2D Materials in Strong Magnetic Fields:
Hofstadter physics from first-principles

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We present a first-principles approach for treating 2D materials from weak to strong magnetic fields [1] and more precisely from the integer to the fractal quantum Hall regime. Our approach relies on the expansion on a correlated basis consisting of Landau levels and Bloch waves. In this manner we are able to compute energy bands of 2D materials as a function of the magnetic field strength and to capture the fractal spectrum of the Hofstadter butterfly [2] from first-principles. Further, the connection of the fractal spectrum to experimental transport measurements [3] will be presented, and how our theory allows for the explanation of these measurements and the intricate phenomena related to the Hofstadter butterfly.

References

