

Carey *et al.* Reply: Mochan and Brudny [1] have attempted to show, by using Green's function, that causality applies in the case of frustrated total internal reflection (FTIR) experiments. In our recent article describing experimental observation of superluminal pulse propagation in FTIR [2], we never argued that causality is violated although it may appear in the experiment that some features of the pulse cross the gap instantaneously or indeed backwards in time. Our article also clearly states that we believe it should be possible to prove theoretically that causality is not violated in FTIR. The arguments used by Mochan and Brudny [1] appear to be sensible and may very well be the basis for a more thorough analysis. However, they could only demonstrate the causal nature of propagation by using a screen that blocks out part of the beam. In that case, the electromagnetic field would no longer be a plane wave but would instead be divergent, and nonevanescent components would mix in with the evanescent components, changing the nature of the propagation problem and making their argument much less satisfactory. Perhaps the causal nature of FTIR can only be satisfactorily demonstrated by considering a signal entering a finite-sized prism

pair from one end and proving that the signal exiting from the opposite side is causally connected to it. Such proof should probably use information theory and consider a finite duration of the signal pulse [3] as well as a finite beam width and a finite angular distribution of wave vectors.

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- [1] W. L. Mochan and V. L. Brudny, preceding Comment, *Phys. Rev. Lett.* **87**, 119101 (2001).
- [2] J. J. Carey, J. Zawadzka, D. A. Jaroszynski, and K. Wynne, *Phys. Rev. Lett.* **84**, 1431 (2000).
- [3] K. Wynne, J. J. Carey, J. Zawadzka, and D. A. Jaroszynski, *Opt. Commun.* **176**, 429 (2000).