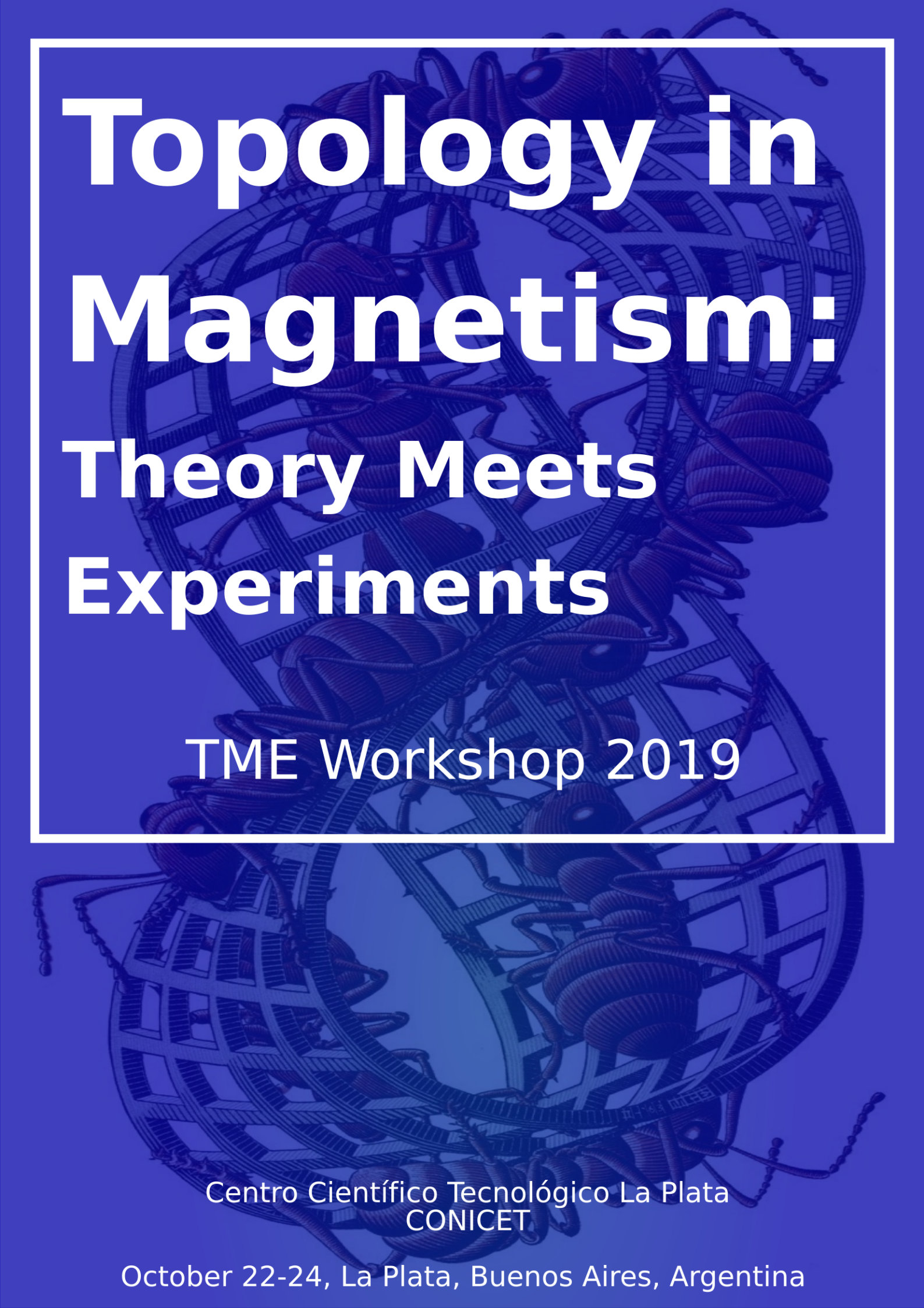

Topology in Magnetism: Theory Meets Experiments

TME Workshop 2019

Centro Científico Tecnológico La Plata
CONICET

October 22-24, La Plata, Buenos Aires, Argentina

ACKNOWLEDGEMENTS

The organizers of « Topology in Magnetism: Theory Meets Experiments », thank all their institutional partners who contributed to organizing this scientific event.

