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Kinetics of plasma formation in sodium vapor excited by nanosecond resonant laser pulses

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Abstract

We have studied theoretically formation of molecular ion Na-2 (+) and the atomic ion Na+ which are created in laser excited sodium vapor at the first resonance transition, 3S(1/2)-3P(1/2). A set of rate equations, which describe the temporal variation of the electron energy distribution function (EEDF), the electron density, the population density of the excited states as well as the atomic Na+ and molecular ion Na-2 (+), are solved numerically. The calculations are carried out at different laser energy and different sodium atomic vapor densities. The numerical calculations of the EEDF show that a deviation from the Maxwellian distribution due to the superelastic collisions effect. In addition to the competition between associative ionization (3P-3P), associative ionization (3P-3D) and Molnar-Hornbeck ionization processes for producing Na-2 (+), the calculations have also shown that the atomic ions Na+ are formed through the Penning ionization and photoionization processes. These results are found to be consistent with the experimental observations.

Keywords

Author Keywords: Plasma; Laser; Collisional ionization; Photoionization; Electron energy distribution function

KeyWords Plus: ASSOCIATIVE IONIZATION; ENERGY-TRANSFER; RUBIDIUM ATOMS; COLLISIONS; PHOTOIONIZATION; SPECTROSCOPY; EXCITATION; SATURATION; LITHIUM; STATES

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