12th Regional Conference on Mathematical Physics

The Regional Conferences are attended by many scientists from the developed world, providing exposure of the young scientists in the host country to the latest developments in the fields covered. Further, they are able to present their own researches to a gathering of international experts. This opportunity provides grooming and develops a higher quality of work. As such, the hosts, this time Pakistan (NCP), stand to gain more than the others.

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Chandra solves Black Hole mystery

The way in which black holes suck in matter from neighbouring stars is a fundamentally magnetic process and not just caused by gravity. That's the conclusion from new measurements of the X-rays emitted by the gas surrounding a nearby black hole in the Milky Way.

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Bill Gates sees a Tablet PC for every student

The uphill battle that tablet computing continues to face in winning favor with consumers hasn't dampened Bill Gates' enthusiasm for the technology. Microsoft Corp.'s Chairman and Chief Software Architect said that someday tablet PCs will replace textbooks for all students.

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12th Regional Conference on Mathematical Physics

The 12th Regional Conference (27 March to 1 April 2006) organized by F. Hussain, A. Qadir Riazuddin and H. Saleem, sponsored by the National Center for Physics, and cosponsored by the Abdus Salam ICTP (as it has been called since soon after the death of Prof. Salam), the Higher Education Commission (HEC) of Pakistan, Pakistan Atomic Energy Commission (PAEC) and the National University of Sciences and Technology (NUST), was held at the campus of the Quaid-i-Azam University, Islamabad. In the 11th Conference the field of Plasma Physics had been included and this was carried on in the 12th. The more formal mathematical areas were also included (six talks this time, one plenary and five invited). In the mornings there were 23 plenary talks of 45 minutes each, which were for a more general audience of physicists and mathematicians from the areas covered by the Conference. The afternoons were devoted to 38 more specialized half-hour talks spread over two parallel sessions: one for Superstring Theory, High Energy Physics and Formal Aspects; the other for Relativity, Astrophysics, Cosmology and Plasma Physics. The total number of participants was about 150 and of speakers 60, of whom about 40 were from abroad. There was also one evening lecture on “Abdus Salam at Imperial College” by Michael Duff, the Salam Professor at the Imperial College of Science, Technology and Medicine, in London, England. There were some of the world’s most renowned physicists and mathematicians participating including the Nobel Laureate, Gerard ’t Hooft such as: A. Sen, Spenta Wadia, N.K. Dadich, V. Hussain (New Brunswick), S. Sheikh-Jabbari(IPM), B. Acharya(ICTP), & M. Duff.

The two fundamental theories of Physics are the Quantum Theory (QT) and General Relativity (GR). The former is needed to discuss phenomena at the very small scale and the latter at the very large scale. Since the start of GR there has been an attempt to obtain a single consistent fundamental theory. However, the two theories as stated are incompatible. These two theories and their unification form the subject matter of all conferences that discuss fundamental Physics. Plasma Physics (PP) arose as a separate subject more than half a century ago but came into its own when it appeared to hold out hope for cheap and abundant energy by nuclear fusion. Of the applications of only QT there was discussion of the standard model (SM) of Particle Physics developed by Salam, Weinberg and Glashow. Though it works extremely well, it is not aesthetically satisfying as there are many constants in the model that have to be put in by hand. Though it works extremely well, it is not aesthetically satisfying as there are many constants in the model that have to be put in by hand. Consequently, there are various proposed models going beyond it. In the SM there are three “generations” of two charged quarks, a charged lepton and a neutral lepton (called a neutrino). There was one talk about the physics of the heaviest of the quarks (the “top”) and one about neutrinos, originally thought to be massless but now known to be massive. There were five talks about fitting observations with various proposals going beyond the standard model, two plenary and three others.
There was also one talk about the energy due to an electromagnetic force felt by neutral matter, called the Casimir force, required by QT and one on the effects of unusual topologies of spacetime on the mass of an “elementary particle”.

