Towards a relationship between single photon nature and randomness

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For discrete variable optical QRNG [1], the randomness of the QRNG directly relates to the quality of single photon property. Here, we investigate a relationship between quantifying parameter for single photon nature of SPDC process ($b=1-g^{(2)}(0)$) and quantifying parameter for randomness, min-entropy ($H_{\text{min}}(X)$). This investigation is done on three independent grounds, namely, time delay ($\tau$), power and orbital angular momentum (OAM) of photons.

**References:**


**Introduction**

We conjecture a relationship between quality of single photon nature ($b$) and quality of randomness ($H_{\text{min}}(X)$), $X$ can take both bit and block length values. This is done by experimentally observing a relationship between $b$ and $H_{\text{min}}(X)$ on different parameters discussed above. The diagram on the left encapsulates the broader picture.

**Conclusion:**

Variation of $b$ with time delay shows decrease in the quality of single photon nature because of multi-photon events from the SPDC process. These multi-photon events also debase the quality of randomness ($H_{\text{min}}(X)$). However, within the range shown (0 to 10 mW), it is evident that quality of randomness ($H_{\text{min}}(X)$) is almost insensitive towards quality of single photon nature.

Variation of $b$ with power shows decrease in the quality of single photon nature because of multi-photon events from the SPDC process. These multi-photon events also debase the quality of randomness ($H_{\text{min}}(X)$). However, within the range shown (0 to 10 mW), it is evident that quality of randomness ($H_{\text{min}}(X)$) is almost insensitive towards quality of single photon nature.

Variation of $b$ with OAM should not degrade randomness. This was observed at low power (1mW). However, with higher power (10 mW), one can see decrease in $b$ and correspondingly a decrease in $H_{\text{min}}(X)$ value. This decrease is associated to multi-photon events that almost go to zero at low power (1 mW).