

Researchers show corkscrew elastic waves carry well-defined orbital angular momentum

March 3 2022, by Bob Yirka

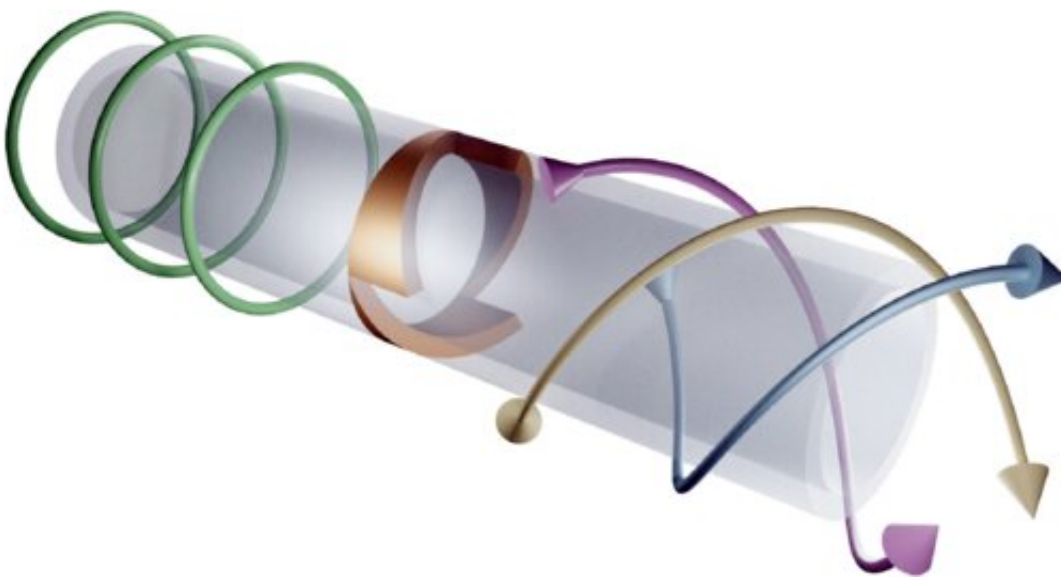


Figure 1. Schematic of an elastic spiral phase pipe (copper region) in a hollow elastic pipe (transparent region). Purely longitudinal waves, e.g., $L(0, 2)$ modes (circular phase fronts), are mode converted into flexural $F(3, n)$ waves (helical phase fronts). Credit: *Physical Review Letters* (2022). DOI: 10.1103/PhysRevLett.128.064301

A team of researchers from the University of Exeter and Piazza Leonardo da Vinci, has shown, theoretically, that corkscrew elastic waves carry well-defined orbital angular momentum. In their paper published in the journal *Physical Review Letters*, the group describes

experiments they conducted with aluminum pipe and simulations they built that showed the possibility of using waves of vibration moving along the walls of a pipe in new types of applications.

Prior research has shown that the wavefront of a twisted light beam can be made to move like a corkscrew because it has [orbital angular momentum](#) (OAM). In this new effort, the researchers wondered if the same might be true for [acoustic waves](#). Prior research has also shown that helical [elastic waves](#) can be generated by pushing elastic waves through the walls of a pipe. The researchers sought to determine whether such waves can carry OAM. They started by building a special pipe (where they replaced a short segment of the pipe with one containing a patterned ring of a different material) that showed that elastic waves traveling along its lengths could be converted to flexural waves curling around the circumference of the pipe due to helical wavefronts. Encouraged by their results they next began analyzing the system theoretically and used that work in the creation of simulations that showed that the waves did indeed carry OAM.

The researchers then carried the idea further by imagining the waves with OAM as they moved into a fluid at the far end of their [pipe](#). In analyzing the impact such waves would have on the water, they found evidence suggesting that they incited pressure waves that also had helical wavefronts. They note that this property could be used to monitor the behavior of fluids in certain applications or to test for cracks in pipes. The researchers also note that pressure waves with OAM are used in [acoustic tweezers](#)—their approach could add a new way to create and use them. For example, the approach could be used to create tweezers that are capable of manipulating extremely small objects in biological systems. Another application might involve the creation of microfluidic circuitry.

More information: G. J. Chaplain et al, Elastic Orbital Angular

Momentum, *Physical Review Letters* (2022). [DOI: 10.1103/PhysRevLett.128.064301](https://doi.org/10.1103/PhysRevLett.128.064301)

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