Is accelerator research useful?

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There is a question almost always asked when talking about science – "OK, this is interesting. But is it useful for something?" Not too many scientists working on basic science are good at answering this question. "Dr. Masatoshi Koshiba sometimes says that the neutrino, his main research subject, is not useful at all. Well, a Nobel laureate could say that, but not us. I try to talk more about useful accelerators these days," said Atsuto Suzuki, the Director General of KEK, at a symposium held in Nagoya, Japan, in November, which was organised by the Advanced Accelerator Association promoting science and technology (AAA).

The track record shows that particle physics studies have been the source of many innovations not originally part of the research to understand the Universe. "Synchrotron radiation light emitted by electrons orbiting in a storage ring of the accelerator makes it possible to analyse structures of the smallest size, such as proteins. Neutron beams produced by accelerators enable us to see through the inner structure of devices without breaking them," Suzuki explained. He also mentioned accelerators are used for medical diagnosis or therapy. Positron emission tomography (PET) enables us to view chemical processes within live organs. Heavy-ion radiotherapy is recognised as a powerful treatment method, delivering a concentrated, targeted dose of heavy ions precisely to the site of a tumor. "In addition to those applications already in effect, accelerators are expected to work as a useful tool in astrophysics or life science," Suzuki said.


Toshihide Maskawa (left) and Atsuto Suzuki at the AAA symposium held in Nagoya, Japan.

Those innovations have changed the way we live and do business. One of the most striking examples is the discovery of electron. The then unknown particle has now become a necessity of our life in many ways, in many shapes. But, for scientists working on basic science research, those innovations were recognised as spin-offs, not the results from their efforts. Therefore, no proactive advertisements had been made to report what was the origin of those useful innovations.

Another factor that makes it difficult to connect innovations and basic research is the length of the lead time. Basic research can precede innovations by decades. "It is said that it takes 50 to 100 years for a result from basic research to reach back into the society," said Toshihide Maskawa, who won the 2008 Nobel Prize in physics, and also gave a talk at the AAA symposium. But he pointed out that the lead times are being 'bypassed' these days. "Some of the innovations are accomplished as quickly as within two or three years. As the experiments got bigger, technical elements for the accelerators and detectors became more complicated, requiring sophisticated and unprecedented technologies. Those technologies are benefitting the society rather than waiting for the scientific results from experiments," said Maskawa.

The World Wide Web (WWW) is one of the good examples of quick innovation. The WWW was invented in 1989 by Tim Berners-Lee, a scientist at CERN. It was originally conceived and developed to meet the demand for automatic information sharing between scientists working in different universities and institutes all over the world. The ILC is also expected to be the source of yet more technological breakthroughs. For example, the superconducting radio frequency accelerating technologies could be adapted to produce monochromatic X-rays for medical diagnoses and treatment, enabling radically new probes of biological processes and tissue protein structure, and help develop new medicines.

Even though the lead times are becoming shorter than in the past, it still is unsure where, when and how, if ever, basic research being done now would benefit us. One can easily imagine that people don't want to invest in unknown possibilities under the tough circumstances we experience now. "However, we cannot forget that the innovation happens by multiplication," said Suzuki. "When you multiply zero by any number, you always get zero. Even when you multiply zero by hundreds of thousands, you still get zero. Our job in science is to produce 'one' to multiply."

"Is it useful for something?" This might be the question answered only by scientists in the future. No one can tell if it is useful or not for sure at the time of the new discovery. But scientists are accountable for explaining what may originate from the innovations we enjoy now.

-- Rika Takahashi