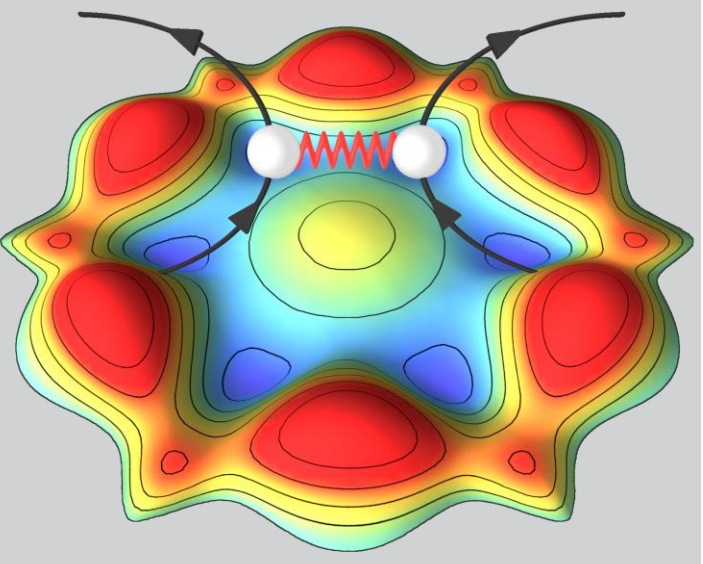
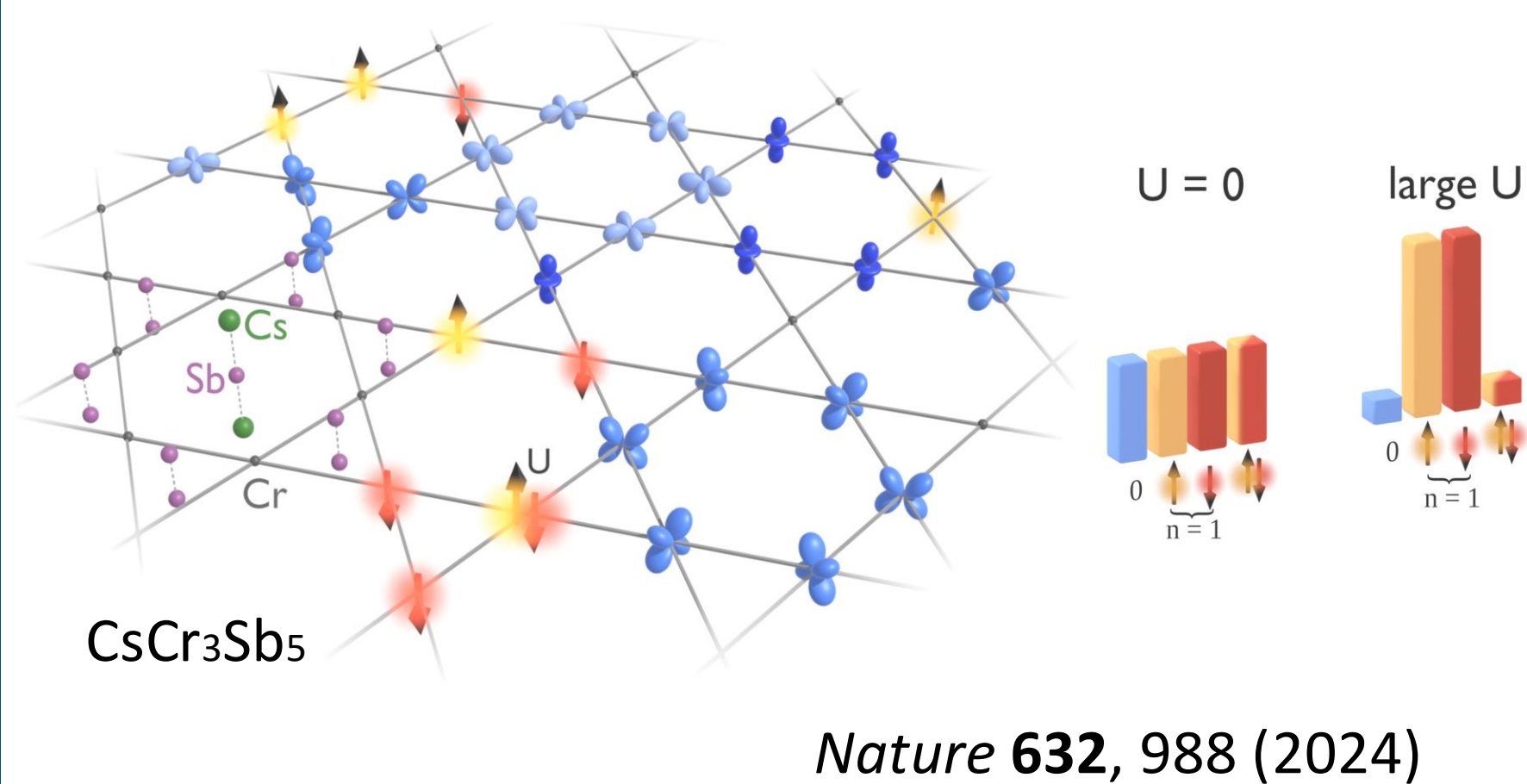




Research topics

- Theory of interacting electron systems
- Topological states of matter
- Realistic calculations of quantum materials
- Quantum magnetism
- Computational methods for strongly correlated fermions

Multi-orbital Hubbard models



- Suppression of double occupation
- Local magnetic moment formation
- Physics of fluctuating local moments

Contact us for a thesis!

