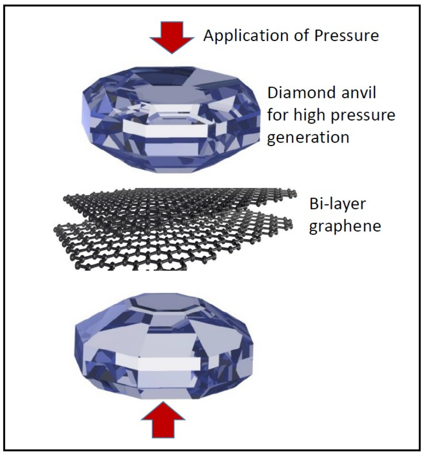
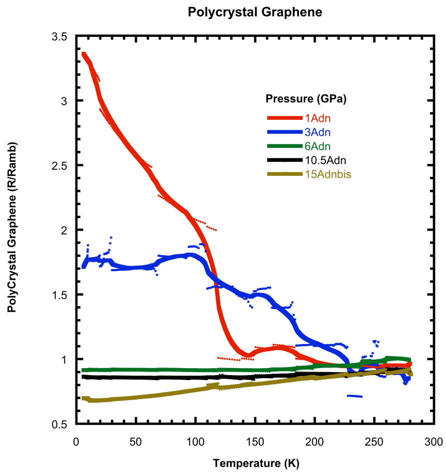
NÉEL INSTITUTE Grenoble

Topic for Master 2 internship – Academic year 2019-2020

Search for superconductivity under pressure in mono and bi-layer graphene

General Scope:
The multiplication of the studies on graphene have resulted in a large number of the new applications. However, very few experimental studies have been performed on his electronic properties under pressure. Certainly, few changes are expected under pressure on the graphene mono-layer as it is extremely hard in the basal plane. However, in our preliminary measurements shown in the figure, it is clear that the resistance of the graphene sample changes enormously under pressure due to doping effects. We intend to optimize this doping under pressure to over-dope single layer graphene and attain the level where it has been predicted to be a chiral superconductor [Nature Phys. 8 (2012) 158]. Furthermore, the physics of bi-layers under pressure is certainly very rich. For example, two graphene monolayers, stacked in a Moiré pattern by a small angle rotation, have been recently shown to be superconducting at low temperatures [Nature 556(2018)43]. We plan to study the effect of pressure on the Tc of Moiré bilayers. Finally, Van-der-Waals bonding between two layers of graphene is weak and should be sensitive to pressure, that will deform a bi-layer of graphene towards a diamond symmetry. Theoretical calculations have predicted these structures to be superconductors [PRL 111(2013)066804].





Research topic and facilities available:
The subject of the internship will consist in a first stage in the adaptation, for its assembly in the high-pressure cells, of the graphene single and double layer samples, synthesized in collaboration with L. Marty of the HYBRID Team. The student will thus acquire a solid experience in nanofabrication. He will proceed then to make transport measurements as a function of temperature down to 1K in both piston-cylinder systems (P<2GPa; with P. Rodière, MagSup team) and in Bridgman cells (<30GPa; with M. Nunez-Regueiro and M-A. Measson MagSup Team). These measurements will enrich his knowledge of electronic properties of two-dimensional materials.

Possible collaboration and networking:
Networking: ANR projet obtained in 2019. Teams of the Néel Institute, Institut Lumière Matière (Lyon), Sorbonne University (Paris).
Possible extension as a PhD: YES
Required skills: Good knowledge of condensed matter physics, curiosity, taste for delicate experiments
Starting date:march-april 2020
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