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COMPUTER SIMULATION OF THE EFFECT OF PERIODIC ELECTRIC FIELDS ON LINE SHAPES

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Plasma diagnostics using Stark-broadened spectral line shapes require an increasing accuracy to obtain detailed information on the physical processes at work in the plasma. In a complementary way to the analytical approaches, computer simulations have been used in the last decades in an attempt to increase the accuracy of the line shape models, e.g. to study an improved treatment of N-body interactions by using molecular dynamics [1,2], and the effect of non-dipole terms or the interaction of the plasma particles within the wave function extent of the bound electron [3,4].

We here use a computer simulation for accurate line shape calculations of hydrogen submitted to the simultaneous effect of the plasma microfield and a periodic electric field. Periodic electric fields can be generated by an external source, such as a microwave generator or laser radiation, but they may also be created inside the plasma, resulting from a nonthermal effect driven by a plasma instability. Our simulation generates classical particles moving in a cubic box with straight paths for the case of neutral emitters. Velocities are sampled from a Maxwellian distribution, and periodic boundary conditions ensure that the number of particles remains constant.

Using a dipolar approximation, we integrate the emitter Schrödinger equation by bretaining the simultaneous effects of the microfield and a periodic electric field $\vec{E}_W = \vec{E}_L \cos(\omega t + \varphi)$, with φ a random phase, and a field magnitude E_L of the order of or larger than the average plasma microfield.

We present simulated Lyman and Balmer line shapes for plasma densities and temperatures corresponding to many laboratory, fusion and astrophysical plasma.

References

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