**1:55**

**2pPAb3. Synthesizing acoustic drill beams by the superposition of detuned vortices.** Noé Jiménez (Instituto de Instrumentación para Imagen Molecular, Universitat Politècnica de València - CSIC, Camino de Vera s/n, Valencia 46022, Spain, nojigon@upv.es), Enrique González-Mateo, Francisco Camarena (Instituto de Instrumentación para Imagen Molecular, Universitat Politècnica de València - CSIC, València, Spain), and Kestutis Staliunas (UPC, Dep. de Física, ICREA, Terrassa, Spain)

We present acoustic drill beams. These singular beams show a dynamic intensity distribution matching the shape of a helix. The intensity distribution rotates along the axis of the beam with a controlled direction and angular frequency, therefore resembling the shape of a mechanical drill bit. Acoustic drills emerge elegantly as the spatio-temporal interference of two confocal and detuned vortex beams. The beam parameters are fully tuneable. The detuned frequency, detuning wave number, and detuned topological charge of the composing beams control the number of arms of the drill, the winding period, the rotation velocity, and its direction. We show that elongated drill beams are obtained using two high-order Bessel beams, enabling analytical solutions for optimal overlapping. In addition, drill beams can also be synthesized by focused ultrasound vortices. Analytic, numeric, and experimental results are shown in the ultrasound regime using a low-cost device based on two confocal 1-MHz piezoelectric transducers and 3D-printed acoustic holograms. This new wave structure opens novel avenues for wave-matter interaction such as contactless particle manipulation, matter processing, or biomedical applications.

**2:20–2:35 Break**

**2:35**

**2pPAb4. Generation and steering of airborne acoustic vortices with broadband electro-active spiral gratings.** Joao Ealo (School of Mech. Eng., Universidad del Valle, Ciudad Universitaria Meléndez, Bldg. E49 - Of.2014, Cali, Valle del Cauca 760032, Colombia, joao.ealo@correounivalle.edu.co), Ruben Muelas-Hurtado (School of Mech. Eng., Universidad del Valle, Cali, Valle del Cauca, Colombia), and Karen Volke-Sepúlveda (Instituto de Física, Universidad Nacional Autónoma de México, Ciudad de Mexico, Mexico, Mexico)

Acoustic beam shaping technology has flourished in the last decade, motivated by its important applications. For example, in the context of contactless manipulation, the use of structured ultrasonic fields has led to significant advances, such as the development of the acoustic tweezers based on the use of ultrasonic vortex beams. In this work, we present a powerful and efficient technique to structure acoustic fields based on the use of planar electro-active diffraction gratings, which can be tailored in practically arbitrary shapes. For this purpose, a lower electrode with the desired shape is printed on a circuit board and covered with an active ferroelectret film, whose metallized top surface acts as a continuous upper electrode. Importantly, these devices can be operated within a broad spectral range of ultrasonic frequencies. Two kinds of structured fields are demonstrated: a focused acoustic vortex and the simultaneous generation of multiple acoustic Bessel beams of different topological charges, well separated among each other along the propagation axis. In both cases, the main parameters of the field can be finely and continuously tuned by setting the operation frequency, which allows an axial steering of the vortices. Experimental results exhibit very good agreement with theoretical analysis and numerical simulations.

**3:00**

**2pPAb5. Active holographic tweezers based on spiraling interdigitated transducers.** Michael Baudoin (IEMN, Université de Lille, Ave. Poincaré, Villeneuve d'Ascq 59652, France, michael.baudoin@univ-lille.fr), Roudy Al Sahely (IEMN, Université de Lille, Villeneuve d'Ascq, France), Zhixiong Gong (IEMN, Université de Lille, Lille, France), Olivier Bou Matar (IEMN, Ecole Centrale de Lille, Villeneuve d'Ascq, France), Jean-Claude Gerbedoen (IEMN, CNRS, Lille, France), Nikolay Smagin (IEMN, UPHF, Valenciennes, France), and Ravinder Chutani (IEMN, Université de Lille, Villeneuve d'Ascq, France)

Recently, our team demonstrated the selective manipulations of microparticles [Baudoin *et al*., Sci. Adv. 5, eaav1967 (2019)] and cells [Baudoin *et al*., Nat. Commun. 11, 4244 (2020)] in a standard microscopy environment with active holographic tweezers based on spiraling interdigitated transducers. In this talk, we will present (i) the ultra-high frequency (250 MHz) selective manipulation of 4 $\mu$m beads with nanoNewton forces and (ii) first results on the the 3D manipulation of particles and in particular their axial displacement without any motion of the transducer, by tuning the driving frequency [Gong *et al*., Phys. Rev. Appl. 16, 024034 (2021)]. We will also introduce a new mixed finite element/angular spectrum code, which enables to understand the underlying physic and opens perspectives to improve the tweezers design.

**3:25**

**2pPAb6. Single focused-beam acoustical tweezers.** Zhixiong Gong (CNRS UMR8520 IEMN, IEMN, Cité Scientifique Ave. Henri Poincaré CS 60069, Lille 59652, France, zhixiong.gong@iemn.fr) and Michael Baudoin (IEMN, Université de Lille, Villeneuve d'Ascq, France)

Single beam acoustical tweezers have seen rapid development for their potential applications *in vitro* and *in vivo* in different fields such as acoustofluidics, microrobotics, precision medicine, and so on. The first single beam acoustical tweezers used a focused beam in analogy with optical tweezers [Lee *et al*., Appl. Phys. Lett., 95, 073701 (2009)]. However, they only succeeded to trap light particles with negative acoustic contrast factor in two dimensions. In this talk, we revisit theoretically the capabilities of acoustical tweezers based on focused beams and demonstrate that they can trap (i) some specific light elastic particles and droplets in three dimensions in and beyond the Rayleigh regime, (ii) dense particles (with positive acoustic contrast factor) in two dimensions near the resonance frequencies, and (iii) lipid cells in three dimensions. Some preliminary experimental results will be presented.

**3:50–4:10**
**Panel Discussion**