

## **Fano-enhanced pulling and pushing optical force on active plasmonic nanoparticles by a plane wave**

We demonstrate tunable pulling and pushing optical forces on plasmonic nanostructures around Fano resonance. The plasmonic nanostructure containing a spherical core with optical gain and a metallic shell shows much larger optical pulling force than a pure gain sphere. One can obtain large field enhancement and giant pulling force at the emerged quadrupole mode. The introduction of optical pump compensate the dissipative loss from metal shell, thus enable the strong coupling between a narrow quadrupole mode and a broad dipole mode, giving rise to Fano resonance. The giant negative forces origin from the reversal of electric field at Fano resonance, which lead to pulling force on bound currents and charges. Our results provide a practical way to manipulate nanoparticles and give deep insight into light-matter interaction.