# Charge-Density-Wave Induced Modifications to the Quasiparticle Self-Energy in 2H-$TaSe_2$

*T. Valla, A. Fedorov, P. Johnson (Physics, BNL), J. Xue, K. Smith (Physics, Boston U.), and F. Di Salvo (Chemistry, Cornell U.)*

Abstract No. Vall8245
Beamline(s): **U13UB**

**Introduction**: Angle resolved photoelectron spectroscopy (ARPES) represents a powerful technique that directly measures the occupied component of the single-particle spectral function in low-dimensional materials, providing an insight into the many-body interactions of the system. Measurements of the spectral width and dispersion allow the determination of the coupling strength and the identification of the energy scale over which the excitation involved in the coupling occurs. Recently, the effects of the electron-phonon coupling on single-particle states have been directly observed[1]. In the present study, we measure the self-energy in 2H-TaSe2, system that shows the charge-density-wave (CDW) instability, and provide evidence of a possible collective mode that exists in the CDW state.

**Methods and Materials**: The experiment was carried out on a high-resolution photoemission facility based on the use of a Scienta SES200 analyzer. Samples grown by a chemical reaction with iodine as a transport agent were cleaved in UHV.

**Results**: The self-energy of the photo-hole in 2H-$TaSe_2$ is measured as a function of binding energy and temperature. In the charge-density wave (CDW) state, a structure in the self-energy is detected at ~65 meV that cannot be explained by electron-phonon scattering. A reduction in the scattering rates below this energy indicates the collapse of a major scattering channel with the formation of the CDW state, accompanying the appearance of a bosonic "mode" in the excitation spectrum of the system. The mode may be attributed to the electron-hole pair creation in those regions that are gapped by the CDW gap, or more precisely, to the scattering from fluctuations associated with the CDW order parameter.

**Acknowledgments**: This work was supported in part by the Department of Energy under contract numbers DE-AC02-98CH10886 and DE-FG02-98ER45680.

**References**: [1]T. Valla, A.V. Fedorov, P.D. Johnson, and S.L. Hulbert, Phys. Rev. Lett. 83, 2085 (1999); M. Hengsberger, D. Purdie, P. Segovia, M. Garnier, and Y. Baer, Phys. Rev. Lett. 83, 592 (1999); S. LaShell, E. Jensen and T. Balasubramanian, Phys. Rev. B 61, 2371 (2000).

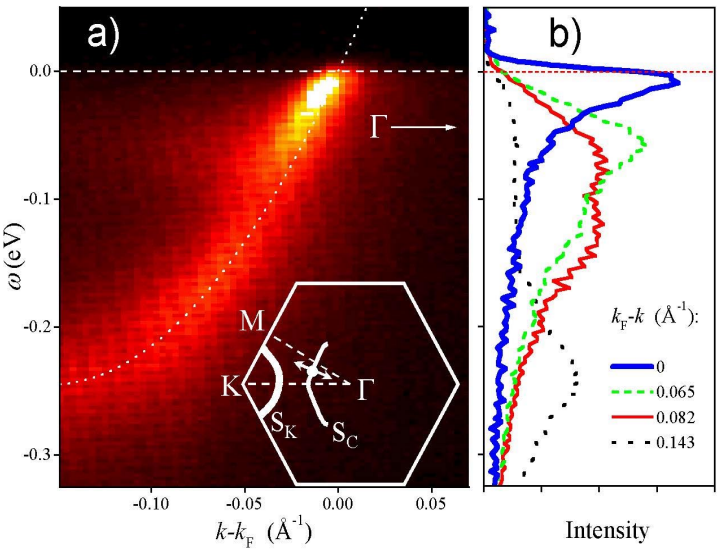


**Figure 1**. (a) The photoemission intensity in the CDW state (T=34 K) as a function of binding energy and momentum along the line indicated in the inset by the double-headed arrow. The dispersing state is a part of the Fermi surface $S_C$ centered at Γ. This Fermi surface is not gapped in the CDW state. (b) EDCs, measured for several moments.

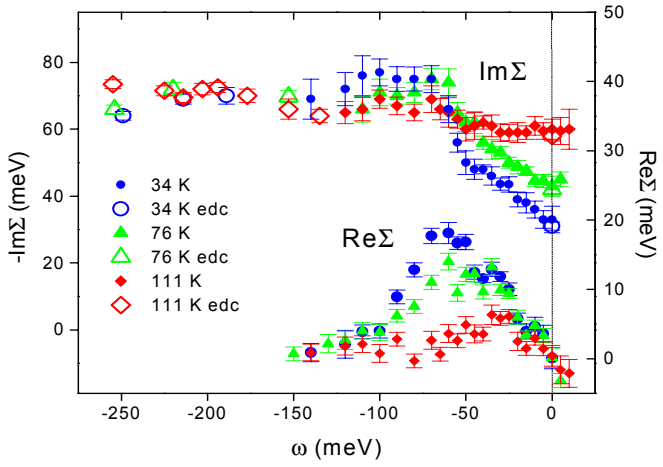


**Figure 2**. Self-energy as a function of binding energy, measured at different temperatures.