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PHOTONIK SEMINAR

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Mid-IR laser filaments for weather control

Clouds, fog, snowfalls and rain showers have a great impact on economy and human wellbeing. On one hand, they affect visibility, disturb traffic and paralyze free-space optical communication, while on the other hand, an absence of rain leads to droughts and shortage of drinking water.
Nowadays, triggering rain and clearing of the sky is done by disposing a large amount of chemicals from airplanes and propane-burning ground stations. This method has inadequate selectivity, high operational costs, poor efficiency and ambiguous ecological impact. In 2003 a group of scientists from “Teramobil” project had suggested to use laser filaments for local control over water precipitation.
Laser filaments are narrow (0.1-1 mm) and long (up to 1 km) channels of light with extremely high intensity of ~50 TW/cm2, maintaining its own size and structure due to modification of optical properties of a medium, in which the light propagates.
Propagating in filamentation regime, laser pulses deposit large amount of energy in a small volume of space, causing ionization and excitation of molecules.
It results in acceleration of photochemical reactions, leading to a formation of aerosols and causes subsequent generation of acoustic waves, pushing aerosols and droplets away from the optical path. This effects can be used for triggering formation of clouds as well as for locally clearing a path through already existing clouds and fog, opening a channel for free space optical telecommunication.
Employment of high energy mid-IR fs lasers allows to involve molecular rotational and vibrational motion in laser-induced control over formation and dissipation of aerosols. It results in enhanced generation of aerosols via photoexcitation of volatile organic compounds and in bigger diameter of the opening in clouds for FSO signal due to generation of stronger acoustic waves, provided by increased energy deposition rates.

V. Shumakova, et al. Opt. Lett.43 (2018)
V. Shumakova, et al. Opt. Lett. 44 (2019)
V. Shumakova, et al. Optica 8 (2021)

Thursday, 18th November 2021, 14:15h

https://tuwien.zoom.us/j/97611870939?pwd=YW5kaEU5MlBjUk04cjJvRHZDdVBhZz09

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