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Introduction to Photoelectron Spectroscopy

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Photoelectron Spectroscopy is one of the most effective and popular spectroscopies for investigating matter in its various aggregation states, from atoms and molecules to solids, finding its application in a variety of scientific fields ranging from atomic and molecular physics, to solid state physics and chemistry, biology and geology, just to mention a few.

In this work, starting from a brief historical view, we introduce the basic principles underlying photoelectron spectroscopy, from atomic physics to the excitation in condensed matter. We shall make use of the quantum description of the interaction between electromagnetic radiation and matter, as outlined in other talks at this school, and we will provide the basic three-step-model upon which photoelectron spectroscopy can be easily interpreted. We will discuss values and limits of the approximations needed in order to obtain physical information starting from the photo-ionisation process and ending with photoemission as a spectroscopic tool.

A few exemplary experiments, photoemission on quantum objects, from simple atoms to surfaces, hetero-structures and nano-systems, will be presented. With the help of these simple examples, we will explain which physical information photoelectron spectroscopy can provide and how to exploit its characteristics, from cross-section to surface sensitivity considerations, in order to gain knowledge on the electronic properties of matter.