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Direct Characterization of Einstein-Podolsky-Rosen Energy-Time Entangled Narrowband Biphotons YEFENG MEI, Hong Kong University of Science and Technology, YIRU ZHOU, SHANCHAO ZHANG, JIANFENG LI, KAIYU LIAO, HUI YAN, South China Normal University, SHI-LIANG ZHU, Nanjing University, SHENGWANG DU, Hong Kong University of Science and Technology — The Einstein-Podolsky-Rosen (EPR) energy-time entangled photons (biphotons) are of great interest for long-distance quantum communication and quantum network. Direct characterization of EPR energy-time entanglement requires joint correlation measurements in both time and frequency domains and remains a challenge. In this work, we produce narrowband (1.8 MHz) biphotons from spontaneous four-wave mixing in cold 85Rb atoms. The temporal correlation and uncertainties are measured by commercial single-photon counting modules. We map the biphoton joint spectrum and energy uncertainties using a narrow linewidth (72 kHz) optical cavity. We obtain the joint frequency-time uncertainty product as low as 0.063+/-0.0044, which not only violates the separability criterion but also satisfies the continuous variable EPR steering inequality. Our result of joint frequency-time uncertainty product is significantly smaller than the previously reported values and pushes its lower bound a step closer to zero. The work was supported by the Hong Kong Research Grants Council (Project No. 16304817), and the William Mong Institute of Nano Science and Technology (Project No. WMINST19SC05).

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