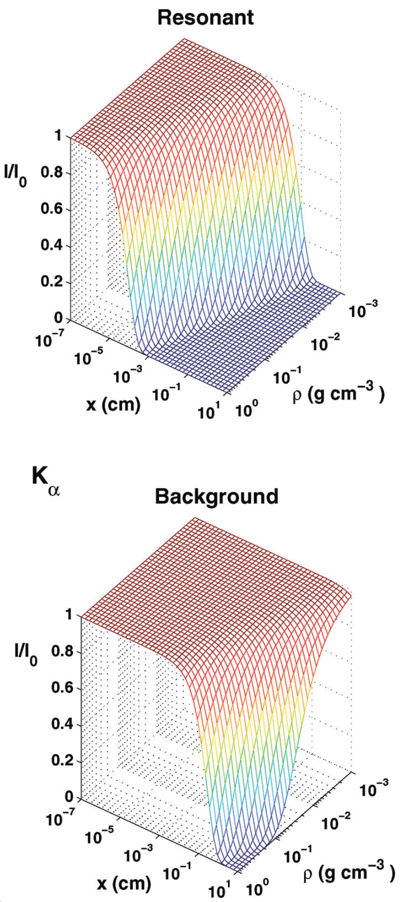


Applying high-end X-rays to cancer treatment

Two Ohio State University astronomy researchers have established an international reputation for using X-rays and supercomputers to search the vast depths of space to identify elusive black holes. Now, they and their interdisciplinary colleagues are repositioning their scientific methodology to peer into the human body to enhance cancer therapy and diagnostics (theranostics).

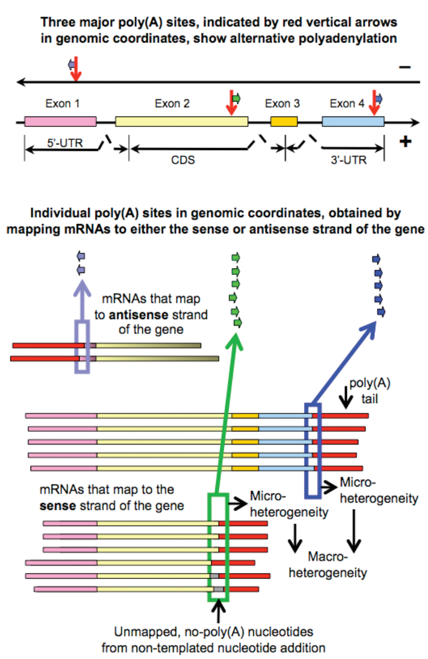
Led by OSU's Anil Pradhan, Ph.D., and Sultana Nahar, Ph.D., an international research team is using new computer-based models and high-end X-ray spectroscopy to minimize radiation risks and enhance therapeutic efficiency for cancer patients. The X-ray irradiation process causes embedded nanoparticles of iron, gold and other heavy elements to release photons and low-energy electrons to help break up the DNA in malignant tumors. The researchers are also experimenting with bromine, iodine and platinum, which are active elements in radiological contrast agents used for imaging.

"The resonant nano-plasma theranostics or RNPT could revolutionize X-ray diagnostics and therapy," Pradhan told the science magazine *Nature*. The RNPT approach would reduce radiation exposure by factors from 10 to 100, he added.

The research team accesses the IBM Cluster 1350 system at the Ohio Supercomputer Center for their modeling needs, as well as for their astrophysics research. In their study of invisible black holes, researchers collect telltale radiation readings from a plasma sea of super-hot atoms, using satellites and large telescopes. Pradhan, Nahar and their team leveraged OSC resources to perform high-accuracy energy calculations to compare with the radiation readings. ■

Project lead: Anil Pradhan and Sultana Nahar, The Ohio State University
Research title: Nanospectroscopy for nanomaterials and nanobiomedicine
Funding source: The Ohio State University

Calculating disparity in RNA polyadenylation



When eukaryotic genes are expressed, precursor messenger RNA (pre-mRNA) must first be processed to become mature mRNA. One step of the maturation process is constitutive polyadenylation: the attachment of a poly(A) tail to mark and protect the end of mRNA. However, alternative polyadenylation at a different poly(A) sites on the pre-mRNA might result in information loss and sometimes can cause cancers and other diseases in humans.

A Miami University research team led by Chun Liang, Ph.D., is investigating potential regulatory mechanisms controlling alternative and constitutive polyadenylation within eight different species – two diatoms, two green algae, spikemoss, moss, Arabidopsis and human.

"It has been shown that polyadenylation is guided by regulatory elements, or motifs, known as the poly(A) signals," said Liang, an assistant professor in bioinformatics. "The process is carried out by the protein complex that recognizes and binds to those motifs, cleaves the mRNA and conducts polyadenylation."

Classical genetic analysis and recent genome-wide bioinformatics analysis suggest that there are three typical regulatory elements in plants: a cleavage element, a near-upstream element and a far-upstream element.

"Using the powerful bioinformatics software package MEME (Multiple EM for Motif Elicitation), we are searching for over-represented sequence motifs from each of the regions," Liang explained. "Our preliminary data analysis reveals interesting differences among different species, but the real challenge is that we have to process a large amount of data to detect significant/meaningful patterns, while processing a large amount of data demands more computational resources." ■

Project lead: Chun Liang, Miami University
Research title: Comparative analysis of polyadenylation signals in eukaryotes
Funding source: Miami University