**Nonlinear transient techniques for characterization of 1.5 μm optical transitions of the acetylene in hollow-core microstructured fibers**

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### Abstract (300 word limit)

Recent investigations have shown that the gas-filled hollow core photonic crystal fibers (HC-PCF) can be used for observation of several quantum coherent effects, such as the photon echo and the electromagnetically induced transparency (EIT), giving rise to important applications in the 1.5 μm wavelength region, at reasonable W-scale laser power level. Applications of such acetylene all-fiber cells, for example, have been demonstrated for laser wavelength stabilization and for self-reference optical phase demodulation. But this can also enable for very interesting applications in the area of quantum communications, information processing and even for development of quantum memories. In all these potential applications the optical transition coherence time (), is one of the main parameters that determine the efficiency of any quantum interaction. In the gas-filled HC-PCF, for example, is fundamentally limited by the transit-time broadening, i.e. by the time required for the molecule to travel across the beam mode area inside the fiber hollow core.

In this work, we present results of an experimental evaluation of the most important spectroscopic parameters of the acetylene molecule confined inside a HC-PCF, such as the longitudinal () and transverse () relaxation time, and the transition dipole moment (μ).To measure the above-mentioned parameters we basically utilized configurations of a two-pulse photon echo and conventional and delayed optical nutation. In the reported experiments the excitation laser wavelength was tuned to the strongest acetylene absorption line P9 at 1530.37 nm, and different sequences of 4-15 ns-width optical pulses with peak powers up to 6 W, were utilized. The gas pressure in the fiber hollow core of 10.3μm diameter was varied in the range of 0.05-0.4 Torr. Computational simulations of the light-matter interaction inside the gas-filled cell, based on the optical Bloch equations, also have allowed us to compare the experimental results with those expected theoretically.

**Recent Publications:**

1. Ocegueda, M., Stepanov, S., Casillas, N., & Hernández, E. (2018). Optical nutation in acetylene-filled hollow-core photonic crystal fiber. Journal of Applied Physics, 123(2), 023101.
2. Casillas, N., Stepanov, S., Ocegueda, M., & Hernández, E. (2017). Pulsed-induced electromagnetically induced transparency in the acetylene-filled hollow-core fibers. Applied Physics B, 123(6), 169.



Biography (150 word limit)

Manuel Ocegueda obtained his Ph.D in Optics in the Center of Scientific Research and Higher Education of Ensenada, Mexico. He is currently an assistant professor in the Physics department of the Autonomous University of Baja California. His work is mainly devoted to the study of the coherence light-matter interaction that takes place inside gas-filled hollow core photonic crystal fibers. Among the transient coherence effects that have already been reported in these gas cells by his research group are the two-pulse photon echo, the electromagnetically induced transparency, the free induction decay and the optical nutation.

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1. Shoemaker, R. L. (1978). Coherent transient infrared spectroscopy. In *Laser and Coherence spectroscopy* (pp. 197-371). Springer, Boston, MA.
2. Sprague, M. R., Michelberger, P. S., Champion, T. F. M., England, D. G., Nunn, J., Jin, X. M., ... & Walmsley, I. A. (2014). Broadband single-photon-level memory in a hollow-core photonic crystal fibre. *Nature Photonics*, *8*(4), 287.