Supplementary Information

Toy model of harmonic and sum frequency generation in 2D dielectric nanostructures

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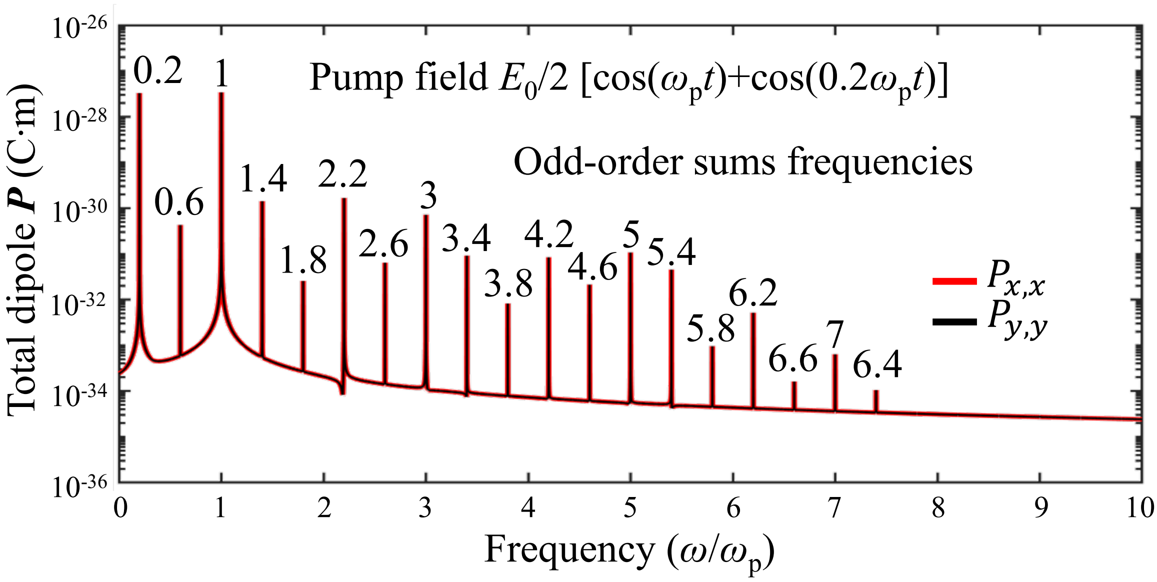

Fig. S1. Sum frequency generation in a nanoparticle of D4 symmetry. Frequency dependence of the electric dipole moment of a square particle consisting of 25 atoms in response to optical pumping at a combination of two frequencies, ω_p and $0.2\omega_p$. $P_{y,x}$ indicates the y-component of the particle's electric dipole moment caused by x-polarized pumping. For either x- or y-polarized pumping, the orientations of pump polarization and generated dipole are parallel, and the generated dipoles have the same magnitude for both cases.

