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Ultra-High Speed Observations of the Mechanism of Sonoporation PAUL CAMPBELL, PAUL PRENTICE, Dundee University — Cells that are exposed to varying amounts of ultrasound energy may undergo either permanent cell membrane damage (lethal sonoporation) or a transient enhancement of membrane permeability (reversable or non lethal sonoporation). The merits of each mode are clear: lethal sonoporation constitutes a significant tumour therapy weapon, whilst its less intrusive counterpart, reversible sonoporation, makes for an effective non-invasive and targeted drug delivery approach. Until now, the mechanism of these interactions has remained unknown. We will demonstrate, for the first time, how an innovative hybridization of hologram based optical trapping technology, together with the application of millisecond pulsed ultrasound energy and parallel observation at MHz frame-rates using microscope objectives, has been used to elucidate the fundamental microscopic mechanism behind sonoporation. We will demonstrate the dependence of the permeabilisation mechanism on both the ultrasound field characteristics and the controlled displacement between individual microbubbles and single cells. High speed movies will be used to illustrate each category, whilst parallel fluorescence microscopy allows bioeffect to be quantified. Strategies for sonoporation optimisation are also illustrated.

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