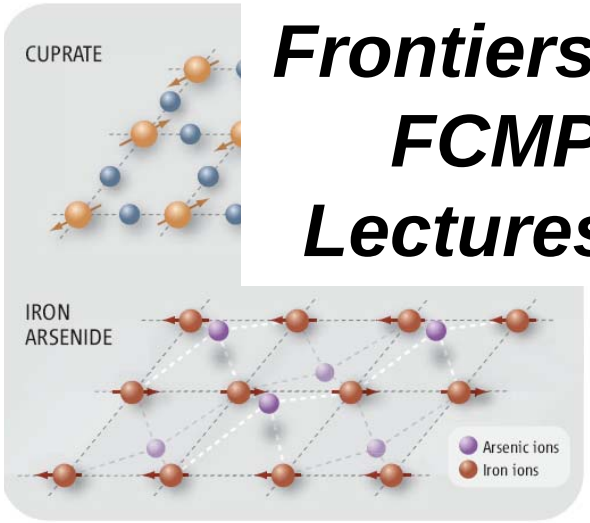
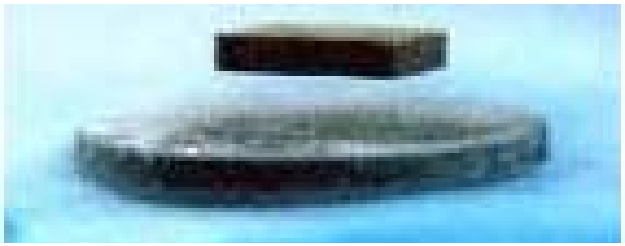
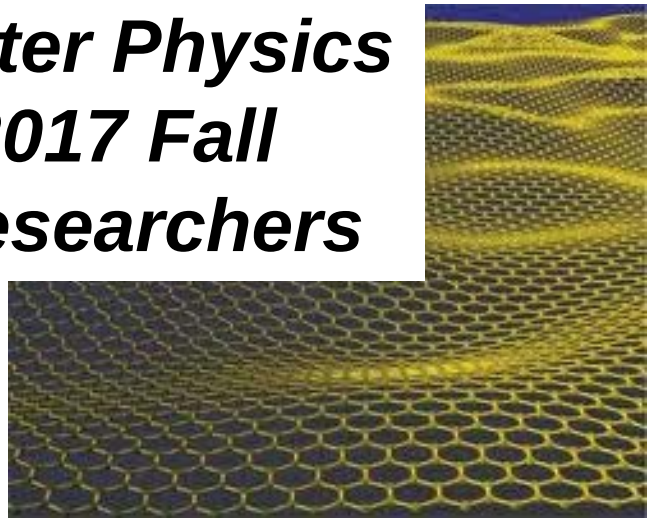


Frontiers of Condensed Matter Physics
FCMP Paris / Palaiseau 2017 Fall
Lectures by leading CMP researchers





Sep. 15 (Friday) 2:00 – 4:50 PM

Live at Ecole Polytechnique Amphi Faure

Simulcast at Columbia U Global Center (M Vavin / Edgar Quinet)

Simulcast at Paul Scherrer Institut Time-out seminar room

Lecture 1. 2:10 – 3:25 PM: Stephen Blundell (Oxford U)

Can you build superconductors with molecular bricks?

Lecture 2: 3:35 – 4:50 PM: Philippe Mendels (U Paris-Sud)

New quantum spin states in model frustrated lattices

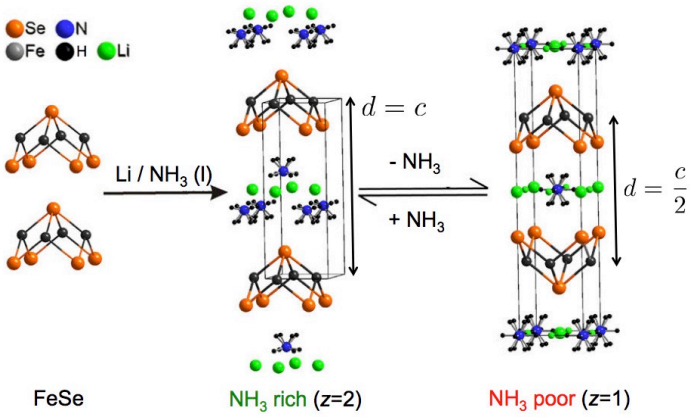
Grad students, post-docs, senior researchers all welcome

Can you build superconductors with molecular bricks?

Stephen J. Blundell
Department of Physics, University of Oxford, Parks Road, Oxford OX1 3PU, United Kingdom

Abstract:

Most superconductors are made using standard techniques involving inorganic components and modifications are made according to a standard set of simple chemical replacements. However, organic chemistry is potentially much more flexible and the addition of molecules into superconductors offers a new route to controlling properties. This has led to the field of organic superconductors and I will outline some of the results that have been achieved in this field [1-3]. I will also describe some new superconductors which have been made using a low-temperature intercalation method that is capable of inserting molecular species in between superconducting FeSe layers. It results in a large increase in superconducting transition temperature - more than a factor of 4 [4,5]. In this talk, I will review recent progress and describe new results on $Li_x[(NH_2)_y(NH_3)_{1-y}]_zFe_2Se_2$ (z = 1, 2) which have been carried out in order to study the effect on the superconducting properties of intercalating additional ammonia, via reversible adsorption and desorption. The reactions were carried out in situ on the muon beamline so that the superfluid stiffness could be measured using transverse-field muon-spin rotation experiment on a single sample, first having undergone exposure to 1 bar of ammonia at 250 K, and then again following desorption. These results illustrate some of the possibilities, but also the difficulties, of using molecules in developing new superconductors. (Work performed in collaboration with S. J. Clarke and coworkers at Oxford, RAL and Durham, UK.)



