Invited Lecture

DYNAMICS RESONANCES IN ATOMIC STATES OF ASTROPHYSICAL RELEVANCE

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Optical methods for the registration and control of parameters of ionized gas media including cold gases of astrophysical relevance have a number of unique properties. Photoionization plasma is created via excitation of the resonance states of atoms with their subsequent ionization. A key role in primary optical excitation is played by the stochastic migration of resonance photons (radiative transfer) in the volume of the absorbing medium in stellar atmospheres Bezuglov et al.(2003). The collision transfer of an atom's electron energy also exhibits features of random (Brownian) motion. For example, in a quasi molecular complex formed by collisions with the participation of Rydberg atoms, the initial state evolves into the final ionization channel accompanied by multiple intersections of intermediate terms and requires that we consider the chaotic migration of excitation along the dense network of highly excited states. Cold collisions favor the development of dynamic chaos, imposing some restrictions on coherent laser control of atoms having resulted, for instance, in the creation of cold plasma in a system of cold Rydberg atoms Park et al.(2011). We should also note the fluorescence that accompanies excitation atoms as a result of spontaneous transitions. Since the distribution of diffused photons over solid angles is of a random character, we must introduce elements of stochastic dynamics to describe the time evolution of radiating quantum systems Bezuglov et al.(2003). The aim of our presentation is to demonstrate the effectiveness of stochastic dynamics along with the formalism of dynamics resonances in describing phase breakdown for a wide variety of processes associated with the physics of creating and subsequently transferring optical excitation. We consider and give the explanation of, in particularly, the abnormal properties of the IR emission spectra of white dwarfs which reveal a gap in the radiation emitted by Rydberg atoms (RA) with values of the principal quantum number of $n \approx 10$ Afanasiev et al.(2006).

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Progress Report

CONTRIBUTION OF LIENARD-WIECHERT POTENTIAL IN THE ELECTRON BROADENING OF SPECTRAL LINE SHAPES IN PLASMAS

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Lienard-Wiechert or retarded electric and magnetic fields are produced by moving electric charges with respect to a rest frame. In hot plasmas, such fields may be created by high velocity free electrons. The resulting electric field has a relativistic expression that depends on the ratio of the free electron velocity to the light velocity c. In this work we consider the semi-classical dipole interaction between the ion radiators and the Lienard-Wiechert electric field of the free electrons and compute its contribution to the broadening of the spectral line shape in hot and dense plasmas.