Centimeter-scale acoustic streaming jet induced by surface acoustic wave transducers

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Surface Acoustic Wave (SAW) transducers have recently been introduced as a convenient way to generate a small scale flow in microfluidic channels or inside droplets settled on a substrate ([1]). The acoustic wave, induced by the vibration of interdigitated electrodes, is traveling at the surface of the substrate. When the interface air/water is reached, a part of the acoustic energy is transferred into the liquid in the form of a propagating and attenuating acoustic wave beam. The reached frequencies are typically of several MHz to GHz. A jet flow is then created under the effect of acoustic streaming. The small scale of the cited applications often prevent the study of the flow on length comparable to the acoustic attenuation length. A characterization of the full jet flow in terms of scaling laws depending on the amplitude of the forcing and frequency is not so common in the literature [2]. We experimentally study the acoustic streaming jet actuated by a SAW transducer in a water tank larger than the attenuation length for 3 values of frequencies (30, 65 and 100 MHz). Jet of several cm/s are typically obtained on distances over few centimeters. The evolution of the on-axis jet velocity, the location and value of the peak of velocity, the vertical and horizontal width of the jet are reported with PIV method. The results will be compared with dimensionless numerical and experimental velocity scaling laws obtained at smaller frequency (2 MHz) for Eckart streaming actuated by piston-type transducer of 30 mm diameter in water[3]. This investigation completes the picture partly drawn by previous studies regarding acoustic streaming jets and will provide a route to wisely choose the frequency and amplitude for microfluidic to centimetric applications.

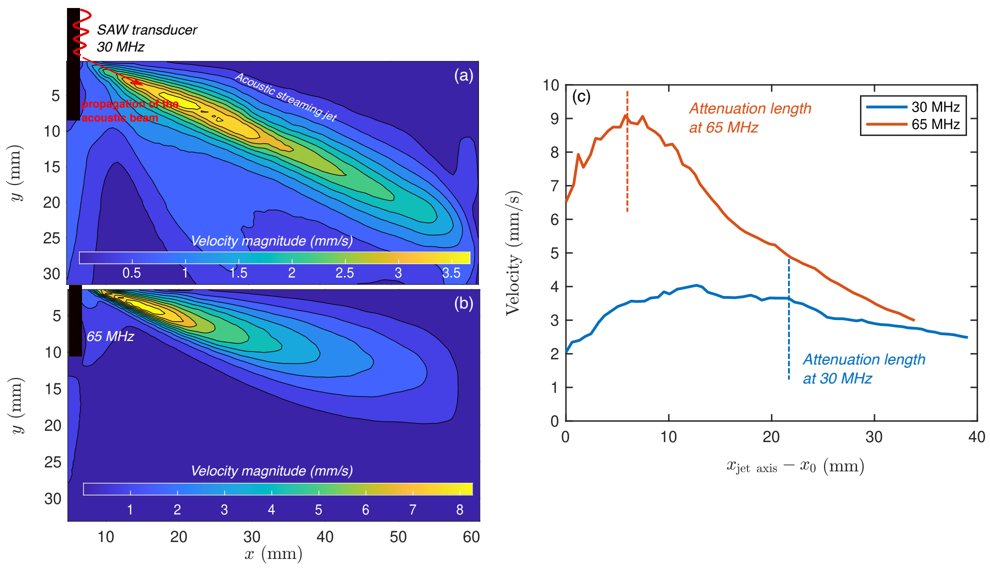

Figure 1: (a) Velocity magnitude observed in an acoustic streaming jet generated with a 30 MHz vertical SAW device in water. The saw device immersed part appears as a black mask in the upper-left angle. This velocity field has been obtained by PIV. (b) Same configuration for a 65 MHz SAW transducer, with the same voltage applied. The maximum velocity is larger and the jet is shorter due to the shorter acoustic attenuation length. (c) On-axis velocity profile of the acoustic streaming jets for 30 and 65 MHz.

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[3] Vincent et al., *Phys.Rev Fluids*, under review