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On the role of quasi-free electrons in photoionization of atomic and molecular clusters using nanosecond laser pulses

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This presentation will focus on multiple ionization and Coulomb explosion observed in different atomic and molecular cluster systems at laser intensities of 10^9 W/cm². Clusters were prepared by supersonic expansion and ionized by Nd: YAG laser (10 ns pulse width). Multiply charged atomic ions possessing high kinetic energies were detected by time-of-flight mass spectrometry. Along with this, presence of energetic electrons (with 25-30 eV kinetic energy) was also confirmed by retarding field method. Formation of such highly charged atomic ions at these intensities is quite unusual and difficult to explain theoretically. In order to understand different factors responsible for enhanced ionization, a systematic study was conducted in which wavelength, cluster size and cluster composition were varied. Ionization wavelength was found to have a pronounced effect on the charge state of ions and a threshold cluster size is essential. For giga watt pulses interacting with a cluster, primary step is multiphoton ionization of atoms/molecules giving rise to an ion and electron, the latter then absorbs energy from the optical field. In case of clusters, electrons which have been detached from parent atom, but are trapped inside the cluster are called quasi-free electrons. The results show that presence of quasi-free electrons and their confinement inside the cluster is very crucial for generation of multiply charged ions.

Biography

R K Vatsa completed his PhD from Bombay University, India and did his Postdoctoral studies at Heidelberg University, Germany. He is currently heading the Structural Chemistry Section in Chemistry Division of BARC. He has published more than 125 papers in reputed journals. He is Vice-President of Indian Society for Mass Spectrometry (ISMAS) and elected fellow of National Academy of Sciences, India.

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