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Time-stamping photons with sub-nanosecond precision for quantum-enhanced imaging and telescopy

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Correlations of photons from entangled quantum sources offer advantages and provide additional opportunities such as low light imaging or new sensing approaches. In general, strong spectro-temporal correlations inherent for entangled photons make those sensing techniques much more precise and resource efficient. To take advantage of the correlations one would need efficient single photon imagers with excellent timing resolution. In the presentation I will review the existing detector options focussing on the time-stamping CMOS and SPAD cameras, which have been used recently in a variety of quantum imaging experiments, in particular the cameras with data-driven readouts. As a motivation for fast imaging in astrophysics I will also review the standard techniques of single-photon amplitude (Michelson) interferometry and two-photon (Hanbury Brown & Twiss) intensity interferometry, and then visit recent ideas for how they can be improved in the optical through the use of entanglement distribution. A proposed new technique of two-photon amplitude interferometry requires precise spectral binning and 10 picosecond scale time-stamping of single optical photons with a product of resolutions close to the Heisenberg Uncertainty Principle limit. In all cases I will illustrate the concepts with recent results and will discuss future directions for the technology.

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