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Characterization of Single-Photon Avalanche Diodes for Time-Resolved Single-Molecule Spectroscopy JASON KING, GUOQING SHEN, LLOYD DAVIS, University of Tennessee Space Institute — Experiments in single-molecule spectroscopy often use single-photon avalanche diodes that provide high quantum efficiency (>60%) for detection of red fluorescence. However, current-model photon detector modules exhibit a count-rate dependent shift in the photon timing and a broadened single-photon timing distribution. Because the fluorescence photon emission rates in single-molecule experiments can rapidly shift from 10 to 10^6 photons/second, these timing errors can significantly deteriorate single-molecule measurements that are dependent on use of pulsed lasers and accurate photon timing. As the problem stems largely from the current design of active quenching circuits, new circuits and modified photon detector modules are under development to counteract this issue and minimize shifts, all while maintaining the required high quantum efficiency. Here, we describe an apparatus developed in our lab for testing and comparing several of these detectors over a wide range of count rates, and we report on ongoing measurements in order to better understand their timing characteristics.

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