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**Optical Integral and Sum Rule violation** SAURABH MAITI, ANDREY CHUBUKOV, Dept. of Physics, University of Wisconsin-Madison, Madison, WI-53706 — We perform direct calculations of conductivities and optical integrals ($W$) in the normal and superconducting states of the cuprates to look at the dependence of their difference($\Delta W$) on the upper cut-off($\omega_c$) placed on the optical integral and the effect of the bandwidth. Our calculations indicate that the frequency cut-off imposed by the bandwidth plays an important role in the sum rule violation. In the presence of lattice $\Delta W$ (as calculated from the Kubo band sum rule) need not approach zero for large $\omega_c$. For BCS model 95% of the spectral weight in the optical sum is recovered up to the bandwidth. But for other models - the single mode model and the collective mode model, only 70%-80% is recovered. We conclude that for all cases but BCS, there is a significant cut-off dependence as far as the recovery of the optical sum is concerned. We argue that $\Delta W$ between the superconducting and the normal state remains negative and point out the differences with the original mode model that claimed to explain positive shift of $\Delta W$. We find that the collective mode model with moderate coupling exhibits behavior consistent with the measured $\Delta W$ in the cuprates.

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