Segal, Graeme

Geometric aspects of quantum field theory. (English) [Zbl 0757.53048]

[For the entire collection see Zbl 0741.00020.]

The article describes various mathematical aspects of modern quantum field theory, which has been a basic tool of particle physics for many decades without satisfactory mathematical ground. Recently the quantum field theory turned shed of light on purely mathematical problems and there are areas where field theory and geometry come together.

The fields in the modern approach are defined as classes of oriented manifolds and their evolution is described in terms of functional integrals describing the propagation from initial to final field configuration. Although this scheme is not fully founded, many important and interesting rigorous results were obtained within particular models. The author collects and analyzes briefly the main results obtained in the following branches of modern field theory: index theory and elliptic genus, topological field theory, 3 + 1 dimensional conformal field theory, central charges and topology of 1 + 1 dimensional conformal field theory, and 1 + 1 dimensional gravity. The article contains many valuable comments and references to the basic papers connected to the discussed topics.

Reviewer: P. Presnajder (Bratislava)

MSC:

53Z05 Applications of differential geometry to physics
58B25 Group structures and generalizations on infinite-dimensional manifolds
81T40 Two-dimensional field theories, conformal field theories, etc. in quantum mechanics

Keywords:

modular functor; functional integrals; index theory; elliptic genus; topological field theory; conformal field theory; central charges