Super-resolution: better, deeper, and richer information

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ABSTRACT:

The 2014 Nobel Prize in Chemistry is an award to praise the development of super-resolution microscopy, which has pushed the fluorescence microscopy to a new summit. However, there still exist challenges for further application of super-resolution: (1) Better spatial resolution is always preferred especially at no additional cost; (2) Deeper imaging depth inside the scattering specimen; and (3) Richer biological information.

I will introduce three technologies we developed recently for these aims. Firstly, With mirror-enhanced super-resolution, we are able to convert a STED system to a STED-4Pi, with ~4x STED intensity and ~2-fold of resolution, with the same STED power (MEANS-STED) [1, 2]. Secondly, benefitted from the rich choice of energy levels of upconversion nanoparticles, we have achieved 28 nm resolution with intermediate state STED, with only 30mW CW laser power [3]. Further, by modulating the STED beam as Bessel beam while maintaining the excitation beam as Gaussian, we have achieved 155 um deep STED imaging (GB-STED) [4]. Thirdly, we have also achieved a new super-resolution technique through the demodulation of fluorescent dipole orientation (SDOM) [5, 6]. The dipole orientation describes the underlying structures it attaches to. A series of biological structures can be revealed by SDOM, but not conventional polarization microscopy.

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