Intraband Optical Spectral Weight in the presence of a van Hove singularity: application to Bi$_2$Sr$_2$CaCu$_2$O$_{8+\delta}$

FRANK MARSIGLIO, University of Alberta, FABRIZIO CARBONE, ALEXEY KUZMENKO, DIRK VAN DER MAREL, Universite de Geneve — While the Kubo sum rule is often applied to the entire optical spectral weight to learn about the bare plasma frequency, the so-called “Kubo single band sum rule” is used to determine the optical spectral weight corresponding to intraband transitions in the valence band. We use a tight binding band with further than nearest neighbour hopping to explore the range of superconductivity-induced changes that are possible. We find that changes of both signs can occur within a conventional BCS framework. Using a band structure determined for Bi$_2$Sr$_2$CaCu$_2$O$_{8+\delta}$, we find that a straightforward BCS calculation of the optical spectral weight cannot account for the experimental observations. Including a scattering rate collapse phenomenologically, however, gives a very good description of the change in optical spectral weight at $T_c$ as a function of doping.

$^1$Supported by NSERC, ICORE, CIAR (Canada) and MaNeP (Switzerland)