A WINNING TRADITION: THE FARADAY CUP AWARD

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The Faraday Cup Award is given for an outstanding contribution to the development of an innovative particle beam diagnostic instrument of proven workability. "Like a 'Nobel Prize' for the beam instrumentation community," is how the 2000 winner, Kay Wittenburg of DESY, describes the Faraday Cup Award. It is presented at the Beam Instrumentation Workshop (BIW), a biennial forum for in-depth discussions of techniques for measuring particle beams produced in accelerators. The Faraday Cup winner receives a US $5,000 cash prize, $1,000 for BIW travel expenses, and a certificate of award. An acceptance speech is given at the workshop by the Awardee in the form of a talk on the design and performance of the winning instrument.

Like many other awards, the Faraday Cup Award comes with a storied tradition. The first Beam Instrumentation Workshop was organized by Richard Witkover and held at Brookhaven National Laboratory in 1989 to stimulate interaction among those in the instrumentation field. The idea for an award was conceived during round-table discussions the last day of that meeting as a way to encourage innovation among young engineers and physicists. Agreement on policies for keeping the award fair and non-commercial was reached in 1991 based on nomination and selection procedures written primarily by Bob Shafer. Naming of the award is attributed to Bob Webber. Financial sponsorship of the Faraday Cup Award is donated by Bergoz Instrumentation.

The BIW Program Committee is solely responsible for selecting the Award recipient. The Committee accepts nominations for the award approximately 12 to 18 months in advance of each BIW. Self-nomination is permitted. The award is open to candidates of any nationality for work done at any geographical location. Instrument performance must be proven using a primary charged particle beam; mere concepts or "bench-top" demonstrations are not acceptable. A description of the device, its operation and performance must be published in a journal or conference proceedings that is in the public domain. In the event of deciding between works of similar quality, preference is given to candidates in the early stages of their beam instrumentation career. The award may be shared between persons contributing to the same accomplishment. Complete rules are available at http://www.faraday-cup.com.

Since the first Faraday Cup Award in 1992, fifteen people from laboratories around the world have received the Award (see Table 1) and have gone on to continued career success. Although each prize award is a one-time event, the rewards from the prize have continued for the winners.

Table 1: Faraday Cup Award Winners

	Winner	Diagnostics
1992	Alexander V. Feschenko, INR	"Longitudinal Bunch Shape Measurement "sing Wire Probe Secondary Emission"
1993	Donald W. Rule & Ralph B. Fiorito, NSWC	"Techniques for Measuring Bunch Shapes by OTR"
1994	Edward Rossa, CERN	"Technique for Measuring the 3-D Bunch Shapes"
1996	Walter Barry, LBL and Hung-chi Lihn, SLAC	"Sub-ps e^- Bunch Shape Measurement Techniques"
1998	Andreas Peters, GSI	"Cryogenic Current Comparator"
2000	Kay Wittenburg, DESY	"Beam Loss Monitor Using PIN Diodes"
2002	Andreas Jansson, CERN	"Quadrupole Beam Pickup"
2004	Toshiyuki Mitsuhashi, KEK	"Interferometric Profile Monitor Using Synchrotron Radiation"
2006	Haixin Huang, BNL, and Kazuyoshi Kurita, Rikkyo Univ.	"Innovative Proton Beam Polarization Monitoring System"
2008	Suren Arutunian, YerPhI	"Vibrating Wire Sensor for Beam Instrumentation"
2010	Florian Loehl, CLASSE, & Kirsten E. Hacker, DESY	"Femtosecond Resolution Beam Arrival Time Monitor"

PhD students can have breakout results and winning instruments have emerged from their thesis work. In 1996, Walter Barry of Lawrence Berkeley National Laboratory and Hung-chi Lihn of the Stanford Linear Accelerator Center shared the Faraday Cup Award for development of techniques to measure the bunch shape of subpicosecond electron beams. Lihn, a PhD student at the time, sees the award as a great recognition, by experts in the field, of his years of work and ideas. Now in industry, Lihn still calls upon the skills that he developed building his winning instrument. While he did not personally continue with further development of the device, Lihn's thesis and paper have been cited by a number of others and the ideas have been adopted in other labs.

