

Optical Precursors with Electromagnetically Induced Transparency in Cold Atoms

Dong Wei, J. F. Chen, M. M. T. Loy, G. K. L. Wong, and Shengwang Du*

Physical Review Letters **103**, 093602 (2009)



Editors' Suggestion

Predicted by Sommerfeld and Brillouin in 1914, the wave front of a step-modulated optical pulse propagating in a dispersive medium always travels at the light speed in vacuum c . This front, in the form of a transient wave now known as the optical precursors, is then followed by the main pulse traveling in its group velocity. For the first time, we successfully separate the optical precursor from the delayed main field using a square laser pulse passing through a dense laser-cooled atomic ensemble ($T = 0.0001$ K) with electromagnetically induced transparency (EIT). Our result also supports that the information velocity does not violate the Einstein Causality and may be different from the group velocity.

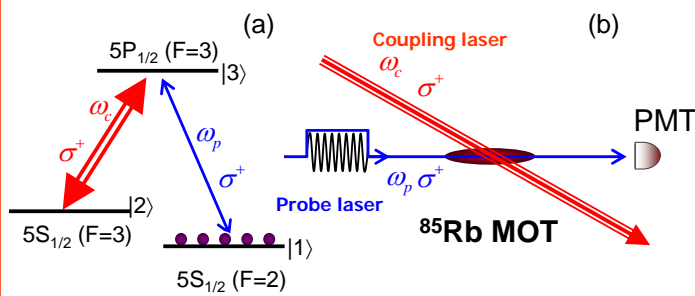


FIG. 1: (a) EIT level diagram and (b) experimental configuration

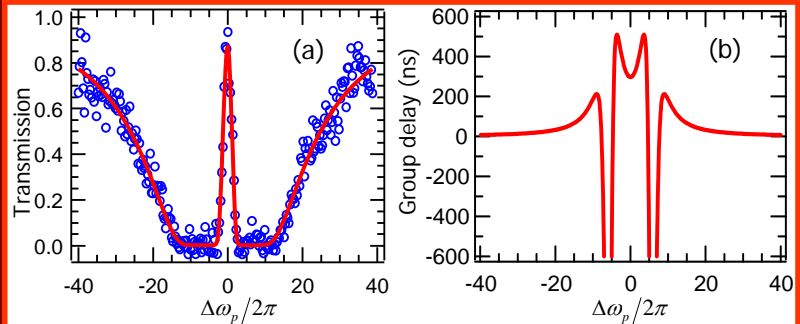


FIG. 2: Probe laser (a) EIT transmission profile and (b) group delay.

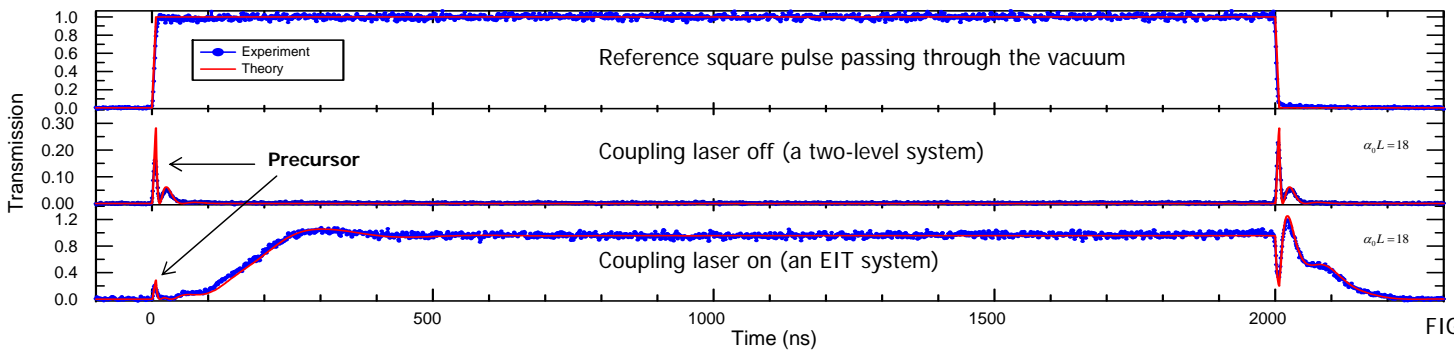


FIG. 3

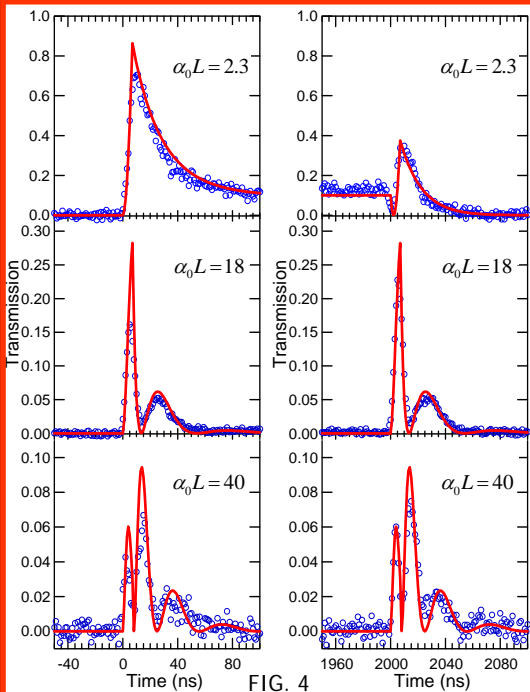
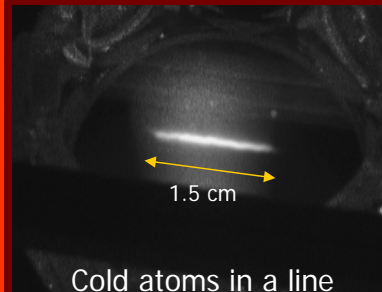


FIG. 4

Precursors at different optical depths ($\alpha_0 L$)

Two level system (coupling laser off)

EIT system (coupling laser on)



Cold atoms in a line ^{85}Rb 2D MOT

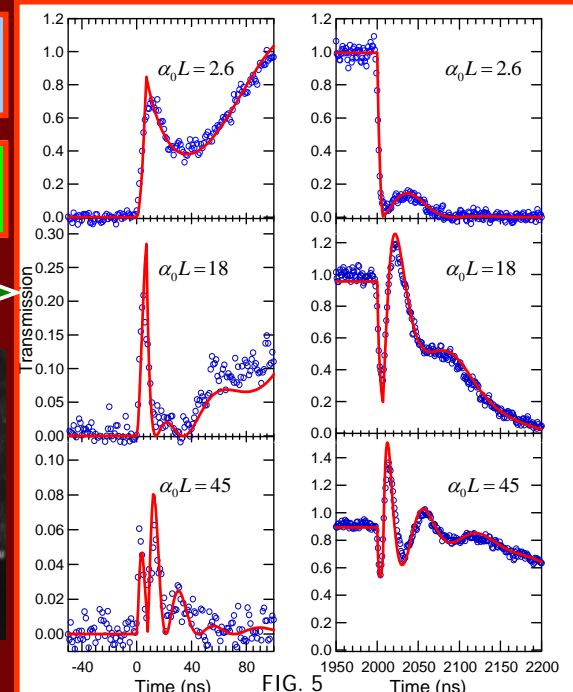


FIG. 5