Entanglement Lab Instructor Manual

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1 Introduction

2 Set-up

Placing the collimators in the proper place is the most difficult part of the lab set-up. Proper coupling with the emitted cone requires correct placement down to the order of millimeters. One way

With all optics in place, there are two degrees of freedom that must be tuned to

3 Theoretical Background

3.1 Non-linear optics

Linear optics

$$P(t) = \epsilon_0 \chi E(t)$$

Nonlinear optics

$$P(t) = \epsilon_0 \left[\chi^{(1)} E(t) + \chi^{(2)} E(t)^2 + \chi^{(3)} E(t)^3\right] \qquad \chi^{(n)} \equiv n\text{-th order susc.}$$

$E(t) = E_0 e^{i\omega t} + \text{c.c.}$ Second harmonic generation from a scalar

$$P^{(2)}(t) = \epsilon_0 \chi^{(2)} E(t)^2 = \epsilon_0 \chi^{(2)} E_0 e^{2i\omega t} + \epsilon_0 \chi^{(2)} E_0^* e^{-2i\omega t} + 2\epsilon_0 \chi^{(2)} E_0 E_0^*$$

parametric - quantum mechanical state of crystal is same before and after

Bibliography

[1] Dietrich Dehlinger and M. W. Mitchell. "Entangled photons, nonlocality, and Bell inequalities in the undergraduate laboratory". In: *American Journal of Physics* 70.9 (Aug. 2002), pp. 903–910. ISSN: 1943-2909. DOI: 10.1119/1.1498860. URL: http://dx.doi.org/10.1119/1.1498860.