ORGANIZING COMMITTEE

-Paul Scherrer Institute, Villigen – PSI, Switzerland

Oksana Zaharko
Jonathan White

Instituto de Física de Líquidos y Sistemas Biológicos (CONICET/UNLP), Argentina

Daniel Cabra
Flavia Gómez Albarracín
Diego Rosales

PROGRAM

Time/Day	Tuesday 22/10	Wednesday 23/10	Thursday 24/10
9:00-9:50	Registration	Christianson	Cheong
9:50-10:20	Batista	Balakrishnan	Schmidt
10:20-10:40			Lobos
10:40-11:10	Coffee break	Coffee break	Coffee break
11:10-12:00	Braun	S. Grigera	Woo
12:00-12:20	Ukleev	Borzi	Guruciaga
12:20-14:00	Lunch	Lunch	Lunch
14:00-14:50	Shi-Zeng Lin (Skype)	Ramesh (Skype)	Reyren
14:50-15:20	Coffee break	Zaharko+Rosales	Coffee break
15:20-16:10	Yusuke Tokunaga	posters and coffee	Yazyev
16:10-16:30	White		Pip
20:00-		Workshop dinner	

Invited Talks
Contributed Talks

(Skype): video conference by Skype

INVITED TALKS

Tuesday 22/10

Cristian Batista
Shull Wollan Center at Oak Ridge National Laboratory (US)

Title: to be confirmed

Hans Benjamin-Braun
University College Dublin (Ireland)

Title: to be confirmed

Shi-Zeng Lin
Los Alamos National Laboratory (US)

Title: to be confirmed

Yusuke Tokunaga
University of Tokyo (Japan)

Title: “Studies on skyrmionic chiral magnets Co-Zn-Mn alloys and some other noncentrosymmetric magnets”

Wednesday 23/10

Andy Christianson
Oak Ridge National Laboratory (US)

Title: “Possible Topological Excitations and Spin Textures in Nd-based Materials”

Geetha Balakrishnan
Department of Physics, University of Warwick (UK)

Title: “Investigations of skyrmion materials”

Abstract: Recently, there has been considerable interest in the physics of magnetic skyrmions due to their potential use in spintronic devices. Magnetic skyrmions are topological magnetic spin structures originally identified in the B20 class of materials, but have more recently been found and investigated in other non-centrosymmetric materials such as GaV_4S_8 [1], and $Co_{10-x}Zn_{10-y}Mn_{x+y}$ [2]. This has motivated us to embark upon a study of several classes of skyrmion materials and explore a wide composition range of each of the above family of compounds: i.e., GaV_4X_8 (X=S, Se), and the $Cu_{2-x}A_xOSeO_3$ (A=Zn, Ni)[3]. Investigations of the effects of substitution and the resulting structural order/disorder on the existence
of the skyrmion phase in these materials sheds light on the origin, the formation, and tuning of the skyrmion lattices. A number of the above materials have been synthesized in polycrystalline as well as single crystal form and structural investigations have been carried out using both powder and single crystal X-ray and neutron diffraction. A study of the magnetic properties of these materials has also been carried out by ac and dc magnetic susceptibility measurements. We present a detailed structural and magnetic study of these

interesting classes of materials demonstrating the structural similarities of these materials and the correlation with their interesting magnetic properties.

[1] Kézsmárki, I et al (2015) Nat. Mater. 14 1116.
[2] Tokunaga, Y et al (2015) Nat. Commun. 6 7638.
[3] Štefančič A et al (2018) Phys. Rev. Mat. 2 111402(R).

Santiago Grigera
Instituto de Física de Líquidos y Sistemas Biológicos, UNLP-CONICET, (Argentina)

Title: “Investigating the nature of a geometrically frustrated material: spin-ice.”

