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Einstein's Tea Leaf Analogy to Electrohydrodynamically-Driven Microfluidic Blood Plasma Separation. JAMES FRIEND, LESLIE YEO, DIAN ARIFIN, Micro/Nanophysics Research Laboratory, Department of Mechanical Engineering, Monash University — The application of a voltage upon a sharp electrode tip, mounted at an inclination angle above the liquid surface of a microfluidic chamber, generates an electrohydrodynamic air thrust that shears the liquid surface and hence induces liquid recirculation consisting of a primary azimuthal rotation and a secondary bulk meridional flow. Colloidal particles suspended within the liquid are then observed to be swept by the recirculation in a helical swirl-like motion and deposited at a stagnation point located centrally at the bottom of the microfluidic chamber. This is due to a delayed centrifugal force and an enhanced inward radial force at the base. We propose that the flow, which is similar to Batchelor flows arising between rotating and stationary disks, is analogous to Einstein's paradoxical observation of tea leaves centrally accumulating at the base of a stirred teacup and show that the phenomenon can be exploited for bioparticle trapping and concentration. In particular, we demonstrate the rapid separation of red blood cells from blood plasma for miniaturized blood diagnostic kits.

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