Quantum Field Theory, White Noise Distribution Theory

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Quantum field theory is basic tool of describing elementary particle physics and quantum statistical mechanics. Moreover quantum field theory is related to various fields of mathematics and provides many problems for mathematicians.

I am interested in the representation theory of infinite dimensional groups (algebra) describing quantum fields. For example, representations of loops in unitary groups or special orthogonal groups on fermion Fock spaces are related to the many-particle Dirac theory for charged or neutral particles.

I study these representations of infinite dimensional groups (algebras) by using the white noise calculus. The white noise calculus, introduced by Takeyuki Hida in 1975, is the theory for white noise test functionals and white noise generalized functionals on the infinite dimensional space, for (continuous) linear operators on these functionals. In the slogan, the white noise calculus is a functional analysis of infinitely many degree of freedom. From the viewpoint of quantum physics, the white noise calculus provides us with a framework of an analysis of boson system. The group of all maps from a Riemann manifold to a semi-simple compact Lie group is called the gauge group. The representation of the gauge group called the energy representation was constructed in 1970s and irreducibility of the energy representation of the gauge group was studied by Albeverio, Galfand et al. All of their results depend on dimension of a Riemann manifold. With the help of the white noise calculus, irreducibility of the energy representation is proved independently of dimension of a Riemann manifold when a Riemann manifold is compact.

I constructed the white noise calculus for the fermion system and now I apply the white noise theory to models of the fermion system.

profile

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