Leica HyD for Confocal:  
An integrated hybrid detector concept for high sensitivity imaging and photon counting

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Biology’s transformation towards quantitative measurements is progressing. Today’s demands in biomedical research often go beyond documentation or phenomenological descriptions. The goal is to unravel functional interaction networks in biochemistry and cell biology. Single photon counting represents an attractive approach to quantitation, since the number of registered photons scales directly with the concentration of molecules under study. Photon counting detectors need to be highly sensitive, have a rapid pulse response and possess a high signal-to-noise ratio. Previous implementations of photon counting detectors often suffered from either a lack of sensitivity or a small dynamic range. Especially the latter limits the versatility of many photon detection concepts such as avalanche photon diodes or photomultipliers with a GaAsP photocathode. The hybrid detector technology discussed here is capable of overcoming these shortcomings making it an all-purpose detector for, both, high sensitivity imaging and single photon counting.

With the Leica HyD series we present an integrated hybrid detector concept which can be freely combined with any new SP5 system as well as retro-fit existing ones. Thanks to its high quantum efficiency of 45 % at 500 nm, its low noise and large dynamic range the hybrid detector is the most versatile detector in our TCS SP5 confocal platform delivering high contrast (Fig. 1). Along with Leica’s trademark filter-free beam-splitting and detection concept, improved scan optics and spectral detection design they make the TCS SP5 ideally suited for quantitative measurements using single photon counting and *in situ* spectroscopy.

![Figure 1: Contrast of HyD vs. PMT](image)

The fixed cell preparation (left panel) was imaged using low laser power and equal settings with a PMT and with a HyD, respectively (0.2 % of total Argon laser power, emission 500-620 nm, scan frequency 400 Hz). The intensity ratio between background (ROI 1) and the brightest region of the image (ROI 2) was plotted for, both, PMT and HyD (right panel). While the PMT delivers a contrast of 5:1 the HyD has 160:1 in this example.