Abstract for an Invited Paper
for the NWS05 Meeting of
The American Physical Society

The Legacy of Einstein's Photoelectric Effect: From Light Quanta to Quantum Phenomena in Solids

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The photoelectric effect, discovered by Hertz in 1887 and explained by Einstein in 1905 on the basis of the revolutionary hypothesis of light quanta, marked the beginning of photoelectric spectroscopy, one of the most active fields in modern science and technology. Owing to recent technical progress, in particular to the development of third generation synchrotron sources, the last decade witnessed a renaissance in this technique and its applications. In this context, angle-resolved photoemission spectroscopy (ARPES) has emerged as the most powerful method of studying the momentum-resolved low-energy electronic structure of solids. Nowadays ARPES enables the detailed mapping of electronic band structures and Fermi surfaces as well the study of many-body quantum phenomena in solids. In this talk I will review the present state of the technique and, by presenting recent experimental results on the high-temperature copper-oxide superconductors, I will illustrate that state-of-the-art ARPES is a unique tool for momentum-space microscopy on novel quantum materials.