Quantum Physics

Classical and Quantum Mechanics from the universal Poisson-Rinehart algebra of a manifold

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The Lie and module (Rinehart) algebraic structure of vector fields of compact support over C infinity functions on a (connected) manifold M define a unique universal non-commutative Poisson * algebra. For a compact manifold, a (antihermitian) variable Z, central with respect to both the product and the Lie product, relates commutators and Poisson brackets; in the non-compact case, sequences of locally central variables allow for the addition of an element with the same role. Quotients with respect to the (positive) values taken by Z* Z define classical Poisson algebras and quantum observable algebras, with the Planck constant given by -iZ. Under standard regularity conditions, the corresponding states and Hilbert space representations uniquely give rise to classical and quantum mechanics on M.

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