On the pure GR side and its applications there was one dealing with Cosmology, one with Astrophysics and seven with formal developments in GR. In the first it was suggested that there could be alternatives to the standard model of Cosmology. For the second the discussion was of measurement of parameters for the large (millions times the mass of the Sun) black holes, such as that at the centre of our galaxy. The other eight included one on a special splitting of the 4-dimensional spacetime into sequences of 3-dimensional spatial sections that are flat; one of the effect of spin on electromagnetic and gravitational interactions; one on a detailed calculation for an unlikely process occurring in an unrealistic cosmological model; and five on the symmetries of spacetimes. There was also one talk on non-relativistic astrophysics about supernovae (exploding stars).

In pure PP there were two talks on basic plasma theory, two on calculations related to nuclear fusion and three on dusty plasmas. The rest of the PP talks were at its boundary with High Energy Physics (quark-gluon plasmas) and at its boundary with Astrophysics and GR. There was one of the former and five of the latter. Special mention needs to be made of one, by Prof. Mahajan, that proposes that apparently diverse solar phenomena are different aspects of a single physical process, whose differences arise due to non-linearity of the differential equations that govern the process and due to small variations of initial conditions.

The rest of the talks dealt with the attempts to unify the two fundamental theories. These can broadly be divided into those that arise from the quantum theorists and those coming from the relativists.

The quantum theorists assume that quantum theory will be unmodified in the unification and relativity will have to be modified. This approach has led to the attempt to either: modify the description of space & time so that points cannot be defined in the usual way, leading to non-commutative geometry; or modify the description of the physical entities so that they do not exist at points but are manifestations of vibrations of superstrings (extremely small loops or open strings) a billionth of a trillionth the size of the particles that make up an atomic nucleus and existing in 10 or 11 dimensions. Superstrings have spawned super-membranes (called branes), which are higher dimensional analogues of the strings that can exist because of the higher spacetime dimensions.) There were three talks on non-commutative geometry and thirteen on superstrings and branes. There were three other talks on approaches to the development of a quantum theory of gravity, including a superb talk by ’t Hooft suggesting that the observed cosmological constant may arise from known aspects of QT for the minimal extension of the standard model.
Visit of an NCP Employee to CERN

Mr. Waqar Ahmed, professionally an electronic engineer in NCP completed his first visit to CERN for the pre-commissioning of the already installed chambers. The main purpose of this visit was to interlink the gas, coolant, HV cables, signal cables, D.C.S cables, LV cables and temperature sensor cables to all the chambers at the yoke -1 station RE +2. This is part of Pre-commissioning and other part is commissioning of installed chambers which can be done after the installation of all accessories like cables etc. These chambers were installed by Pakistan on Feb-March 06 at station RE+2. The total chambers that can be installed are 72 with 36 RE2/2 and 36 RE2/3. But, there are 70 chambers installed at station RE+2, only 2 RE 2/2 off yoke chambers are missing due to non-availability at that time. He has performed all work on the yoke and applied high voltage sector by sector after flashing of gas approximately twenty hours. The Dark Current of all sectors he tested was good, except one sector because two chambers were missing. High Voltage Vs Dark current of all chambers on 9.4Kv are shown below.
He has done interconnections between RE2/2, RE2/3 and bulkhead, to interlink the gas, coolant, HV cables, signal cables, D.C.S cables, LV cables and temperature sensor cables to all the 70 chambers at the yoke -1 station RE +2 successfully within time. Further he carried out gas leakage test of gas pipes between RE2/2, RE2/3 and bulkhead and measured dark current under high voltage.

