Building momentum in radiation science through collaboration

By Nicole Jawerth

The diverse ways radiation is used today are the result of one scientist's research and expertise building on and feeding into that of another, and together these results translating into innovative, practical applications that touch people's everyday lives. One way scientists connect today is through IAEA Collaborating Centres.

To get a glimpse into the work of an IAEA Collaborating Centre in radiation science and technology, Suresh Pillai, Director of the National Center for Electron Beam Research and a professor of microbiology and molecular biology at the Texas A&M University answered a few questions for the IAEA Bulletin about his centre and its designation as an IAEA Collaborating Centre. He explained how their work contributes to the use of electron beam technology for food, health and environmental applications, and how it functions as a platform for researchers from about ten countries. He also talks about the future and some of the innovative research being done at his centre.

Q: What does it mean to be a designated IAEA Collaborating Centre?

A: We have worked on the development and commercialization of electron beam technologies for the past 15 years. We do not-for-profit work, and our services equate to around US $1–2 million worth of electron beam activities each year, both commercially as a model for industry to adopt and for research and development (R&D).

Being an IAEA Collaborating Centre is one way for us to move beyond merely publishing high-quality research towards ensuring our work has global ramifications. We maintain a strong connection with the IAEA and take part in its technical and coordinated research projects. These help us to connect our expertise with the people on the ground who might need it. They also allow us to establish strong connections with other scientists around the world, helping us to stay at the forefront of what is happening in the field and to keep an overview of where it is headed.

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—Suresh Pillai, Director, National Center for Electron Beam Research, Texas A&M University, USA

Q: What does your institute do as a Collaborating Centre?

A: Our mandate is broad. Our work is primarily focused on three areas: raising awareness to encourage a greater understanding and use of electron beam technology; providing guidance and expertise to countries, companies, entities, and individuals to help them adopt and commercialize this technology; and continuing to push the proverbial envelope in research to add value to products and people's lives.

We do this by hosting IAEA-sponsored visiting scientists, travelling to other countries involved in IAEA projects

to provide expertise, and organizing workshops involving IAEA-sponsored participants, including at our annual, one-of-a-kind hands-on electron beam technology workshop, where scientists actually work with the technology and learn how to use it.

One of the projects we have recently worked on was through an IAEA technical cooperation project for Latin America. We worked with a small industrial group in Mexico who built the first commercial electron beam facility in Tijuana, which just opened in February 2017. In the span of two to three years, we educated them in all the nuances of the technology, in everything from training people, all the way to building a sustainable business. We helped them set up collaborations with other local institutes. In this project, the IAEA helped provide guidance to officials and facilitate connections between experts around Latin America and in Mexico.

Q: What are electron beams and how does your institute use them?

A: Electron beams are streams of highly energetic electrons, which are produced with specialized equipment such as linear accelerators.We use electron beams to conduct research that can be used to clean, heal, feed and shape the world and beyond.

For cleaning, we use it for environmental remediation research, whether for wastewater treatment, drinking water treatment, or water reuse. For healing, we do research to formulate advanced vaccines and sterilize advanced pharmaceuticals and medical devices. For feeding, we use it in research to enhance food quality, safety and security, including food defence where this technology is used to decontaminate deliberately contaminated food. For 'shaping', we perform research on how to use the beams to make advanced materials that range from traditional polymers to very advanced nanomaterials and nanocomposites. This shaping also involves developing commercial applications and doing advanced R&D, including in space, through our close work with the National Aeronautics and Space Administration (NASA) on advanced applications for electron beam technology for manned and unmanned space missions.

Q: What are the advantages of using electron beams instead of other methods?

A: Electron beams are one of the cheapest and most organic approaches to creating free radicals. Electron beams don't require us to introduce chemicals or heat to effect changes in materials as other methods do, and they have a much lower carbon footprint. Also, other ionizing radiation technologies don't have the same simple switch-on, switch-off dimension.

Because they do not rely on a radioactive source and because they are able to be switched on and off, electron beams allow us to continue to develop radiation-based applications without having to fear any sort of nuclear proliferation, theft or nuclear exposure. This is very important in the security-conscious world in which we now live.

Q: What is one of the coolest things your institute is working on?

A: There are two areas I am really interested in. One is the development of vaccines for human and animal health. All the research we're doing on infectious diseases tells us that we are only scratching the surface of the potential for high value vaccines with this technology. We now know we can create very high value, high potency vaccines for different infectious diseases in humans and animals. That is very exciting for us.

The other area is in environmental remediation. Be it chemical pollutants in groundwater or municipal waste, we know that compared to other technologies out there today, electron beam technology will be a change agent. A change agent comes with a lot of challenges, but as you know, it is capable of flipping the entire industry on its head. How we look at waste would be to no longer call it a wastewater treatment plant, but instead something like a "resource recovery facility", where the connotation of waste is taken away and instead every drop of water that leaves a home or an industry is looked at as something that can be mined for energy and other resources.