Tutorial Proposal – I2MTC 2014

Tutorial title: **Alkali atoms at the heart of photonic devices**

Proposed by/main speaker: **Dr. Horacio Failache**
Instituto de Física, Facultad de Ingeniería, UdelaR
e-mail: heraclio@fing.edu.uy
CV link:
http://www.sni.org.uy/buscador_sni/exportador/ExportarPdf?hash=62d33369f2912c12dbc5c545412c344b

Abstract:

Resonances of atoms or molecules in low density vapors are extremely narrow compared with resonances of solid state media, as atoms in vapors can be considered isolated and then dissipation channels very weak. Unfortunately dilute vapors usually contained in glass cell are not well adapted to be miniaturized and integrated in electronic or photonic devices. However dilute vapors of alkali atoms are used today at the heart of several devices like miniaturized atomic clocks [1], optical frequency references [2], magnetometers [3], etc., but miniaturize and integrate in these devices the cell containing the dilute atomic vapor is still a difficult task.

At micrometric cells the resonances widths are essentially limited by the atom-light interaction time, as the atom-wall collisions are inelastic. A usual solution to this problem is to use a high pressure of a buffer gas to induce a diffusive movement for the alkali atoms that longer the observation times or to use a polymer coating on the cell walls in order to have an almost perfect elastic atom-wall collisions. After a review of the latest advances in the subject it will be considered our research on dilute alkali vapor confined at the micrometric scale.

It will be considered the spectroscopy of rubidium atoms confined to micrometric thin cells that allows to miniaturize the cell with a small penalty on the quality factor of atomic resonances [4]. Thin cells were combined with a novel spectroscopy using multiple laser light beams that allows system miniaturization and enhance performance [5].

The recent development of an atomic magnetometer to the measurement of the ambient magnetic field will be discussed. Atomic magnetometers are based in the Zeeman effect intrinsically dependent on the magnetic field modulus. A new magnetometer configuration also based on the Zeeman effect but that allows to measure the magnetic field vector will be presented [6].

The latest advances on the spectroscopy of alkali atoms in porous materials, where the dilute atomic vapor fill the micrometric interstices of a random porous glass [7] will be considered. The remarkable property of these new spectroscopy cells recently developed by us is that they mechanically behaves like a solid state amorphous material but presenting narrow atomic resonances like those of dilute atomic vapors.

[1] R. Lutwak et al., in 2007 International Frequency Control Symposium, pp. 1327–1333, (IEEE 2007); S. Knappe et al., Opt. Lett. **30**, 2351 (2005).
[2] S. Knappe et al. Opt. Express **15**, 6294 (2007); W. et al. Nature Photonics **1**, 331 (2007).
[3] P. D. D. Schwindt et al. Appl. Phys. Lett. **85**, 6409 (2004).
[4] H. Failache at al. Phys. Rev. A76, 053826 (2007); L. Lenci et al. Optics Letters **34**(4), 425-427 (2009).
[5] H. Failache at al. Phys. Rev. A **81**, 023801 (2010).
[6] L. Lenci et al. J. Phys. B: At. Mol. Opt. Phys. **45**, 215401 (2012); L. Lenci et al. To be published.
[7] S. Villalba et al. Opt. Lett. **38**, 193 (2013); S. Villalba et al. To be published.

(I have never organized a tutorial on the same or similar topic in a previous I^{2}MTC)