SUPPLEMENTARY INFORMATION

# Second harmonic Rayleigh scattering optical activity of single Ag nanohelices in a liquid

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The simulations presented in Figure S1, S2 and S3 are performed with the Lumerical FDTD software. The details of all the numerical simulations are provided in the Methods section of the main manuscript.

## 1. Magnetic field in the y-z plane

In Figure S1, the amplitude of the magnetic field in the y-z section of the nanohelix is plotted as a color map for various illumination conditions. The left panels of the figures correspond to illumination with LCP and the right panels with RCP light. The top, middle and bottom rows show results for illumination (i.e. **k** vector propagating) along the x, y, and z directions, in the reference frame in Figure 1(b) from the main manuscript.

For illumination with **k** vector along the x or y directions, the magnetic field amplitudes around the nanohelix are not particularly sensitive to the direction of circularly polarized light. However, for illumination with **k** vector along the z direction the difference is dramatic. For nanohelices freely revolving in a liquid, the orientation with respect to the incident light is random and therefore the average response is determined by the dramatic effect observed when **k** is along (parallel to) the z direction.

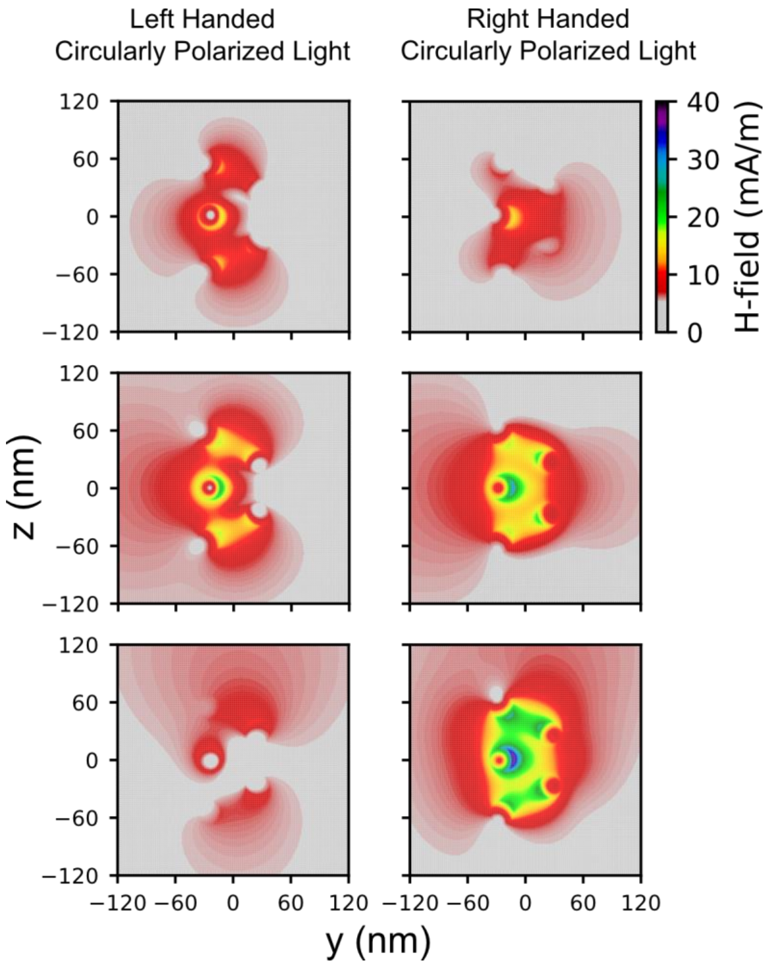


**Figure S1**. Amplitude of magnetic field in the x-z plane for left-handed (left column) and right-handed (right column) circularly polarized light simulated with an incident pulse centered at 730 nm. Top: light propagating along the x axis; middle: light propagating along the y axis; bottom: light propagating along the z axis.

## 2. Electric fields in the x-z plane

In Figure S2, the amplitude of the electric field in the x-z section of the nanohelix is plotted as a color map for various illumination conditions. The left panels of the figures correspond to illumination with LCP and the right panels with RCP light. The top, middle and bottom rows show results for illumination (i.e. **k** vector propagating) along the x, y, and z directions, in the reference frame in Figure 1(b) from the main manuscript.

For illumination with **k** vector along the x or y directions, the electric field amplitudes around the nanohelix are not particularly sensitive to the direction of circularly polarized light. However, for illumination with **k** vector along the z direction the difference is again dramatic.