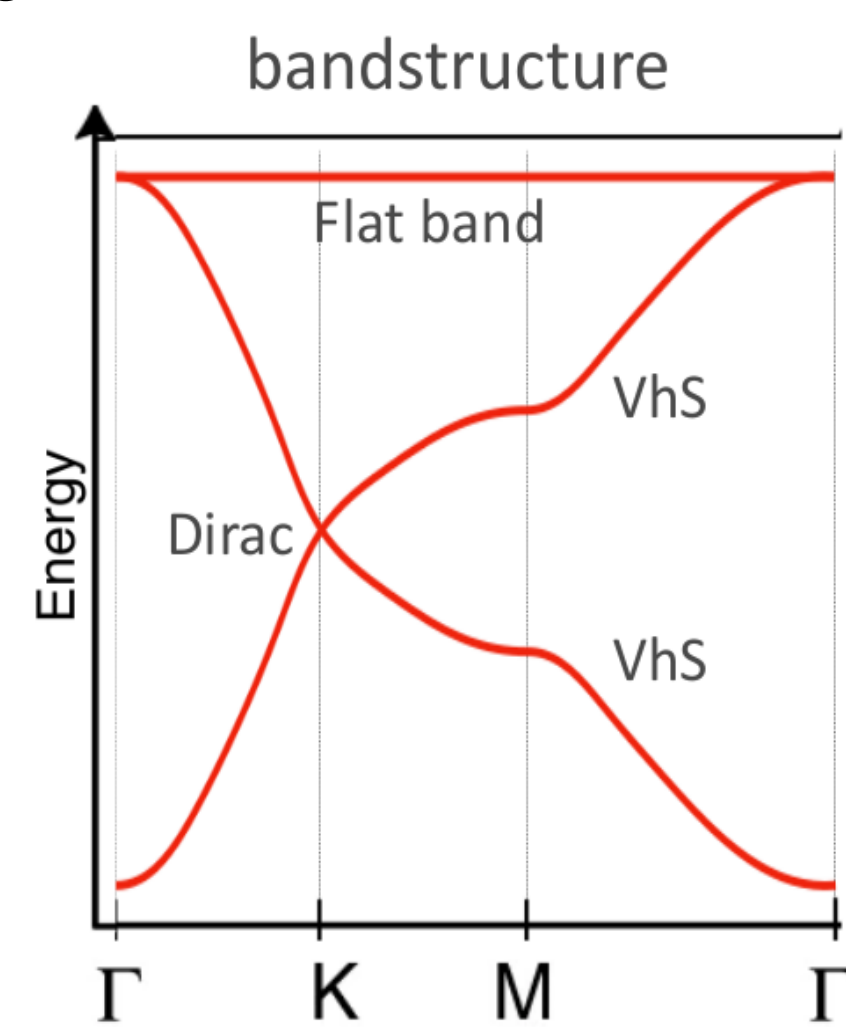
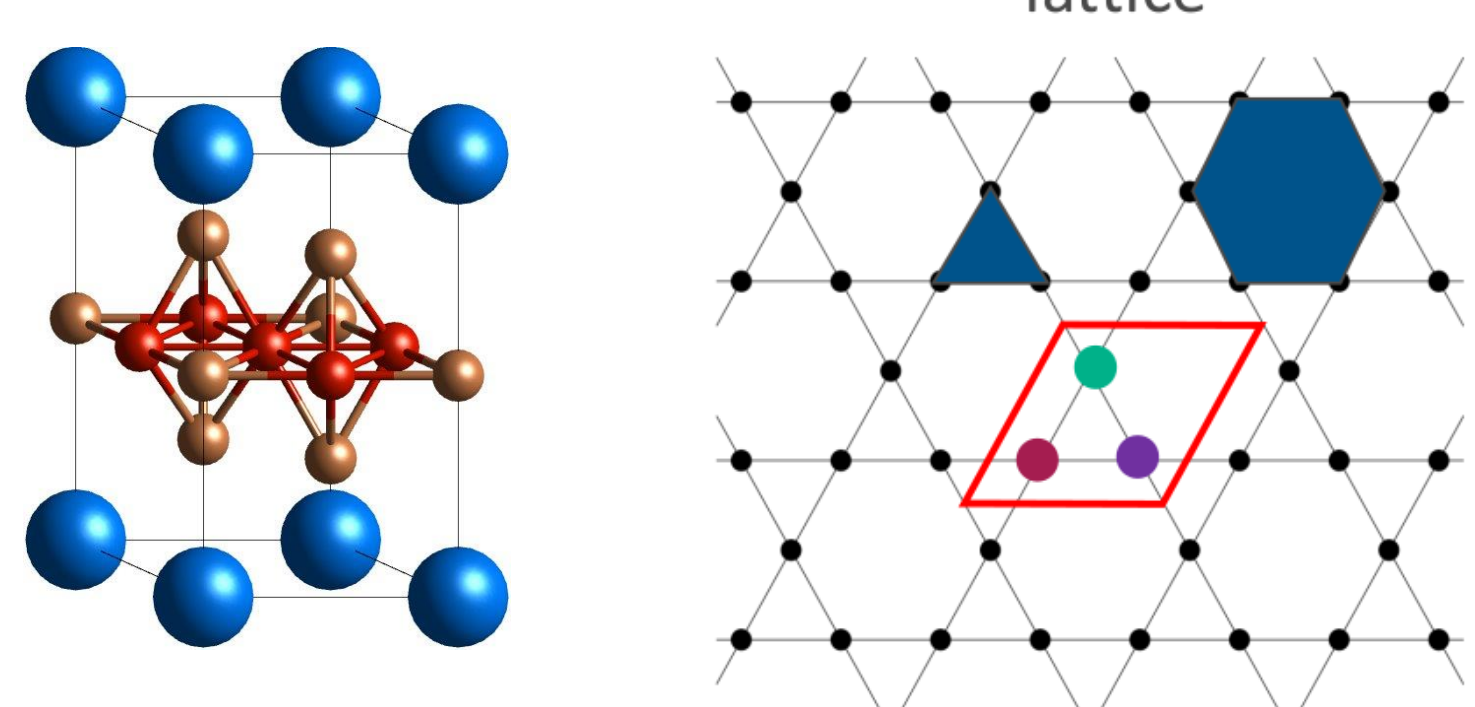
- Conduct research bridging theory and experiment
- Model and solve many-body/quantum materials, analytically and numerically
- Apply computational methods and develop programming and data analysis tools
- Acquire problem solving skills



