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The Properties of Cryogenic CMOS Avalanche Photodiodes ERIK JOHNSON, Radiation Monitoring Devices, RORY MISKIMEN, University of Massachusetts, CHRISTOPHER STAPELS, XIAO JIE CHEN, JAMES CHRISTIAN, Radiation Monitoring Devices — Physics experiments may require extreme conditions, such as temperatures down to a few Kelvin and high magnetic fields of several Tesla. Though PMTs are a standard for reading out scintillation materials, they are highly susceptible to magnetic fields and are large heat load in cryogenic environments. Avalanche photodiodes (APD) are a reasonable alternative to phototubes in that they are compact and less susceptible to magnetic fields but have smaller gains and slightly larger noise terms. Solid-state photomultipliers (SSPM) have the advantages of APDs but provide gains similar to a PMT. The SSPM operation below 70 K is limited by the noise terms associated with after pulsing, even though the quantum efficiency down to 5 K is reasonable ($\sim$45% at 500 nm). Based on similar diode structures used in SSPMs, a set of APDs has been developed for operation at temperatures below 50 K, and we present the overall operation of the diodes at 5 K for the HIFROST target at the HIγS facility at TUNL. The diodes show a slight decrease in quantum efficiency at 5 K with respect to 300 K and with a wavelength dependence. Though gains of 100 can be achieved, the prototype diode shows a proportional response to the intensity of light pulses down to 150 detected photons with a gain around 20.

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