SATURATED ABSORPTION COMPETITION MICROSCOPY

Guangyuan Zhao, Cheng Zheng, Cuifang Kuang*, Xu Liu
State Key Laboratory of Modern Optical Instrumentation, Zhejiang University
Hangzhou 310027s, China
***E-mail: cfkuang@zju.edu.cn**

KEY WORDS: Super resolution, Absorption competition, Fluorescence saturation.

1. PRINCIPLE

We introduce the concept of saturated absorption competition (SAC) microscopy as a means of providing sub-diffraction spatial resolution in fluorescence imaging. Unlike the *post*-competition process between stimulated and spontaneous emission that is used in stimulated emission depletion (STED) microscopy[1], SAC microscopy breaks the diffraction limit by emphasizing a *pre*-competition process that occurs in the fluorescence absorption stage in a manner that shares similarities with ground-state depletion (GSD) microscopy[2]. Moreover, unlike both STED and GSD microscopy, SAC microscopy offers a reduction in complexity and cost by utilizing only a single continuous-wave laser diode and an illumination intensity that is ~ 20x smaller than that used in STED. SAC can be physically implemented in a confocal microscope by dividing the input laser source into a time-modulated primary excitation beam and a doughnut-shaped saturation beam, and subsequently employing a homodyne detection scheme to select the modulated fluorescence signal. Herein, we provide a physico-chemical model of SAC and experimentally demonstrate a transverse spatial resolution of ~λ/6.

2. IMAGING VERIFICATION

We conducted experiments with vero cells to verify the resolution of SAC. As shown in Fig.1, SAC was successfully applied to studying details of nuclear pore complex. Nuclear pores that appear clustered together in confocal images can be individually identified in SAC images.

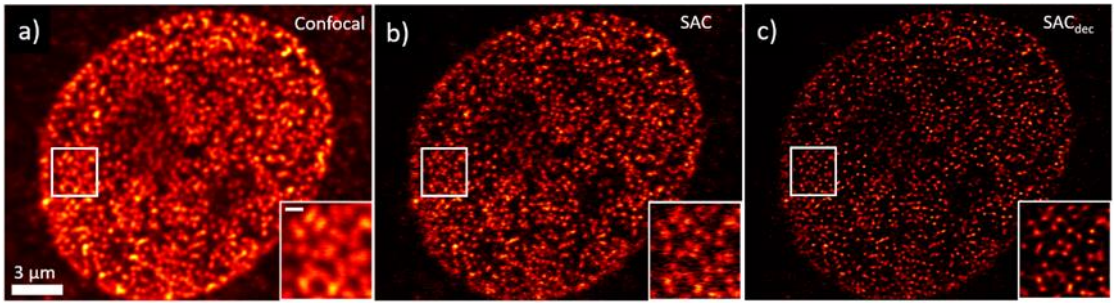

Figure 1: Imaging results of vero cells (Vero PFA, STAR-635P) with confocal and SAC microscopy. Images of (a), Confocal at 1.5 μW, (b), SAC for saturation power of 40 μW, (c), RL deconvolution result of (b) with 20 iterations. Inset scale bar, 500 nm.

1. S. W. Hell, and J. Wichmann, "Breaking the diffraction resolution limit by stimulated emission: stimulated-emission-depletion fluorescence microscopy," Optics letters **19**, 780-782 (1994).
2. E. Rittweger, D. Wildanger, and S. W. Hell, "Far-field fluorescence nanoscopy of diamond color centers by ground state depletion," Epl **86**, 14001-14006 (2009).