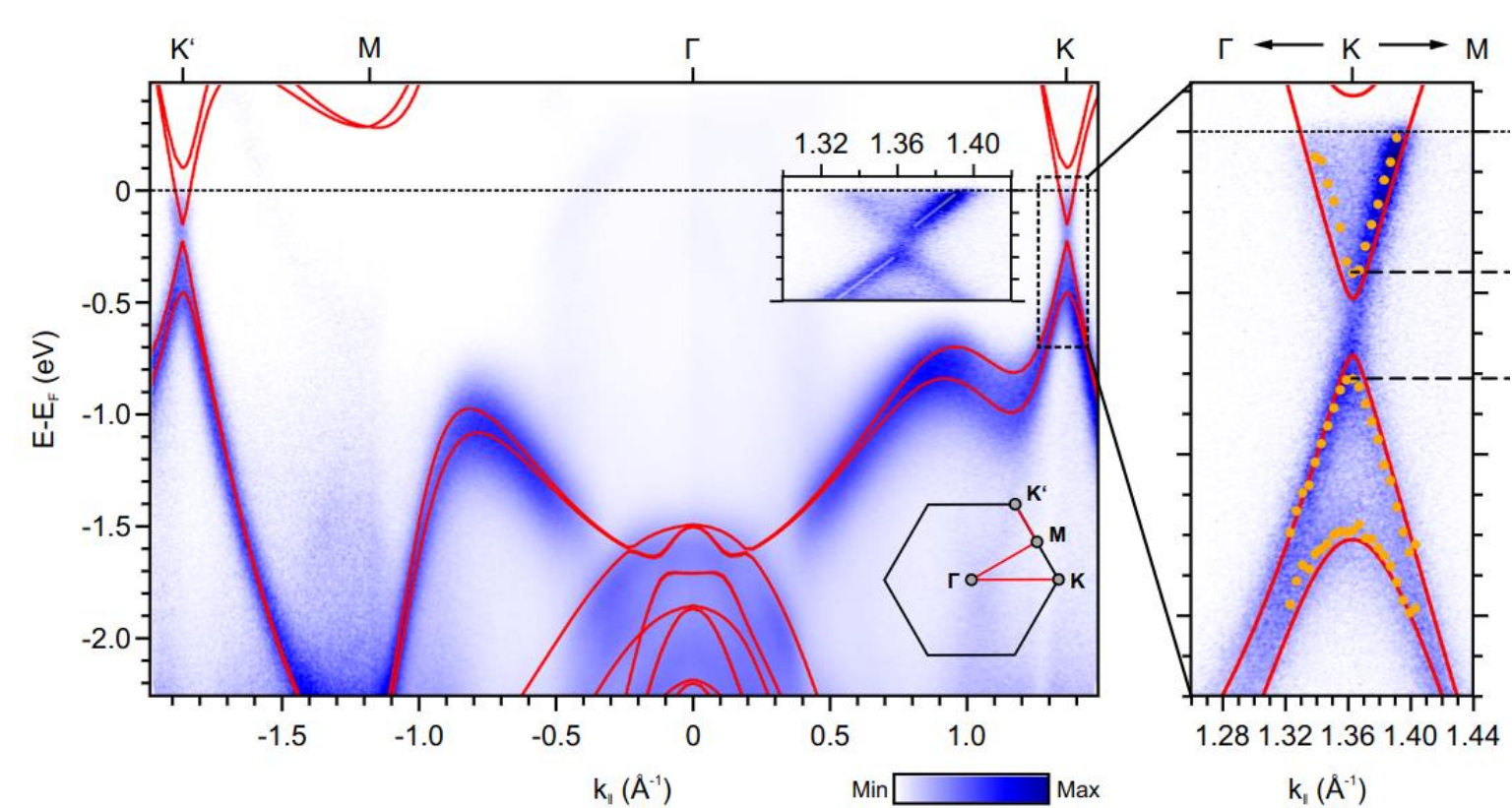
Quantum Materials

Realistic simulation of real-world materials

• Kagome metals



• Indenene

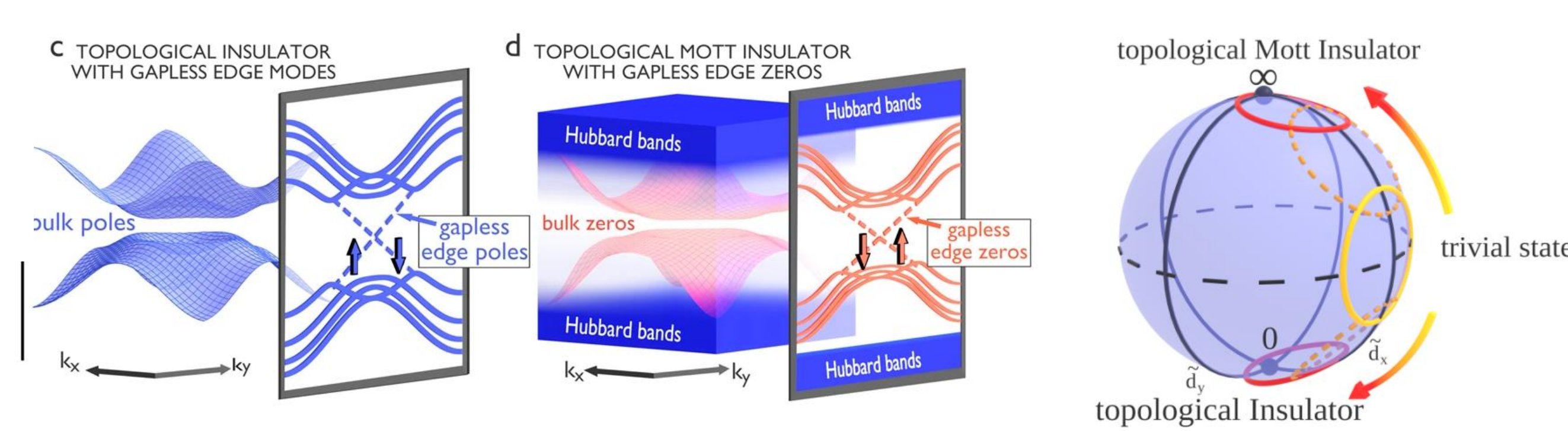


- Comparison with experimental results (EP4)

