Electron-photon Chern number in cavity-embedded 2D moiré materials

Danh Phuong Nguyen\textsuperscript{1}, Geva Arwas\textsuperscript{1}, Zuzhang Lin\textsuperscript{2}, Wang Yao\textsuperscript{2}, and Cristiano Ciuti\textsuperscript{1†}

\textsuperscript{1}Laboratoire Matériaux et Phénomènes Quantiques – Centre National de la Recherche Scientifique, Université Paris Cité – France
\textsuperscript{2}Department of Physics, The University of Hong Kong – R.A.S. chinoise de Hong Kong

Résumé

We explore theoretically how the topological properties of 2D materials can be manipulated by cavity quantum electromagnetic fields for both resonant and off-resonant electron-photon coupling, with a focus on van der Waals moiré superlattices. We investigate an electron-photon topological Chern number for the cavity-dressed energy minibands that is well defined for any degree of hybridization of the electron and photon states. While an off-resonant cavity mode can renormalize electronic topological phases that exist without cavity coupling, we show that when the cavity mode is resonant to electronic miniband transitions, new and higher electron-photon Chern numbers can emerge.