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Quantum melting of the hole crystal in the spin ladder of $\mathbf{Sr_{14-x}Ca_xCu_{24}O_{41}}$ ANDRIVO RUSYDI, University of Hamburg, P. ABBAMONTE, UIUC, H. EISAKI, AIST, Y. FUJIMAKI, S. UCHIDA, University of Tokyo, G. BLUMBERG, Bell Laboratories, M. RUEBHAUSEN, University of Hamburg, G.A. SAWATZKY, UBC — The "spin ladder" is a reduced-dimensional analogue of the high temperature superconductors that was predicted to exhibit both superconductivity and an electronic charge density wave or "hole crystal" (HC). Both phenomena have been observed in the doped spin ladder system $Sr_{14-x}Ca_xCu_{24}O_{41}$ (SCCO), which at x = 0 exhibits a HC which is commensurate at all temperatures. To investigate the effects of discommensuration we used resonant soft x-ray scattering (RSXS) to study SCCO as a function of doped hole density, δ. The HC forms only with the commensurate wave vectors $L_L = 1/5$ and $L_L = 1/3$ (Not at 1/4!) and exhibits a simple temperature scaling $\tau_{1/3}/\ \tau_{1/5} = 5/3$. For incommensurate values the HC "melts". During this study, the distribution of holes in ladder (n_L) and chain (n_c) of SCCO are redetermined as a function of x using polarization-dependence x-ray absorption spectroscopy (XAS). An interpretation of polarization dependent XAS is proposed. Based on our interpretation, for $x = 0$, the estimation of n_L and n_c is 2.8 and 3.2, respectively. The number of holes in the ladder is linearly increasing with x. For $x = 11$, the estimation of n_L and n_c is 4.4 and 1.6, respectively. This number of holes is matching well with the model of paired of holes needed to explain the RSXS result.

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