

## **X-ray irradiation of heavy element high-Z nanoentities for cancer theranostics**

Sara N. Lim, Sultana N. Nahar, Anil K. Pradhan

*Biophysics Graduate Program, Chemical Physics Program, Department of Astronomy,  
The Ohio State University, Columbus, Ohio, USA  
e-mail: pradhan@astronomy.ohio-state.edu*

### **Abstract**

Cancer is now the leading killer in many countries. In the U.S., one in two men and one in three women will contract some form of cancer during their lifetimes. While considerable incremental progress has been made in treatment, the overall mortality rates have not declined for several types of cancer. In emerging nations such as India, cancer is also fast becoming alarmingly common owing to improved detection and diagnostics. It is clear that novel pathways and treatments must be developed to counter cancer in the myriad forms that it manifests itself. We describe the use of heavy element high-Z (HZ) nanovehicles as radiosensitizing agents for cancer therapy and diagnostics (theranostics). Numerical Monte Carlo simulations demonstrate that low energy X-rays (LEX), <100 keV, should be more effective for killing HZ-sensitized cancer cells than the MeV high energy X-rays (HEX) from Linear accelerators (LINAC) used in conventional radiation therapy. We present experimental in vitro results on F98 rat glioma (brain cancer) cell lines sensitized with platinum based compounds, such as carboplatin, using broadband 160 KV and 6 MV LINAC X-ray sources. The general agreement found between theoretical and empirical data also suggests potential combination of chemotherapy and radiation therapy. Studies using gold nanoparticles (GNP) and other cancer cell lines are discussed. We also describe biomedical research devoted to the development of new devices for diagnostics and treatment.