These are some of the important images of the apparatus:
CERN Visit of a Ph.D. Scholar Completed

Mr. Ijaz Ahmed, a Ph.D. research scholar from the experimentation domain of NCP has returned back after a scientific research visit from CERN, Geneva, Switzerland. The duration of his visit was one year starting from July 1, 2005 to June 30, 2006. The objectives which he achieved there are:

He joined CMS-PRS (Physics Reconstruction and Selection) SM (Standard Model) physics analysis group. Initially he worked with two different groups to learn about the general analysis techniques in CMS, including a top quark group from Belgium & another one from Russia and Iran. There he attended two international conferences on physics of top quark at LHC:

1. TOP2006, International Workshop on Top Quark Physics, January 12-15, 2006, University of Coimbra, Portugal
2. HERA and the LHC, A workshop on the implications of HERA for LHC physics, CERN - DESY Workshop 2006

Apart from 2 other local group talks, he presented his analyzed results based on top quark physics in the Standard Model meeting at CERN in the form of four presentations which are available at:

http://indico.cern.ch/getFile.py/access?contribId=2&sessionId=0&resId=1&materialId=slides&confId=3791

Furthermore, he was involved actively in several running meetings & seminars at CERN. He also took part in the RPC (RE2/2, RE2/3) cosmic test at ISR (Intersecting Storage Ring) & its data analysis.

Basic aim to visit CERN from physics point of view was the reconstruction of top quark mass from semi-leptonic decay channel through gluon-gluon fusion and quark anti-quark annihilation processes at the Large Hadron Collider (LHC). His approach and method is explored first time in CMS, using high transverse momentum top events above 200 GeV, due to which the daughter particles try to overlap in (eta, phi) space from the hadronic top decay.
Due to the high top boost both tops decay back-back making two distinct hemi-spheres inside the detector and the opening angles of the decaying final products get very narrow, so the idea is to reconstruct all the calorimeter clusters inside a big cone in which these three jets reside and overlap. So in this way the invariant masses of the calorimetric clusters around the top flight direction is correlated to the known top quark mass.

This task has been accomplished first of all by understanding the CERN computing framework/setup, secondly the corresponding software/packages technicalities in generating the Monte Carlo events from generator PYTHIA at the partonic level, which are being simulated by passing through the CMS (Compact Muon Solenoid) geometry to observe the particles' propagation and their energy deposition inside the strong magnetic field of 8 tesla.

These particles are emerging due to the consequence of proton-proton bunches collision at the 14 TeV centre of mass energy at LHC. The simulation is done using the GEANT4 (GEometry ANd Track) based framework called OSCAR (Object-oriented Simulation for CMS Analysis and Reconstruction). Then the digitization (simulation of electronic response) and reconstruction (conversion of binary signals to physical objects) phase has been performed with the help of a framework called ORCA (Object-oriented Reconstruction for CMS Analysis). The physics observables (e.g., tracks, clusters, jets, muons, electrons, vertices) are stored persistently in DSTs (Data Summary Tapes). The steps described above are typically performed using GRID computing resources and tools. Mostly DST samples are accessed from outside CERN like FNAL (Fermi National Accelerator Laboratory), while jobs' submission, monitoring and data retrieving process is carried out using GRID tool CRAB (CMS Remote Analysis Builder). Finally the analysis was done by making histograms/plots with the help of ROOT (An Object Oriented Data Analysis Framwork) macros for scaling and calibration.

All the results have been achieved with both full and fast detector simulations. In case of fast simulation FAMOS (Fast Monte-Carlo Simulation) package is used, for that purpose a huge data sample has been generated.

All the above mentioned accomplishments have been prepared in the form of two CMS internal notes which are in the completion pipeline, while the third analysis note would be ready in a couple of months.

During his CERN stay he accompanied and discussed his work with the following persons: Martijn Mulders, Jorgen D’hondt, Steven Lowette, Jan Heyninck, Filip Moortgate, Majid Hashemi, Mojtaba Najafabadi, Albert De Roeck & Shahzad Muzaffar.
Fermilab Probes Matter-Antimatter Transitions

The international CDF collaboration at Fermilab has made the most precise measurement to date of the extremely rapid transitions between matter and antimatter. The experiment has found that certain B mesons spontaneously turn into their own antiparticle equivalents -- anti-B mesons -- and back again at a rate of three trillion times per second. The result agrees well with the Standard Model of particle physics and confirms yet again the existence of CP violation -- the reason why there is more matter than antimatter in the universe.

