Stimulated Parametric Down-Conversion with Partially Coherent Light

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Parametric down-conversion is a nonlinear process where photons from a pump laser are converted into pairs of photons having lower energy. In the spontaneous emission regime, the down-converted photons are quantum correlated and have found a number of applications in Quantum Information science and technology. This process can be stimulated by a seed beam, and as a result, the intensity of the down-converted beams is highly increased (StimPDC). On the one hand, in this regime, the quantum correlations cannot be observed anymore. On the other hand, the interacting optical modes are still subjected to the phase matching conditions and, therefore, can be used to perform quantum state tomography indirectly. This characteristic makes the StimPDC a platform for designing quantum optical systems based on parametric down-conversion. Here, we present an experimental study of StimPDC where a partially coherent beam is used as the seed. We prepare twisted Gaussian Schell model beams (TGSM) and use them to seed the StimPDC process. These beams are partially coherent beams that may possess an average orbital angular momentum, and due to their unique properties, they have found applications in communication schemes affected by turbulent transmission channels. Our results demonstrate that the idler beam, which is indirectly stimulated in StimPDC, is also turned into a TGSM beam. They also show that even in this regime of partial coherence, the idler beam is the phase conjugated copy of the seed beam.