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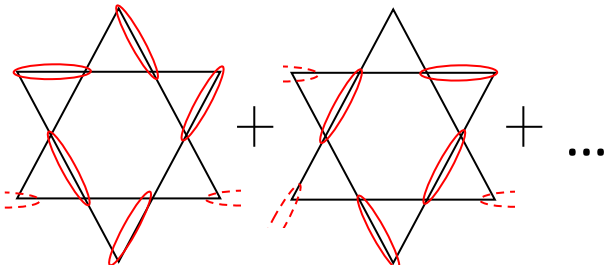
New quantum spin states in model frustrated lattices

Philippe Mendels

Lab. Physique des solides, Univ. Paris-Sud, Univ. Paris-Saclay

Finding new states of matter is one main goal of research in condensed matter which often gives rise to novel concepts and sometimes to remarkable technological innovations. In the field of magnetism, the frustration of the magnetic interactions in well-chosen lattice geometries is the key ingredient to promote truly original ground states. This field of research has grown tremendously during the last 15 years with the emergence of new concepts such as the spin ices or the spin liquids and the corresponding original excitations, magnetic monopoles and spinons. Spin liquids for instance can be viewed as resonant singlets (antiferromagnetic spin pairs), a model quantum ground state first advocated for the interpretation of high Tc superconductivity [1].



A spin liquid on the « kagomé » network. The spins are paired into resonant singlets.

After a long and basic introduction of this field of research and the challenges it has opened, I'll focus on the emblematic case of the kagome geometry. Indeed the low connectivity of the kagome network together with the quantum fluctuations enhanced for low spin ½ destabilize any ordered state in favor of a fluctuating ground state at T=0, coined a spin liquid. The recent discovery of model compounds for this physics, namely with a true kagome lattice decorated by quantum S=1/2 spins (Cu^{2+} or V^{4+}), has boosted both the theoretical and the experimental research in this field. The spin liquid state is for instance realized in the archetypal ZnCu3(OH)6Cl2 "herbertsmithite" compound. The latter shows no sign of frozen on-site magnetism, ie no spontaneous breaking of symmetry, down to mK temperatures while the magnetic interaction is of the order of hundreds of Kelvin [2,3]! The precise nature of the ground state and of its elementary excitations, the phase transitions that can be induced by various parameters are at the heart of the current debates and a seed for new concepts in the field of frustrated magnetism. I will review the major and recent advances in the field and will underline the power of two local techniques, NMR and µSR to study such a field of research [4].

References

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Schedules of speakers and live lecture locations: Paris-Palaiseau FCMP I in Fall 2017

Date	Location Live / (simulcast)	Lecturer 1 (2:10-3:25 PM) (8:10-9:25 AM US EST)	Lecturer 2 (3:30 – 4:45 PM) (9:30 – 10:45 AM US EST)
Sep 8	CUGC (EP)	Tomo Uemura (Columbia / EP)	Kamran Behnia (ESPCI)
Sep 15	EP (CUGC)	Stephen Blundell (Oxford)	Philippe Mendels (Orsay)
Sep 22	CUGC (EP)	Dirk van der Marel (Geneva)	Jerome Lesueur (ESPCI)
Sep 29	EP (CUGC)	Alain Sacuto (Diderot)	Bernhard Keimer (Stuttgart)
Oct 6	EP (TBA)	Sadamich Maekawa (JAEA)	Eiji Saitoh (JAEA/Tohoku)
Oct 13	CUGC (EP)	Piers Coleman (Rutgers)	Marc Gabay (Orsay)
Oct 20	EP (TBA)	JC Seamus Davis (Cornell)	Masatoshi Imada (Tokyo)
Oct 27	CUGC	Gil Lonzarich (Cambridge)	Louis Taillefer (Sherbrooke)
	Party: no simulcast	Dinner Party at CUGC after the event	
Nov 3	EP (CUGC)	Catherene Pepin (CEA)	Luca de Medici (ESPCI)
Nov 10	CUGC (EP)	Antonio Bianconi (Rome)	Marcin Konczykowski (EP)
Nov 17	EP (CUGC)	Dimitri Basov (Columbia)	Marc-Henri Julien (Grenoble)
Nov 24	CUGC (EP)	Pengcheng Dai (Rice)	Antoine Georges (EP / Simons)
Dec 1	EP (CUGC)	Andrea Cavelleri (Hamburg)	Luca Perfetti (EP)
Dec 8	CUGC (EP)	Kosmas Prassides (Tohoku)	Steve Bramwell (UCL)
Dec 15	EP	Albert Fert (CNRS-Thales)	Alessandra Lanzara (Berkeley)
	(Lecturer 3)	Naoto Nagaosa (Tokyo) 5:00 – 6:15 PM (11:00 AM-12:15 Noon US EST)	
	Party: no simulcast	Dinner Party at Ecole Polytechnique at 6:30-8:30 PM	

A different class Paris FCMP-II in Spring 2018

Jan 12	Gabe Aeppli (PSI)	Kees van der Beek (EP)
Jan 19	Andrea Gauzzi (UPMC)	Tomo Uemura (Columbia)
Jan 26	Andres Santander Syro (Orsay)	Philippe Bourges (CEA-LLB)

Most-likely continuing until April 2018