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EDITORIAL

Physics Research in Sri Lanka

To the average Sri Lankan, "physics" means a tough affair unavoidable for gaining entry to the medical and engineering streams in our universities but may safely be forgotten thereafter. Posters on walls advertise the subject as a marketable commodity. Parents invest in it, hoping to secure the financial future of their children. Unlike decades previous, the school teachers rarely enlighten the intellectual value of physics. The rush in coaching a competitive exam prevents them engaging in such discussions. If the exam questions imitate riddles rather than exercises designed to assess the ability to grasp the physical principles, the tutors capitalize out of it, guessing problems likely to appear in the forthcoming examination. Students study question papers and follow tutors instructions to solve them but not the class notes or the explanations given by the teacher, where the subject is presented coherently and logically. Such learning styles shut-off the curiosity and the broad outlook of the students, who merely seek avenues in finding answers to the exam questions.

The status of school advanced level physics transcends to the universities as well. As physics is considered a difficult and employment unfriendly subject, virtually no student wishes to enter universities for the sole purpose of pursuing it. As a pitfall remedying measure, some institutions have adulterated the physics curriculum with engineering, electronics, information technology, at the expense of basics and prerequisite mathematics. Such dilution of physics deprives talented in undertaking intellectual challenges of the subject, thus producing graduates insufficiently prepared and motivated to continue advanced studies and research.

A recent trend in promoting occultism as our own rightful path towards understanding nature and blaming science as "Western", seems to distract the society away from scientific thinking. Strangely, those who value foreign "materialistic benefits", reject far reaching ides in science as Western thinking and fail to realize that the quality items they desire to possess originated from the very concepts they reject. Physics and all the other sciences have no color, caste, creed or religious affiliations. Physics concepts and their applications have been a part of our culture. For incidental reasons, physics as a separate discipline built on a solid conceptual foundation was first developed in the West. However, physics is neither Western nor Eastern. It has originated as a consequence of man's incessant inquisitiveness.

In Sri Lanka, Physics as a compartmented discipline was first introduced to Ceylon Technical College in early nineteen hundreds and then to the University of Ceylon, Colombo. Following the tradition, some physics research was initiated concurrently. As the first such major effort - *cosmic ray research* was carried out at the University of Colombo, delivered noteworthy contributions to the field[1,2]. When accelerators came to operation in the United States, European laboratories gave up cosmic ray experimentation. Sri Lanka following the European example can be seen as a gross mistake. Cosmic ray research is now a hot and fashionable area of Physics research. If Sri Lanka continued and developed this field, we would have made a global impact by now.

The other hurdle towards progress has been the lack of sufficient emphasis on theory in physics teaching and research, a trend continuing even to date. Earlier theoretical physics was confined to Departments of Mathematics. Although there were excellent teachers and researchers, in mathematics and physics groups, they rarely interacted fruitfully[3]. Subsequent mathematics reforms affected physics adversely. Mathematics departments replaced theoretical physics component with less challenging alternatives. Physics administration appears to have overlooked the adoption of adequate compensation strategies in strengthening the theory.

Ending cosmic ray research, physics research in the country shifted to solid earth and atmospheric sciences. Here the contributions to ionospheric physics, atmospheric electricity, geomagnetism and earth's gravity are significant. Although the participation is limited and confined to one or two institutions, the projects remained established.

A physics involved research theme conducted indigenously, continuing and more widely spread is solar energy conversion. Although indigenous research in the area had received international acclaim[4, 5], the country has not succeeded in diverting a concerted collective effort to raise it to a higher level. Findings that originated in Sri Lanka are further developed and pursued in foreign laboratories. Sri Lankan contributions are less frequently cited or ignored. Probably the largest amount of government research funding diverted to physics research in Sri Lanka has gone to solar energy. It is also a research area where Sri Lanka had gained reputation in organizing international conferences and collaborations. The science policy makers should analyze above research prototype to identify the causes of successes as well as failures and determine whether funding needs to be continued, escalated or reduced to cater other underrepresented areas in physics.

