《基于微纳光纤双模式干涉的亚波长聚焦光场及光捕获应用》的补充材料

吴婉玲　王向珂　虞华康† 李志远

（华南理工大学物理与光电学院, 广州　510641）

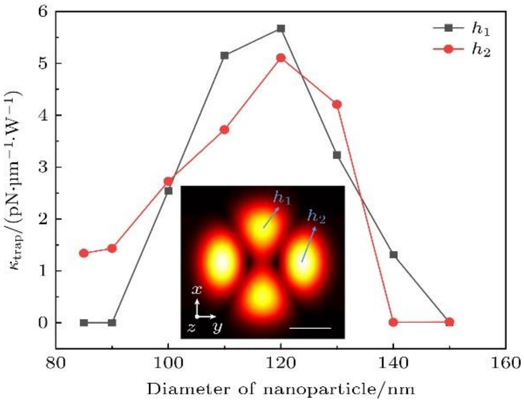

图 S1　模式组 HE_{11} + EH_{11} 的聚焦光场捕获不同直径的纳米颗粒时的捕获刚度. 插图为聚焦光场在焦平面上的电场分布|***E***|，黑色方点为焦点 h_1（在 xy 平面上位于(x, y) = (0.5, 0) μm）的捕获效果；红色圆点为焦点 h_2（在 xy 平面上位于(x, y) = (0, 0.44) μm）的捕获效果

Fig. S1. Trapping stiffness for 85 nm polystyrene (PS) nanoparticles versus diameters under the two-mode interference of x-HE_{11} and even-EH_{11}. Considering a nanoparticle located at a position of (x, y) = (0.5, 0) μm (black dots) and (x, y) = (0, 0.44) μm (red dots) respectively, longitudinal forces could be calculated by moving nanoparticles along the z-direction. Thus, one obtained κ_{trap} via the slopes of longitudinal forces near the trapping equilibrium position. The inset shows the ***E***-field in the focal plane, where two kinds of foci were referred to as h_1 and h_2.

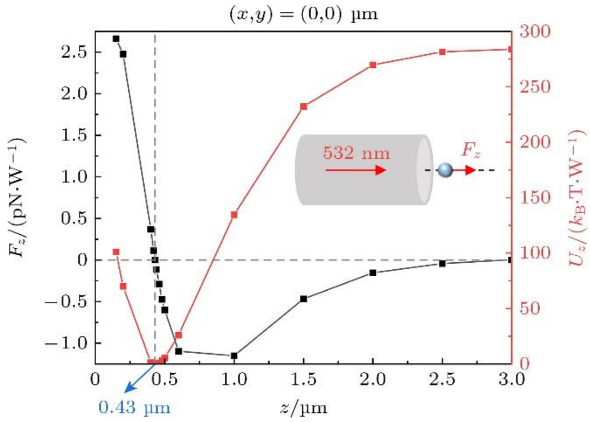

图 S2　准 x 线偏振态模式组 HE_{11} 和 HE_{12} 的聚焦光场对 PS 颗粒的纵向捕获强度 (黑色曲线为纵向光力；红色曲线为势能. 插图为计算模型)

Fig. S2. Longitudinal trapping strength for an 85 nm PS particle under two-mode interference of x-polarized HE_{11} and HE_{12} (Longitudinal force (black curve) and potential energy (red curve) along the fiber axis. The inset shows the calculated model).