Abstract: Geometrically frustrated magnetic materials, where the symmetry precludes the possibility of satisfying every pairwise interactions, are extremely interesting systems from a statistical mechanical point of view. The competition between different ordering tendencies can induce complex and novel phenomena. A particularly notable example of this type of systems are the so-called ‘spin-ice’ materials, which are an experimental example of fractional magnetic excitations and emergent Coulomb-like interactions.
Spin-ice materials owe their name to their analogy with water ice. The ‘ice-rules’ that the ground state must obey are the very origin of the emergent gauge structure. Followed to the letter they predict a macroscopically disordered state with Pauling’s residual entropy. Additional interactions, such as a dipolar term, are expected to break this degeneracy and order the system at sufficiently low temperature.
Yet, no evidence of long range order has been found, and the true nature of the ground state of spin-ice systems remains a mystery, which the extremely rapidly growing characteristic times shroud into further obscurity.
The idea of this talk is to give a general introduction to this problem and class of materials and to discuss some of the tools used to investigate their nature, including diffuse neutron scattering, heat capacity, susceptibility and noise measurements, and theoretical and computational analysis, including machine learning techniques.

Ramamoorty Ramesh
University of California (US)

Title: to be confirmed

Oleg Yazyev
Ecole Polytechnique Fédérale de Lausanne (EPFL) (Switzerland)

Title: to be confirmed

Thursday 24/10

San-Wook Cheong
Rutgers University (US)

Title: to be confirmed

Seonghoon Woo
IBM TJ Watson Research Center (US)

Title: “Skyrmion-based artificial synapse and skyrmion lattice in van der Waals magnets”

Nicolas Reyren
Unité Mixte de Physique CNRS-Thales (France)

Title: “Magnetic Skyrmions in Metallic Multilayers: FM and SAF Structures, Chirality and Electronic Transport Properties”

Abstract: A fundamental aspect of magnetic skyrmions is their chirality, which results from the Dzyaloshinskii-Moriya interaction (DMI) at interfaces for the metallic multilayers that I will present. I will discuss about the experimental methods allowing the determination of the chirality in multilayers, and in particular the x-ray resonant magnetic scattering (XRMS) [1]. These experiments indicate that, in some cases, the dipolar interaction is stronger than the DMI, leading to 3D magnetization textures with hybrid chirality [2]. The torques and forces exerted on a skyrmion being strongly dependent upon its chirality, these textures must be carefully examined.
Producing synthetic antiferromagnetic (SAF) by coupling antiferromagnetically adjacent ferromagnetic layers reduces the role of the dipolar interaction, allowing skyrmions to be stable with smaller diameters. The SAF structure also leads to a reduction or cancellation of the skyrmion Hall angle, which might be detrimental in some applications. I will describe our progress about the design of such SAF systems and the resulting observation of very small skyrmions [3].
Finally, I will discuss about the electrical properties related to the presence of magnetic skyrmions and other magnetic textures, starting by their detection using anomalous Hall effect [4] and anomalous Nernst effect [5]. I will conclude by describing and modelling the longitudinal magnetoresistances in SAF systems [6].

[1] J.-Y. Chauleau et al, Phys. Rev. Lett. 120, 037202 (2018)
[2] W. Legrand et al, Science Adv. 4, eaat0415 (2018)
[3] W. Legrand et al, Nat. Mater. DOI: 10.1038/s41563-019-0468-3 (2019)
[4] D. Maccariello et al, Nat. Nanotechnol. 13, 233 (2018)
[5] A. F. Scarioni et al, to be submitted
[6] D. Maccariello et al, to be submitted

CONTRIBUTED TALKS

Victor Ukleev
Paul Scherrer Institut (Switzerland)

Title: Frustration-induced magnetic fluctuations as an origin of the low-temperature skyrmion phase in $Co_7Zn_7Mn_6$
Authors: Victor Ukleev, Kosuke Karube, Hubertus Luetkens, Akiko Kikkawa, Daisuke Morikawa, Andrew Wildes, Lucille Mangin-Thro, Yuichi Yokoyama, Le Yu, Rina Takagi, Yuichi Yamasaki, Pierluigi Gargiani, Manuel Valvidares, Horia Popescu, Nicolas Jaouen, Henrik M. Rønnow, Takahisa Arima, Yoshinori Tokura, Yasujiro Taguchi, Jonathan S. White.

