In this work, we report the experimental control of the spatial correlations of paired photons and exploit this capability to study the effects of different spatial correlations on lensless ghost imaging [1, 2]. Experimentally, we control the spatial correlations of pairs produced by spontaneous parametric down conversion (SPDC) by using the waist of the pump beam as a tuning parameter [3, 4]. The effects of different types of spatial correlations on two-photon imaging experiments have been reported theoretically [5, 6]. We take advantage of the experimental capability we have, to control the spatial correlations in a unique setup to corroborate the theoretical prediction [7].

**Far-Field Ghost Imaging**

The propagation of the MF of Biphoton-State

\[
\Phi_{\psi}(\rho_A, \rho_B) = \int d^2q_A \int d^2q_B \times G_s(q_A, \rho_A, z_A)G_q(q_B, \rho_B, z_B)\Phi_{\psi}(q_1, q_2),
\]

where \( G_s(q_A, \rho_A, z_A) \) with \( \mu \in \{s, i\} \) are the Green's function. For each arm the Green's Functions become:

\[
G_s(q_A, \rho_A) = G(q_A, \rho_A, 2f)
\]

\[
G_i(q_B, \rho_B, 2f) \times T(\rho_B),
\]

In the Fourier Plane, the mode function is

\[
\Phi_{\psi}(\rho_A, \rho_B) = C^3 T(\rho_B)\Phi_{\psi}(\frac{2\pi}{\lambda f} \rho_A, \frac{2\pi}{\lambda f} \rho_B).
\]

Finally the coincidence rate become

\[
gT_{\psi}(\rho_A) \propto \int d^2 \rho_B T(\rho_B)\Phi_{\psi}(\frac{2\pi}{\lambda f} \rho_A, \frac{2\pi}{\lambda f} \rho_B)\]

As a quantity for the degree of spatial correlation, we used the Pearson correlation coefficient.

\[
\rho^2 = \frac{C_{ij}^2}{\sqrt{C_{ii}^2 C_{jj}^2}}
\]

**Experimental Results**

- Spatial Correlations
  - \( W_p = 120\mu m \)
  - \( W_p = 740\mu m \)

**Conclusions**

- We control the spatial correlations of pairs of photons, generated via SPDC, by modifying the spatial properties of the pump beam.
- We control the resolution of ghost imaging by tuning the spatial correlations.
- We observe the relation between the spatial correlations with the resolution and orientation of the ghost images.

**Bibliography**