THREE DIMENSIONAL SUPER RESOLUTION IMAGING BASED ON POLARIZATION MODULATION (CONFOCAL & MA-TIRF EXAMINATIONS)

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Due to the vectorial nature of light, light's interaction with matter is polarization sensitive. When it comes to the fluorescent imaging, only the dipole that has a parallel orientation with the incidence polarization is fully activated. Thus, when altering the polarization of the incident light, the emission intensity of the dipoles are modulated by their relative angle to the incident light, which adds sparsity to the recordings. With easy implementation and no-constraint on fluorescent dyes, polarization modulation has been used in wide-field fluorescent microscope, achieving sub-diffraction resolution as well as resolved dipole orientation [1].

Here, we first applied polarization modulation in point scanning microscopy and TIRF microscopy, together with sparsity based reconstruction algorithm, to realize super resolution. The polarization modulation is realized by simply inserting a vortex half-wave retarder into the conventional microscope. As shown in Fig. 1, sub-diffraction resolution of $\lambda/5$ in polarization modulated confocal has been achieved in nuclear pore complex proteins and tubulins in Vero cells. Moreover, we observed the thin, extended tubular intermediates of mitochondria in live U20S cell with three dimensional resolution Fig. 2(a) by combing polarization modulation and multi-angle in TIRF microscope. Dynamic process of mitochondria fission and fusion is also recorded in Fig. 2(b) with a temporal resolution of 2s.

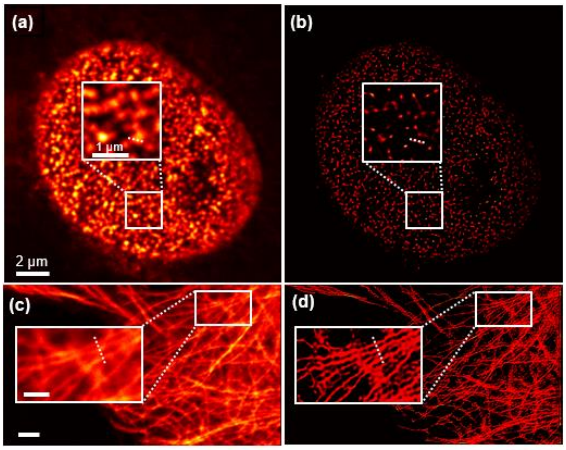

Figure 1: Super resolution results of polarization modulated confocal microscope

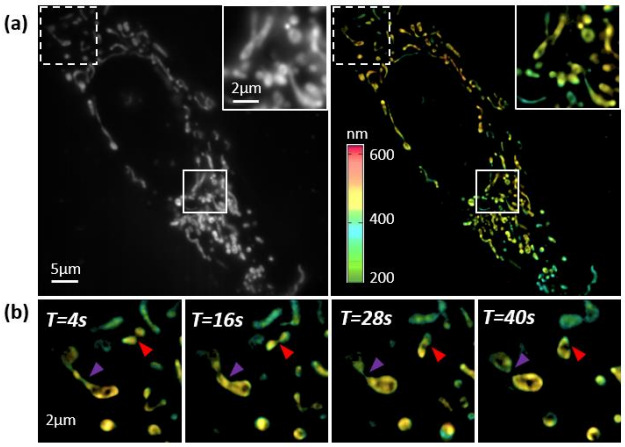

Figure 2: 3D super resolution results of polarization modulated TIRF microscope

REFERENCE:

1.N. Hafi, et al., "Fluorescence nanoscopy by polarization modulation and polarization angle narrowing," Nature Methods 11, 579-584 (2014).