It is encouraging to note that several other physics projects have been attempted or initiated indigenously during the past two decades. In this context, Sri Lanka's contribution to "solid-state ionics research" has been

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significant. Other areas include magnetic materials, ceramics, thin films, thermoelectricity, sonoluminance, instrumentation, medical physics as experimental topics and general relativity, quantum systems, elementary particles, computational physics and climate physics as areas of theory.

A number of cutting-edge physics fields essential for uplifting the scientific and intellectual standing of a nation are almost entirely absent in Sri Lanka. We have no astronomy or astrophysics research in our universities or at the only research institute mandated to carry out fundamental studies. Astrophysics today, amalgamates heavily with two other forefront themes – elementary particles and relativity. Sri Lanka needs to keep in touch with above developments and initiate advanced fundamental studies. Fascinating mega-projects in astroparticle physics are unrevealing deepest secrets of nature. Financial constraints prevent us from engaging in these activities directly, but theoretical studies that cost only miniscule can be pursued. There is no evidence to the effect that rigorous studies and research in plasma physics, nuclear physics, optics, biophysics and several other frontier topics are pursued in Sri Lanka. There is a great need to diversify physics research in Sri Lanka.

Sri Lanka is in the process of catching up the field of nanotechnology. Many Sri Lankan academic and research intuitions now have nanotechnology research arms. Nanotechnology encompasses physics, chemistry and biology. The American theoretical physicist Richard Feynman realized the potential of nanotechnology nearly five decades ago. His ideas were later highlighted by other authors. Feynman imagined designing electronic and mechanical systems, constituted of atoms and molecules organized at nano-scale dimensions. The photosynthetic apparatus of the green plant, which splits water and reduces carbon dioxide to carbohydrates, transducing sunlight represents an inspiring example of a nano-device. Nanotechnology aims at the design and fabrication of nanoscale structures of similar capability to perform tasks hard to accomplish via routine techniques. The flexibility and broadness of nanotechnology and its definition also allow branding many products as nano. If a cosmetic contain nano-particles, one could patent it as a nano-cosmetic. Survey of literature reveals that the larger share of nanotechnology research in Sri Lanka is chemistry biased. The physics component needs to be promoted to address more advanced problems, especially in the area of nano-devices.

An idea floating around advocates, research conducted should be in the so-called "relevant areas" and the curriculum in educational institutions should be adjusted accordingly. Can an issue such as value addition to minerals be resolved by limiting undergraduate education solely to this problem? A proper scientific understanding of materials to solve these problems essentially requires a knowledge of electromagnetic theory, thermodynamics and statistical mechanics, quantum mechanics, solid state physics and great deal of basic inorganic chemistry. Students exposed to above basics, when specialized with post-graduate level research dgrees will be much better equipped to solve such problems. Our plan should be to provide a sound knowledge of basics at college and university undergraduate levels and facilitate avenues for specialization at a later stage. Involvement of qualified physicists in our industries is also marginal and probably very few such persons currently serve in management boards of our industrial enterprises. Addressing this point could bear more fruits than remodeling of our undergraduate curricula. Such moves will also promote employability of physicists.

There seems to be similar misunderstandings or misinterpretations of fundamental studies and its relation to applied research. Fundamental studies, imply investigations conducted to fathom workings of nature for its own shake. Its main task is seeking explanations and advance scientific theories. Here irrespective of what you do, physics and its method play a crucial role. Applied research strive to solve practical problems. There again, tools of physics are used to achieve the goal in mind. Separating applied from fundamental and giving opportunity for a rare lot of ablest to dream at tax payers expense is justified provided the dreams are radical and transformative. Sri Lanka is poor in its performance in the area of truly fundamental research, warranting appropriate remedial measures.

Sri Lanka's political will to support advanced basic research in Physics and related areas will be a blessing to the exceptional caliber minds among our young and to be born, provided scientific community doesn't shy away. More than three decades ago, the Institute of Fundamental Studies was commissioned. Recently, the Ministry of Science, Technology and Research signed a partnership with CERN enabling our physicists to collaborate. The Ministry has also expressed keen interest in conducting initial preliminary studies for establishing an astroparticle research facility in Sri Lanka. A collective effort by physicists is essential to bring this praiseworthy political green light to a reality.

Physics secures the intellectual future of our children. How it has fared and its future is a matter of importance to the whole nation.

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