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Spectral analysis for N-particle systems with Stark effect: non-existence of bound states and principle of limiting absorption

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§ 1. Introduction.

The local commutator method has been initiated by Mourre [11] and major progress has been made in the spectral and scattering theory for many-particle Schrödinger operators during the last decade. By making use of this method, for example, the principle of limiting absorption has been established by [11, 13] and the non-existence of positive eigenvalues has been proved by [3]. Furthermore, it has also played a basic role in proving the asymptotic completeness of wave operators ([4, 9, 16, 17, 21]). In this work, we use this remarkable method to prove the non-existence of bound states and the principle of limiting absorption for many-particle Stark Hamiltonians with homogeneous electric fields. The results obtained have an important application to the problem on the asymptotic completeness of wave operators. We are going to give a full explanation about the matter in another paper.

We now consider a system of N particles moving in a given constant electric field $\mathcal{E}\in R^3$, $\mathcal{E}\neq 0$. We denote by m_j, e_j and $r_j\in R^3$, $1\leqq j\leqq N$, the mass, charge and position vector of the j-th particle, respectively. We also use the notation $\langle\cdot, \cdot\rangle$ to denote the usual scalar product in the Euclidean space. Then the total energy Hamiltonian for such a system is described as

$$-\sum_{1\leqq j\leqq N}\{\Delta/2m_j+e_j\langle\mathcal{E}, r_j\rangle\}+V\,,$$

where the interaction potential V is given as the sum of pair potentials

$$V=\sum_{1\leqq j<k\leqq N}V_{jk}(r_j-r_k)\,.$$

For notational brevity, the values of masses are fixed throughout as

$$m_j=1, \qquad 1\leqq j\leqq N,$$

but the values of charges are regarded as real parameters. As usual, the Hamiltonian above is considered in the center-of-mass frame. We introduce the configuration space X as