

# Dispersive optical nonlinearities in a Rydberg electromagnetically-induced-transparency medium

Tue, 2014-06-03 15:16 - [Michel Brune](#) [1] **Date:** 2013-11-26

**Author(s):**

Jovica Stanojevic, Valentina Parigi, Erwan Bimbard, Alexei Ourjoumtsev, and Philippe Grangier

**Reference:**

J. Stanojevic, V. Parigi, E. Bimbard, A. Ourjoumtsev, P. Grangier, Dispersive optical nonlinearities in a Rydberg electromagnetically-induced-transparency medium, PHYSICAL REVIEW A 88:5, 053845 (2013)

DOI: 10.1103/PhysRevA.88.053845

**URL:**

<http://journals.aps.org/prabstract/10.1103/PhysRevA.88.053845> [2]

We investigate dispersive optical nonlinearities that arise from a Rydberg excitation blockade in cold Rydberg gases. We consider a two-photon transition scheme and study the nonlinear response to a weak optical probe in the presence of a strong control beam. For very low probe fields, the dominant nonlinearities are of the third order and they can be evaluated in a steady-state regime. In a more general case, the change in average atomic populations and coherences due to Rydberg interactions can be characterized by properly defined scaling parameters, which are generally complex numbers but in certain situations take the usual meaning of the number of atoms in a blockade sphere. They can be used in a simple “universal scaling” formula to determine the dispersive optical nonlinearity of the medium. We also develop a technique to account for the Rydberg interaction effects, by simplifying the treatment of nonlocal interaction terms, the so-called collisional integrals. We find algebraic relations that only involve two-body correlations, which can be solved numerically. All average populations and coherences are then obtained straightforwardly.

- [QIPC](#) [3]
- [FP7](#) [4]
- [SIQS](#) [5]
- [15. IMPLEMENTATIONS: QUANTUM OPTICS](#) [6]

**Source URL:**

<http://qurope.eu/db/publications/dispersive-optical-nonlinearities-rydberg-electromagnetically-induced-transparency-m>

**Links:**

[1] <http://qurope.eu/users/brune>

[2] <http://journals.aps.org/prabstract/10.1103/PhysRevA.88.053845>

[3] <http://qurope.eu/category/qipc/qipc>

[4] <http://qurope.eu/category/european-commission/fp7>

[5] <http://qurope.eu/category/projects/ips/siqs>

[6] <http://qurope.eu/category/qics/10-quantum-computation/15-implementations-quantum-optics>