Ion- molecules and ion-cluster collision using fast and slow ions.

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Fast ion-atom collisions with atoms and molecules are known to be very useful technique to learn more about the structure and mechanisms of inelastic processes involved. The study of electron emission from a molecular hydrogen helps to study not only the ionization process itself but also a more fundamental process, namely, the coherence and the interference process which have been studied by measuring the Cohen-Fano-type oscillations are studied in detail. Several aspects of the interference have been explored in collisions of ~MeV/u bare C and F ions with H$_2$: frequency parameter, angular asymmetry parameter, influence on the Compton profile and the frequency doubling. Its angular distribution are measured for the interference process. In addition we have explored the effect on interference process on the forward-backward While the electron emission mechanisms in collisions with atoms and molecules are quite well known, the ionizations of a many-body system like C$_{60}$-fullerene are governed by more complicated processes, such as, collective Plasmon resonance. Several complementary measurements to detect the x-rays and recoil-ions emitted and now the “plasmon” electron detection has provided wealth of information on the single and double Plasmon excitation. Very recently we have measured the low energy (1-300 eV) e$^-$ - DDCS from C$_{60}$ in collisions with fast bare F ions at various angles. A direct evidence of the GDPR characteristic peak (“Plasmon electrons”) has been obtained for the first time through electron channel.

These studies are now been extended to large bio-molecules such as the uracil which is a DNA/RNA-base. Ionization and breakup of this molecule is also crucial for the microscopic details of the radiation damage process in cancer-therapy.

For most of the experiments a 14 MV tandem Pelletron accelerator has been used. The experimental setups based on electron, recoil-ion, x-ray spectroscopic techniques are involved. In addition, very recently we have installed a 14.5 GHz 500W ECR ion source the collision experiments with clusters, biomolecules, surfaces and plasma diagnostics. A coherent and comprehensive discussion will be provided using.

Some of the References:

Research from Germany on slow ion collisions using the COLTRIMS approach. A very important paper. Copyright

In recent experiments on slow and swift heavy ion collisions with polyatomic molecules like CO$_2$, only this simultaneous breakup and some contribution from the asynchronous reaction mechanism have been observed [17, 18]. Figure 1(b) clearly proves that in slow ion collisions the asynchronous dissociation mechanism, preceded by molecular bending and asymmetric stretching of the molecular ion, take place, as well; events resulting from molecular bending are located within the green dashed oval, while events allocated to asymmetric stretching can be found inside the black solid-line ovals (left). The ions are accelerated by a potential difference $V_T$ applied between perforated plates (grids) and this same potential keeps electrons from also leaving through these grids. The electrons from the ionization chamber are collected by an anode, and in order to prevent very rapid negative charging of the spacecraft (which has very limited electrical capacity), they must be ejected to join the ions downstream of the accelerating grid. After one such collision, the newly formed low-speed ion is easily accelerated into the screen. The screen current takes, however, a strong upwards swing when the beam current increases beyond some well-defined limit. d) Metastable excited atoms surrender the excitation energy upon wall collision. 10. Ion irradiation is used to analyze and modify the structure of condensed matter. It can for instance be used to form and shape nanocrystals in solids. In research on materials for high radiation environments, ion beams function as a controlled source of irradiation for studying the basic mechanisms of ion-solid interactions and for analyzing the structure of materials by methods like Rutherford backscattering spectrometry. Especially ion irradiation of nanomaterials is a topic that is under active research. The short-lived collision cascades caused by energetic ions in solids cannot be studied in experiments and are therefore often modeled in computer simulations. Such simulations can give a host of valuable information about processes that occur in nature.