

Popular Summary

It is widely known that electric charges of the same sign mutually repel each other. On the other hand, equally directed electric currents are mutually attracted when they pass in parallel conductors. When light illuminates DNA molecules, currents flow along its helical structure and these forces act on the two helices. Since the currents in two DNA strands pass at a very close distance from each other, the equilibrium of this molecule depends on their interaction. For such complex shape, the interaction force of the currents and charges requires careful investigations, which is the subject of this work.

Suppose that an electromagnetic wave is incident laterally on two parallel rectilinear conductors, while the distance between the conductors is significantly smaller than the wavelength of the electromagnetic field. Then, the equilibrium of the conductors occurs for two reasons: the induced charges of the same sign are mutually repulsive, and the arising equally directed currents are mutually attracted (Fig. 1). If there is a double helix in the field of the external wave, the currents interaction in this helix depends heavily on its pitch angle. For a DNA-like helix, not only charges, but also currents are repelled in two strands of the helix (Fig. 2).

This means that light illumination can harm DNA, since the disbalanced forces can break the molecule strands. On the other hand, the influence of optical waves can offer a new possibility create of controlling the double helix shape.

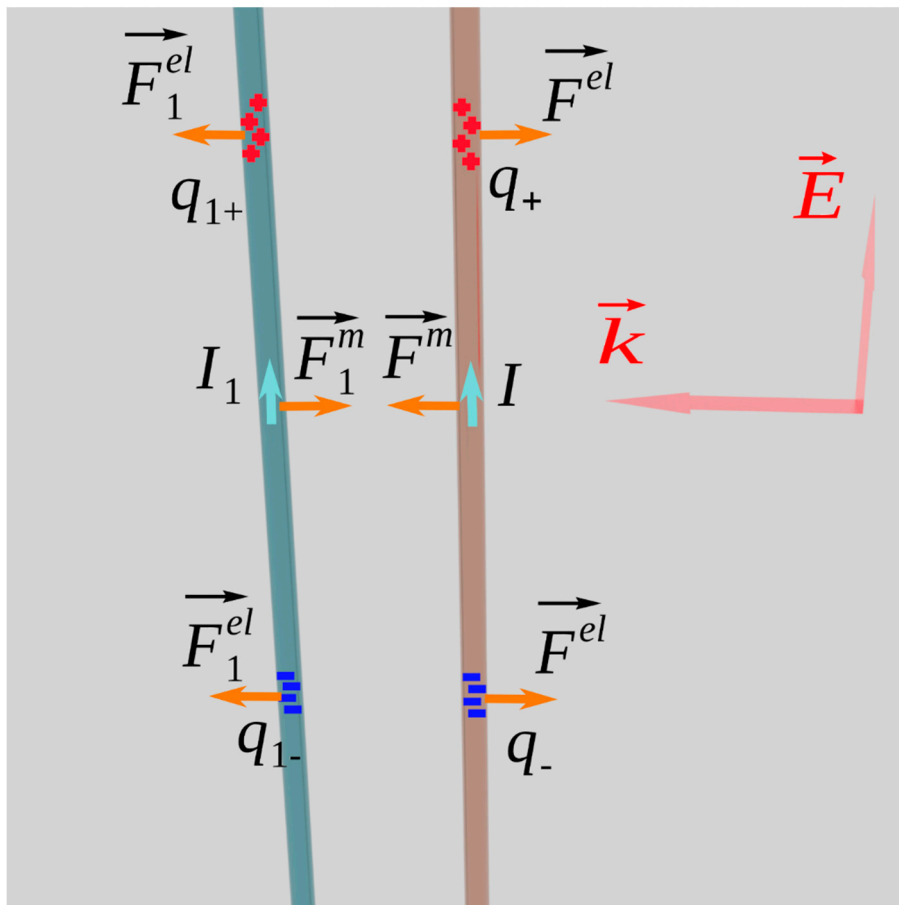


Figure S1. The equilibrium of two rectilinear conductors: charges are mutually repelled, currents are mutually attracted.

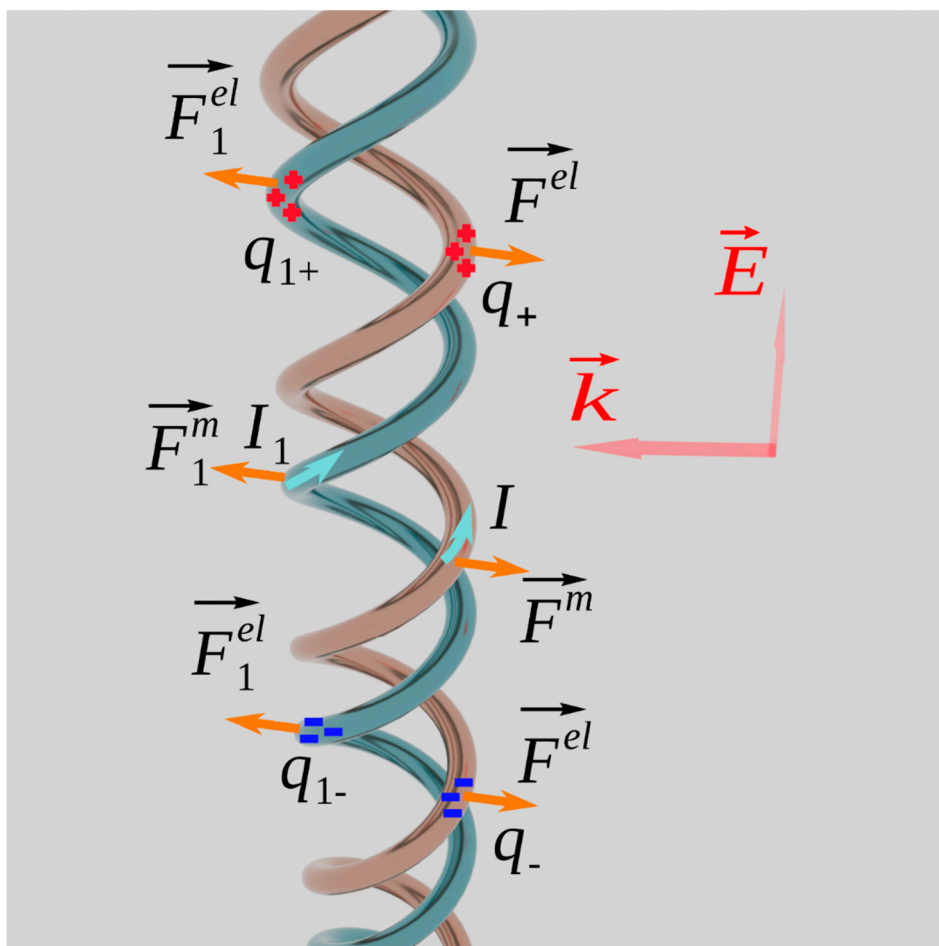


Figure S2. Disbalance force in a double DNA-like helix: not only charges, but also currents are mutually repelled as well.