Introduction

Several Calculations indicted that a positron (e⁺) does not form any bound state with the He(S)(L=0) atom but could bind itself to the triplet state He(2³S) atom against dissociation into Ps+He⁺[1,2]. These calculations mainly aimed at investigating the stability of the system and revealing the annihilation process. Resonances ine⁺-He(2³S) scattering have not been studied. There has been increasing interest to investigate atomic resonance phenomena involving positrons. Up to now, two kinds of resonances have been widely studied. One is the type formed by an exited positronium moving in the field of positively charged atomic core[3-5]. These resonances are due to the degeneracy of the excited Ps (e⁺e⁻) states that leads to a permanent dipole moment for the excited Ps. The other type resonances are below the e⁻-B(B is atom) threshold. [5]

Methods

Hyperspherical coordinates

The Jacobi coordinate of system:

\[ r_p = R \cos \phi \]

\[ r_c = R \sin \phi \]

The adiabatic potentials and channel functions are defined as the solutions of the following adiabatic eigenvalue equation which is solved with B-splines as basis functions

\[ H_{ad}(R, \phi, \theta) \phi(R, \phi, \theta) = R^2 E \phi(R, \phi, \theta) \]

The three-body Sch. Eq. is solved using the slow variable discretization method (SVD).[4]

Results and discussion

1. Bound state and structure

TABLE IV: Computed energy and expectation values for the e⁺He(2³S) system obtained in the present work and comparison with other results.

<table>
<thead>
<tr>
<th>Method</th>
<th>Energy</th>
<th>\langle r_c \rangle</th>
<th>\langle r_p \rangle</th>
<th>\langle r_{cp} \rangle</th>
<th>\langle r^2_c \rangle</th>
<th>\langle r^2_p \rangle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Present</td>
<td>-0.250 61</td>
<td>15.261</td>
<td>15.705</td>
<td>3.1506</td>
<td>346.97</td>
<td>351.55</td>
</tr>
<tr>
<td>FCSVM</td>
<td>-0.250 5803</td>
<td>15.4524</td>
<td>15.8902</td>
<td>3.148 72</td>
<td>356.266</td>
<td>363.781</td>
</tr>
<tr>
<td>SVM</td>
<td>-2.250 595 08</td>
<td>15.805 61</td>
<td>359.518</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ECG</td>
<td>-2.250 593 715</td>
<td>15.749 5907</td>
<td>353.868 46</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Conclusions

In summary, the S-wave resonances in the positron-helium(2³S) system have been studied using the hyperspherical stabilization method. Two resonances located at -0.068 88, -0.079 22 a.u. are obtained. And using the hyperspherical stabilization method for fixed hyperradius, the binding of positron to a metastable state of helium is also indicated with a total energy about -2.250 61 a.u.. And the geometry of e⁺He(2³S) is also presented.