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Generation of terahertz radiation from water enhanced using two-color laser excitation FREE

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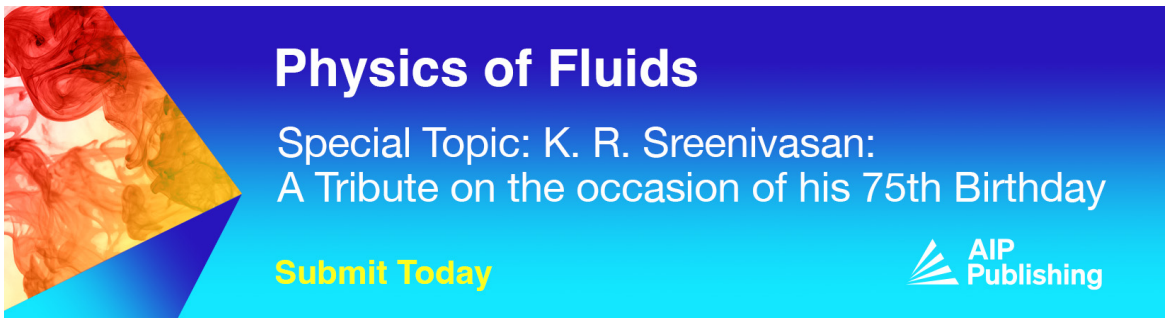

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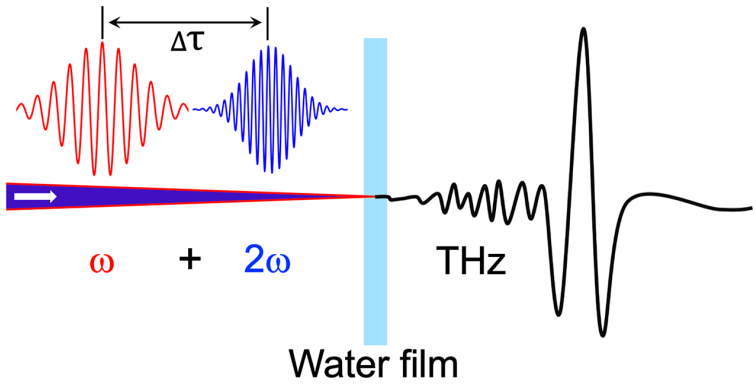
A laser pulse and its second harmonic frequency produce significantly higher terahertz energy.



The terahertz portion of the electromagnetic spectrum can be used for a variety of applications, such as material characterization, medical imaging, security, and chemical and biological spectroscopy. However, more robust generation sources are needed for many reasons, such as higher power output, source cost, and control over the generated beam properties. Of the four fundamental states of matter, liquids, especially water, have been the least explored as a terahertz source.

Jin et al. recently improved on their previous technique of generating terahertz radiation from a thin water film using a laser excitation method. Their new work utilizes a two-color approach with an 800-nanometer laser and its second harmonic to generate THz energy about 10 times stronger than the one-color approach.

The authors used a free-standing, running water film with a 1-kilohertz-pulsed laser repetition rate where they tested different ratios in the powers and phases for the primary and second harmonic frequencies.

In contrast to their previous work using a single laser frequency to induce the terahertz radiation, which followed a linear trend with the laser power, they found that the modulated THz energy increases quadratically with the increase of the excitation laser pulse energy, while the unmodulated component increases linearly.

In addition to significantly enhancing the power output, phase modulation of the terahertz wave was observed when coherently altering the relative phases of the two incident laser beams, which could have potential in data sharing or telecommunication applications. The authors plan on publishing future work tuning the optical excitation parameters and water conditions and have preliminary results indicating even higher terahertz radiation power outputs.

Source: "Terahertz wave emission from a liquid water film under the excitation of asymmetric optical fields," by Qi Jin, Jianming Dai, Yiwen E, and Xi-Cheng Zhang, *Applied Physics Letters* (2018). The article can be accessed at https://doi.org/10.1063/1.5064644.