The One-Body and Two-Body Density Matrices of Finite Nuclei and the Center of Mass Correlations

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The last few years the interest in the study of nuclei from both experimental and theoretical point of view has shifted from the investigation of one-body quantities towards the investigation of two-body quantities, which are connected to the two-body density matrix (2DM) in coordinate or momentum space. A prominent role towards the experimental investigation of the 2DM and related quantities is played by the study of electromagnetically induced 2-nucleon emission (γ, NN), (e, e′NN) which is carried out with high accuracy in photon facilities and electron accelerators with high energy, 100% duty-cycle beams [1, 2]. One of the theoretical issues under discussion is the proper consideration of the requirement of translational invariance (TI) and the proper elimination of Center-of- Mass (CM) correlations.

In this work [3] the one-body and two-body density matrices in coordinate space and their Fourier transforms in momentum space are studied using appropriate intrinsic operators, intrinsic wavefunctions constructed by means of the Ernst-Shakin-Thaler projection technique and an algebraic technique based upon the Cartesian representation [4]. Thus, TI is respected. In the course of our calculation the Tassie-Barker factors and other relations are derived in a model independent way. As specific examples the intrinsic one-body η(p) and two-body momentum distributions (TBMD) $\eta^{[2]}(\vec{p},\vec{k})$ for the ^{4}He have been calculated within the context of the independent particle shell model using harmonic-oscillator wavefunctions. By comparing our results with those of ref [5] we find that CM correlations introduce important effects in the momentum distributions. Using the above formalism we could calculate the intrinsic TBMD of other than ^{4}He Z=N ℓ-closed nuclei within the context of the harmonic oscillator model. In addition, one could even investigate the effect of short-range correlations of Jastrow type on these intrinsic momentum distributions.

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