Supplemental Document

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Splicing exponential point spread function design for localization of nanoparticles: supplement

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In the field of particle three-dimensional positioning, the Double-helix point spread function (DH-PSF) is often used, so we compare our SE-PSF with various DH-PSFs in supplementary materials. In comparison, we choose three different Double-helix point spread functions, as follows,

2π-DH-PSF[1]. The 2π-DH-PSF is based on the Fresnel zone design, and it can rotate by 2π radians, which is twice the rotation angle of the conventional DH-PSF.

Distorted Grating And Double-Helix Point Spread Function Combination Microscopy (DDCM)[2]. DDCM is a method of combining distortion grating with DH-PSF, which can generate three main diffraction orders, and further expand the detectable axial range of DH-PSF.

Combined DH-PSF[3]. Clemens Roider used a special optical system to combine two single-helix PSFs into a DH-PSF, which rotates the DH-PSF by 2π radians

Under the same axial detection range (10μm in 100× microscopy imaging system, NA=1.4, λ=514nm), we compared the three-dimensional localization precision of the SE-PSF (α=40, β=0.35), the 2π-DH-PSF, the DDCM, and the Combined DH-PSF. In the calculation, we set the detected number of photons as 3000, set the average background noise B as 15, and add Gaussian noise and Poisson noise as interference.

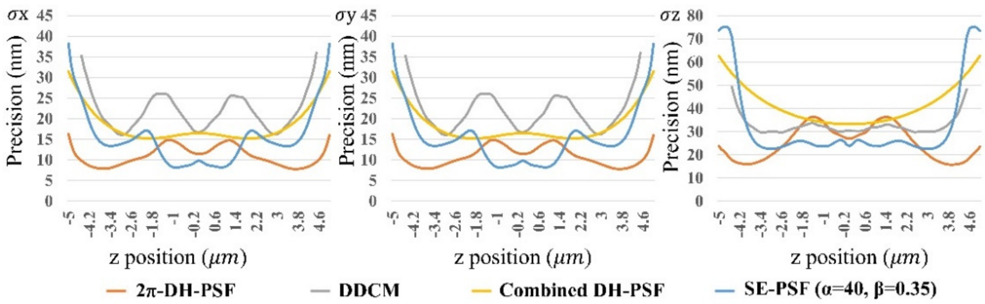

Fig. S1. Comparison of the localization precisions.

As shown in Fig. S1, the three-dimensional localization precisions of SE-PSF are significantly better than that of the DH-PSFs in the middle part, but at both ends, its three-dimensional localization precisions are lower than that of the 2π-DH-PSF. Compared with the DDCM and the Combined DH-PSF, the SE-PSF performs better in three-dimensional localization precisions but has shortcomings in comparison with the 2π-DH-PSF.

References

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