Modeling of Line Shapes Using Stochastic Processes

M. Christova

Dept of Applied Physics, Technical University of Sofia
1000 Sofia, Bulgaria

H. Capes, D. Boland, A. Bouzaher, F. Catoire, L. Godbert-Mouret, M. Koubiti, S. Mekkaoui, J. Rosato, Y. Marandet, and R. Stamm

Physique des Interactions Ioniques et Moléculaires UMR6633, Université de Provence et CNRS, Marseille, France

Accurate calculations of line shapes are widely used by physicists to obtain information on the emitting gas or plasma. For the radiation emitted in such environments, the modeling of line shapes often asks for the solution of a stochastic differential equation describing the evolution of the emitter submitted to random perturbations. In plasma, the major perturbation is usually brought by the electric microfield created by the numerous charged particles moving around the emitter. Here the method consists of substituting the true electric field with an effective stochastic electric field, whose evolution is characterized by stepwise constant values separated by instantaneous jumps distributed according to a chosen dynamical process. Using the Continuous Time Random Walk theory (CTRW) [1], the standard Kangaroo process where the waiting time distribution between electric field jumps follows a Poisson distribution will be extended to various waiting time distribution including Lévy distributions. The standard Kangaroo process for the microfield have first been proposed several decades ago, using a Markov approximation for the microfield entering the emitters [2]. We will show that using the CTRW allows to retain non-Markovian effects. We will compare the previous and new results obtained with these models with profiles obtained by a plasma computer simulation coupled to a numerical integration of the Schrödinger equation.

References

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[2] A. Brissaud and U. Frisch (1971) *J. Quant. Spectrosc. Radiat. Transfer* **11**, 1767 ; (1974) *J. of Mathematical Physics* **15**, 524.

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