

Measuring entangled two photon absorption cross sections and controlling the frequency correlations of paired photons for spectroscopic applications.

Matthieu Pellaton, Juan Pablo Villabona-Monsalve, John Fredy Suarez,
Alejandra Valencia, Mayerlin Nunez-Portela

Laboratorio de Óptica Cuántica, Universidad de los Andes, A.A. 4976, Bogotá D.C., Colombia

Intermediate state spectroscopy using correlated photons is a technique that aims at obtaining spectroscopic information about the intermediate states of a dipole forbidden transition. In contrast to standard laser spectroscopy techniques, intermediate state spectroscopy with entangled photons allows to retrieve information of the atomic system without changing the wavelength of the light source and using a broadband source of photons. The information of the intermediate states is relevant not only as an interesting spectroscopic tool, but also to selectively excite specific energy levels in an atom or a molecule opening possibilities for the next generation of chemical and biological technologies.

The information of the intermediate states can be access by measuring the entangled two photon absorption (ETPA) cross section [1], when a time delay is introduced between the two photons that are send to the sample and performing a two-dimensional Fourier analysis of it [2]. It has been theoretically demonstrated that the possibility to obtain information of intermediate states depends on the entanglement time [3, 4] and spectral shape of the frequency correlations of the absorbed photons [5] that governs the ETPA process.

In this work we present our progress towards such intermediate state spectroscopy using entangled light. We focus on measuring the ETPA cross sections and on shaping the frequency correlations of entangled photons produced by Spontaneous Parametric Down Conversion (SPDC). We will report on measurements of ETPA cross sections for different molecules at low photon fluxes presenting excellent signal to noise ratio thanks to a coincidence detection scheme[6]. Additionally we present measurements of different frequency correlations for type I and type II SPDC sources.

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