Abstract: The competition between the magnetic interactions in non-centrosymmetric compounds results in complex phase diagrams. Thus, the interplay between exchange interaction, antisymmetric Dzyaloshinskii-Moriya interaction (DMI) and anisotropy can stabilize long range modulated magnetic phases hosting helical, conical and skyrmion lattice (SkX) orders. Skyrmions are of particular interest since they can be manipulated easily by external current pulses with ultra-low current densities, microwave fields and temperature gradient. Moreover, the typical size of a skyrmion varies in range from a few to a few hundred nm making them promising candidates for spintronics applications [1]. Recently a class of chiral magnets with beta-Mn structure was found to be skyrmion-hosting where, moreover, SkX formation in CoZnMn compounds occurs close to the room temperature or even above [2]. Frustration of the Mn site in Co-Zn-Mn alloys results into the spin-glass transition observed at Tg~10 K in $Co_8Zn_8Mn_4$ and at Tg~30 K in $Co_7Zn_7Mn_6$ [3,4,5]. Moreover, a low-temperature frustration-induced equilibrium skyrmion phase has been recently found in the latter [4]. We report on complementary study of dynamical frustration effects in $Co_7Zn_7Mn_6$ by muon spin relaxation spectroscopy (muSR), diffuse wide-angle neutron scattering (DNS) and resonant elastic small-angle x-ray scattering (RESAXS). The muSR experiment revealed the increment of the relaxation rate just above the temperature of the spin-glass transition caused by frustration-induced dynamics. This additional fluctuation regime is reminiscent of the thermal fluctuations near Tc and triggers stabilisation of the disordered equilibrium skyrmion phase. Analysis of magnetic DNS on powdered sample suggests that a quasi-static magnetic disorder persist in $Co_7Zn_7Mn_6$ up to the room temperature. Finally, element-specific RESAXS data points to the unambiguous conclusion that the frustration is driven by Mn sublattice, while Co atoms keep long-range helimagnetic order even below the spin-glass transition temperature.

[1] Nagaosa, N., Tokura, Y.. Nature Nanotechnology, 8(12), 899 (2013).
[2] Tokunaga, Y., et al., Nature Communications, 6, 7638 (2015).
[3] Karube, K., et al., Nature Materials, 15, 1237 (2016).
[4] Karube, K., et al., Science Advances, 4(9), eaar7043 (2018).
[5] Bocarsly, J., et al., Physical Review Materials, 3(1), 014402 (2019).

Jonathan White
Paul Scherrer Institute (Switzerland)

Title: Multiple-q noncollinear magnetism in the itinerant hexagonal magnet $Y_3Co_8Sn_4$
Authors: Jonathan White, Rina Takagi, Satoru Hayami, Ryotaro Arita, Dirk Honecker, Henrik Rønnow, Yoshinori Tokura, Shinichiro Seki.

Abstract: Multiple-q spin order, i.e., a spin texture characterized by a multiple number of coexisting magnetic modulation vectors q , has recently attracted attention as a source of nontrivial magnetic topology and associated emergent phenomena. One typical example is the triple-q skyrmion lattice state stabilized by Dzyaloshinskii-Moriya interactions In noncentrosymmetric magnets, while the emergence of various multiple-q states of different origins is expected according to the latest theories. Here, we investigated the magnetic structure of the itinerant polar hexagonal magnet $Y_3Co_8Sn_4$, in which several distinctive mechanisms favoring multiple-q states are allowed to become active. Small angle neutron-scattering

experiments suggest the formation of incommensurate triple-q magnetic order with an in-plane vortex-like spin texture, which can be most consistently explained in terms of the novel four-spin interaction mechanism inherent to itinerant magnets. The present results suggest a new route to realizing exotic multiple-q orders and that itinerant hexagonal magnets, including the $R_3M_8Sn_4$ family with wide chemical tunability, can be a unique material platform to explore their rich phase diagrams.

Rodolfo Borzi
Instituto de Física de Líquidos y Sistemas Biológicos, UNLP-CONICET (Argentina)

Title: The Polarized Monopole Liquid: a Coulomb phase in a fluid of magnetic charges

Authors: D. Slobinsky, L. Pili and R. A. Borzi

Abstract: The forging of strong correlations on decreasing temperature can take place without the arousal of conventional order. If this happens, as in some geometrically frustrated magnets, disorder can be a phenomenon more interesting than order itself. A Coulomb phase, for example, has critical-like pair-spin correlations, leading to neutron scattering *pinch points* and emergent electromagnetism; its local excitations are quasiparticles behaving as magnetic monopoles.