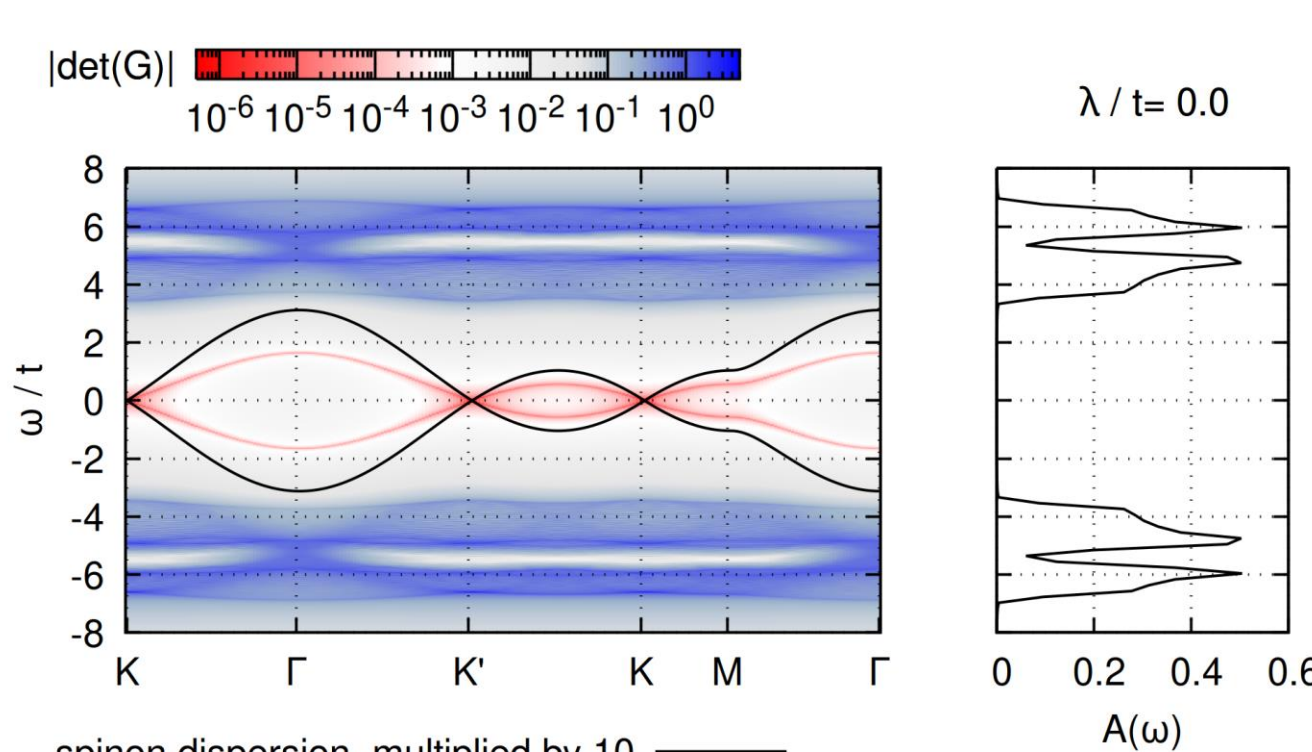
Nat Commun 12, 5396 (2021)

Topology in the strong-coupling limit

• Green's function zeros



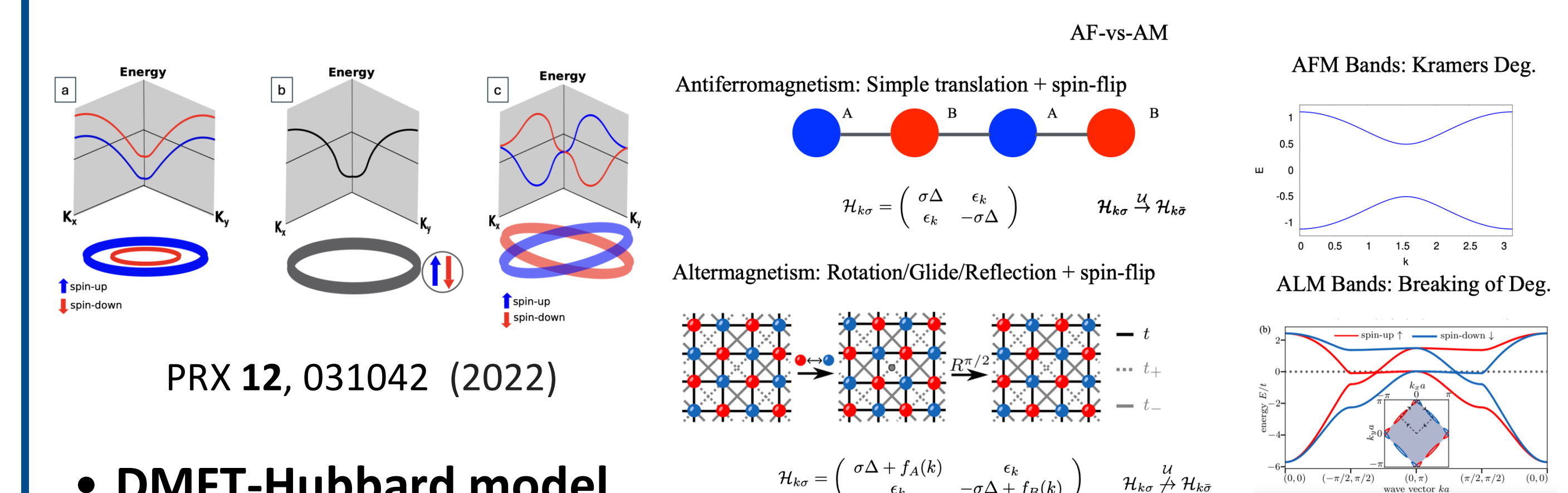
• Slave-rotor method $c^\dagger = f^\dagger e^{-i\theta}$



