Landau-Zener transitions and Dykhne formula in simple continuum models

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The Landau-Zener model describing the interaction between two linearly driven discrete levels is useful in describing many simple dynamical systems; however, no system is completely isolated from the surrounding environment. Here we examine two generalizations of the original Landau-Zener model to study simple environmental influences. First we consider a model in which one of the discrete levels is replaced with a continuum, in which we find that the survival probability for the initially occupied diabatic level is unaffected by the presence of the continuum. This result can be predicted by assuming that each step in the evolution for the diabatic state evolves independently according to the Landau-Zener formula, even in the continuum limit. We also show that, at least for the simplest model, this result can also be predicted with the natural generalization of the Dykhne formula for open systems [1]. We also consider a second generalization in which a continuum is added to the traditional Landau-Zener model. Here we find that there is a shift in the survival probability due to the continuum [2]. We also observe dissipation as the non-escape probability from the discrete levels is no longer equal to one. [1] A. M. Dykhne, Sov. Phys. JETP 14, 941 (1962). [2] A. Dodin, S. Garmon, L. Simine, and D. Segal, J. Chem. Phys. **140**, 124709 (2014).