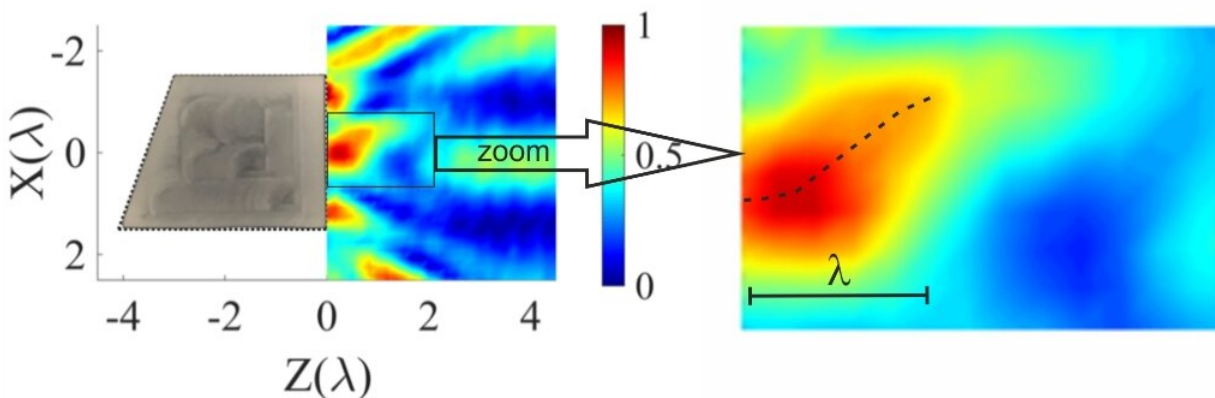


# New type of curved acoustic beams to provide manipulations with nanoparticles

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Acoustical hook visualization. Credit: Tomsk Polytechnic University

Previously, scientists knew only one type of curved optical rays—Airy beams and their derivatives. They were obtained back in 2007. Due to their physical properties, the beams can be used for manipulating small particles, which can be applied in microfluidics and cell biology. Obtaining such beams requires advanced equipment. Therefore, researchers from all around the world are looking for new types of curved beams that could be obtained much easier.

"Principles of obtaining new curved beams are an interesting and promising research field for both fundamental and applied areas. In 2018, our team theoretically predicted the existence of a new type of

curved hook-like self-accelerating light beam. We named it a photonic hook, which is a curved [electromagnetic wave](#). After that, we wondered if such curved beams could be obtained from an [acoustic wave](#)? Our new study positively responded to this challenge. We can obtain this beam incomparably easier than Airy beams," Igor Minin, the head of the project and professor of the TPU Division for Electronic Engineering, says.

To generate an acoustical hook, the researchers used a microparticle made of Rexolite dielectric material with an asymmetric shape. This particle was placed in water during experiments and irradiated with ultrasound. Passing through a particle of this shape, a sound wave was curved in the shape of a hook at the exit from the particle. The experiments were carried out at the Polytechnic University of Valencia (Spain).

"Today, the main application of acoustical hooks is biomedicine, synthesis of new materials, manipulation of nanoparticles using ultrasound with high sub-wave accuracy.

They can be used where other types of curved acoustic beams such as Airy cannot. In the future, we plan to carry out experiments and try to use acoustic hooks directly for particle manipulations, " Igor Minin says.

**More information:** Constanza Rubio et al, Acoustical hooks: A new subwavelength self-bending beam, *Results in Physics* (2020). [DOI: 10.1016/j.rinp.2019.102921](https://doi.org/10.1016/j.rinp.2019.102921)

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