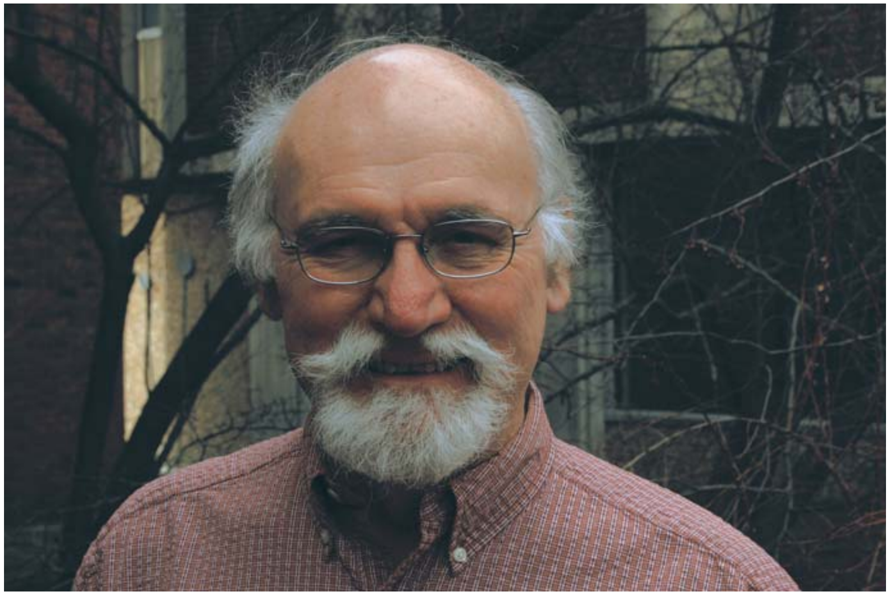
The Institute of OPTICS

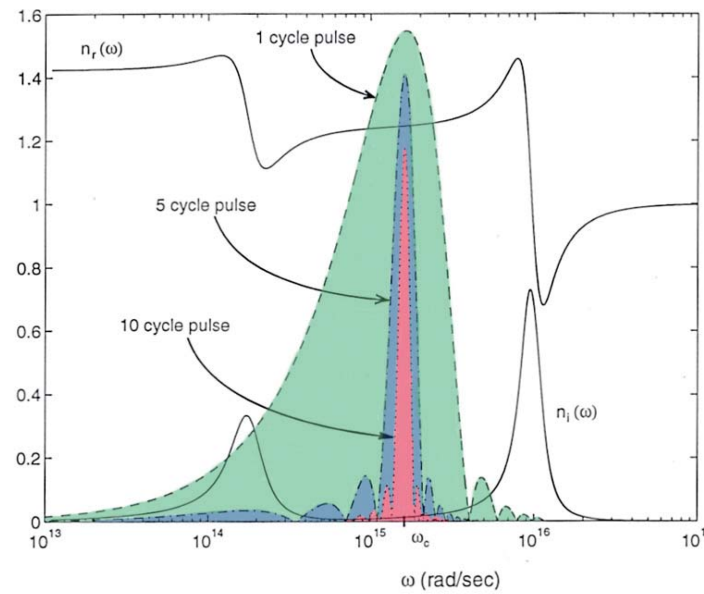
Colloquium

UNIVERSITY of ROCHESTER

Precursor Wave Fields:

The Characteristic Wave Structure of Dispersive Attenuative Media





Prof. Kurt Oughstun
University of Vermont

BA Physics and Mathematics, Central Connecticut University, 1972
MS 1974, PhD 1978 in Optics, U of Rochester

This talk we will decribe the propagation of a pulse through a linear, temporally dispersive medium with the resulting evolution of well developed precursor fields whose peak amplitude only decays algebraically (and not exponentially) in an absorptive medium.

3:00 pm, Monday, April 12, 2010
Sloan Auditorium, Goergen 101
Refreshments provided.

HAJIM
SCHOOL OF ENGINEERING
& APPLIED SCIENCES

Kurt Edmund Oughstun
Professor of Engineering & Mathematical Sciences
University of Vermont

Abstract: The dynamical evolution of a pulse as it propagates through a linear, temporally dispersive medium is a classical problem in both electromagnetics and optics. If the system was nondispersive, an arbitrary plane wave pulse would propagate unaltered in shape at the phase velocity. In a dispersive attenuative medium, however, the pulse is modified as it propagates due to two fundamentally interrelated effects: each spectral component of the initial pulse propagates through the dispersive system with its own phase velocity so that the phasal relationship between the various spectral components of the pulse changes with the propagation distance, and each spectral component is absorbed with increasing propagation distance at its own rate so that the relative amplitudes between the spectral components of the pulse also change with the propagation distance. These two simple effects result in a complicated change in the dynamical structure of a propagated ultrawideband pulsed wave field, manifesting themselves through the formation of well-defined precursor fields whose evolution is completely determined by the causally interrelated dispersive and absorptive properties of the medium. The precursor fields are readily distinguished in the dynamical pulse evolution as the range of their oscillation frequency is typically quite different from that of the input pulse and their attenuation is typically much less than that at the pulse carrier frequency. Therein lies their usefulness as precursor-type pulses can be designed whose peak amplitude only decays algebraically (and not exponentially) with propagation distance in a given dispersive absorptive medium, thereby surpassing the Beer-Lambert-Bouger law limit.

Biography: Received a B.A. Cum Laude in Physics and Mathematics from the Central Connecticut State University in 1972, an M.S. in Optical Engineering in 1972 and a PhD in Optics in 1978 from the University of Rochester. His dissertation was entitled *Propagation of Optical Pulses in Dispersive Media.* He is a a Fellow of the Optical Society of American, a Member of the United States National Committee of the International Union of Radio Science (URSI) Commission B, a Fellow of The Electromagnetics Academy, and a Member of the Applied Computational Electromagnetics Society. He has published three research monographs

K. E. Oughstun and G. C. Sherman, *Electromagnetic Pulse Propagation in Causal Dielectrics,* Springer Series on Wave Phenomena, vol. 16 (Springer-Verlag, Berlin-Heidelberg, 1994).

K. E. Oughstun, *Electromagnetic & Optical Pulse Propagation 1: Spectral Representations in Temporally Dispersive Media*, Springer Series in Optical Sciences (Springer, New York, 2006).

K. E. Oughstun, *Electromagnetic & Optical Pulse Propagation 2: Temporal Pulse Dynamics in Dispersive, Attenuative Media*, Springer Series in Optical Sciences (Springer, New York, 2009).