

The Future of Atomic Physics

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We have a theory in which infinite factors appear when we try to solve the equations. These infinite factors are swept into a renormalization procedure. The result is a theory which is not based on **strict mathematics**, but is rather a set of working rules.

Many people are happy with this situation because it has a limited amount of success. But this is not good enough. Physics must be based on **strict mathematics**. One can conclude that the fundamental ideas of the existing theory are wrong. A new mathematical basis is needed.

The situation is comparable to that in the early 1920s, before Heisenberg made his breakthrough in 1925. We then had to work with the Bohr orbit theory. The work was successful for some problems, where there was just one electron in an atom that was mainly involved. But the success was very limited. One had no method for taking into account the interaction of the electrons in an atom. Strenuous efforts were made to remedy this defect by introducing a suitable interaction between the Bohr orbits. But these efforts led nowhere.

One can see now how hopeless these efforts were. To make real progress one needed a new mathematics, involving noncommutative algebra. The idea for this was provided by Heisenberg in 1925.

We are now again in the situation of needing some new mathematics. Many people who realize this are trying to extend and develop **field theory**. But it is doubtful whether such a development will go deep enough. Field theories, involving some kind of curved space, are needed if we are dealing with gravitation. But gravitation is excessively weak in atomic physics, so it seems unlikely that it will play an important role. Thus we should look elsewhere.

[The further aspects may be completed by the source...]