Joint CQSE and CASTS Seminar

Weekly Seminar
Feb. 26, 2016 (Friday)

TIME Feb. 26, 2016, 14:30 ~ 15:30
TITLE Analytical form of helium wave function
SPEAKER Prof. Henryk A. Witek
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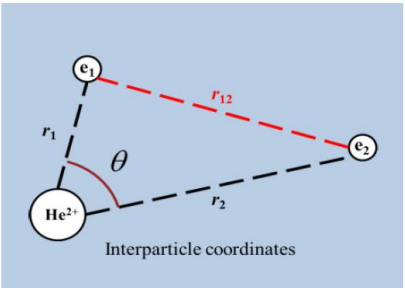
PLACE Rm716, CCMS & New Physics Building, NTU

Abstract

Implicit analytical form of the ground state wave function for helium

$$\Psi(r_1, r_2, r_{12}) = \sum_{n=0}^{\infty} (r_1{}^2 + r_2{}^2)^{\frac{n}{2}} \sum_{p=0}^{\left\lfloor \frac{n}{2} \right\rfloor} (\ln(r_1{}^2 + r_2{}^2))^p \cdot f_{np}\left(\underbrace{\frac{r_1{}^2 - r_2{}^2}{r_1{}^2 + r_2{}^2}}_{\cos\alpha}, \underbrace{\frac{r_1{}^2 + r_2{}^2 - r_{12}{}^2}{2 r_1 r_2}}_{\cos\theta} \right)$$

was proposed by Fock in 1954 [1]. Explicit determination of the angular Fock coefficients $fn(\alpha,\theta)$ turned out to be a complex task; only few of them are found up to date [1–6]. The Fock series can be considered as an extended Taylor series of the exact wave function in the coordinates $\left(r = \sqrt{r_1{}^2 + r_2{}^2}, \ln r, \cos\alpha, \cos\theta\right)$ around the triple coalescence point r=0. The current talk will show how the Fock series emerges. In particular, it will show how the logarithmic terms appear in low-order Fock coefficients in order to guarantee physical behavior (continuity and finiteness) of the resulting wave function. We will address also the question of Fock expansion for helium in states with non-zero angular momentum.



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