Cosmologists believe that equal amounts of matter and antimatter were created in the big bang. But if matter and antimatter particles were exact opposites of each other, they should have annihilated to leave only photons. This did not happen, which is why there is so much more matter than antimatter in the universe.

The existence of our matter-dominated universe suggests that matter and antimatter underwent different processes after the big bang. In the Standard Model of particle physics, a process called charge-parity (CP) violation is responsible for the difference between matter and antimatter. CP violation means that the laws of physics change slightly when a particle is replaced by its antiparticle and when all three directions in space are reversed.

CP violation can manifest itself in different ways. In the "indirect" process, first observed in neutral kaon particles in 1964, quantum mechanics allows particles to change into their antiparticles and back again in a process known as "mixing". In 2001, The BaBar team, working at the Stanford Linear Accelerator (SLAC) -- and independently the Belle collaboration at the KEK laboratory in Japan -- were the first experiments to detect this in a B meson. BaBar observed "direct" CP violation in 2004 by showing that the number of decays observed for B mesons was higher than for their antiparticle equivalents.

A B meson is a short-lived particle made up of both matter and antimatter -- one quark and one antiquark. The CDF physicists measured the rate of matter-antimatter transitions for the neutral Bs meson, a particle composed of a "bottom" quark and a "strange" antiquark. They did this at the Tevatron proton-antiproton collider at Fermilab by analysing data from over a billion collisions in an experiment called "Tevatron Run II", which began in 2001. Although the Tevatron produces many orders of magnitude more hadrons than do the machines at KEK and SLAC, it is nevertheless much harder to study the decay of B mesons in proton-antiproton collisions. The experiment found that the transition rate is three trillion (3 x 10^12) times per second, measured to a precision of 2%. This is the most precise measurement of this rate ever made and agrees very well with predictions in the Standard Model. A separate analysis by the D0 collaboration at Fermilab was only able to give a range for the transition rate of between 2.7 and 3.3 trillion times per second.

The new result also places stringent constraints on other more exotic models, such as supersymmetry theories, that require oscillation rates that are much higher still. In other words, establishing the oscillation frequency makes it possible to begin to study CP violation in Bs mesons, which could in turn lead to signs of physics outside the Standard Model.

"Although the new measurement confirms the Standard Model with precision, it cannot -- by itself -- fully explain the observed imbalance between matter and antimatter in the universe," says CDF team member Aurore Savoy-Navarro of the University of Paris VI in France. "In this sense, the result adds to this mystery!"
How to make an object Invisible

Theoretical physicists in the UK and US have proposed a clever way of making objects invisible. It would involve surrounding the object by a "metamaterial" -- a type of composite material that has unusual electromagnetic properties. According to the researchers, light rays incident on the material would be bent around the object, only to emerge on the other side in exactly the same direction as they began. Although the work is only theoretical, the researchers reckon that materials invisible to radio waves could be produced within five years.

Composed of tiny rods, ensembles of metal rings and the like, metamaterials are artificially structured composite materials that were first made by David Smith, now at Duke University, and colleagues in 2000. What makes them unusual is that they have a negative refractive index -- that is, they bend light in the "opposite" direction to ordinary materials. Their electromagnetic properties can also be "tuned" by manipulating their precise structure.

John Pendry of Imperial College London -- working with Smith and his Duke colleague David Schurig -- has now shown how metamaterials could guide light around a hole within it. Any object placed inside this hole would then be "hidden" because light can not reach it and you would be able to see behind the object as if it was not there. All light rays that come from one direction would propagate around the hole and then be recombined as if nothing were there, a bit like water flowing round a rock. Working independently, Ulf Leonhardt of the University of St Andrews in the UK has also come to the same conclusion.

