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Nuclear fusion rate for an ordinary $dd\mu$ ion

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Domain : other

A consistent theoretical approach, based on a new wave function to $dd\mu$ molecular ion is developed. The present method provides a calculation of nuclear fusion rate for $(J,v)=(1,1)$ level, a resonance state. The behavior of the wave function is important for the calculation of the element matrixes related to nuclear and photon fields [1,2,3]. In this work, we introduce the below wave function for the $dd\mu_{1,1}$ ordinary ion:

$$\psi(\vec{r},\vec{R}) = \zeta L f(R)\chi^{1,1}(R) \sum_{m=1,0,-1} \sum_{i=1,2} Y_{1,m} c_i(\beta_i,\beta_i^{'}) \exp(-|\beta_i^{'}\vec{r}+\beta_i\vec{R}|).$$

Where $\vec{r}$ and $\vec{R}$ are the notations for the displaying of Jacobin coordinates of the muon and the nuclei. The radial wave function $\chi^{1,1}(R)$ is related to the moving of the nuclei in the effective potential. For the mentioned muonic ion, the constant parameters are variationaly optimized and then, used for the fusion rate of $(1,1)$ level. The calculated rate is in the orders of $10^9\ \mathrm{s}^{-1}$, and close to precise data. As the limited function $Lf(R)$ is linear from $R=0$ to $2.2\times10^{-10} cm$ and then being constant(=0.7071), the numerical calculations are done with a short computation time.

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