In this talk we present a new instance of disorder in an Ising pyrochlore lattice: the *Polarized Monopole Liquid* (PML), a dense monopole fluid with pinch points in the *magnetic charge*-pair correlations. It is a phase of ``monopole matter" never considered before which can be stabilized in real materials using a magnetic field and uniaxial stress along the [100] direction. To explain how the monopole correlations arise, we show that the PML is a Coulomb phase in which spin fluctuations cannot be assigned either to monopoles or to internal magnetic moments, but necessarily comprehend both degrees of freedom.
We use a simple but nontrivial method to Helmholtz decompose the spin field into a divergenceless and a divergenceful part in magnetic charge disordered pyrochlores that shows the appearance of pinch points associated to the divergenceful component in places where Bragg peaks are observed for the ``all-in/all-out" antiferromagnet.

Oksana Zaharko/DiegoRosales
Paul Scherrer Institute, Villigen - PSI (Switzerland).
Instituto de Física de Líquidos y Sistemas Biológicos, UNLP-CONICET (Argentina)

Title: Fractional antiferro-skyrmion lattice in $MnSc_2S_4$ spinel

Authors: O. Zaharko, S. Gao, G. Kaur, V. Tsurkan, D. Rosales, F. Albarracin, D. Cabra

Abstract: $MnSc_2S_4$ spinel with magnetic Mn^{2+} ions forming the diamond lattice is an excellent model material for study magnetic frustration conceiving exotic states such as spiral spin liquid, competing long-range ordered phases and triple-q state in applied magnetic fields [1]. Neutron diffuse scattering gives direct experimental evidence for the existence of the spiral spin liquid (T_{N1}=2.3K <T< T_{cw}=23K), which was predicted to occur in the J_1-J_2 model on the diamond lattice, when the ratio between the ferromagnetic first and antiferromagnetic second neighbour couplings is $|J_2/J_1|>0.125$ [2].Neutron single crystal diffraction unravels three long-range ordered phases supplanting each other on temperature lowering (T_{N1}=2.3K, q_1=3/4 3/4 0; T_{N2}=1.75K, q_2=3/4+d 3/4-d 0; T_{N3}=1.6K, q_3=q_1) and, from the field variation of intensities of the different q_3 arms discloses the triple-q state. In order to provide a better description of the magnetic behaviour we employ the Luttinger-Tisza approximation and extensive Monte Carlo simulations to scrutinize additional magnetic interactions. We propose a minimal model including the 3rd neighbor exchange coupling, single ion anisotropy and exchange anisotropy. With the inclusion of these ingredients we find good agreement between neutron scattering data and Monte Carlo simulations and establish that this set of parameters indeed stabilizes the lattice of dense topological objects akin to skyrmions [3].

[1] S. Gao, O. Zaharko, V. Tsurkan, et al. Nature Physics, 13, 157-161 (2016).
[2] D. Bergman, J. Alicea, E. Gull, S. Trebst, L. Balents, Nature Physics 3, 487-491 (2007).

[3] S. Gao, D. Rosales, V. Tsurkan, O. Zaharko, et al. in preparation.

Juan Schmidt
Universidad de Buenos Aires (Argentina)

Title: "Interplay between nematicity and superconductivity in $Ba(Fe_{1-x}Co_x)_2As_2$ "

Authors: J. Schmidt, V. Bekeris, G. S. Lozano, M. V. Bortule, M. Marziali Bermudez, C. W. Hicks, P. C. Canfield, E. Fradkin and G. Pasquini.

Abstract: Phase diagrams with multiple intertwinned orders are a common aspect in the iron-based superconductors as well as in other unconventional superconductors. Results from the last decade have revealed the existence of an electronic nematic order, in which the electron system spontaneously breaks some rotational symmetry of the host crystal lattice. Even more interesting is the fact that this phase is expected to have a key role in the unconventional pairingmechanism in these materials. Under a Ginzburg-Landau formalism, this relationship can be addressed by proposing different coupling terms between nematic and superconducting order parameters, and assessing them experimentally. Nematic susceptibility is generally measured by means of elastoresistivity experiments, a powerful technique involving a number of non-trivial technical challenges. Recently, a novel piezoelectric-based apparatus capable of achieving large sample strains at cryogenic temperatures, with compensation of undesirable piezoelectric thermal deformations, was designed [1]. In a recent collaboration, such device was installed in order to perform absolute strain elastoresistivity measurements at low temperatures and orientable magnetic fields, in the Low Temperature Laboratory of FCEyN, UBA. Here we present recently published results [2], where we show evidence of nematic effects in the mixed superconducting phase of slightly underdoped $Ba(Fe_{1-x}Co_x)_2As_2$. By means of elastoresistivity measurements under a rotating magnetic field we were able to evaluate the effects of nematicity on the in-plane superconducting stiffness. Our results show that although nematicity contributes in a decisive way in the conduction properties, its contribution to the anisotropic properties of the stiffness of the superconducting order parameter is not as significant in these samples.