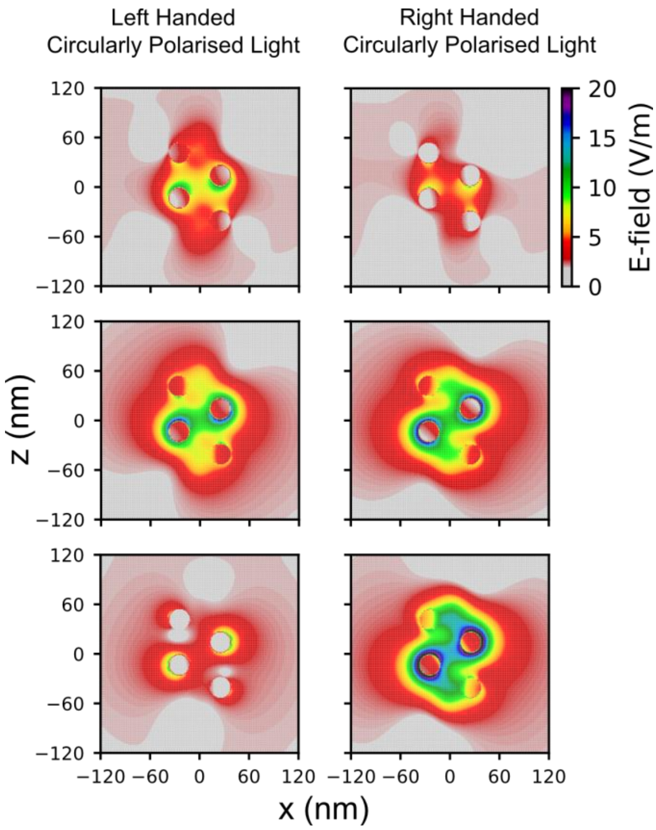


**Figure S2.** Amplitude of electric field in the x-z plane for left-handed (left column) and right-handed (right column) circularly polarized light simulated with an incident pulse centered at 730 nm. Top: light propagating along the x axis; middle: light propagating along the y axis; bottom: light propagating along the z axis.

## 3. Magnetic fields in the x-z plane

In Figure S3, the amplitude of the magnetic field in the x-z section of the nanohelix is plotted as a color map for various illumination conditions. The left panels of the figures correspond to illumination with LCP and the right panels with RCP light. The top, middle and bottom rows show results for illumination (i.e. **k** vector propagating) along the x, y, and z directions, in the reference frame in Figure 1(b) from the main manuscript.

For illumination with **k** vector along the x or y directions, the magnetic field amplitudes around the nanohelix are not particularly sensitive to the direction of circularly polarized light. However, for illumination with **k** vector along the z direction the difference is again dramatic.

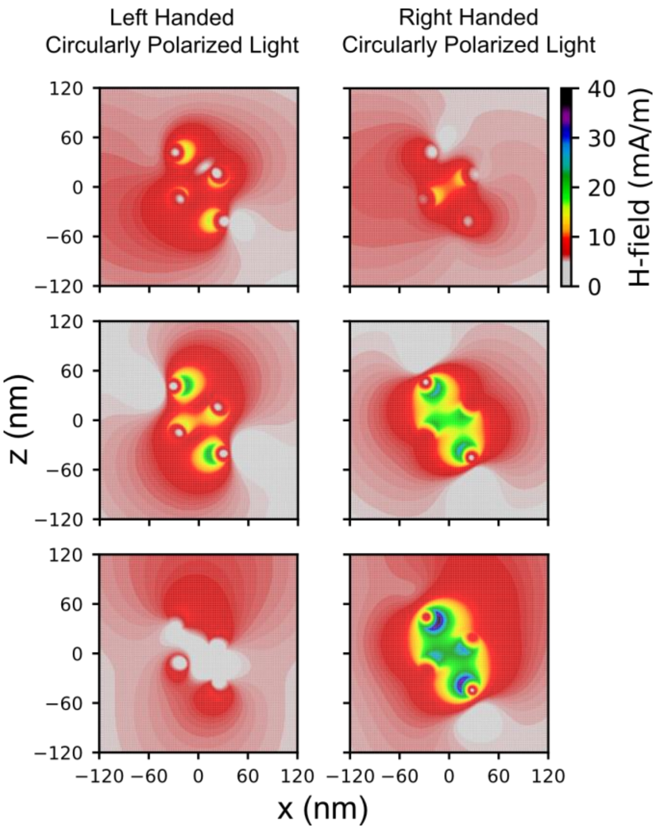


**Figure S3.** Amplitude of magnetic field in the x-z plane for left-handed (left column) and right-handed (right column) circularly polarized light simulated with an incident pulse centered at 730 nm. Top: light propagating along the x axis; middle: light propagating along the y axis; bottom: light propagating along the z axis.