

# Single-photon detector array for simultaneous label-free Raman and fluorescence lifetime spectroscopy (Digi- $\gamma$ -Det)

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**RADESS**

Raman spectroscopy and fluorescence lifetime spectroscopy are commonly used methods to resolve the chemical content of a material. Due to their different origin, combining fluorescence lifetime and Raman spectra offers more powerful method for material analysis than either of them alone. The objective of Digi- $\gamma$ -Det is for the first time to implement and validate a single-photon avalanche detector (SPAD) system capable of resolving high quality fluorescence lifetime and Raman spectra simultaneously from biological samples having high fluorescence level and short lifetimes (ns). For example, label free Raman and fluorescence signals allow the detection of the small molecule drug synthesis during the drug processing and thus solving critical safety issues of the novel pharmacological products. Additionally, the proposed combination of the Raman and fluorescence spectra provides high analytical power without labels opening new era in the field of the biomedical applications. The aimed implementation is based on a pulsed laser (100 ps), a SPAD array and accurate time-to-digital converters which collect each photon individually and determine their time-of-arrival simultaneously for all spectral points. The Raman and fluorescence photons are separated by post-processing the data. Besides the novel electronic implementation the spectrometer performance is further elaborated by introducing multiple fiber-optic probes to facilitate measurements from several physically separated locations.