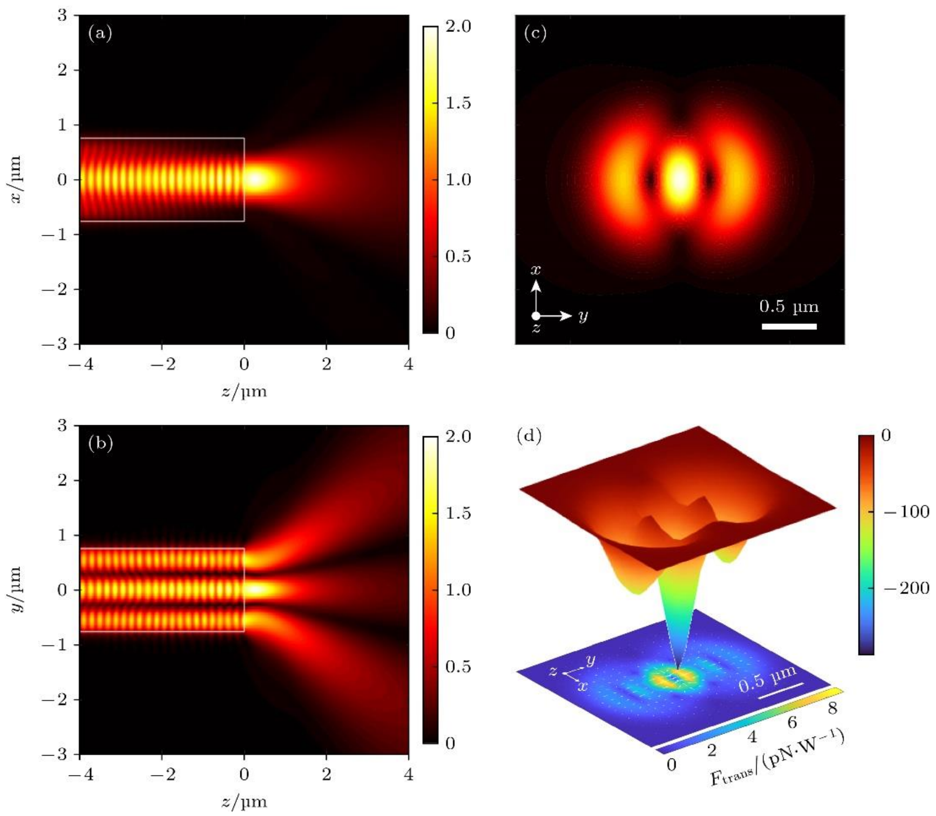

图 S3 模式组 $HE_{11}+HE_{12}$ 的聚焦光场及对直径 85 nm 的 PS 颗粒的捕获强度 (a) xz 平面; (b) yz 平面; (c) 焦平面上的电场强度的模值分布（$|\boldsymbol{E}|$），单位为 V/m. (d) 捕获平面上的势能密度分布（三维图）和横向光力分布（底部的二维图），其中势能单位为 $k_{\rm B}$T/W、光力单位为 pN/W. 图(c), (d)中比例尺为 0.5 μm

Fig. S3. ***E***-field and trapping strength for an 85 nm PS particle under two-mode interference of even-HE_{11} and x-HE_{12}. ***E***-fields in (a), (b) the central cross-sections (xz and yz planes) and (c) the focal plane (xy plane at z = 0.25 μm) have a unit of V/m. Solid rectangles depict microfiber profiles. (d) Potential energy densities (3D profile) in trapping planes, with a unit of $k_{\rm B}$T/W. The image below shows the transverse force exerted on the nanoparticle in the trapping plane: the color scale indicates the magnitude of the force and the arrows indicate its direction. The scale bars in panels (c) and (d) are 0.5 μm.

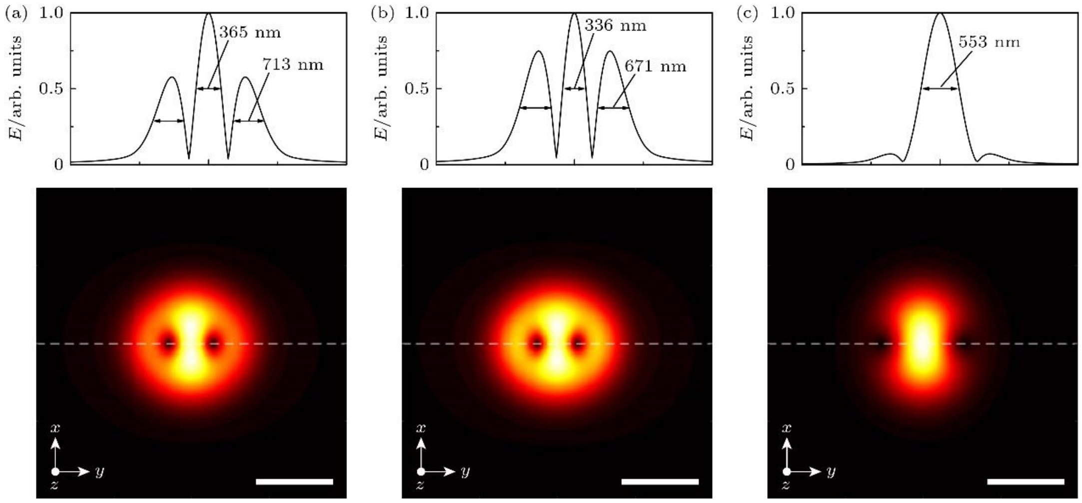

图 S4 模式组 $HE_{11}+EH_{11}$ 在不同相对功率比下的归一化电场强度，HE_{11} 模式的功率保持 1.04419 fW (a) P_{HE} ∶ P_{EH} = 1 ∶ 5.28; (b) P_{HE} ∶ P_{EH} = 1 ∶ 11.88; (c) P_{HE} ∶ P_{EH} = 3 ∶ 1