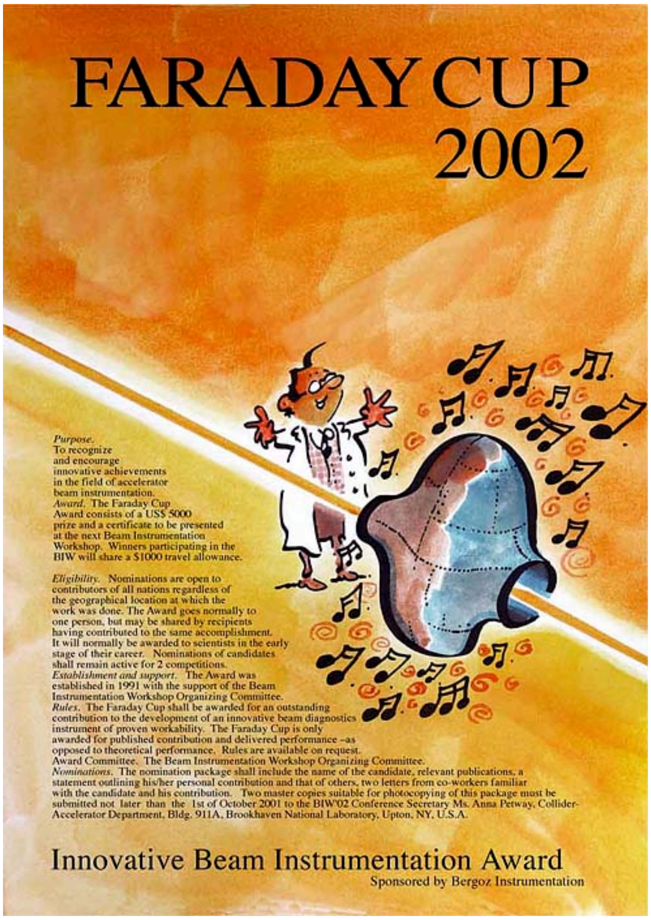

Figure 1. Example of Faraday Cup Award poster by the artist Pecub. More on the Faraday Cup Award web Site (*http://www.faraday-cup.com*).

Development of a magnetic quadrupole pick-up began as a simple idea that eventually became a main theme of Andreas Jansson's PhD dissertation. Working many hours at CERN with a network analyzer by his side, Jansson won the 2002 award for his pick-up which measures the quadrupole moment, or ellipticity, of a particle beam. After BIW '02, nearing the end of a CERN postdoc position and looking to widen his horizons, he visited several US laboratories and then accepted a People's Fellowship at Fermi National Accelerator Laboratory, where he continues to work. Jansson credits some of his career success to his Faraday Cup Award win and the resulting visibility.

Like Lihn, who faced different challenges when moving to an industry position, Jansson had to call on his acquired skills in his new position at FNAL. The pick-up that he had developed for the CERN PS was not optimal for the Tevatron with its dual beams and helical orbits. He started work on other instruments such as Ionization Profile Monitors and Microwave Schottky Monitors. Jansson's fondness for his PhD work is evident as he tries to keep up with the development of various quadrupole detectors by others, including quadrupole mode cavities and electro-optical devices.

In its history, the Faraday Cup Award has recognized a wide range of innovations and advancements in beam diagnostics. The very first winner of the Award, Alexander V. Feschenko of the Institute for Nuclear Research in the Academy of Sciences of Russia, won for a technique to measure the longitudinal bunch shape of a charged hadron beam with picosecond resolution using secondary emission from a fine wire probe. Bunch shape information is used to study beam dynamics and to tune an accelerator.

A device to measure three-dimensional bunch shapes of picosecond e+/e- bunches in a single shot was the winning device for Edward Rossa in 1994. He developed this using a streak camera for the CERN Large Electron Positron collider. Synchrotron radiation emitted by particles creates images of the density distribution; Rossa's optical setup provides front, top, or side views.

Applications based on radiation emitted from charged beams have resulted in several prize-winning devices. In 1993, the first joint award of the Faraday Cup was given to Donald W. Rule and Ralph B. Fiorito for their work at the Naval Surface Warfare Center – White Oak using optical transition radiation (OTR). Together they developed several techniques to measure the divergence and emittance of charged particle beams utilizing OTR produced from thin intercepting foils.

In the years since the award, Rule pursued other fields of research, but has continued contributing to beam instrumentation development in small ways. He states that the recognition of receiving the award was an encouragement to remain actively connected to the beam instrumentation community and has offered great opportunities to meet and collaborate with many interesting and exciting colleagues. Fiorito echoes these statements, indicating that the national and international awareness provided by the award directly resulted in new professional opportunities which he believes would not have otherwise been possible.

Other benefits resulted from this award. At the time of their research, studies of beam physics had just recently been established at their laboratory. The Faraday Cup Award pointed out to the Navy, as well as to the accelerator community at large, that significant new ideas could be generated outside of a traditional accelerator laboratory setting. The award also stimulated a great deal of interest in transition radiation based techniques and gradually more scientists and engineers have implemented these and related techniques at facilities around the world.

