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By Minwah Leung

Dr. Jacquelyn Ciel Yanch is a professor in the Nuclear Engineering Department at MIT and a faculty member of the Harvard-MIT Division of Health Sciences and Technology. Her primary research focuses are biomedical applications of radiation and radiation health.

Professor Yanch originally began her undergraduate education at McMaster University in Ontario, Canada with an interest in English Literature. After some time, she felt the need to study a more practical subject and switched her major to Psychology. As she fulfilled her basic science classes, she encountered an engaging physics professor. His captivating lectures and demonstrations led to her interest in physics. After she finished her degree in Psychology, she pursued a second bachelor's degree in physics. Fortunately at that time, her university was offering a new Master's program in health and radiation physics. As a result, she continued her research with the program and received a Masters of Science in Health and Radiation Physics. Afterwards, she tried to find the next step in life. She ultimately decided to continue in academia, but since she had stayed at the same university for numerous degrees, she went to the University of London in England for her PhD in physics.

While in London, she studied nuclear medicine imaging at a cancer hospital. In nuclear medicine imaging, patients ingest radioactive material tagged with a drug that targets a specific region of interest. The images show distribution of the emitted radiation, providing information about blood flow and metabolic activity and therefore used to diagnose conditions of a disease. In her thesis, she researched how to reduce noise in the images due to scattered radiation.

After her PhD, she was unsure of what she should do next, but applied for post-doctoral positions at academic institutions across Canada and the United States and finally came to MIT. Professor Yanch says she never had a clear idea of where she would end up, but found herself through the opportunities that became available to her. She took each degree one step at a time, then followed with what seemed like the next natural step. She doesn't believe that never having a clear goal in mind is the best way to live life, but simply letting her interests lead her seemed to have worked.

After several years at MIT, she felt overwhelmed with the workload and stress. In addition, she wanted to take some time off to explore industry, since she had never had any experience outside of academia. She worked for a company nearby that was developing a radiation treatment for metastasis in the brain. One goal of the company was to find a technique similar to a biopsy, where the tissue of interest is sampled from your

brain for diagnosis. They were developing an insertable x-ray device that would irradiate the tumor for a short period of time and then be extracted from the tumor.

While working in the company, she always felt the presence of a boss on top of her, constantly looking over her shoulder. She disliked the hierarchy of a company and meetings with managers. She also found herself getting bored towards the end of the day. After a year, she decided industry wasn't for her and returned to MIT. Although MIT was stressful, she had a certain freedom in her research and was never bored.

Recently, Professor Yanch started her own business through the Small Business Innovative Research Program. This program is the government's method for promoting new innovative products and small businesses. Through this program, large research-based federal institutions, such as the National Institute of Health and National Science Foundation, must allot 2.5% of their budget every year towards helping small businesses. The program distributes grants to those with ideas for potential commercially successful products but need money for further research.

There are two phases of grants. Phase I is an exploratory stage where the business is given six months' time to find a method that successfully solves your problem. If results from Phase I are favorable, the business may apply for a Phase II grant. For Phase II, the business is given a grant for up to two years time to further develop and incorporate the idea into a product that can be commercialized. After Phase II, the business is no longer able to receive funding from the program.

Professor Yanch developed a computer program that measures the absorbed dose of organs from diagnostic radiological scans. Measuring this dose is important because safety regulations require that the absorbed dose of each organ must be recorded for a patient receiving a radiological scan. However, the procedure to obtain these numbers is laborious as there are numerous conditions and parameters to consider during the scan. In an attempt to eliminate the need for this procedure, her program simulates the effects of the radiological scans and models the amount of absorbed dose received in each organ. During Phase II, she also worked on factoring fat into the effects of absorption. The program provides an easy way for calculating the absorbed dose of organs. Someone can simply input several parameters and select the type of radiological scan, then the program will perform the calculations and ultimately present a number reflecting the absorbed dose.

Professor Yanch encourages all students with innovative ideas for commercial products to look into the small businesses initiative.

Current Research

At MIT, Professor Yanch has been heavily involved in research of using neutrons for radiation therapy, namely a cancer therapy called Boron Neutron Capture Therapy (BNCT). This therapy technique uses the interaction between boron and a neutron beam to damage tumor cells, while mostly unaffecting the surrounding healthy tissue. Professor

Yanch has also derived treatments of other diseases from this technique, such as Boron Neutron Capture Synovectomy, a treatment for arthritis. This treatment uses the same technique to remove inflamed joint tissue while similarly keeping most neighboring healthy cells unaffected. She has also been involved with a third type of neutron radiation therapy named Fast Neutron Brachytherapy. The researchers developed an accelerator whose tip contains a neutron producing target and can be placed in direct contact with the tumor. This research has been published in the 2002 January issue of Medical Physics.

Professor Yanch's most recent research investigates more effective drug delivery to brain tumors. The researchers are using focused ultrasound and MRI to guide drugs to the specific location of the brain tumor. Such a technique will have an impact on limiting side effects of the drugs on surrounding healthy tissue. The project is being conducted at Brigham and Women's Hospital. Here is a link to the project abstract:
http://hst.mit.edu/servlet/ControllerServlet?handler=ResearchHandler&action=view&topicID=831

Her other ongoing projects include finding new ways to understanding the interaction between radiation and biological materials. She has worked on developing new energy accelerators that can target a specific part of a cell to investigate cellular response to radiation.

Resources

If you would like to read more about Boron Neutron Capture Therapy, check out their work at MIT's nuclear reactor:
http://web.mit.edu/nrl/www/bnct/bnct_home.html

Here is the MIT News article that was published in 1996 about neutron therapy for rheumatoid arthritis:
http://web.mit.edu/newsoffice/1996/arthritis-0214.html

Check out the website of MIT's nuclear reactor laboratory. Here, you can find more details on their different research projects as well as work and research opportunities for students:
http://web.mit.edu/nrl/www/index.html

For more information about Yanch's research and other bionuclear research at MIT:
http://web.mit.edu/nse/research/science_eng/bionuclear.html

If you would like to know more about Yanch's research projects, or want a UROP along these topics, feel free to contact Professor Yanch.