ParisTech ESPCI PARIS PSL

RESEARCH TOPIC FOR THE PARISTECH/CSC PHD PROGRAM

Field: ***Materials Science, Mechanics, Fluids***

Subfield: Physics, Applied Physics

Title: Electronic and Thermoelectrical properties of dilute metals

ParisTech School: ESPCI Paris PSL

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Lab location: ESPCI,(Lab/Advisor website): https://qm.lpem.espci.fr/

Short description of possible research topics for a PhD:

In presence of a magnetic field, the electronic spectrum an electrons gas is quantized in Landau levels. At high enough magnetic field, only one or two Landau levels are occupied, this is the quantum limit. This limit has been extensively studied in two dimension systems in the context of the quantum Hall effect. It has been however poorly studied in three dimension since this regime can only achieved in low carrier density metals. In the last years we have shown that, beyond this limit, 3D dilutes metals displays a rich variety of electronic phase transitions ranging from : a succession of a many body field induce state in the semi-metals graphite [1,2,3] or a metal-insulator transition in the narrow gap semi-conductor InAs [4].
In both case this transition is accompanied by a remarkable electrical and thermoelectrical properties. To date the largest magnetoresistance has been reported in the semi-metal, Sb, at high magnetic field [5] and a giant thermoelectrical power accompanied the field induced MI transition in InAs [4]. In this internship/PhD we propose to understand the parameters which pinned down the amplitude of these giant responses in dilute metals. The internship/PhD work will be to measure the electrical and thermoelectrical properties in a large range of temperature, magnetic field and to develop a new experimental set up to track the current distribution in these high mobile conductors.

Required background of the student: material science, solid state physics

1. B.Fauqué et al, PRL, 110, 266601 (2013)
2. D. LeBoeuf, Nat. Com. 8, 1337 (2017)
3. Z. Zhu et al., PRX, 9, 011058 (2019)
4. A.Jaoui et al, arXiv:2008.06356
5. B. Fauqué and al., PRM, 2, 11420 (2018)