Non-Hermitian Real Operators in Quantum Mechanics

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Abstract

Generation of quantum systems has been a subject of interest since the early development of quantum mechanics , in view of understanding physics behind micro world that may deal atomic systems, nuclear systems , quantum field theory etc. In fact it gained momentum after the induction of supersymmetry in Hermiticity or $\mathcal{PT}$-symmetry (space-time symmetry). In both the cases one can have only isolated systems satisfying the conditions

$$E = E_B + E_F \tag{1}$$

$$E_B \to E_n^{(+)}; E_F \to E_n^{(-)} \tag{2}$$

$$E_n^{(+)} = E_{n+1}^{(-)}; E_0^{(-)} = 0 \tag{3}$$

However, generation of two different bosonic and fermionic systems can hardly be achieved in simple supersymmetry . On the other hand if momentum operator is suitably incorporated in supersymmetry, one can generate twins satisfying the relation

$$E = E_B^{(1,2)} + E_F^{(1,2)} \tag{4}$$

$$E_B^{(1)} \rightleftharpoons E_F^{(2)} \tag{5}$$

or

$$E_B^{(2)} \rightleftharpoons E_F^{(1)} \tag{6}$$

In fact, a close view reveals that corresponding complex $\mathcal{PT}$-symmetry ,$\mathcal{T}$-symmetry and mixed symmetry operators are actually $\mathbf{Real-Non-Hermitian}$ - operators with well defined spectra . The main question now comes to our mind as to : if $\mathbf{Real-Non-Hermitian}$ - operators exist in different symmetry , why they will not exist in ordinary complex - bounded operators involving $\mathcal{PT}$-symmetry . Recent investigation reveals that simple complex $\mathcal{PT}$-symmetry systems involving the term $(ix)^{K=odd}$ have equivalent $\mathbf{Real-Non-Hermitian}$ operators . Hence our new generation will find/visualize/generate only $\mathbf{Real-Operators}$ that may be Hermitian or non-Hermitian . Hope this platform will motivate to generate new $\mathbf{Real-Non-Hermitian}$ - **atomic** and **nuclar** systems .