

Qualitative models of quantum systems. Symmetry and topology aspects.

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November 20, 2010

Quantitative and qualitative description of physical phenomena are two complementary sides of our understanding of nature. Taking as examples very simple objects, namely finite particle quantum systems, i.e. atoms and molecules, and looking them as dynamical systems with a small number of degrees of freedom I'll present the qualitative approach to the analysis of their properties and dynamical behavior. The basic ingredients of this approach are symmetry and topology which allow to classify and to predict a number of characteristic structurally stable features observed first of all in the energy spectra of isolated quantum systems.

Correspondence between quantum systems and associated classical symbols is used to explain such qualitative phenomena as energy level clustering, quantum bifurcations, quantum monodromy. Direct applications of Morse theory, singular fibrations and characteristic Chern classes to concrete physical problems is illustrated with rotational, vibrational and electronic states of atoms and molecules.

References

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