Controlling acoustic metamaterials with magnetic resonances: The best of both worlds

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Our civilization is defined by the functionalities delivered by devices, ranging from smartphones to airplanes. These functionalities are however constrained by materials available to engineers, when constructing and indeed even conceiving a device. Radically new dynamical properties and advanced functionalities can be created by tailor-tuning the spectra of wave excitations in structured media – so-called metamaterials. Among other waves, 'surface acoustic waves' have been investigated for over one hundred years and currently used e.g. for a wide and diverse range of functions, e.g. analogue signal processing in mobile phones. Recently, the field of metamaterials research has expanded to acoustic waves. To date, however, there have been very few suggested ways of designing acoustic metamaterials that can be dynamically reconfigured and tuned. Integration with magnetic materials, well known for their ability to store information e.g. in magnetic hard disk drives, offers an exciting route for achieving non-volatile tuning of acoustic metamaterials. We strive to develop a new class of magneto-acoustic metamaterials in which the role of their building blocks ("meta-atoms") is played by magneto-acoustic resonators [1,2]. Such metamaterials will add magnetic field tunability to structures aimed to control the propagation of surface acoustic waves, opening intriguing opportunities both in fundamental science and technology. The memory phenomenon inherent to magnetism will enable significant energy savings in non-volatile magneto-acoustic data and signal processing devices. For instance, they would be instantly bootable and could be more easily integrated with the existing magnetic data storage devices. From the point of view of fundamental science, the magneto-acoustic metamaterials will serve as an excellent test bed for studying the physics of wave propagation in non-uniform and non-stationary media.

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1. O. S. Latcham, et al, "Controlling acoustic waves using magneto-elastic Fano resonances", Appl. Phys. Lett. **115**, 082403 (2019).
2. O. S. Latcham, et al, "Hybrid magnetoacoustic metamaterials for ultrasound control", Appl. Phys. Lett. **117**, 102402 (2020).