Aiming to a mathematical understanding of the Quantum Hall effect (QHE), we study the dynamics of non-interacting electrons in a 2-dimensional periodic background, under the additional influence of a uniform transverse magnetic field.

By using adiabatic methods, we show that, in the limit of weak (resp. strong) magnetic field, the dynamics is asymptotically unitarily equivalent to a simpler one, described by the so-called Hofstadter model (resp. Harper model).

The geometric structure hidden in such effective models is outlined, and it becomes the key-idea to show the duality existing between the models, leading to a rigorous proof of the TKNN formula.

The seminar is based on joint works with G. De Nittis and F. Faure.