Publ. Astron. Obs. Belgrade No. 99 (2020), 326

ADIABATIC REPRESENTATION OF ATOMIC COLLISION PROCESSES

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Abstract. The use of an adiabatic representation to describe collision between atomic systems dates from the early days of quantum mechanics, when Landau recognized the importance of avoided crossings of the adiabatic potential energies, leading to excitation and charge exchange in collision between ions and neutral atoms and molecules. The early models, such as those developed by Landau and Zener were successful for certain specific processes but the development of a consistent theoretical model going beyond the Born-Oppenheimer approximation proved difficult. The first fully quantum mechanical formulation, proposed by Bates et al. in 1947 (Bates and Massey 1947) raised many inconsistencies. A decade later, an impact parameter method was developed, but this involved the introduction of a time variable, which cannot be uniquely was different, the notion of translation factors was introduced. Such factors have proved useful cannot be well defined. It was only in the late 1970's that a fully quantum mechanical description of the adiabatic representation by Thorson et al was made possible by the introduction of appropriate reaction coordinates. This solved many problems but not all. Indeed, the outstanding question was to ensure that an adiabatic basis including only those involved in an avoided crossing was sufficient to describe all the reaction channels. This was only achieved at the turn of the century. It had taken 70 years to finally develop a method which enables the use of an adiabatic basis to represent the collision. A review of methods using an adiabatic representation been given recently (Rabli and McCarroll 2018).

References

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