Contribution ID: **18** Type: **not specified**

Separable Schmidt modes of a non-separable state

Tuesday, 29 April 2014 16:20 (30 minutes)

A. Avella 1 M. Gramegna 1 A. Shurupov 1 G. Brida 1 M. Chekhova 3, 4 and M. Genovese 1

1) INRIM, Strada delle Cacce 91, Torino 10135, Italy
2) Max-Planck Institute for the Science of Light, G.-Scharowsky Str 1/Bldg 24, 91058, Erlangen, Germany
3) M. V. Lomonosov Moscow State University, 119992 GSP-2, Moscow, Russia

The development of quantum information protocols is one of the most promising applications of the intrinsic properties of quantum mechanics such as quantum superposition and entanglement [1,2].
Two-photon states entangled in continuous variables such as wavevector or frequency represent a powerful resource for quantum information protocols in higher-dimensional Hilbert spaces [3,4,5,6]. At the same time, there is a problem of addressing separately the corresponding Schmidt modes. For wavevector variables, a single Schmidt mode can be filtered out with the help of a single-mode fibre [7], but no similar procedure exists for the frequencies. This filtering, in principle, can be lossless, which is crucial for experiments with twin-beam squeezing [8–14]. Here we propose a method of engineering two-photon spectral amplitude in such a way that it contains several non-overlapping Schmidt modes, each of which can be filtered losslessly. The method is based on using a pump with a comb-like spectrum, which can be obtained, in particular, by passing a laser beam through a Fabry-Perot interferometer. For the two-photon amplitude to consist of non-overlapping Schmidt modes, the crystal dispersion dependence, the length of the crystal and the width of a single Fabry-Perot transmission peak should satisfy a certain condition. We experimentally demonstrate the control of Schmidt modes structure through these parameters.

1) T. D. Ladd et al., Nature, vol. 464, pp. 45–53, (2010).
2) N. Gisin and R. Thew Nature Photon., vol. 1, pp. 165
3) C. K. Law, I. A. Walmsley, and J. H. Eberly, Phys. Rev. Lett. 84, 5304 (2000).
4) I. Ruo-Berchera, Advanced Science Letters 2, 407-429 (2009).
5) M. V. Fedorov et al., Phys. Rev. Lett. 99, 063901 (2007).
6) G. Brida et al., EPL 87, 64003 (2009).
7) S. S. Straupe et al., Phys. Rev. A 83, 060302(R) (2011).
8) G. Brida et al., Phys. Rev. Lett. 102, 213602 (2009);
9) E.Lopaeva et al., Phys. Rev. Lett. 110, 153603 (2013).
10) G. Brida, M. Genovese, I. Ruo Berchera, Nature Photonics 4 , 227 (2010).
11) M. Bondani et al., Phys. Rev. A 76, 013833 (2007).
12) J. Blanchet et al., Phys Rev. Lett. 101, 233604 (2008).
13) O. Jedrkievicz et al., Phys. Rev. Lett. 93, 243601 (2004).
14) I. N. Agafonov, M. V. Chekhova, and G. Leuchs, Phys. Rev. A 82, 011801(R) (2010).

Presenter: Dr AVELLA, Alessio (Istituto Nazionale di Ricerca Metrologica)