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ARPES sensitivity to short-range antiferromagnetic correlations
AMIT KANIGEL, ROBERT WALLAUER, Technion, SAMUELE SANNA, Universita di Pavia, ELIAS LAHOUD, Technion, PIETRO CARRETTA, Universita di Pavia — We chose $Sr_2CuO_2Cl_2$, a prototype of a spin $S = 1/2$ antiferromagnet (AF) on a square lattice, as a test case for the sensitivity of angle-resolved photoemission spectroscopy (ARPES) to short-range correlations. As expected, in the antiferromagnetic (AF) phase we observe the maximum of the highest occupied band at the $(q_x = \pi/2, q_y = \pi/2)$-point with significant spectral weight beyond the AF zone boundary. At temperatures about twice the Néel temperature, owing to the significant AF correlations, almost no change in the spectrum is observed. In order to reduce the correlation length we substituted Cu^{2+} (S=1/2) by Zn^{2+} ($S = 0$). The modification of the AF correlation length as a function of Zn concentration and temperature was derived using NMR and a direct correspondence between the amplitude of the spectral weight beyond the AF zone boundary and the correlation length was established. Remarkably, even at correlation lengths as short as 3 lattice constants we still observe a significant spectral weight in the back-bended band. These findings prove that the ARPES technique is very sensitive to short-range correlations and provide a hint for the understanding of ARPES results in the underdoped regime of high temperature superconductors.

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