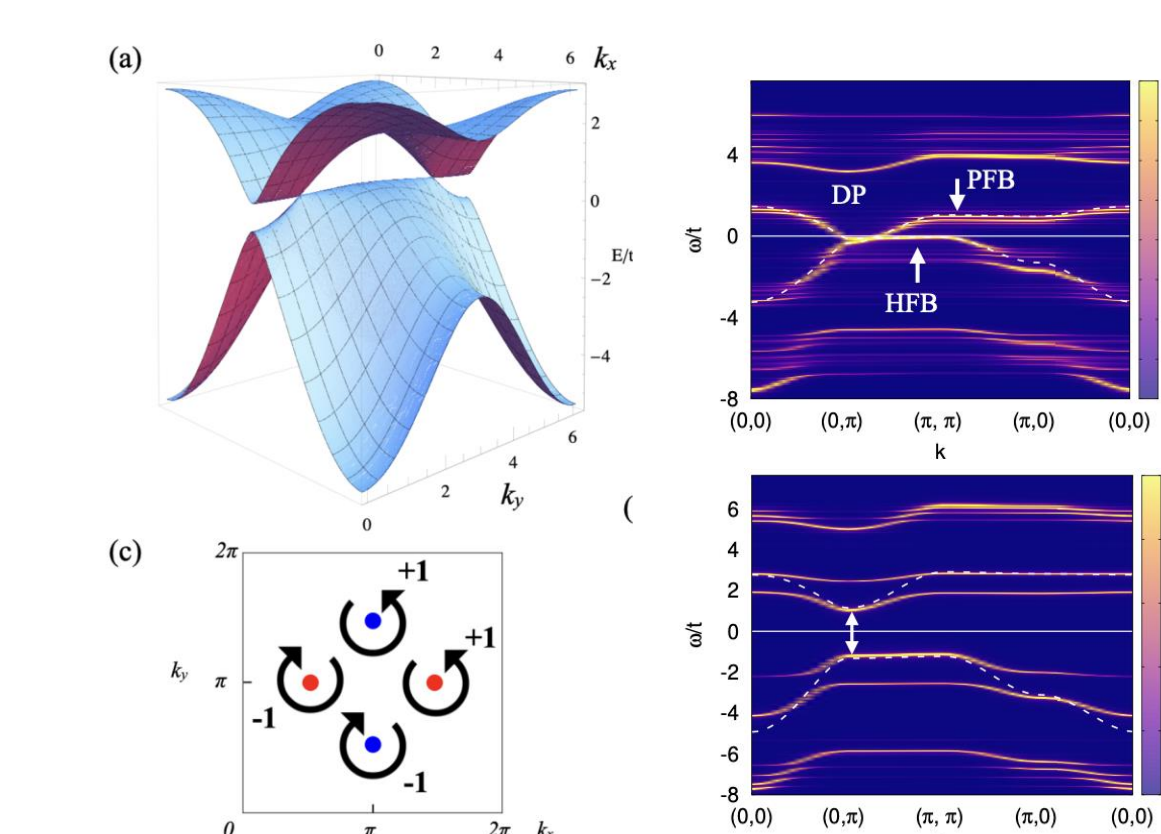
Kane-Mele model

Nat Commun 14, 7531 (2023), PRL 133, 126504 (2024)

Altermagnetic materials

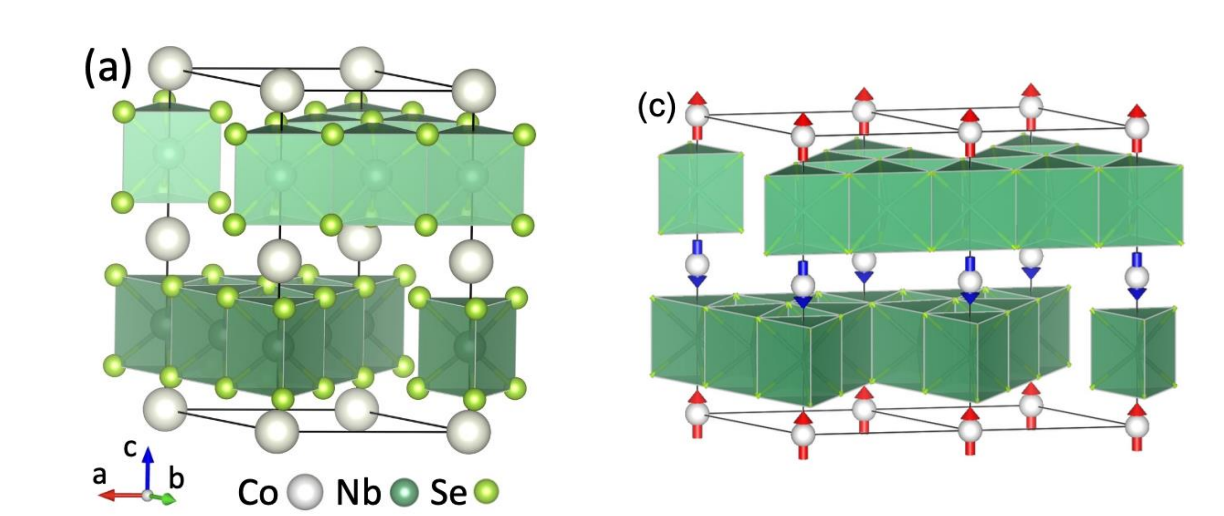


• DMFT-Hubbard model



Phys. Rev. Research 7, 033234 (2025)

