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Quantum Imaging and Metrology

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Use Entanglement To Improve Measurement Techniques

- Spontaneous Parametric Down-Conversion (SPDC) of light produces photons with special properties
 - Near simultaneity of 2 photons
 - Energy conservation $\omega_{\text{pump}} = \omega_{\text{signal}} + \omega_{\text{idler}}$
 - Phase matching $\mathbf{k}_{\text{pump}} = \mathbf{k}_{\text{signal}} + \mathbf{k}_{\text{idler}}$
 - Entanglement
- Knowledge of one photon gives information about the other





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Demonstrated Applications

- Absolute measurements without standards
 - Detector quantum efficiency e.g. NIST has found significant QE variations across face of APDs
 - Source radiance
 - Ellipsometry
- Image amplification (detection sensitivity below that of coherent light)
- Enhanced spatial resolution
- Cryptographic ranging
- Holography and tomography



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JEN's Proposed Applications

- Quantum imaging to beat the atmospheric coherence length
- Measurements of satellite distances
 - Possible applications to clock synchronization
 - Enhanced gravity and relativity tests
- Guide-star-free adaptive optics

