# Basic principles and applications of ARPES and Spin-ARPES in the investigation of systems with strong spin-orbit coupling

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Angle resolved photoemission (ARPES) is based on the photoelectric effect discovered by Einstein in 1905 and represents the unique technique that allows to measure directly the electronic bands of solids. It went through the first renaissance when employed in the investigation of high-$T_c$ superconductors in the nineties: ARPES contributed crucially to establishing the unconventional nature of high-$T_c$ superconductivity by mapping the Fermi surfaces of the cuprates and their evolution (gap) at the transition to the superconducting state. This progress was accompanied by the development of the first bidimensional detectors that increased the efficiency of the data acquisition and improved overall experimental resolution.

The second renaissance starts at the turn of the century, when the signatures of the strong electron-phonon coupling (Rashba effect) in the electronic band structure were first observed on the crystal surfaces and continues with the discovery of topological insulators, and other exotic systems that hold promise for the fields of spintronics and quantum computing due to the fact that their surfaces naturally host spin-polarized electrons that may propagate ballistically. The crucial quantum number, apart energy and momentum, becomes spin. This brings to the development of new spin detectors for implementing in efficient way spin-resolution in ARPES and results in spin-resolved photoelectron spectroscopy (Spin-ARPES).

In my lecture I will address the main principles of ARPES and Spin-ARPES and show through a few examples how they contribute to the understanding of the electronic and spintronic properties of materials. This will be followed by the practical at the beamline APE [1] where students will have hands-on experience with ARPES and our newly developed VESPA Spin-ARPES setup [2].

References:
[1] http://www.elettra.trieste.it/elettra-beamlines/ape.html
[2] C. Bigi *et al.*, J. Synchrotron Rad. **24**, 750 (2017).