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RECENT PROGRESS IN THE STUDIES OF ATOMIC IONIZATION PROCESSES INVOLVING

SYNCHROTRON AND LASER RADIATIONS

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Résumé

Cet article passe en revue certains résultats récents obtenus par spectrométrie d'électrons sur des atomes, à l'aide du rayonnement synchrotron émis par l'anneau de stockage à électrons ACO, à Orsay, couplé dans certains cas avec l'utilisation du faisceau d'un laser à colorant continu. L'étude du calcium et de l'hélium dans l'état fondamental et d'atomes de sodium préalablement portés dans un état excité à l'aide du laser sert à illustrer l'état actuel des recherches en photoionisation atomique.

Abstract

This paper reviews recent results obtained in photoelectron spectrometry studies carried out on atoms with the synchrotron radiation emitted by the ACO storage ring in Orsay, combined, in some cases, with the use of a cw tunable dye laser. Photoionization from the ground state of Ca and He and from laser excited sodium atoms serves to illustrate the present status of the experimental studies in atomic photoionization.

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Synchrotron radiation (also known as magnetobremsstrahlung radiation) is the electromagnetic radiation emitted when charged particles are accelerated radially, e.g., when they are subject to an acceleration perpendicular to their velocity (a ⊥ v). It is produced, for example, in synchrotrons using bending magnets, undulators and/or wigglers. If the particle is non-relativistic, the emission is called cyclotron emission. If the particles are relativistic, sometimes referred to as ultrarelativistic, the Significant progress in recent development of synchrotron radiation (SR) sources has offered the opportunity for time-resolved X-ray diffraction studies of fast lattice dynamics in atomic scale. The coherent atomic motion, as seen in coherent optical and acoustic phonons which are induced by femtosecond pulsed laser irradiation of semiconductor surface has directly been observed with the time-resolved X-ray diffraction technique. In this chapter, the time-resolved diffraction methods using an SR beam is summarized, and the demonstrations for acoustic pulse echo, coherent acoustic phonon, and o The study of light-matter interactions at the atomic level dates back more than one hundred years starting with Heinrich Hertz' discovery of the photo-electric eect and Johann Balmers observations of the hydrogen emission lines in the late 1880s. For example, ionization is the key initial process in HHG, as we will see in Chapter 4. Additionally, many experiments rely on the detection of electrons created by a strong ionizing pulse and any interpreta-tion of such experiments relies on the understanding of strong-eld ionization. When molecules ionize, the additional freedom associated with nuclear motion gives rise to phenomena that do not occur for atoms in strong elds. laser-molecule interaction for the typical intense laser of optical frequencies. Experimental techniques using synchrotron radiation as the incident probe are finding widespread application throughout all fields of science, including physics, chemistry, and biology. The incident particle is clearly a photon. However, the emitted particles may be photons, electrons, atoms, ions, or molecules. Magnetic x-ray scattering has also been used to study magnetic properties in the bulk [37]. Here the x-ray scatters the magnetic lattice rather than the atomic lattice. The technique has been particularly successful in studying the magnetic structure of the rare earths [38]. Synchrotron radiation is the most suitable photon source for PEEM and EXPEEM. Synchrotron radiation is emitted from electrons traveling near light speed, v≈c. Calculation of atomic ionization and recombination properties in synchrotron and FEL radiation S. Fritzsche. GSI Helmholtzzentrum für Schwerionenforschung, D-64291 Darmstadt, Germany Department of Physics, University of Oulu, Box 3000, FI-90014 Oulu, Finland. states involved in the process. The main problem in explaining these experiments is uncertainties in the Ar+ spectrum. One may predict that investigations at lower photon.