Spin singlet and quasiparticules excitations in cuprates

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The transformation from an anti-ferromagnetic (AF) Mott insulator to a metal superconductor is a key element in understanding the physics of hole doped cuprates. Until now, many experimental techniques have tried to follow this transformation and some have succeeded only partially. In this manuscript we show that electronic Raman scattering developed over a very large spectral range is an ideal probe to follow this transformation provided that we focus simultaneously on the low energy quasiparticle excitations stemming from the charge carriers and the high energy spin singlet excitations originate from the remnant of the AF lattice. Using this new approach, the pseudogap phase considered as the one of the most mysterious phase in the cuprates is naturally interpreted as the stiffening of the relic of the AF lattice which block the charges. We also reveal a new relationship between the maximum amplitude of the superconducting gap and the critical temperature which is consistent with empirical laws proposed by other experimental techniques. These new results open up new insights for theoretical models dealing with short-range anti-ferromagnetic fluctuations for understanding the normal and superconducting phase of cuprates.