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Optical precursors in a weakly dispersive double narrow-resonance dielectric[1] HEEJEONG JEONG, Department of Physics, Faculty of Science, University of Malaya, CHANG-WON LEE, School of Basic Science, Institute of Advanced Optics and Photonics, Hanbat National University, ANDREW M. C. DAWES, Physics Department, Pacific University, DANIEL J. GAUTHIER, Department of Physics, Ohio State University — We report the observation of optical precursors through double-resonance cold atoms (39K). We present how double-resonances affect the optical precursor patterns, especially for the case of weakly dispersive narrow resonance. The separation of double resonance associated with the excited state energy splitting causes fast modulation patterns at a constant period of 17 ns in addition to a tunable modulation due to the carrier frequency detuning that appeared in a single-resonance Lorentz dielectric. We obtain analytic expression showing the modulation at the excited state splitting of 39K D1 transition (58MHz), by assuming interference between optical precursors originated from each peak of the double resonance. The analytic expression agrees well with our experimental data. The fixed modulation pattern will reversely be used to probe a single- or double-resonance Lorentz dielectric. Most of the resonant optical precursor research has been performed for a single-resonance because of complex analysis in double-resonance. Our work can be extended to the multi-resonance optical precursor study for the application of optical communication or biomedical imaging requiring deep penetration through multi-resonance dielectric media.

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