

Title : Study of scientific Complementary Metal–Oxide–Semiconductor (sCMOS) camera and few photons imaging

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ABSTRACT

Imaging phenomena involving a few photons imaging require cameras with high sensitivity and low noise. One example for this task is imaging of photons emitted from the single atom traps in quantum atom research. This is crucial in control and manipulation of atoms in the atom quantum computer and simulator system. The Scientific Complementary Metal–Oxide–Semiconductor (sCMOS) camera is technology in scientific images, offering a wide dynamic range and high frame rate. sCMOS cameras are suitable for capturing phenomena with low photon counts. The aims are to study the properties and working principles of the sCMOS camera and to develop techniques for few-photon imaging with low-noise. In the experiment, the Sona 4.2B-6 sCMOS camera model is used to investigate low-photon imaging. The 780 nm diode laser is utilized along with series of polarizing variable attenuators to reduce the laser intensity to achieve low photon counts. The Andor Solis software is used to capture photons signal images obtained with the Sona 4.2B-6 sCMOS camera model and analyze with Fast Fourier Transform (FFT) technique to eliminate noise from image. In conclusion, the parameters of the experiment that

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affects the generation of a few photons is the input of laser power before the attenuator system. The optimal input power for generating a low photon signal was determined to be approximately 30 microwatts and attenuator factor of $4.1235E-10$ producing around 20 photons at the camera with exposure time of 20 milliseconds. In the image processing, a FFT technique can be used for noise reduction, whereas the processed image can also loss some detail due to filtering process with filters.

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