

A Comparison of the Resonance Energies and Widths of the Be $1P^o$ and $3P^o$ Doubly Excited States Obtained with the BSCR and Stabilization Methods along with the BSCI Approach

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The resonance energies and widths of the Be $2pns$ and $2pnd$ ($1P^o$ and $3P^o$) doubly excited states are determined. The densities of the resonance states are calculated by using the stabilization method along with the B-spline-based configuration interaction (BSCI) approach. The results obtained from the stabilization method are in good agreement with those obtained from the B-spline-based complex rotation (BSCR) calculation and other theoretical and experimental results.

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I. INTRODUCTION

Mandelshtam *et al.* [1] proposed a procedure for calculating the resonance energy (E_r) and width (Γ) of a resonance. They calculated the densities of resonance states by using the stabilization method. The use of the stabilization method to investigate atomic resonances has a long history [2, 3]. The method has been used to estimate resonance positions for different atomic systems [4–6]. Efforts have been made to calculate the autoionization widths by combining the stabilization method and the L^2 -technique [7]. Recently, Mandelshtam *et al.* [1] have successfully applied the procedure to a model problem. Muller *et al.* [8] applied the method to calculate doubly excited S-wave resonances in He, and Bachau [9] applied it for the triple excited states of the N^{4+} ion.

In addition, the B-spline-based configuration interaction (BSCI) approach [10] has recently been shown to be an effective and accurate method for studying the atomic structures of two-electron and divalent atoms. The diagonalization of the real Hamiltonian matrix is carried out with a modified two-step Davison procedure [10] that can be performed with a maximum memory requirement of approximately half the size of the matrix. The first method used in this work is a combination of the stabilization method and the BSCI approach.

In other cases, the complex-rotation method has been proven to be an attractive approach for obtaining energies and widths of resonances produced in atomic and molecular collisions. The first practical application of the complex basis functions for photoionization in a multielectron atom was carried out by Rescigno in 1985 [11], in which the ground-state