The new calculations involved placing a hole in a material and then calculating, using Maxwell's equations, what properties the material would need to have to divert light around it. For this to happen, the material would have to be designed so that the light travels relatively slowly far from the hole and faster as it travels near the hole. (In fact, the light would have to travel infinitely fast when it brushes along the surface of the hole itself, although this would not violate relativity provided the radiation is within a certain frequency band.) Metamaterials would allow this vision to become reality because they can be designed such that the refractive index -- and hence the speed of light -- varies from point to point.

Although the new results are only calculations, the researchers hope that it will be possible for others to make the metamaterials that can produce the required variations in light speed. This may not be as difficult as it sounds because physicists already know how to design metamaterials that have such properties for radio waves. Indeed, "cloaking" devices for this part of the electromagnetic spectrum could appear in as little as five years, the team says. Such devices could have all sorts of applications in defence and wireless communication.
Physics News

Chandra solves Black Hole mystery

The way in which black holes suck in matter from neighbouring stars is a fundamentally magnetic process and not just caused by gravity. That's the conclusion from new measurements of the X-rays emitted by the gas surrounding a nearby black hole in the Milky Way. Although predicted by theory over 30 years ago, this is the first time that this effect has been seen. The result -- based on measurements from the Chandra X-ray observatory -- could affect theories on how matter falls onto black holes and other compact objects (Nature 441 953).

Black holes have such strong gravitational fields that they attract large amounts of neighbouring gas and dust. As the disk is compressed, frictional forces encountered by the material make it heat up and emit X-rays, which can be detected by astronomers to provide observational evidence for the black hole.

However, astronomers have long known that gravity alone is not enough to make the gas fall into a black hole. Before it can spiral inwards, the gas must also lose some of its orbital angular momentum (or spin) otherwise it would simply remain in orbit around the black hole indefinitely.

Until now, it was not clear how this angular momentum was removed, but scientists suspected that it was due to magnetic turbulence in the disk. This turbulence generates friction in the disk and drives a wind from it. The wind can carry away the angular momentum and therefore allows matter to fall into the black hole.

Jon Miller of the University of Michigan and colleagues have now produced the first observational evidence that magnetic fields are indeed responsible for this effect. Using NASA's Chandra X-ray Observatory, the team studied a stellar-mass black hole in the Milky Way called GRO J1655-40. As intergalactic distances go, GRO J1655-40 is relatively nearby at "just" 10,000 light years away. The X-ray spectrum of the black hole shows that the speed and density of the wind from J1655's disk corresponds to theoretical simulations performed by the team for winds that are magnetically-driven.

According to Miller and co-workers, the new results could have implications for theories on how matter falls onto black holes, how black holes grow and how they affect their environment. The work could also be important for looking at the role of magnetic fields in accretion onto other compact objects, like neutron stars or white dwarfs.
Gates sees a tablet PC for every student

TOKYO - The uphill battle that tablet computing continues to face in winning favor with consumers hasn't dampened Bill Gates' enthusiasm for the technology. Microsoft Corp.'s Chairman and Chief Software Architect said that someday tablet PCs will replace textbooks for all students.

"We do see, over time, that the ink input for the tablet and speech input will become as important as the keyboard, not replacing it but equally important." Gates said at a news conference in Tokyo.

"In fact, we see a day where every student, instead of their textbooks, will simply have their tablet computer connected up to the wireless Internet," he said. "And so the teacher can customize the material, they can quiz the student. That student can have that tablet with them wherever they go and it's actually lighter than the textbooks and more flexible, richer in terms of what it can offer."

Tablet computing has long been a technology in which Gates has believed.

After some early trials of the technology Microsoft gave it a major push in 2001 when at the Comdex trade show Gates launched the tablet PC platform. "It's a PC that is virtually without limits and within five years I predict it will be the most popular form of PC sold in America," he said.

The first tablet PCs came on the market in 2002. However, the original dream of Microsoft and hardware makers to push the technology into the mainstream never came true. Today, tablet PCs remain in several vertical markets but have yet to break out to the average consumer.

Now, the technology is about to get another chance.

