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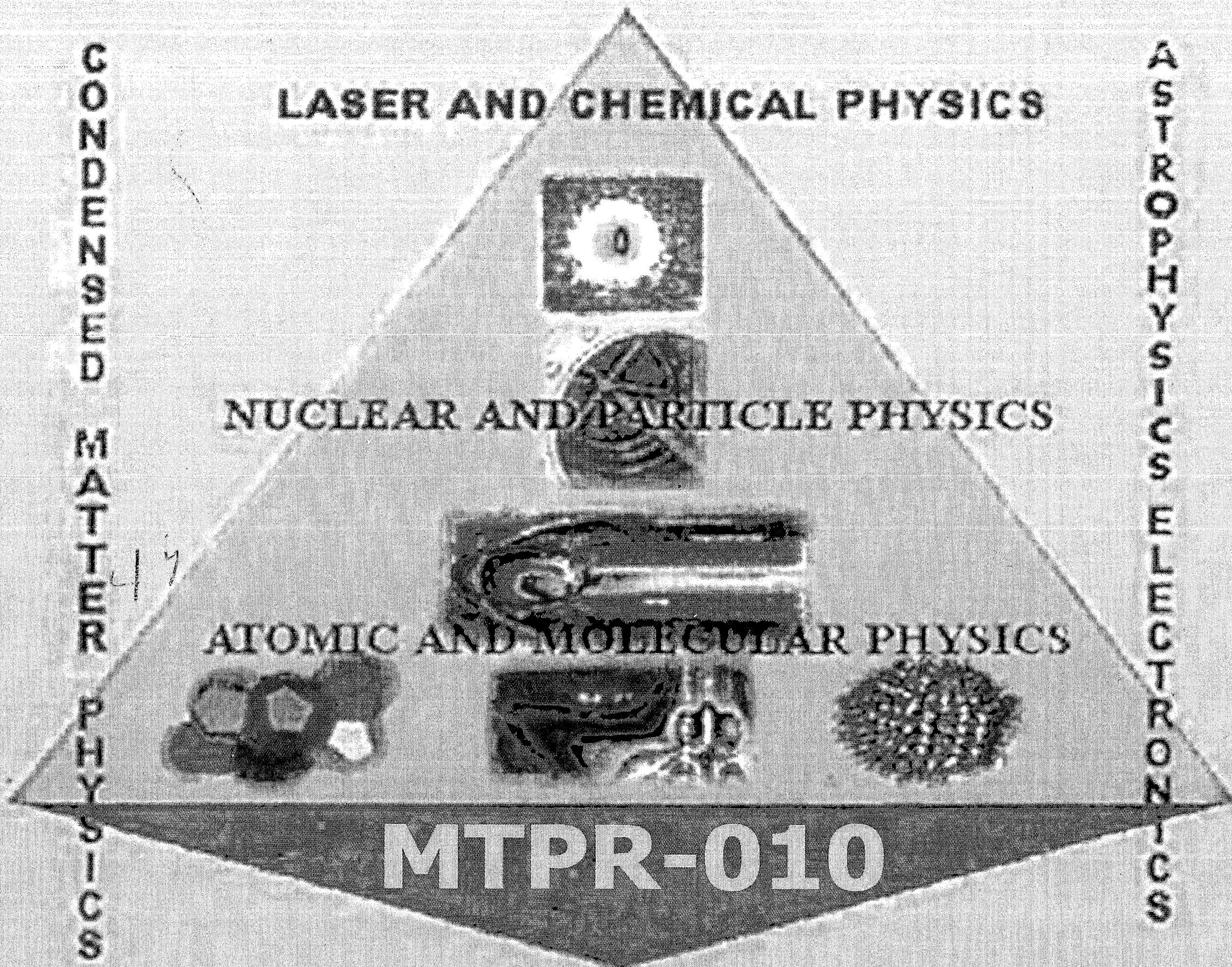

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X-Rays of Heavy Elements for Nanotechnological Applications: W & Pb Ions

Sultana N. Nahar
The Ohio State University, Columbus, OH 43210, USA

ABSTRACT: Heavy elements can absorb or emit hard X-rays and hence are commonly implemented in various nanotechnological applications. For example, gold nanoparticles are used in radiation therapy research. X-ray emissions from high-Z tungsten ions are useful for diagnostics of magnetically confined high temperature tokamak plasmas. Lead is one most known element for X-ray radiation shielding in biomedical, space and various other applications. However, detail study to understand the atomic properties of these ions has been very limited and hence the properties are largely unknown. These ions absorb or emit high energy X-rays mainly through the 1s-2p transitions, and can also be used as the source for radiation or electron production in the applications. For enhanced productions of electrons and photons in the nanobiomedical applications, investigations have focused on the K-shell ionization of the atom or ion. The reason is the well-known rise in photoionization at the K-shell ionization threshold. However, experimental investigations to find any evidence of this rise have not been found. We have developed a new method, Resonant Theranostics [e.g. 1] for biomedical applications, where we show that the energy for the rise is related to 1s-np, particularly 1s-2p transitions. The energy for the 1s-2p transitions varies some with the ionic state of the element and gives a narrow resonant energy band-width for the element. The strength of the process depends on the oscillator strength of the transitions at various ionic states. I will demonstrate these through illustrations of the resonant energy range and strengths of photoabsorption due to K-alpha transitions using some elements, such as tungsten and lead.

An X-ray photon can ionize a high-Z element by ejection of a K-shell electron. This will create a hole which through the Auger process will be filled out by an upper shell electron with emission of a photon. Such process can lead to Koster-Kronig cascade giving out a number of photons and electrons as the element goes through various ionic states. Such emissions are highly desirable in radiation therapy application. through due to Auger process. Present illustrations will include electric dipole allowed transitions for nine ionic states, from hydrogen to fluorine like ions. The 2p subshell is filled beyond fluorine. The number of tramsitions in each ionic state is different. For example, while there are two 1s-2p transitions for the one electron hydrogen-like ion, there are thirty five 1s-2p transitions for the six carbon-like ion.

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References:

1. A.K. Pradhan, S.N. Nahar, M. Montenegro, Y. Yu, H.L. Hang, C. Sur, M. Mrozik, R. Pitzer, J. Phys. Chem. A 113, 12356¿12363 (2009)