Optical-field ionized gases: a new route for studying kinetic plasma instabilities

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More than 99% of the observable matter in our universe is in the plasma state. When the velocity distribution functions of the plasma electrons, ions, or both are nonthermal, plasmas are susceptible to kinetic instabilities. Kinetic instabilities are ubiquitous in both laboratory and astrophysical plasmas and their theory has been one of the foundational pillars of plasma physics. Yet the experimental studies of them have been relatively limited due to the lack of suitable experimental platforms. In this talk, I will introduce a new platform that is suitable for investigating kinetic instabilities such as streaming, filamentation, and Weibel instabilities. The platform allows one to initialize nonthermal and anisotropic electron velocity distributions in a controllable manner and then to follow the onset, growth, and saturation of these instabilities. Experimental results will be presented.