Fig. S4. Normalized ***E***-field of interference pattern via the two-mode set of *x*-HE_{11} and even-EH_{11} with diverse power ratios, one kept the power of *x*-HE_{11} mode to be 1.04419 fW: (a) P_{HE} ∶ P_{EH} = 1 ∶ 5.28; (b) P_{HE} ∶ P_{EH} = 1 ∶ 11.88; (c) P_{HE} ∶ P_{EH} = 3 ∶ 1.

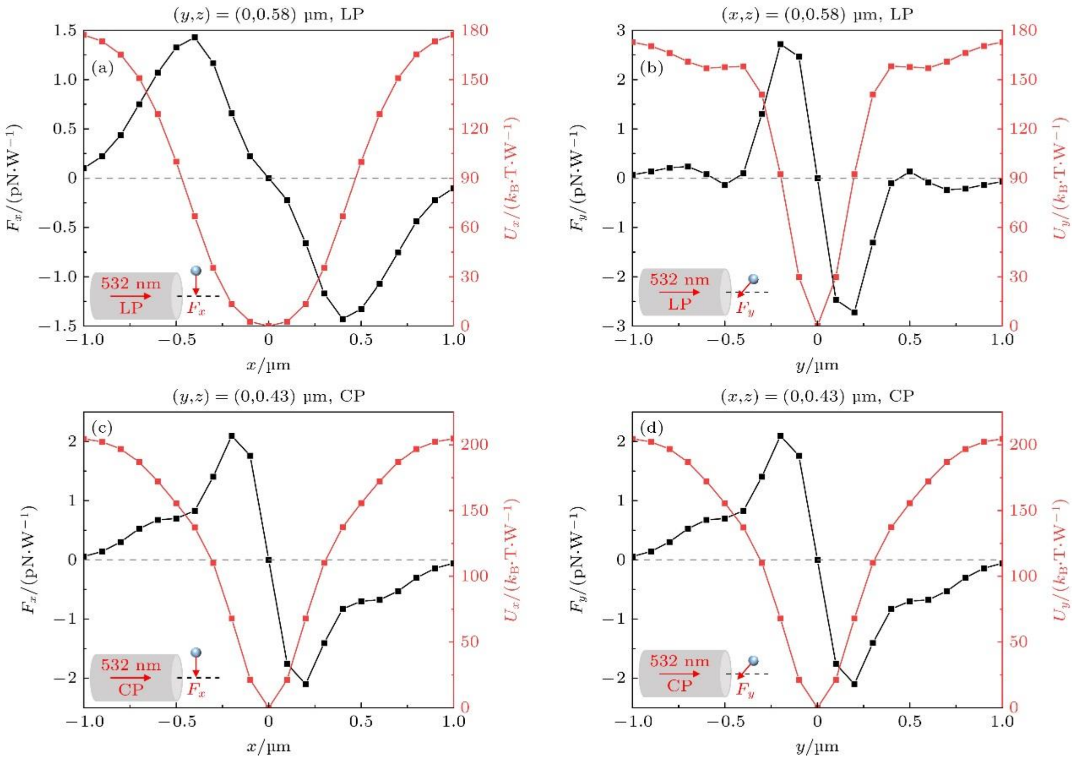

图 S5 模式组 $HE_{11}+EH_{11}$ 的聚焦光场捕获直径 85 nm 的 PS 颗粒时的横向效果(黑色曲线为纵向光力；红色曲线为势能；插图为计算模型) (a), (b) 线偏振态模式组；(c), (d) 圆偏振态模式组。

Fig. S5. Transverse trapping strength for an 85 nm PS particle under the two-mode interference of *x*-HE_{11} and even-EH_{11} (Transverse force (black curves) and potentials (red curves) in trapping planes under (a), (b) linear and (c), (d) circular polarization excitation. The insets show the calculated models).