# Shannon and Fisher entropies as indicators of atomic avoided crossings for Stark states of Rydberg atoms

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**Synopsis** We propose a method to calculate the positions of avoided crossings for Stark states of Rydberg potassium by using Shannon and Fisher entropies. The results are in excellent agreement with observed and other calculated results by using the ionization energies.

Information concepts play a growing role of importance in studying physical systems [1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14]. Recently, an alternative picture of energy level crossings and avoided crossings phenomena based on the information concepts have been proposed [1, 2, 3, 4]. They have shown that the avoided crossing phenomenon is not only a mechanism of the energy level reordering, but it is also a mechanism for state information-theoretic character exchanging [2, 3, 4]. The evidence for the correspondences between the exchange of Shannon or Fisher entropies and energy level avoided crossings for hydrogen atoms at the critical value of magnetic field strength are clearly observed [2, 3, 4]. We propose a method to calculate the positions of avoided crossings for Rydberg potassium in a static electric field by using Shannon and Fisher entropies [15, 16]. The deciding of the position for a given avoided crossing can be divided into two steps. Step 1: we made a rough estimate of the range of the static electric field strength at which the given avoided crossings occur through strength dependence of the Shannon or Fisher entropies for all the related states [15, 16]. Step 2: we obtained the position of the given avoided crossing by calculating the Shannon or Fisher entropies intersection field strength for the two involved states [15, 16]. The Shannon or Fisher entropies are calculated by using the one-electron wave functions derived from a well-established diagonalization method which is based on B-spline expansion technique and a parametric one-electron model potential [15, 16]. We have used this method to calculate a number of positions of both s and p states of avoided crossings for Rydberg potassium. The results are in excellent agreement with observed and other calculated results by using the ionization energies [15, 16]. Our study proves that Shannon and Fisher entropies are efficient information-theoretic parameters for characterization and prediction of avoided crossings of Rydberg atoms when the avoided crossings are well separated from each other or when one can identify individual entropy exchange events. Our method can be considered as a beneficial supplement for the traditional calculation methods.

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