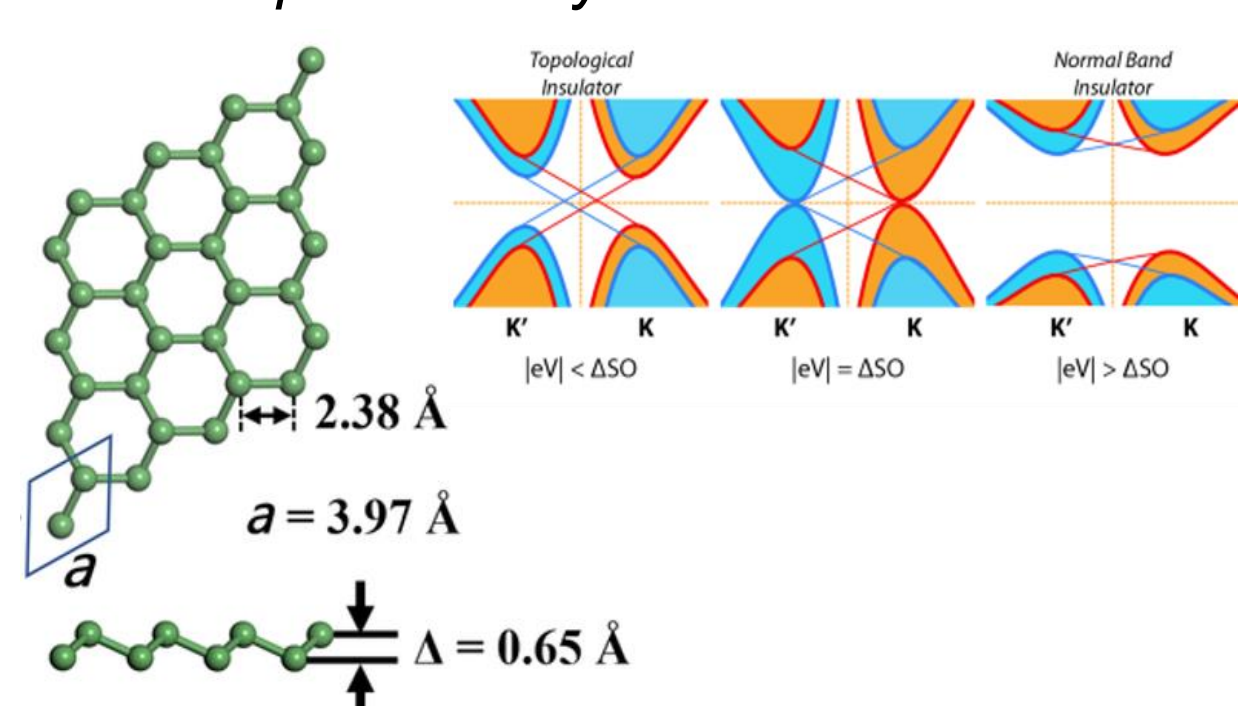
• Quest for real materials



arXiv:2408.08835 (2024)

DFT Study of Topological Field-Effect Transistor Germanene

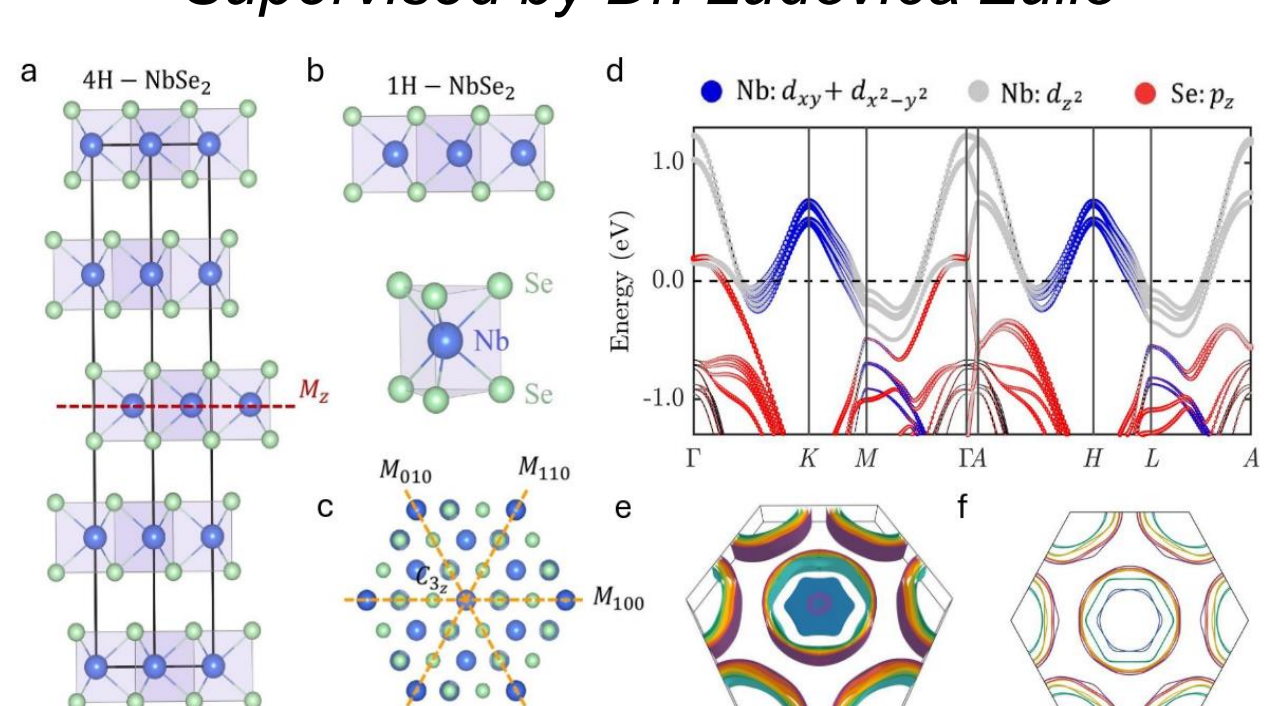
Supervised by Stefan Enzner



"From structure to device: Simulation of **2D topological edge states** under influence of electrical field."