[1] C. W. Hicks et al., Rev. Sci. Instr. 85, 065003 (2014).
[2] J. Schmidt et al., Phys. Rev. B 99, 064515 (2019).

Alejandro Lobos
Facultad de Ciencias Exactas y Naturales - UNCuyo – Mendoza (Argentina)

Title: "Anisotropy and spin-fluctuation effects on the spectral properties of Shiba impurities"

Authors: J. A. Andrade and Alejandro M. Lobos

Abstract: We theoretically consider a quantum magnetic impurity coupled to a superconductor and obtain the local density of states at the position of the impurity taking into account the effect of spin fluctuations and single-ion magnetic anisotropy. We particularly focus on the spectrum of subgap Yu-Shiba-Rusinov (YSR or Shiba) states induced by a quantum impurity with easy- or hard-axis uniaxial anisotropy. Although this is a relevant experimental situation in, e.g., magnetic adatoms on the surface of clean metals, it is customary that theoretical descriptions assume a classical-spin approximation which is not able to account for single-ion anisotropy and other quantum effects. Here, quantum fluctuations of the spin are taken into account in the equations of motion of the electronic Green's function in the weak-coupling limit and considerably modify the energy of the Shiba states compared to the classical-spin approximation. Our results point towards the importance of incorporating quantum fluctuations and anisotropy effects for the correct interpretation of scanning tunneling microscopy (STM) experiments.

Pamela Guruciaga
Centro Atómico Bariloche – CONICET (Argentina)

Title: “Simplified micromagnetic model to study domain-wall dynamics in thin ferromagnetic systems”

Authors: Pamela C. Guruciaga, Nirvana B. Caballero, Vincent Jeudy, Javier Curiale, Sebastián Bustingorry

Abstract: Fully understanding domain-wall motion in ferromagnetic systems is considered essential for the design of new magneto-electronic devices. Together with experiments, numerical simulations are key to gaining an insight into the underlying mechanisms. However, simulating model systems at time and length scales comparable with those of experiments still represents a great challenge. Here, we present a simplified micromagnetic model-halfway between full micromagnetism and Ginzburg-Landau theory-- to study the dynamics of domain walls in quasi two-dimensional ferromagnetic systems with perpendicular magnetic anisotropy. Our approach relies on the local parametrization of the in-plane magnetization in terms of its out-of-plane component. We show that our model quantitatively reproduces previous experimental velocity-field data in Pt/Co/Pt ultra-thin films in the three dynamical regimes of domain-wall motion (creep, depinning and flow). In addition, we present a statistical analysis of the domain-wall width, showing that our model can provide detailed nano-scale information while reaching length and time scales comparable to the experiments.

Petai Pip
Affiliation: ETHZ, EMPA, PSI (Switzerland)

Title: “Fabrication of complex 3D Nanostructures”

Authors: Petai Pip, Claire Donnelly, Laura Heyderman, Laetitia Philippe

Abstract: In nanomagnetism, topological structures are promising candidates for low-energy spintronic devices due to their topological stability, and the low currents required to propagate them. Recently, there is increasing interest in complex three-dimensional (3D) topological spin configurations, known as magnetic knots, or hopfions, which offer a transition to three-dimensional structures and devices. However, so far they have not yet been observed experimentally. Here, we present an alternative route to these new topologies through the patterning of topologically non-trivial geometries magnetic structures by combining two-photon lithography and electroless deposition.

