Université Blaise Pascal-Clermont II
UFR Sciences et Technologies
Département de Physique.

Advanced Quantum Mechanics

Doctoral School of Fundamental Sciences

The aim of this course is to present, with a simple formalism, some topics of Modern Quantum Mechanics to a large audience including doctoral students in Mathematics, Physics and Chemistry.
Thanks to both conceptual developments and to technology progress, new horizons have been opened in the field of Quantum Mechanics, and crucial experiments devoted to the test of its fundamental principles have been performed; for instance testing the Superposition Principle, the Decoherence problem, and many other issues in QM.

In our opinion and whatever our research theme is, Quantum Mechanics offers always new and passionate subjects of debate. This last aspect encourages us (D.Solnyshov, V.Morenas, Z.J.Ajaltouni) to reflect on some courses (or conferences) where those questions could be clearly discussed. Here are the main topics which we would like to present :

I) Causality and Chance in QM

- Theory of Measurement in QM (Copenhaguen Interpretation)

- Incomplete aspect of QM : EPR Paradox

- D.Bohm's point of vue. Causality in QM.

- Bell's Inequalities.

- Experimental tests of Bell hypothesis (Aspect experiment).

- Decoherence in QM (Zurek approach).

- Open questions in Modern QM.

II) Feynman Path Integral

- Origin and Interpretation of Feynman Integral in QM.

- Feynman Integral in Quantum Electrodynamics.

- Feynman Integral in Statistical Physics.

- Modern Applications of Feynman Integral.

III) Advanced Topics in QM

- Quantum Geometry Tensor.

- Berry Phase. Its role in QM.

The subjects exposed above are very flexible. Other questions, especially in part **III**, could be approached and studied according to the interest of the audience.

With our best regards,

D.S , V.M , Z.J.A