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Preface

The symposium "Quantum Science and form" was held at the Institute of Statistical Mathematics in Tachikawa city, Tokyo on June 2016 by the conference chair: N. Nishigaki (Saitama Univ.) and S. Nakamura (Riken). It was held as the 81st symposium of Society for Science on Form. The purpose of the symposium was to discuss on the form that appears in the quantum theory. Four guest speakers have discussed mainly on the quantum chemistry, and another one from fellow has discussed on the spherical harmonics from algebraic view point.

A special issue on this symposium, which is a collection of papers presented at this symposium as well as a newly contributed paper related to the symposium theme has been published here. There are four contributions, and I will roughly introduce them here.

Profs. Nohira and Nohira have discussed on the correlation diagram of molecular orbitals for the pre- and post-chemical reaction. The essential concepts are to take the chemical reaction as a single step one without unsteady intermediate states and to consider the resultant change of molecular orbitals under the constraint of minimum change of the entire 'shapes'. By using this approach, they succeeded in explaining the conversion reactions of Dewar benzene to benzene and prismane to benzene. The results thus obtained are obeying to the Woodward-Hoffmann rule and Fukui's theory.

Prof. Tokita has shown the graphics of absolute square of the angular wave functions (spherical harmonics) with each quantum numbers, and showed the relation between quantum numbers and the numbers of spherical-, planar-, and conical-nodes, and he also introduced the glass object of spherical harmonics by which we can easily imagine the form of spherical harmonics in three dimension.

On the other hand, I (Ogawa) have discussed the algebraic method to obtain the angular wave function without solving the Schrödinger equation. By introducing the $SU(2)$ operators and mirror operators in matrix representation, the form of spherical harmonics is constructed from the restriction by symmetry.

Prof. Kaino studied magnetic properties of rare-earth metals by using the exchange interaction between conduction-electrons and the f-electrons of all atoms. The angular momentum of f-electron at the n-th atom is replaced by the mean value $\langle S_n \rangle$ which is assumed to have a conical structure. He considered the quantum theory of the fluctuation of f-spin system by using the spin-wave theory.

I hope that the readers enjoy reading this issue, and find new viewpoints or ideas for Science on Form.

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