POSTERS

Mariano Marziali Bermudez
Instituto de Física de Líquidos y Sistemas Biológicos, UNLP-CONICET (Argentina)

Title: After the trail of a true ground state in spin ice

Authors: Mariano Marziali Bermúdez and Santiago A. Grigera

Abstract: State-of-the-art models of spin-ice material $Dy_2Ti_2O_7$, featuring magnetic interactions up to third nearest neighbors and long-ranged dipolar forces, predict an ordered ground state which breaks the cubic symmetry of the lattice [Borzi et al., Nature Communications 7:12592 (2016)]. In the presence of long-range magnetic order, neutron scattering experiments were expected to yield sharp Bragg peaks. However, even after very long relaxation times, such an ordered state could not be observed down to 300 mK. Instead, a diffuse pattern was obtained, indicating no long-range order. In this work, we show that experiment-compatible states already imply some degree of order, since the experimental structure factor cannot be reproduced simply by random two-in-two-out configurations. The small energy difference (~ 70 mK) between the ground state and disordered states compatible with the experiment in comparison with the high energy cost of single monopole-pair excitations (~ 4K) and the large number of sequential excitations required may account for the system's not reaching the true ground state.

César Leandro Londoño Calderón
Institute of Technology in Polymers and Nanotechnology - ITPN, UBA - CONICET, FIUBA (Argentina)

Abstract: We present an in-depth magnetic study of polycrystalline, microstain-free, magnetic, and thermally stable cobalt ferrite ($CoFe_2O_4$) octahedrons with an edge dimension of 214 nm. Nanoparticles were synthesized from granular $CoFe_2O_4$ nanotubes growing on bacterial nanocellulose and annealed at T = 1273 K. SEM, XRD, and VSM were used to investigate the morphology, structure and magnetic properties of the octahedral particles. The results indicate that heat treatment increases the sizes of the crystallites (2 times) and of the particles (4 times), compared with the starting material. The particles show a change of the magnetization saturation and magnetic anisotropy around 150 K compared with canonical ferrimagnetic materials, associated with a First Order Magnetization Process. The magnetization process as a function of temperature, cooling without (ZFC) and with (FC) different applied magnetic fields are explained by multi-domain theory. ZFC-FC curves show an irreversible branching temperature, which is highly sensitive to the applied magnetic field. In contrast, the temperature for the maximal magnetization value in the ZFC curves, change slightly with the external applied magnetic field, H.

Aneely Carrero
CONICET (Argentina)

Abstract: Nowadays, a huge effort is being made in the integration of perovskite oxides to silicon waffers with the aim of improving existing electronic devices or introducing new ones. our work shown the grown of different perovskite oxides systems integrated onto silicon by PLD. An structrural and morphological characterization, show, that systems are flatness and high cristalinity further, an study of their properties magnetic and electrics reveal that this systems are interesting for applications in sprintronic materials.

Pablo Domenichini
Departamento de Física - Universidad de Buenos Aires (Argentina)

Title: Transient magnetic domain wall AC dynamics studied by MOKE imaging

Authors: Domenichini P., Quintero C., Granada M., S. Collin, J. M. George, Curiale J., S. Bustingorry, Capeluto M., Pasquini G.

Abstract: Beside practical applications, the understanding of the magnetic domain walls (DMs) dynamics is also relevant on a wider context. From a basic point of view, DWs can be described within the general class of disordered elastic systems [1][2]. A large amount of work during the last decades has been devoted to understanding the relationship between the different dynamic regimes and the morphology and spatial correlation lengths in these systems [3][4][5]. However, there are still many unanswered questions. In particular, the AC dynamics of driven DWs has not been extensively explored up to now. In fact, the response to alternating magnetic fields has only been explored in limited cases and analyzed in terms of the constant field solution.

[1] Nattermann et al., PRB 42, 8577, 1990;
[2] Kolton et al., PRL 97, 057001, 2006.
[3] Jeudy et al., PRL 117, 057201, 2016;
[4] Ferre et al., C. R. Physique 14, 651, 2013;
[5] Caballero et al., PRE 97, 062122 ,2018;

Joaquín Fernández
CONICET (Argentina)

Title: “Quantifying the leading role of the surface state in the Kondo effect of Co/Ag(111)”

Guratinder Kaur
Paul Scherrer Institut, Villigen (Switzerland)

Title: Spin-Correlations in S=2 Triangular Antiferromagnet $FeGa_2S_4$

Authors: Guratinder Kaur, Marcus Schmidt, Oksana Zaharko

Abstract: In two dimensions (2D), the triangular lattice is the canonical example of geometrical frustration. $NiGa_2S_4$, S=1 a triangular lattice has been extensively studied experimentally [1] and theoretically predicting quadrupolar correlations [2], spin-disordered states [3] and a topological transition driven by the Z2-vortex binding-unbinding [4]. We explore the sister compound $FeGa_2S_4$ S=2, using neutron scattering. We intend to establish the dominant terms in the spin Hamiltonian and to reveal the possibility of multi-k formation [4].