Ab initio study of phonons of bulk layered non-centrosymmetric 4Ha-NbSe2

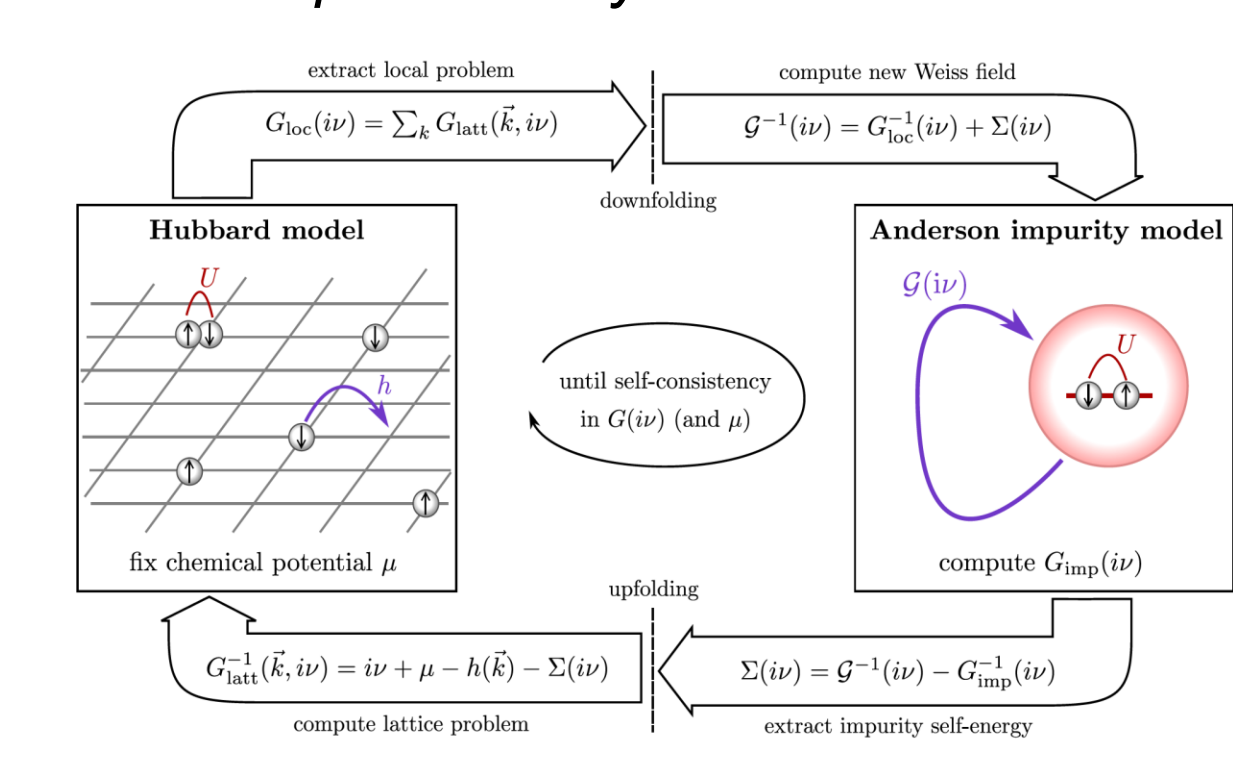
Supervised by Dr. Ludovica Zullo



"Is there a **charge density wave** that competes with **superconductivity**? Let's do **DFT** on new real materials to study **phonons** anomalies!"

w2dynamics: a (lively) dynamical mean field theory solver

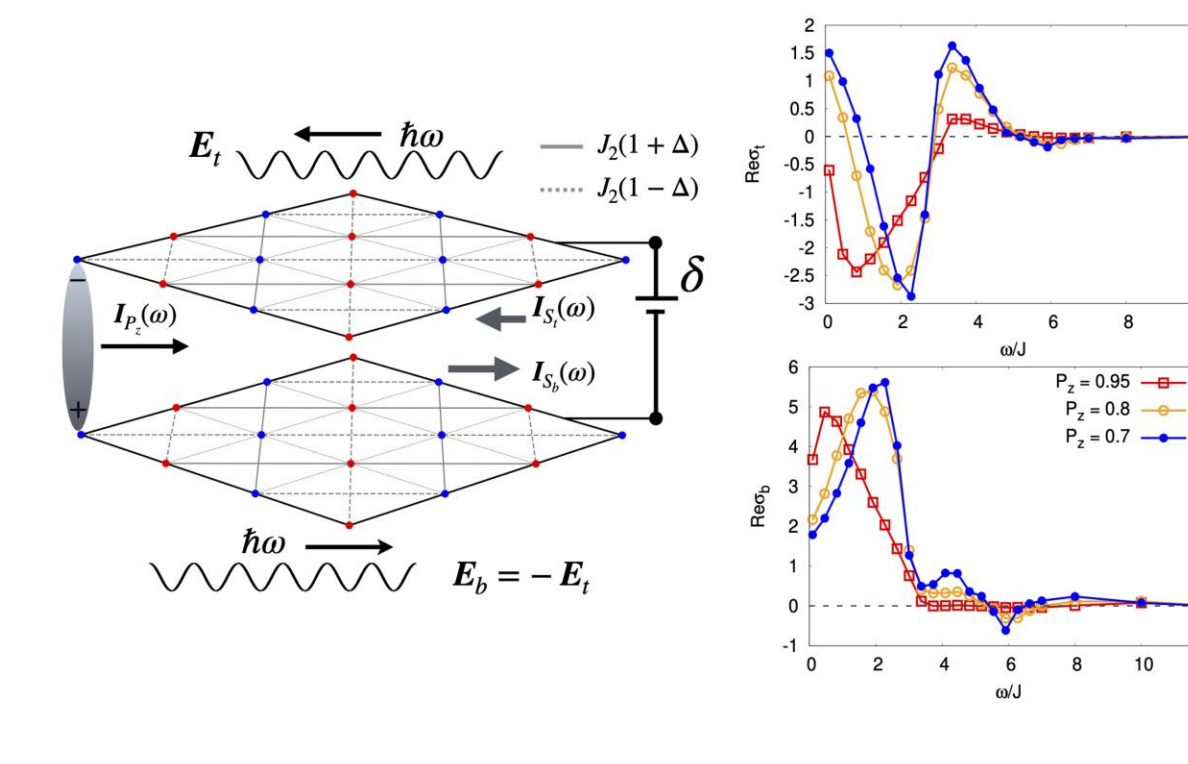
Supervised by Alena Lorenz



"Are you passionate about **programming**? Join us to develop the Würzburg–Vienna code package **w2dynamics** and explore **strongly correlated electron systems**."

