Research Director's Report

16 July 2009


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Spreading the excitement of discovery

This month's Research Director's Report was written by Jim Brau, co-chair of the Worldwide Study and regional detector contact for the Americas.

Why is the down quark's charge precisely one-third that of the electron? This is a remarkable relationship that challenged high school physics teachers meeting this summer with the Oregon QuarkNet programme. They will ponder this issue with their students when they return to the classroom in the autumn. Students now learn about quarks in high school and are armed with the knowledge needed to appreciate this remarkable reality: despite many distinctly different properties, the electron and the quark charges are related in this remarkably simple way. Why? And does it matter?


Public lectures like this one at the University of Oregon often draw a big crowd.

The high school physics teachers who gathered at the University of Oregon for the annual summer QuarkNet programme, organised every year in Eugene, USA, by Ray Frey and the Center for High Energy Physics, worked on cosmic ray detectors, shared their classroom experiences, and dealt with puzzles of the cosmos. In considering particle physics and cosmology (see my talk) we explored a number of the mysteries pursued with particle colliders: the source of dark matter, the origin of mass, and the relationships between the fundamental forces and the quantum numbers of the fundamental particles. We also discussed the size of the universe, what might lie beyond humankind's view, string theory and hypothesised new particles, and a variety of other fascinating topics.


Michael Faraday invented the Royal Institution's popular Christmas Lectures.

The teachers responded with wonder and endless questions. They will return to their classrooms in the autumn with a heightened preparation to address these wonders with their students. This is important work; President Obama stressed its importance when he acknowledged that our future depends on our young citizens' decisions to pursue careers in science, mathematics, and engineering, when speaking at the National Academy of Sciences Annual Meeting, held on 27 April 2009.

The QuarkNet teachers considered a J.J. Thomson 1934 statement, reflecting on his 1897 discovery of the electron (listen to the full recording):

Could anything at first sight seem more impractical than a body which is so small that its mass is an insignificant fraction of the mass of an atom of hydrogen? — which itself is so small that a crowd of these atoms equal in number to the population of the whole world would be too small to have been detected by any means then known to science..

Looking back, today we marvel at the impact of this fundamental discovery. But, as Thomson suggested, it was far from clear in 1897 what consequences would result. In fact, the 1897 Thomson discovery came just a few years after the 1894 pronouncement of soon-to-be Nobel Laureate Albert A. Michelson:

The more important fundamental laws and facts of physical science have all been discovered, and these are now so firmly established that the possibility of their ever being supplanted in consequence of new discoveries is exceedingly remote.

--A.A. Michelson, at the dedication of the Ryerson Lab, University of Chicago, 1897

We often attribute Niels Bohr or Yogi Berra with this well-known saying: “Predictions can be very difficult – especially about the future.” The public understands this, but is generally optimistic about the future impact of scientific discovery. Perhaps today's discoveries at the frontier will one day be appreciated as those of 100 years ago are now.

This QuarkNet session with high school physics teachers was just one of many recent opportunities to share the excitement of our science. Interest is very high, from the very young to the elder citizens, from those with no science background to teachers or engineers. In general, a large fraction of the public wants to know more about what we do, what we know, and what we expect to find with our colliders.

We can reinforce the public's interest and support for basic science by speaking about our science and our ambitions. When travelling to take shifts or attend a meeting, I frequently find that the person sitting right next to me on the plane or train is interested in particle physics, astronomy, and cosmology, and asks me many insightful questions during our conversation. In formal settings, I have welcomed the chance to speak recently to astronomy groups, the Science Pub's monthly event, a public lecture to promote astronomy in a venerable, restored theatre in Central Oregon, at a county museum of natural history's monthly "topics on tap" event in a local pub, to very large gatherings for public lectures on the Oregon campus, and a host of other events. The public brings their interest and raises many questions. I realise the audience includes prospective future scientists, and I work to inspire them.

Our outreach efforts are not new for scientists. Nearly two centuries ago, Michael Faraday was committed to sharing his discoveries with the public, and among his efforts was to establish the Royal Institution's Christmas Lectures in the 1820s which continue to this day. Just as Faraday did back then, we also share the latest developments in our science with the public. We are privileged to pursue our scientific interests through public support, and we must share with them the wonder of our work. We share our wonder in the relationships between quarks and leptons and we find increased joy in our discoveries. In return, our public increases their interest and support for our science, and more young people choose to join the profession.

-- Jim Brau