HIGH-RESOLUTION X-RAY EMISSION SPECTROSCOPY: A POWERFUL TECHNIQUE FOR INNER-SHELL ATOMIC PHYSICS AND FUNDAMENTAL PARAMETERS DETERMINATION

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High-resolution x-ray spectroscopy represents a powerful and sometimes unique tool for the investigation of atomic inner-shell processes. Indeed many aspects of the mechanisms governing the atomic excitation and decay channels can be studied by means of this technique which has played a central role in our present understanding of atomic structures and dynamics. The wealth of x-ray based applications in many domains of modern physics and other fields of science and technology and the recent advent of new tools such as synchrotron radiation facilities combined with increasingly sophisticated instrumentation have given a new boost to the domain.

In the first part of my talk, basic aspects of wavelength dispersive instruments will be presented. Bragg-type and Laue-type spectrometers will be outlined and their advantages and drawbacks discussed. Two high-resolution crystal spectrometers constructed in Fribourg will be then described in more detail: the Laue-type DuMond crystal spectrometer used for photon energies higher than 12 keV and the Bragg-type von Hamos crystal spectrometer employed for photon energies between 0.6 keV and 16 keV.

In the second part, examples of recent projects performed by means of high-resolution x-ray spectroscopy will be presented. Some typical results obtained in our long-term work on the metrology of x-ray transitions will be first reported. The usefulness of high-resolution will be then illustrated with two studies, the x-ray resonant Raman scattering and the radiative decay of hollow K-shell atoms produced by photoionization.

In the last part, the outlines and the status of the industrial x-ray fundamental parameter project carried out within an international scientific collaboration between four research institutes and a group of x-ray companies will be given. The aims of this project which was proposed in the framework of the ongoing International Initiative on X-Ray Fundamental Parameters are the development of new methodologies for fundamental parameters determination with reduced uncertainties and the improvement of the databases for the x-ray fluorescence analysis of materials.