



From Condensed Matter To Quantum Simulators

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Quantum materials exhibit emergent collective behaviors giving rise to exotic quantum phases and quantum phase transitions. The progress in « quantum control » in ultra-cold atoms, nanotechnology and quantum circuits also allows to engineer many-body Hamiltonians with modern applications in quantum information and quantum computation. This opens the door to the implementation of Feynman quantum simulators and quantum machines.

We will discuss a few examples of

- Emergent phases and quantum phase transitions
- Quantum engineering of topological phases of matter and gauge theories, in relation with spin-orbit materials and artificial gauge fields
- Applications in « protected » quantum transport and quantum computing
- Sensing (dynamics, transport, light-matter phenomena, Floquet engineering)
- Quantum information perspectives, entanglement measures and efforts in mathematical and numerical methods.