Interaction of an Intense Laser Beam with Anharmonic clusters and Resonant Third Harmonic Generation

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**Abstract**. This model investigates the third harmonic generation of a laser beam in nanoclustered plasma. When an intense laser beam interacts with a clustered plasma of Argon gas, it displaces electrons within the medium. A restoration force is generated which is assumed to vary nonlinearly with the displacement of the electrons, resulting in an anharmonic response of the electron clouds in the cluster. To ensure resonant harmonic generation, a ripple is applied to both the cluster density and the surrounding plasma electron density. Using perturbation theory, the nonlinear current at the third harmonic frequency, which drives third harmonic generation, is examined. Numerical computations are carried out to explore the impact of various laser and cluster parameters on the efficiency of the generated third harmonics. Additionally, it is observed that the anharmonic cluster structures exhibit strong optical nonlinearities, broadening the surface plasmon resonance.