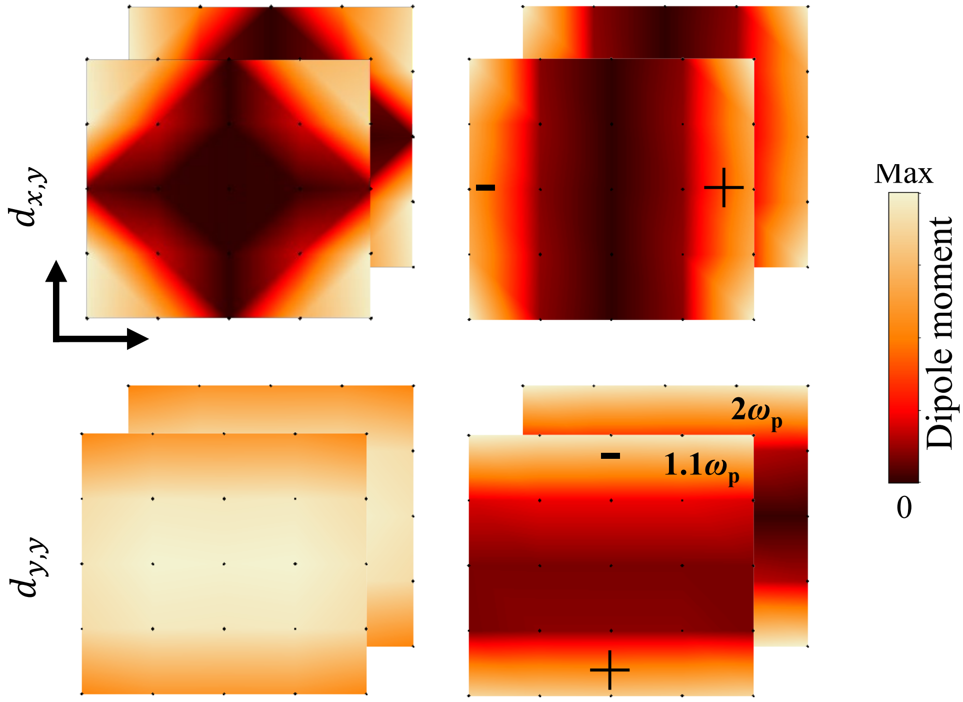

Fig. S2. Magnitude (colours) and sign ("+" and "-") of the dipole moment per atom, ***d***, generated at lowest-order sum frequencies in response to pumping at frequencies ω_p and $0.1\omega_p$. The top (bottom) row shows the dipole component orthogonal (parallel) to the pump polarization. Stacked images for different – either even or odd – sum frequencies show the same qualitative behaviour.

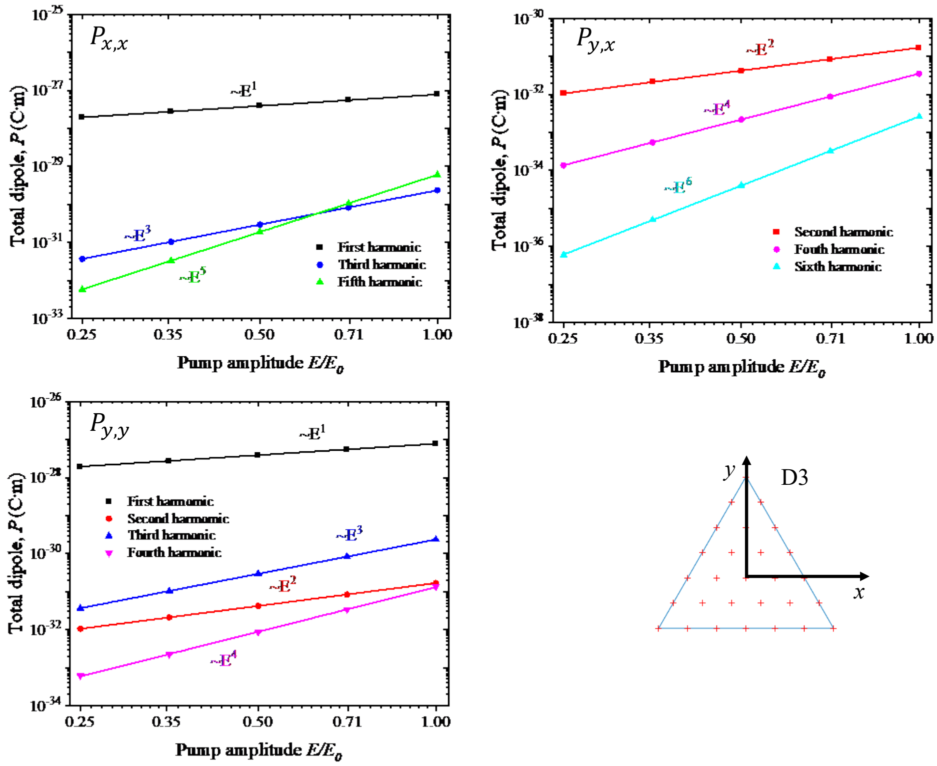

Fig. S3. Scaling of the triangular particle's electric dipole moment at harmonic frequencies with the pump field amplitude for the cases of Fig. 3.

