PAUL SCHERRER INSTITUT

PSD Mini Symposium

X-ray scattering

Tuesday, December 10, 2019

10:00 to 11:00, WBGB 019

10:00: Talk – 20min
Doping evolution of the spin dynamics in two-leg spin ladders probed by resonant inelastic X-ray scattering
Tseng Yi, Kumar U., Zhang W., Paris E., Puphal P., Deng G., Bag R., Asmara Teguh C., Strocov V., Singh S., Pomjakushina E., Nocera A., Rønnow H. M., Johnston S. and Schmitt T.

10:20 Coffee break

10:40: Talk – 20min
X-Ray Dual Phase Interferometer design for a Multi-scale characterization of mineral building materials
Caori Organista, Kagias M., Blykers B., Cnudde V. and Stampanoni M.

Doping evolution of the spin dynamics in two-leg spin ladders probed by resonant inelastic X-ray scattering

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Spectroscopic probing the spin and charge dynamics of hole-doped spin ladders provides direct access to their underlying spin and charge correlations, long predicted to be crucial for the prerequisite of their superconducting phase under pressure. We present a study of the low-energy magnetic excitations in self-hole-doped ladders of $(Ca_xSr_{14-x})Cu_{24}O_{41}$ materials using Cu L_3-edge resonant inelastic X-ray scattering (RIXS). By comparing the RIXS spectra from an underdoped (x = 0) to a heavily hole-doped ladder (x = 12), we infer a clear evolution of the spin dynamics from collective two-triplon excitations to weakly-dispersive damped paramagnon modes. The latter is reminiscent of the excitation spectrum of two-dimensional (2D) superconducting cuprates in the overdoped regime. The experimental results are qualitatively in line with recent theoretical calculations on doped t-J ladders using exact-diagonalization (ED) and density-matrix renormalization group (DMRG). Our study provides insight in the momentum-resolved spin fluctuations in doped spin ladders, in proximity to a heavily hole-doped phase that evolves to a superconducting state when elevated pressure is applied.

X-Ray Dual Phase Interferometer design for a Multi-scale characterization of mineral building materials

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Mineral building materials are pillars in the construction industry; they are used in concrete manufacturing, road or house making, railway ballast among other applications. Due to its environmental and economic impact, one of the major challenges is to improve the durability and sustainability of such materials which deteriorate by external -physical and chemical- phenomena. To achieve this, a multi-scale characterization of their internal structural composition is required. For example, a description of the pore-distribution would help to design models that predict the deterioration on a macroscopic scale. To gain this structural information, standardized characterization techniques – such as conventional lab-based µCT and electron microscopy- have been exploited. Nevertheless, these techniques are limited either by resolution, field of view or require destructive procedures.

To overcome this, we propose the implementation of a dual-phase grating interferometer (GI) [1], [2] for a multi-scale characterization of the internal structure of mineral materials. With this instrument the dark-field signal is retrieved; which sense the visibility reduction caused by small-angle scattering of the wave front due to interaction with subpixel-size structures. Measuring this scattering signal [3] will yield quantitative information on unresolved microstructural features - beyond the resolution of the detection system- in large volumes of the material. In this talk we discuss how this interferometer works and how can it be described by numerical simulation for its optimization and future implementation.

[1] M. Kagias, Z. Wang, K. Jefimovs, and M. Stampanoni, "Dual phase grating interferometer for tunable dark-field sensitivity," *Appl. Phys. Lett.*, vol. 110, no. 1, 2017.

[2] H. Miao *et al.*, "A universal moiré effect and application in X-ray phase-contrast imaging," *Nat. Phys.*, vol. 12, no. 9, pp. 830–834, 2016.

[3] M. Strobl, "General solution for quantitative dark-field contrast imaging with grating interferometers," *Sci. Rep.*, vol. 4, pp. 1–6, 2014.