Di-Nucleus Configurations of Molecular Resonances and Particle-γ Angular Correlations in ^{28}Si $+^{28}$ Si System

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Recently we have analyzed new characteristic experimental data on particle-γ angular correlations on the resonance of $\mathbf{^{28}Si} + ^{28}\mathbf{Si}$ system at $\mathbf{E_{c.m.}} = \mathbf{55.8MeV}$ with $\mathbf{J} = \mathbf{38}$ [1]. There, we describe quantum states of the di-nucleus system with the molecular model [2]. For a given total angular momemtum, intrinsic molecular normal modes are solved. In each molecular eigenstate, the constituent $\mathbf{^{28}Si}$ nuclei have their own characteristic spin-orientations. The results of the analysis have elucidated that the correlations are crucial in determining the structure of the di-nuclear configuration, more precisely motions of the constituent nuclei $\mathbf{^{28}Si}$ in the resonant state. This is reasonable, because spin orientations of the constituent $\mathbf{^{28}Si}$'s show different correlations between decaying particles and their γ rays emitted.

Actually, molecular modes of excitation show apparently different angular correlations, as is exemplified with the butterfly mode in the left hand side of Fig.1. In addition, the total di-nuclear system has an axially asymmetry, and thus undergoes so-called wobbling rotations as a whole. Their excitations also show quite different angular correlations, as shown in the right hand side. It is obvious that the measured correlations correspond to those of the molecular ground state with no wobbling excitation. Not only the angular correlation data but also all the available data such as angular distributions in the elastic and the inelastic scatterings, and the particle decay widths are comprehensively explained with the model [3, 4].

The results are so regular and thus strongly encourage systematic measurements of the correlations on the neighboring resonances, which will unveil the mystery of the resonances in heavy-ion collisions.

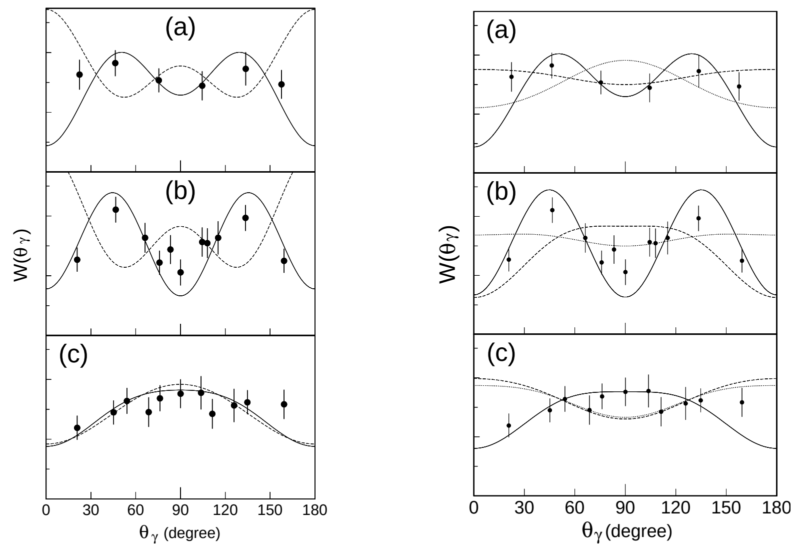

Figure 1: Angular correlations of various molecular excitations in the mutual 2^+ channel decays. The pannels (a), (b) and (c) correspond to three quantization z-axes : (a) beam direction, (b) normal to the reaction plane and (c) fragment direction taken perpendicular to the axes (a) and (b). Dots with error bars are experiment. *Left*: Comparison with the butterfly mode excitation. Solid lines show the theoretical results for the molecular ground state with no wobbling excitation, and dashed lines for the butterfly excited state, respectively. *Right*: Comparisons among wobbling rotations. Solid lines show the theoretical results for the molecular ground state with no wobbling excitation, dashed lines for the first wobbling excited state and the dotted lines for the second excitation, respectively.

References

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