The most recent iteration of the technology is Microsoft's Origami platform, which is based around a tablet version of Windows XP. The software is used in Ultra Mobile PCs (UMPC), a small form-factor computer platform developed by Microsoft and Intel Corp. that is intended to sit between a laptop computer and PDA (personal digital assistant).

Samsung Electronics Co. Ltd., which will begin selling its Q1 UMPC on May 1, 2006, expects to sell about 400,000 of the computers in its first 12 months on the market.
TOKYO - Samsung Electronics Co. Ltd. will launch two portable computers next month that use flash memory in place of a hard-disk drive for data storage, the company said Tuesday.

Flash memory has long been eyed as a potential replacement for hard-disk drives because it works faster, is lighter and more shock-resistant, but it’s still more expensive. Despite the costs, flash memory chip prices are coming down to a range that some specialist users might be willing pay for the benefits.

Samsung has built 32G bytes of NAND flash memory into a case the same size as a 1.8-inch hard-disk drive. The so-called "solid state disk" (SSD) has the same interface as a hard-disk drive, so it can be directly substituted with little extra work.

There are several benefits to using flash memory, Samsung said. The flash drives can withstand about twice the impact as would cripple a similar hard disk, and are much less affected by harsh environmental conditions. Read speed is 300 percent faster and write speed 150 percent faster than a hard-disk drive, so Windows boots faster and data can be loaded more quickly. The solid-state disks also make no noise when in use.

Until now Samsung has been coy on the price of the drives but with the announcement of the two new computers -- a version of its Q1 ultramobile PC and Q30 laptop -- the price premium is clear.

The Q1-SSD will cost 2.3 million won (US$2,452) and the Q30-SSD will cost 3.5 million won. Equivalent models of the same computers with hard-disk drives cost 1.2 million won and around 2.6 million won respectively putting the SSD premium at about US$1,175.

Samsung said nothing has been decided regarding an overseas launch of the SSD-based computers.

Other computer makers are expected to soon announce computers with flash memory-based drives. Samsung, which is a leading maker of flash memory, has started offering the drive to its customers. Sony Corp. last week said it plans to use an SSD in a new version of its UX50 portable PC due out around the middle of this year.
TOKYO - Next week, the high-definition video fight for consumers' hearts, minds, and wallets begins in the U.S.

The first player and content for the Blu-ray Disc high-definition movie disc format will be launched then, about three months after the first hardware and movies for the rival HD DVD format went on sale.

Blu-ray Disc and HD DVD are both new optical disc formats vying to replace current DVDs for high-definition content such as movies. The main backers of Blu-ray Disc include Sony Corp., Matsushita Electric Industrial Co. Ltd. (Panasonic) and Samsung Electronics Co. Ltd., while companies supporting the rival HD-DVD format include Toshiba Corp., NEC Corp. and Intel Corp.

The launch on June 20, 2006 of the Samsung BD-P1000 player and eight movies from Sony Pictures Entertainment will signal Blu-ray Disc's entry into the consumer market.


There is technically little difference between the formats as both use the same basic blue-laser technology & the same compression systems so the picture qualities will be very close or identical.

For consumers shopping for a high-definition disc player, early title availability will likely be one of the deciding factors for choosing either Blu-ray Disc or HD DVD. Currently the major Hollywood studios are backing one or the other of the two formats so the same movie won't be issued initially in both formats.

Another differentiator will be price. The Toshiba HD-A1 HD DVD player can be picked up for around US$500, while the Samsung player to be launched next week is listed at $1,000 on Amazon.com. Movie discs for both formats cost from around $20.

Some analysts and industry watchers expect the duelling formats to cause many people to delay purchase until it becomes apparent which of the two formats is stronger, in a fight reminiscent of the Betamax versus VHS videotape battle in the 1980s.

Another possibility is a so-called "Ultra Multi Drive" that can manage both new formats. Several companies are working on such drives and they are likely to appear around the end of this year or sometime in 2007.