Spin Transport in Altermagnetic bilayers

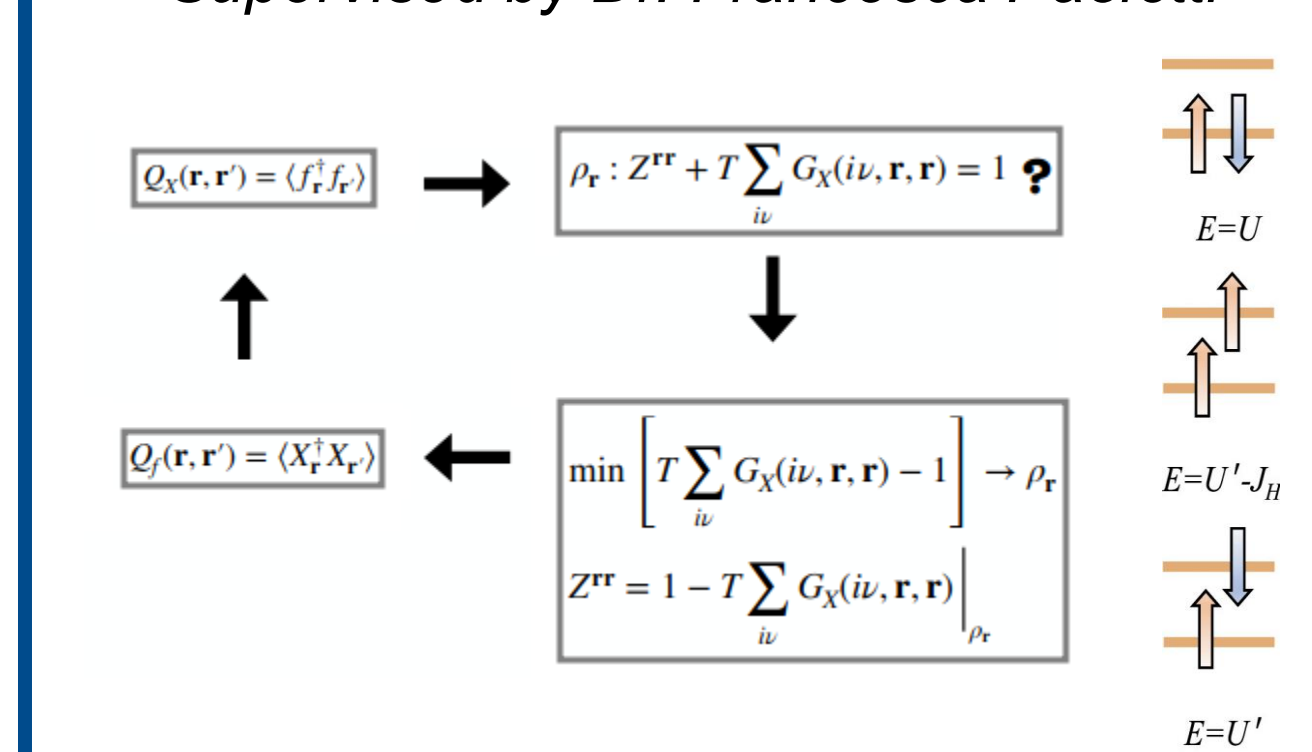
Supervised by Dr. Lorenzo Del Re



"Bilayers systems with AM properties can be engineered for hosting non-trivial **spin-transport** properties with potential application to **spintronics** and **quantum materials**."

Extending the Slave-Rotor Method to Multiorbital Interactions

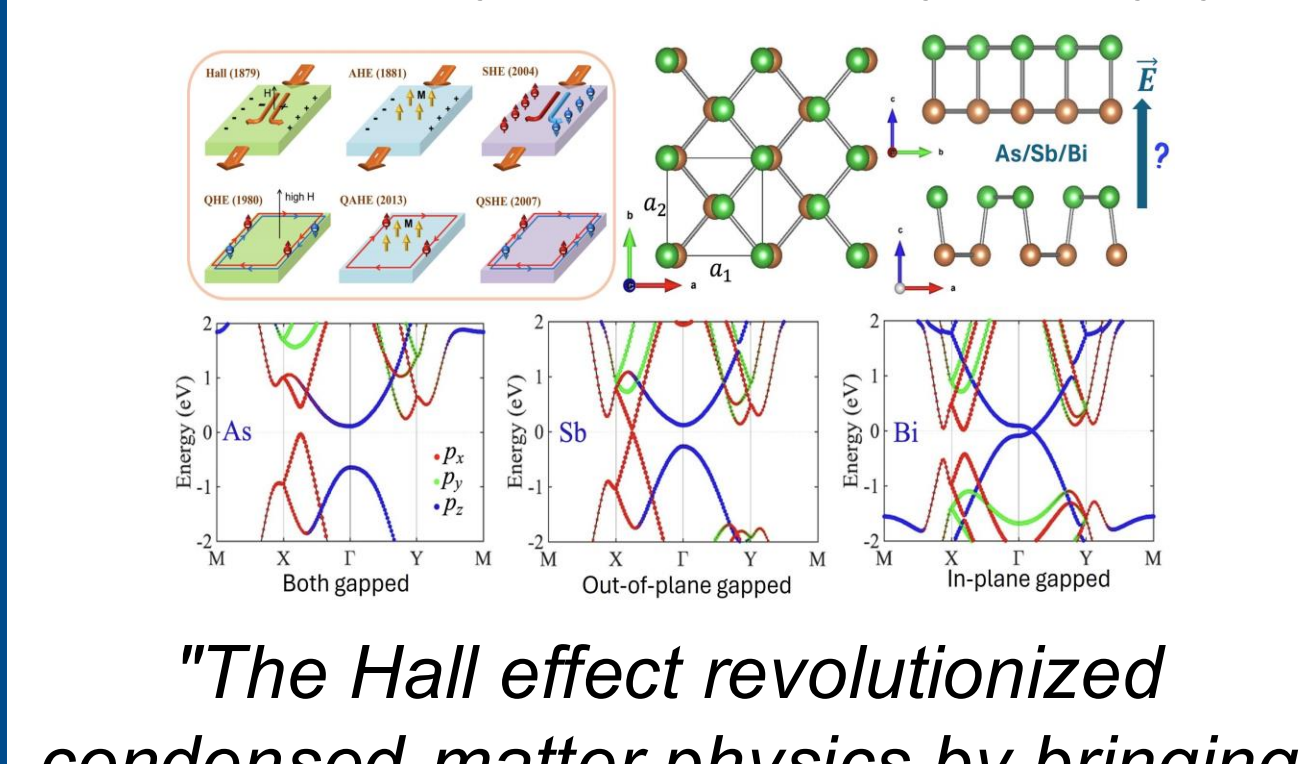
Supervised by Dr. Francesca Paoletti



"Curious about **strongly correlated electrons**? Explore the slave-rotor method, which **separates charge and spin**, and help us extend it from single-orbital to **multiorbital systems**!"

Hall Effect: but Wait, Where is the Magnetic Field!!!

Supervised by Dr. Arka Bandyopadhyay



"The Hall effect revolutionized condensed-matter physics by bringing topology into the spotlight. Ready for the next twist? Join us in exploring the new **nonlinear Hall effect** in α -phase group-V monolayers, and the cool part is -- **no magnetic field is needed**!"