[1] C. Stock et al. PRL 105,037402(2010)
[2] E.M. Stoudenmire et al. PRB 79,214436(2009)
[3] S. Nakatsuji et al. PRL 99,157203(2007)
[4] T. Okubo, H. Kawamura J.Phys.Soc.Jpn 79,084706(2010)

Alejandro Mezio
Instituto de Física Rosario (Argentina)

Title: Effect of the Hund’s rule and orbital anisotropy in the two-band Hubbard model: a finite-temperature slave-spin treatment

Abstract: The interest in the role of orbital degeneracy, Hund’s rule, and multiple bands in strongly correlated electron materials has increased in the last years due to the study of transition metal oxides, colossal magnetoresistance, and the new iron-based superconductors. Recently it was shown that Hund’s rule has a complex effect on correlations: it modifies the critical value of the correlation above which a Mott insulator is formed in a way that depends on the number of electrons per site and the orbital character. Here, we use the Slave-Spins Mean-Field Theory (SSMFT) to study the temperature dependence of paramagnetic phases of the two-band Hubbard-Kanamori model and compare the one-band results with the slave-bosons mean-field method. We pay particular attention to how the Hund’s rule and bandwidth anisotropy affects the coherence temperature Tcoh that signal the crossover from a Fermi liquid to a regime without quasiparticles, i.e., a bad metallic state. By calculating the quasiparticle spectral weight Z of each band, we can identify the Tcoh as the temperature where they collapse. Near the Mott metal-insulator transition, we find this Tcoh to be much

lower than the Fermi temperature of the uncorrelated Fermi gas and to follow the effect of the Hund's rule on the ground state. We also explore the consequence of band anisotropy and discuss the appearance of a different Tcoh for each band, or otherwise the emergence of a common energy scale for two different bands.

Lucas Pili
Instituto de Física de Líquidos y Sistemas Biológicos, UNLP-CONICET (Argentina)

Title: to be confirmed

Martín Tomé
Instituto de Física de Líquidos y Sistemas Biológicos, UNLP-CONICET (Argentina)

Title: "Effect of quantum fluctuations on Skyrmion and Meron crystals"
Authors: Martín Tomé, Héctor Diego Rosales

Abstract: In this work we calculate the effects of quantum fluctuations on two kinds of non trivial topological textures on the triangular and square lattices by means of the Holstein-Primakoff representation. In both cases, we discuss the magnon bands, zero-point energy and the magnon distribution density.

Flavia Gómez Albarracín
Instituto de Física de Líquidos y Sistemas Biológicos, UNLP-CONICET (Argentina)

Title: Field-induced pseudo-skyrmion phase in the antiferromagnetic kagome lattice
Autores: Martín Villalba, Flavia Gómez Albarracín, Diego Rosales, Daniel Cabra

Abstract: We study the effects of an in-plane Dzyaloshinskii-Moriya interaction under an external magnetic field in the highly frustrated kagome antiferromagnet. We focus on the low-temperature phase diagram, which we obtain through extensive Monte-Carlo simulations. Given the geometric frustration of the lattice, highly non trivial phases emerge. At low fields, lowering the temperature from a cooperative paramagnet phase, the kagome elementary plaquettes form non-coplanar arrangements with non-zero chirality. As the field increases, there is a transition from this "locally chiral phase" to an interpenetrated spiral phase with broken Z 3 symmetry. For a broad range of magnetic fields we identify a pseudo-skyrmion phase (pSkX) in a large portion of the magnetic phase diagram characterized with a topological order parameter, the scalar chirality by triangular sublattice. This phase consists of a crystal arrangement of three interpenetrated non-Bravais lattices of skyrmion-like textures.

Jonathan White
Paul Scherrer Institute (Switzerland)

Title: "Disordered skyrmion phase stabilized by magnetic frustration in a chiral magnet $Co_7Zn_7Mn_6$".

PRACTICAL INFORMATION