Master 2: *International Centre for Fundamental Physics*

INTERNSHIP PROPOSAL

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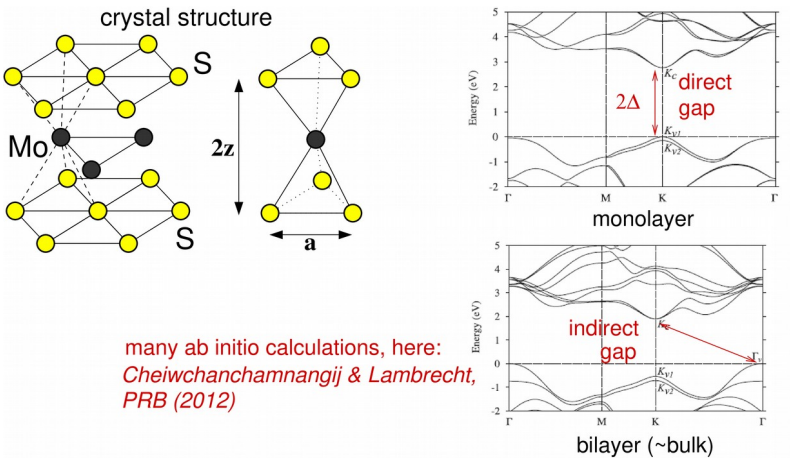
Internship location: LPS Orsay
Thesis possibility after internship: YES
Funding: NO

Search for Berry-curvature enhanced superconductivity in 2D materials

Two-dimensional (2D) materials provide a novel and extremely rich platform for the study of unconventional electronic properties. Graphene is certainly the best known with its massless "relativistic" carriers, while 2D transition-metal dichalcogenides (such as MoS2, WS2, WSe2,...) are particular semiconductors (see figure) in which the low-energy carriers populate bands that are intrinsically coupled, as it is unveiled by a prominent non-zero Berry curvature. Usually, the Berry curvature, which is at the origin of unusual geometric and topological properties in these materials, is not apparent in the spectrum of the energy bands. However, recent theoretical and experimental work shows that it plays a role in the spectral properties of excitons, i.e. *electron-hole pairs* that are governed by their mutual Coulomb interaction.



Based on this observation, we plan to understand theoretically whether the Berry curvature similarly influences the *electron-electron pairs* that are responsible for superconductivity in these materials, e.g. upon doping. What are the corrective terms one needs to add to the BCS Hamiltonian in order to account for the Berry curvature? Under which condition can a pre-existing superconductivity be enhanced or even induced in these materials? The project is situated in a more general framework of modern condensed-matter research where we investigate the interplay between topology and geometry on the one hand side and electronic correlations on the other.

Condensed Matter Physics: YES	Macroscopic Physics and complexity: NO
Quantum Physics: YES	Theoretical Physics: YES