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Stark Resonances in Disordered Systems

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Abstract. By slightly restricting the conditions given by Herbst and Howland, we prove the existence of resonances in the Stark effect of disordered systems (and atomic crystals) for large atomic mean distance. In the crystal case the ladders of resonances have the Wannier behavior for small complex field.

1. Introduction

In 1981 Herbst and Howland had provided a setup for the definition of resonances in the case of one-dimensional regular crystals as well as of disordered systems in a uniform electric field. They omitted the existence proof.

Starting from such a construction, and slightly restricting the general conditions of Herbst and Howland (1981), we provide existence theorems for resonances in disordered systems in the regime of large distance between atoms at small fixed electric field. This result adds to and completes the recent results on the crystal case given by Bentosela and Grecchi (1991), Buslaev and Dmitrieva (1990) and Combes and Hislop (1991) (see also Agler and Froese (1985) for the case of large electric field). Our proof (see Sect. 2) is very general and refers to standard techniques of eigenvalue stability. If our treatment is specialized to the case of an ordered atomic crystal (see Sect. 3), we obtain exact ladders of resonances, that are uniquely associated with the complex field states of Avron (1979) and Bentosela et al. (1988) and with the single-band approximation of Wannier.

As a particular case, we consider a model that in the zero field case coincides with the classical Lamé problem, which, for integral values of a parameter, gives rise to a finite number of bands. In the last case, but for small positive field, we prove the existence of a ladder for each Lamé finite band, as suggested by Avron (1982). For a study of the quasi regular case by perturbation theory methods we refer to the paper of Nenciu and Nenciu (1989).