The 2000 winner, Kay Wittenburg, triumphed for the design of a beam loss monitoring detector using PIN diodes in a coincidence configuration. His design discriminates between synchrotron radiation present in electron accelerators and radiation due to actual beam loss. The design eventually became commercialized and is now used in accelerators worldwide. DESY granted Bergoz Instrumentation a license to use the original concept of the PIN Photodiode Beam Loss Monitor, to further develop it, and to sell instruments based on this principle. Wittenburg, leader of the DESY Machine Diagnostics and Instrumentation since early 2000, believes that the development of a new idea, the overall performance, and the reliable functioning of the system was greatly important to him.

Employing synchrotron radiation for a unique beam profile monitoring system won Toshiyuki Mitsuhashi of KEK (High Energy Accelerator Research Organization, Japan) the Faraday Cup Award in 2004. Mitsuhashi labored on the development of synchrotron radiation (SR) monitors for twelve years before receiving this award, with the development of the SR interferometer being the most significant topic. He conceived the idea in 1994 while investigating the coherence of SR and determined that he would be able to use the SR interferometer for measurement of beam profile and size.

The Faraday Cup has honored 'bright' ideas based on synchrotron light, along with some 'cool' ideas as well. Andreas Peters of GSI won the 1998 award for his work on the Cryogenic Current Comparator (CCC). This device measures nanoampere DC beam current by comparing it to a known current as both are passed through a cryogenic cylinder. Since Peters' development, several groups have worked on the CCC, especially in Japan where a CCC was built at TARN-II. CCC projects are now underway at DESY and again at GSI for the FAIR project. Peters declares that the "Faraday Cup Award was a great honor and a gratification for some years of hard, but exciting, work on the CCC project at GSI". He became the beam diagnostics group leader at GSI in 2000, and believes winning the award was the "kick" to this new position. At the end of 2006, Peters became head of the accelerator operations for the Heidelberg Ion Therapy project, a heavy ion cancer treatment facility of the Heidelberg University Clinics, and he still works on special beam diagnostics topics.

A joint award was given in 2006 to Haixin Huang of BNL and Kazuyoshi Kurita of Rikkyo University for an innovative proton beam polarization monitoring system. Their design uses ultra-thin carbon filaments and an array of silicon detectors to deduce the degree of polarization from proton-carbon elastic scattering. Huang calls the award a great milestone in his career and welcomes the recognition of his and Kurita's contribution to the device. In the two years since the award, the CNI polarimeters at BNL have been upgraded, most notably with a new target drive assembly for more precise target control. Kurita is now in charge of implementing the CNI polarimeter for polarized proton projects at the new 50 GeV J-PARC accelerator currently under construction in Japan.

Suren Arutunian of the Yerevan Physics Institute received the 2008 award for developing Vibrating Wire Sensors. These sensors measure a change in frequency of a vibrating wire, have been tested on a multitude of beam types, such as electron, proton, and hard x-ray undulator beams, and can be used on other beams as well . A major advantage of using a frequency signal is that it can be transferred large distances without disturbances.

The most recent additions to the Faraday Cup Award family are Florian Loehl, presently of CLASSE (Cornell Laboratory for Accelerator-based Sciences and Education), and Kirsten Hacker of DESY. Together they worked on a femtosecond resolution beam arrival time monitor for FLASH (Free Electron Laser in Hamburg) at DESY. As PhD candidates under the direction of Holger Schlarb, they designed an electro-optical detection scheme using a beam pick-up signal to modulate the intensity of a laser pulse train, and then measure the energies of the laser pulses to determine the bunch arrival time. An expansion of the implementation of the devices is currently taking place within the optical synchronization system at FLASH. Other laboratories are also now using this system. Synchrotron Trieste implements the monitors in their Free-Electron Laser (FEL), FERMI, and the Paul Scherrer Institute (PSI) has ongoing efforts for such a system at their Swiss FEL project.

Hacker, who is about to defend her thesis at the University of Hamburg, feels that this award is quite an honor since it is not often that students are given award-worthy thesis concepts to build and test. Similarly Loehl feels that receiving the award and having his PhD work recognized by world experts in beam diagnostics is a great honor and reward for the many long days of hard, but interesting work during the last several years.

Clearly, the Faraday Cup award has been a career highlight for past winners. They all overwhelmingly acknowledge and appreciate the recognition from experts in the field and from collaborators alike. Their stories prove that innovation can come from anywhere – a student or a professional, a government accelerator facility, university, or other lab, and any geographic location.

The BIW Program Committee is eager to receive nominations for devices that are pioneering and provide new insight into particle beam measurements. If you or a colleague has developed any instrument that meets the award criteria, please nominate it for the 2012 competition by November 1, 2011.