Chiral sensing with dielectric metasurfaces

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Detection of chiral molecules

- Chirality is a geometrical property whereby the mirror image of an object does not coincide with the object itself.
- The handedness (left or right orientation in space) of chiral molecules defines its action on living organisms. Therefore, chiral sensing is a crucial task in biology, chemistry and medicine.
- The difference in transmission between left- and right-handed circularly polarized incident light ΔT is used as a sensing measure.
- Naturally, ΔT is extremely small and the goal is to enhance this signal.

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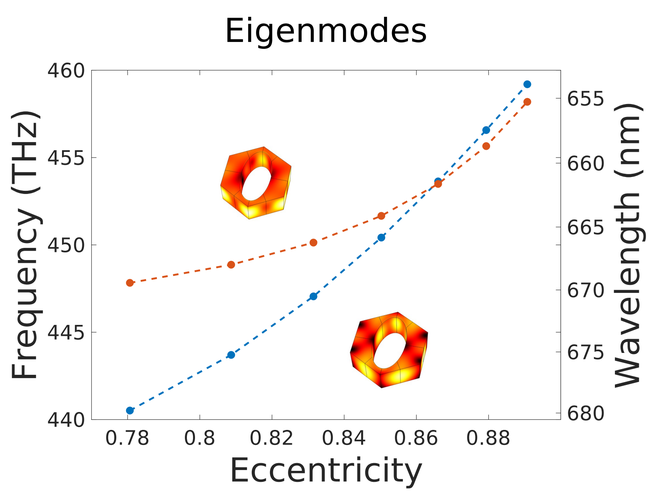
Methodology

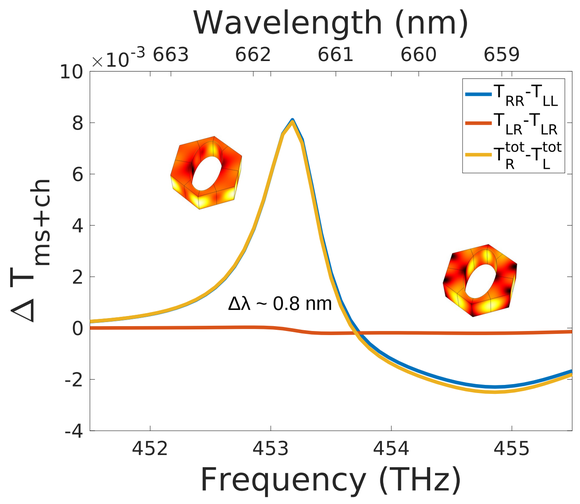
- The Pasteur parameter κ is used to describe chiral molecules in electromagnetism. Considering the chiral analyte as an isotropic medium, one can formulate the constitutive equations as

$$\mathbf{D} = \varepsilon_0 \varepsilon \mathbf{E} - i\tfrac{\kappa}{c}\mathbf{H},$$

$$\mathbf{B} = \mu_0 \mu \mathbf{H} + i\tfrac{\kappa}{c}\mathbf{E}.$$

- Bound states in continuum have attracted a lot of interest in recent years. These states are characterized by an infinite Q-factor and cannot be excited from the free space. By deformation of the unit cell, however, these states become quasi bound states that are accessible. Their radiative Q-factor is then finite, but still extremely large, promising better sensing performance.





Results

- A hexagonal dielectric metasurface that supports two bound states in the continuum is investigated.
- The symmetry of the unit cell is broken by inner hole stretching in order to excite quasi bound states in the continuum.
- The metasurface demonstrates significant enhancement of ΔT signal associated with the quasi bound states in use.
- The effect is observed for realistic values of Pasteur parameter and the signal can be potentially detected in experiment.

We work for **tomorrow**

https://physik.uni-graz.at/en/theoretical-solid-state-physics/