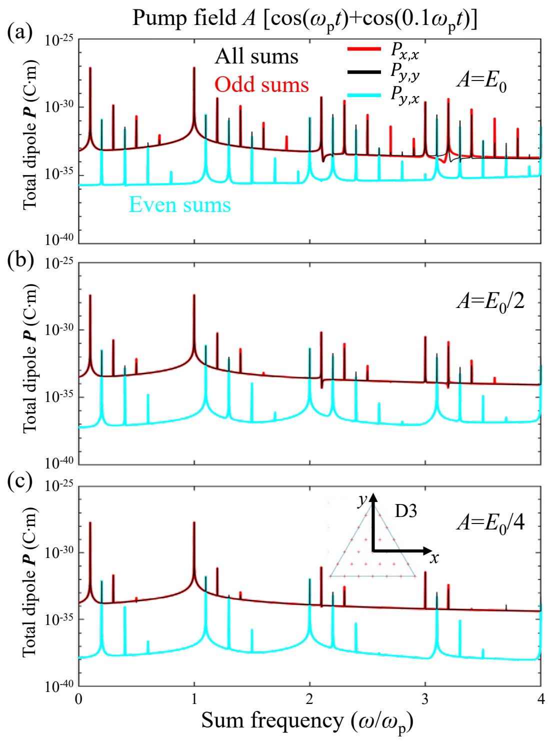

Fig. S4. Sum frequency generation in a structure of D3 symmetry with co-polarized pumping. (a)-(c) Frequency dependence of the electric dipole moment of the triangular particle of 28 atoms (inset) in response to pumping at a combination of two frequencies, ω_p and $0.1\omega_p$ for different pump electric field amplitudes of (a) E_0, (b) $E_0/2$, (c)$E_0/4$.

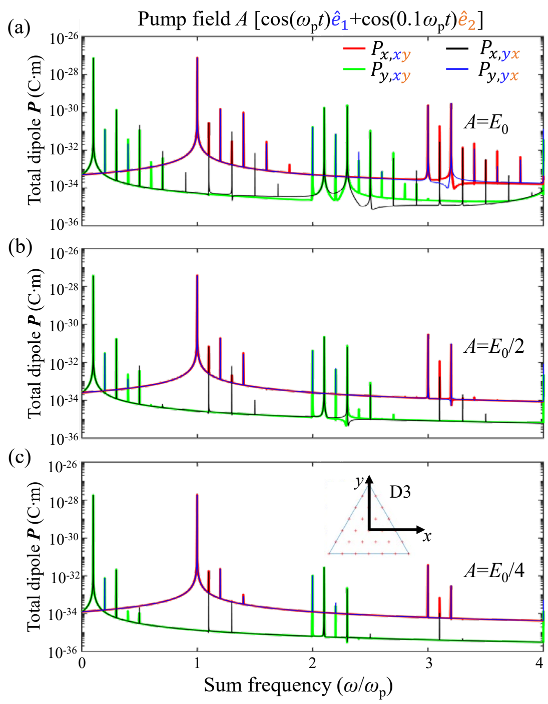

Fig. S5. Sum frequency generation in a structure of D3 symmetry with cross-polarized pumping. (a)-(c) Frequency dependence of the electric dipole moment of the triangular particle (inset) in response to pumping at two frequencies, ω_p and $0.1\omega_p$, where the pump fields at different frequencies have orthogonal polarizations. $P_{i,jk}$ refers to the i-component of the dipole moment caused by j-polarized pump field at ω_p and k-polarized pump field at $0.1\omega_p$, where i,j,k is x or y. Different panels show different pump electric field amplitudes of (a) E_0, (b) $E_0/2$, (c)$E_0/4$.