Can an acoustic dipole surf on its self-generated radiation force? Toward a 3D macroscopic wave-particle coupling

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Since the seminal work by Couder et al. [1] on "walking" droplets, many studies have investigated the ability of this system exhibiting wave-particle duality to reproduce quantum like behaviours, within a two-dimensional space [2][3][4]. In this work, we aim to open perspectives for extending such quantum analogs to 3D by the mean of acoustics. For this purpose, we study the possibility for an acoustic source to surf on its self-generated wave through a nonlinear force called the acoustic radiation force. We introduce a small translation perturbation to the source, and look whether the asymmetric radiation force resulting from Doppler effect is able to propel the source. Our results show that a monopolar source is stable since the force is opposite to the motion of the source [5] while for a dipolar source, the perturbation is amplified by the self-generated acoustic radiation force.

References

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