A Compact, Low voltage Electron Bombarded Array

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Low light level imaging applications will depend on detectors with high quantum efficiency (QE), high dynamic range, and stable response. In addition detectors often need to be compact, low power, and robust. Electron-bombarded arrays including electron-bombarded CCDs (EBCCDs) benefit from the mature and high quality silicon imaging technology, and they can provide high efficiency and photon counting capabilities. Of the photoemissive devices, EBCCDs have been reported to have the highest QE. However, their drawback is in the bulky design, use of a magnet to bend electrons, and high voltage requirements. The NASA vision of smaller, lower cost, and more frequent missions mandates the miniaturization of instruments. The compactness and improvement of devices can be a mission-enabling factor. Other fields of observation can also greatly benefit from a compact image intensifier.

A new electron-bombarded CCD (EBCCD) design will be discussed. Key elements of this design are its low-voltage (<1 keV) and proximity-focus mode of operation which does not require a bending magnet. The new design permits a lighter instrument that does not require high voltage supplies. We use a thinned, delta-doped silicon array for detecting low-energy electrons in a compact, magnet-free configuration with a semitransparent cathode. For preliminary measurements Cesium-Iodide photocathodes were paired with the electron detector array. We will present the configuration, spectral discrimination, and sensitivity of our electron bombarded imaging array and we will discuss alternate photocathode approaches that require no cesiation.

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Figures

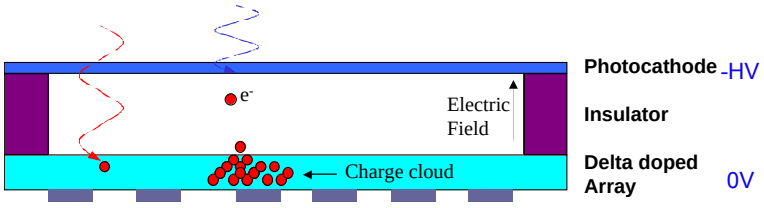

Figure 1. Schematic diagram of a proximity focused low voltage (~1 keV) electron bombarded CCD or CMOS array. The low voltage operation is enabled by direct detection of low energy electrons with a delta-doped array.

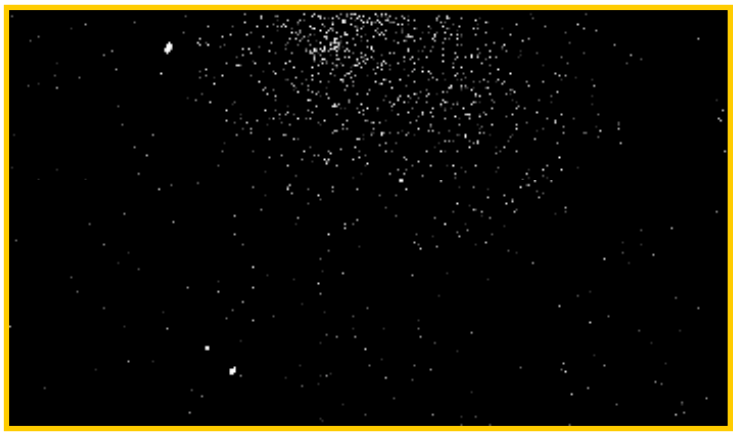

Figure 2. Discrimination against out of band events showing individual UV events.

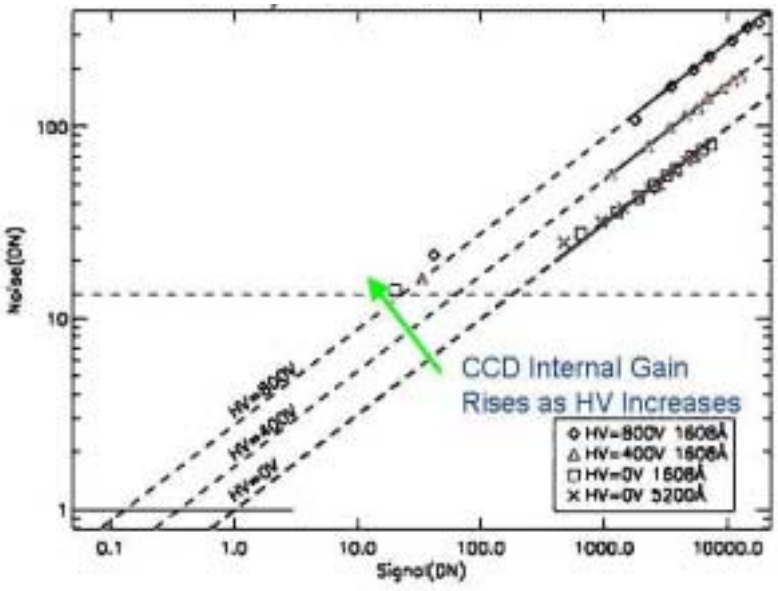

Figure 3 Measured gain as a function of acceleration voltage using photon transfer technique.