# Master 2 Internship

**Title:** Rotating matter with acoustic vortices

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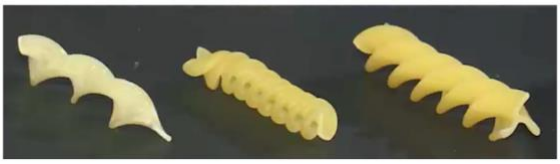
**PhD funding :** possible opportunities for interested candidates.

## Project

Phases singularities represent a common feature to any scalar wave whatever its nature. They represent generic events in wave physics prone to appear in usual observations conditions as three planes waves are enough to construct them. In our laboratory, we develop experimental techniques to generate them from 3D printed objects and unveil their mechanical effects on matter as a result of sound-matter interaction. This is done both qualitatively and quantitatively, owing to visual observations [1,2]. As a phase singularity is imprinted on an initially smooth propagating pressure field, an acoustic vortex is born and leaves a mechanical fingerprint to matter in the form of a torque exerted on it. Indeed, acoustic vortex beams carry (orbital) angular momentum pointing along their propagation. Therefore, according to angular momentum conservation principles, sound-matter angular momentum transfer allows us to rotate matter with acoustic waves, in a contactless manner. Here, we will experimentally explore non-intuitive sound-matter interaction geometries leading to nonzero acoustic torque contributions lying in the transverse plane with respect to the propagation direction rather than pointing along it. This will be done by direct and simple means, using suitably designed 3D printed objects placed in the course of an ultrasonic vortex propagating in the air.



$\ell = +1$ $\ell = +2$ $\ell = +3$

Noodle images illustrating helical-shaped wavefronts analog to those of vortices of sound, light or elementary article wavefunction.

**References**

[1] B. Sanchez-Padilla, L. Jonusauskas, M. Malinauskas, R. Wunenburger, and E. Brasselet, *Direct mechanical detection and measurement of wave-matter orbital angular momentum transfer by non-dissipative vortex mode conversion*, Physical Review Letters 123, 244301 (2019).
[2] B. Sanchez-Padilla and E. Brasselet, *Torsional mechanical oscillator driven by the orbital angular momentum of sound*, Physical Review Applied 13, 064069 (2020)

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