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Master student traineeship proposal

Title: *Exploring collective magnetic and electronic excitations in layered RBaMM'O5 perovskites: from crystal growth to advanced synchrotron spectroscopies*

Abstract:

This master traineeship project explores the versatile family of layered RBaMM'O5 transition metal perovskites. While sharing an isostructural framework, these compounds exhibit distinct physical properties. Specifically, YBaCuFeO5 is a magnetically frustrated system characterized by a room-temperature spin spiral order [1,2], whereas the RBaFe2O5 series features mixed-valence Fe ions undergoing a metal-insulator transition (MIT) alongside polaronic behavior and unconventional charge ordering [3,4]. The student will investigate magnetic and electronic excitations across both systems through large-facility scattering experiments and laboratory characterization. The project will be based at the ESRF ID32 beamline in Grenoble, and will benefit from synergies with the Institut Néel and ETH Zurich / PSI. The project goals include single-crystal growth and using advanced synchrotron and neutron scattering, principally X-ray Absorption and Resonant Inelastic X-ray Scattering (RIXS) at ID32, to characterize the interplay between spin, orbital, and lattice degrees of freedom. For YBaCuFeO5, RIXS at ID32 will be used to unveil how local Cu/Fe chemical disorder affects collective spin excitations and shapes the high-temperature spin spiral order. In parallel, exploratory studies on RBaFe2O5 will examine charge, orbital, and polaronic excitations to clarify the mechanisms driving the MIT. This hands-on project provides comprehensive training in spectroscopic probes, sample synthesis, and collaborative research.

References:

[1] A. Romaguera, et al., Front. Mater. 11:1448765 (2024). [2] A. Romaguera, et al., arXiv:2604.23597 (2026). [3] P. M. Woodward et al., J. Am. Chem. Soc. 125, 29 (2003). [4] D. K. Pratt et al., Phys. Rev. B 87, 045127 (2013).

Scientist in charge: Arnau Romaguera Camps

Beamline(s)/Host Group: ID32 beamline/X-Ray Spectroscopy (XSP) group

Traineeship supervisor(s): Arnau Romaguera Camps (ESRF ID32). Collaborators: Elise Pachoud (Institut Néel, C2MA), Monica Ciomaga Hatnean (PSI / ETH Zurich)

Access to Instruments/labs/computing/software: ID32 RIXS/XAS beamline; Institut Néel (C2MA) and PSI/ETH laboratories for sample growth and characterization; Python-based RIXS/XAS data analysis pipelines, software for XAS/RIXS modeling

Starting date and Duration: March/April 2027, 6 months (or September/October 2027); including a short 1-2 week research stay at PSI / ETH Zurich

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