# Photon Counting vs Photon Integration at SubMM Waves

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Future needs of submillimeter wave astronomy include ultrasensitive detector arrays capable of achieving a noise equivalent power (NEP) ~ $10^{-20}$ W/Hz$^{1/2}$ at 0.1 K. Bolometric detectors using superconducting transition-edge sensors are considered as the most promising technology. An alternative way to achieve an equivalent sensitivity is to use photon-counting devices. The photon counting in the submillimeter wave range has been recently demonstrated by Astafiev et al. using quantum dots. Other proposals include various superconducting structures potentially capable of registering single quantum events. Besides achieving an unparallel sensitivity, both technologies will face a great challenge of maintaining a sufficiently large dynamic range limited by the cosmic background and the instrument bandwidth. The maximum optical loading for a bolometer directly decreases with the sensitivity ($P_{opt.} \sim NEP^2$). For the photon counters, handling high level of background radiation translates into high counting rate that can be engineered in some types of the devices. The readout electronics for an N-element array of counters should be, however, at least N times faster in order to detect individual photons from each element. Since the intensity of the cosmic background varies strongly over the submillimeter wave range, the trade-off between the sensitivity and the dynamic range will depend on the wavelength.

We will present an analysis of the potential performance of promising photon integrating and photon counting devices for subMM wave background limited narrowband applications. The emphasis will be made on a comparison of the hot-electron superconducting direct detectors and photon counters with other technologies.

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