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Condensation growth of levitated microdroplets in an electric field

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A laboratory technique has been developed to keep water droplets (30–100 μm diameters) in a levitated, stationary state within an upward-oriented airstream. The droplets are organized in a hexagonal monolayer which forms in a steam jet. They are kept in equilibrium for up to several minutes [1]. Almost immobile droplets thus travel a distance of many meters relatively to the jet, which makes the system comparable to the concept of the "Leipzig Aerosol Cloud Interaction Simulator LACIS" [2]. However, in our case, optical microscopy can be used to study the positions and sizes of the microdroplets in real time.

At the first place, we studied the droplets' growth according to the Maxwell's law for condensation. Later, a technology was developed to suppress condensational growth through the exposure to infrared radiation [3]. More recent research focused on the influence of periodic heating of the subjacent water layer on the droplets' growth [4]. This was the starting point to study the droplets' growth under the influence of an external electric field.

Electric fields in the order of 10^5 V m^{-1} were applied and an enhancement of condensation was observed. To our knowledge, this is the first experimental observation of a process that has long been proposed in theoretical considerations [5]. A mathematical model based on theoretical data is in moderate agreement with our experimental data. Also, a strong anisotropy of condensation within the electric field as well as effects on droplet growth are predicted. The results are promising and will likely contribute to the understanding of electrophysics of natural cloud droplets [6] and eventually of the formation of precipitation [7, 8].

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References:

[1] Fedorets A.A. *et al.* Sci. Rep. **7** 1888 (2017). DOI: 10.1038/s41598-017-02166-5

[2] Kiselev A. *et al.* Appl. Opt. **44**(22) 4693 (2005), DOI: 10.1364/AO.44.004693

[3] Fedorets A.A., Dombrovsky L.A. Int. J. Heat Mass Transf. **104** 1268 (2017). DOI: 10.1016/j.ijheatmasstransfer.2016.09.087

[4] Fedorets A.A. *et al.* Int. J. Heat Mass Transf. **127A** 660 (2018). DOI: 10.1016/j.ijheatmasstransfer.2018.07.055

[5] Murino G. South Afr. J. Phys. (South Africa) **2** 113 (1979).

[6] Andreev S.N., Gabyshev D.N. Bull. Lebedev Phys. Inst. **45**(9) 257 (2018). DOI: 10.3103/S1068335618090014

[7] Pruppacher H.R., Klett J.D. Microphysics of Clouds and Precipitation (Springer, 2010).

[8] Nadykto A.B. *et al.* Aerosol Sci. Tech. **37**(4) 315 (2003). DOI: 10.1080/02786820300961