Introductory Remarks
In the Special Session on World Year of Physics Held on November 19, 2005

RIAZUDDIN

As you all know the UNESCO has declared the year 2005 as the World Year of Physics to commemorate the centennial of Albert Einstein's seminal papers on relativity, radiation, molecular dimensions, and Brownian motion, which changed the face of physics. The idea behind the World Year of Physics is to raise the public awareness of physics and its achievements. The NCP was actively engaged in celebrating the World Year of Physics in Pakistan under the patronage of Dr. Ishfaq Ahmed, who is chairing the session. The NCP provided the secretariat to the country coordinator Dr. Khalid Rashid.

The first half of the 20^{th} century witnessed the creation of relativity and quantum mechanics, the two of seven concept-driven revolutions, which according to Thomas Kuhn occurred in the last 500 years associated with the names of Copernicus, Newton, Darwin, Maxwell, Freud, Einstein and Quantum Mechanics. During the same period, according to Freeman J. Dyson, there have been about twenty tool-driven revolutions, starting with the invention of telescope by Galileo, mostly in biology, computer science, astronomy, engineering and medicine, using tools created by physics. These break throughs occurred when physicists tried to extend the laws of physics beyond the everyday experience, resulting in the birth of atomic and subatomic world. This brought us to relativity and quantum mechanics, unification theories in physics, the big-bang ideas in cosmology, genetic code in biology and plane techtronics in earth sciences. Likewise technologies, which previously nobody could think of have been created; you build things you cannot see.

Physics is all encompassing-linking the universe on the tiniest of scales: electrons and quarks to the universe at the largest of scales: galaxies, clusters of galaxies and the vast expanse of the universe itself. It makes time meaningful from yoctoseconds to giga-

years. It covers the energy scales of 3 x 10^{-2} eV, typical energy of a particle in Brownian motion, to 10^{28} eV, the gravitational cut off given by the Planck mass. It is here that our understanding of the universe is again being challenged, now with an unexplained accelerating expansion.

New tools have been and are being invented by physicists – tools which find applications, not only in Physics, but also in Chemistry, Biology, Medicine, Computers and even in Finance. We can probe distances as small as 10^{-16} cm, measure times as short as 10^{-23} sec, and masses as small as 10^{-37} Kg. We can see the universe 300,000 years after the big bang by studying the microwave background radiation (CMB) which is a direct relic of the universe when it became transparent to electromagnetic radiation after atoms were formed. By measuring the fluctuations in the CMB radiation by an orbiting observatory called Wilkinson Microwave Anisotropy Probe (WMAP) with a precision of a few parts in one hundred thousands and their analysis, there is a dramatic observation that we understand only four percent of the composition of the universe. The ninety six percent of the universe's mass-energy is essentially unknown (twenty-three percent dark matter, seventy three percent dark energy, that works against gravity on large scales in physics implying that the expansion of the universe is speeding up, rather than decelerating as mentioned earlier). We can calculate quantities with a precision of one part in million and verify them experimentally with the same precision.

"Everyone can see how much physics has changed our view of the world and influenced our technology; communications, energy production, medical images are just a few examples of this fact. Those advances did not occur by trying to improve our existing technologies, 'electricity was not invented to make better candles' and there is no reason to believe that our century will be any different in that respect". C. Brézen.

Thus pure science is necessary and as M. Virasoro, a former Director of Abdus Salam ICTP, Italy, said "…The opportunity to participate in pure science is a basic human right". We have to provide this opportunity and through National Centre for Physics, we are trying to do this in Pakistan.

It is not easy for a non scientist to appreciate the role of pure science. The scientists and non-scientists have different perception of science. C.P. Snow in his book on "Two Cultures" mentioned two events of great significance in late 1950's-the

"Sputnik" and the discovery by Yang and Lee – the on-conservation of parity. It was one of the most astonishing discoveries in the whole history of science. "The "Sputnik" was admirable for quite different reasons, as a feat of organization and a triumphant use of existing knowledge" – marking the displacement of military and economic anxieties onto the issue of technological compeletiveness. "Sputnik" attracted great public attention. In contrast the work of Yang & Lee, "although of great beauty and originality, which makes us think about some of the fundamentals of the physical world", did not make much public impact as the Sputnik did.

Let me now make a few comments on the present state of Physics. As Fred Hoyle said: "It is essential to live at the right moment for every big discovery. When I was a student of Dirac in 1938-1939, he told me the time then for such discoveries was not ripe, which judgment proved correct. That turned me to astronomy". The situation is not very different now – there is much excitement in astrophysics and cosmology. No big experimental discovery (other than those predicted by the theory) has been made since CP violation in 1967 with the possible exception of that of the charm in 1974. Even charm was predicted to exist in famous GIM mechanism to remove all phenomealogical obstacles to a proper and an elegant theory of weak interaction and the work of Ben Lee and Mary Gillard showed that it should exist around 1GeV; perhaps the only surprise was the discovery of very narrow width of $c\bar{c}$ bound state.

We are passing through a state of zero progress. Again in the words of Fred Hoyle: "A state of zero progress also suits the World's scientific establishments. A scientific revolution, such as the one that occurred with the arrival of quantum mechanics in 1925, sweeps away the pillars of scientific establishments. Within only two or three years, they are gone, to be replaced be a new generation of young people in their twenties. Today, in a state of zero progress there is little hope for young people in their twentites. They must do what aging gurus tell them to do".

I hope that things will change after Large Hadron Collider (LHC) at CERN becomes operational and some unexpected discovery will usher in the right moment for big discoveries leading to a scientific revolution of the type that occurred with the arrival of quantum mechanics. In order that right questions are asked, let me remind you that according to R.E Periels: "Heisenberg's greatest contribution was to recognize that the

contradictions of the old quantum theory were the result of asking questions to which there was no physical answer."

We are celebrating the great achievements of physics and how our lives have been unrecognizably changed from those of our grand parents. But the benefits have not reached the thirty percent of the poor, although the wealth created by Science & Technology could have abolished the poverty. Unfortunately not – and the disparity between the rich and the poor is increasing. The phenomena are not new. About eighty years ago, the Cambridge mathematician G.H. Hardy wrote "A science is said to be useful if its development tends to accentuate the existing inequalities in the distribution of wealth, or more directly promotes the destruction of human life". Even though the modern peacetime technology does not directly promote the destruction of human life as nuclear weapons did, but still the Hardy's view of technology has relevance. Thus while we celebrate the achievements of science, we should also reflect on how to pass on the benefits of science and technology to the poor "who give everything they have and yet receive nothing in return, to the weak and oppressed people whose tears nobody bothers to notice." (Sarat Babu, author of Devdas)