# Quantum Imaging: New Methods and Applications

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## Objective

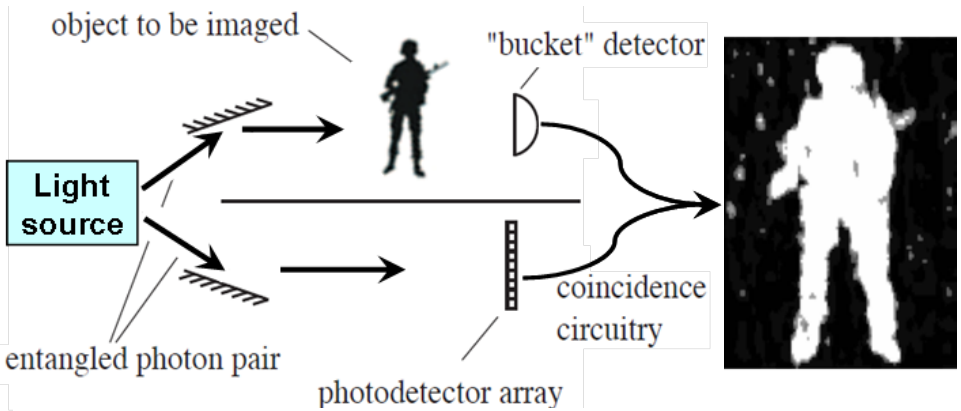
- Explore advantages of quantum optics (e.g., using "entangled" photons) that may lead to new capabilities
  - Ghost imaging, thermal and quantum
  - Quantum lithography
  - Quantum laser radar
  - Quantum optical coherence tomography
  - Quantum image encoding

## Approach

- Investigate potential applications in:
  - Ghost imaging—detecting objects using photons that never contacted the object
  - Single-photon image discrimination—transmitting data using just one photon
  - Aberration correction—using entangled photons to eliminate some limitations associated with conventional imaging

## Technical Successes

- Imaged an object using reflected light (light that never "touched" the object), producing a "ghost image"
- Demonstrated ability to discriminate between two objects when illuminated by only a single photon




Using photon correlations, an image of an object (a "ghost image") was produced using photons that never directly interacted with the object

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## Potential Scientific Impact

- Ghost imaging can advance sensor technology, allowing an object to be imaged with photons that never interacted with that object, enabling imaging even if fog or smoke obscured normal observation
- Development of single-photon image discrimination could be used for covert transmission of essentially an entire image using just one photon
- Application of aberration correction using entangled photons could form images with higher resolution or higher sensitivity than conventional optical imaging

## Potential Payoff for the Army

- Imaging, reconnaissance, and surveillance are key DoD applications
  - Increased capabilities afforded by quantum imaging could significantly enhance performance and enable new or stealthy approaches
- MURI team is actively engaged with the Army despite the truly basic nature of the research
  - CISD is actively participating with the MURI team performing novel experiments and publishing ground breaking work
  - SEDD and AMRDEC are participating through theoretical work complementary to the MURI