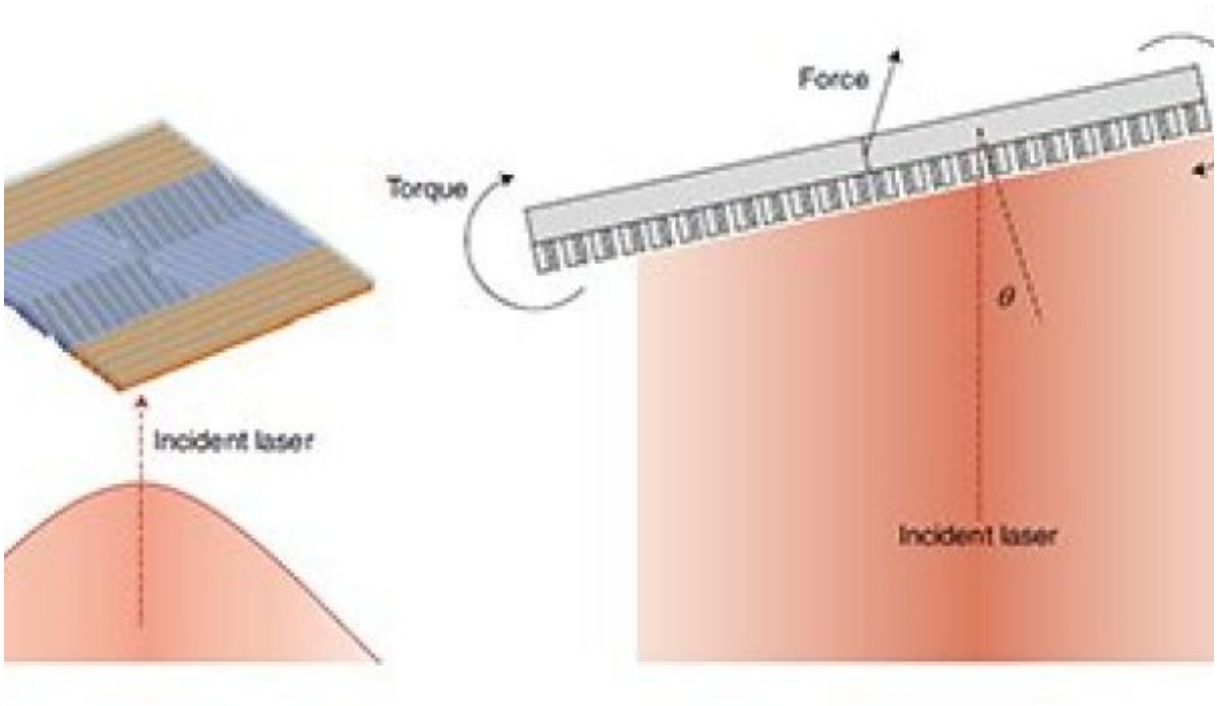

News and Views on optical manipulation

ICREA Prof. at ICFO Romain Quidant provides a review in Nature?s News and Views about a Nature Photonics study regarding an innovative approach on optical control for propelling spacecraft.

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Understanding the dynamics of massive mesoscopic objects levitated in high vacuum is among the most exciting recent areas of study in the field of optical manipulation. Research on the so-called Levitodynamics, which refers to the control of both the translational and rotational motion of levitated systems, has so far been limited to objects smaller than a fraction of a millimeter, in a laboratory setting.

In this context, the Breakthrough Starshot initiative aims to use laser light to propel an ultra-light and thin spacecraft in space. Because light-enabled levitation of flat macroscopic

objects would allow reaching much higher velocities, scientists envision this approach as a means to explore our Universe, well beyond what has been allowed by existing propulsion technologies.

However, the transition from manipulating a mesoscopic particle to a flat macroscopic object raises the challenge of tilt stabilization and lateral shift with respect to the fixed propelling laser axis.

In a study published in Nature Photonics and reviewed in Nature News and Views by ICREA Prof. at ICFO Romain Quidant, Caltech researchers Ilic and Atwater present a new theoretical approach in which they tackle this stabilization challenge. In their proposal, the surface of the flat object is structured by an inhomogeneous metasurface formed by different unit cells, each of them refracting the incident light in a different way. They state that instabilities can be overcome by adequately distributing the different cells symmetrically with respect to the centre of mass of the macroscopic flat object, allowing the object to experience a restoring torque whenever it rotates out of its equilibrium orientation. This passive stabilization feedback automatically keeps the object in a stable trajectory.

"Despite these encouraging results," concludes ICREA Prof. at ICFO Romain Quidant, "there is still a long way to go to implement experimentally such a proposal with multiple challenges".