Consumers who use medicines inappropriately and create demand for such drugs are also to be blamed. For example, the misuse of creams containing steroids for skin bleaching and body-building medicines has generated a market for counterfeit steroid-containing medicines. Often, these medicines are distributed through unauthorized channels or illicit markets.

Counterfeit drugs that have been discovered have rarely been efficacious and in most of the reported cases, they are not equivalent in safety, efficacy and quality to their genuine counterparts. They are not within the control of the Drug Regulatory Authority (DRA) of the country concerned. Hence, if needed, an effective product recall would not be possible. Treatment with ineffective counterfeit drugs such as antibiotics can lead to the surfacing of resistant organisms and may have a deleterious effect on a wide section of the population. In severe cases, counterfeit drugs may even cause death.

As a result of such damaging effects, counterfeit drugs may erode public confidence in healthcare systems, healthcare professionals, suppliers and sellers of genuine drugs, the pharmaceutical industry and national DRAs. Incorrect labelling as to the source can also be detrimental to the reputation and financial standing of the original and/or current manufacturer whose name has been falsely used.

Counterfeiting medicines in all forms continues to represent an understandable concern for regulators, law enforcement authorities, and healthcare professionals. Lack of suitable legislations and regulations has encouraged counterfeiters to continue their practices. Various countries where the severity of counterfeiting is more, should harmonize stringent legislations and regulations. Insufficient resources for drug regulation activities and absence of appropriate training of DRAs' personnel may also manifest as inefficiency and incompetence of national DRAs. The consequence of this will be increased infiltration of counterfeit medicines into national distribution channels.

There is no simple solution or remedy that can be applied to get rid of counterfeit medicines nor can the problem be solved by an individual company or government. The problem has reached global dimension and needs a global approach. Development of a system which helps in reporting counterfeit drugs, implementation of anti-counterfeiting technologies, enforcement of stringent, proven anti-counterfeiting laws and regulations, and severe penalties on convicted offenders will help combating counterfeit drugs.

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NEWS

Quark–gluon plasma: fifteen years of Indian effort

The Quark–Gluon Plasma (QGP), that enigmatic new state of matter almost 20 times denser than normal nuclear matter, supposedly existing in the early universe a few microseconds after the big bang and predicted to be formed in the laboratory in ultra-relativistic heavy nuclear collisions as a consequence of de-confinement phase transition, has been at the centre of intense experimental study in the accelerator facilities at the CERN laboratory, Geneva, Switzerland and at the Brookhaven National Laboratory (BNL), New York, USA over the last two decades[1,2]. Quantum chromo-dynamics (QCD), the current theory of strong interactions, predicts that at sufficiently high energy density and temperature, achievable in high-energy heavy nuclear collisions, hadronic matter may undergo phase transition and an extended volume of interacting quarks, anti-quarks and gluons, referred to as QGP, can be realized as a transient state. This state will have collective properties different from that of hot hadronic matter and these differences form the basis for experimental signatures in the search for QGP.

About a decade and a half ago, a major initiative in the experimental study of QGP was taken up by scientists from the Variable Energy Cyclotron Centre (VECC), Kolkata, who knitted an Indian collaboration with the Institute of Physics, Bhubaneswar and the university groups from Chandigarh, Jaipur and Jammu, with the aim to study photon production in nuclear collisions. Photons are produced in the whole of the phase space in all stages in the evolution of the system created in nuclear collisions and carry information about the history of evolution as they do not interact strongly with the system and have large mean free path. Theoretical study of photon production, as one of the signatures of QGP formation, has been carried out by several Indian groups since a long time[3].

The Indian team set its sight on the forward region in nuclear collisions. This region, with high particle density, is particularly difficult for the study of photons because traditional equipment, the electromagnetic calorimeters, cannot be used due to large overlap of showers. There had been no measurement of photons in this part of the phase space earlier. Using the concept of a preshower detector, where shower formation is controlled by using a thinner converter and the transverse size of shower restricted to minimize overlap, one can measure the spatial distribution of photons produced in nuclear collisions. High particle density requires high granularity of the detector to keep occupancy to a reasonably low value.

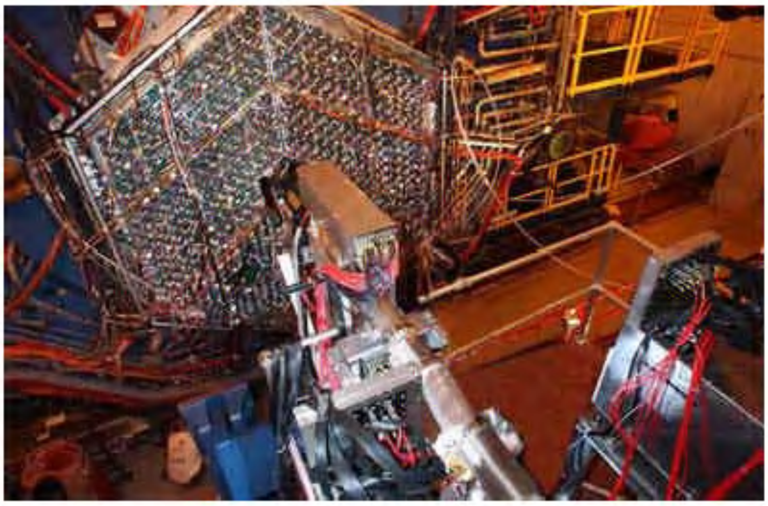
These measurements of photon distribution allow one to study event shapes and multiplicity fluctuations, thus providing important clues for the de-confinement phase transition and critical phenomena near the phase boundary. Photon measurements coupled with those of charged particles in the common part of phase space can be used to study charged-neutral fluctuations and chiral symmetry restoration.

In search for evidence of phase transition from hadronic matter to QGP in relativistic nuclear collisions, it is important to establish that thermalization occurs in the reacting system. If the system reaches local thermal equilibrium, pressure gradients may be produced in matter. The evolution of such a system will be accompanied by collective flow of produced particles. The emerging pattern of particles is azimuthally anisotropic in such a situation.

The formation of hot and dense matter in high energy heavy nuclear collisions has the possibility of creating a chiral symmetry-restored phase in the laboratory. After the initial stage of collision, the system cools and expands leading to normal QCD vacuum in which the chiral symmetry is spontaneously broken. During this process, a metastable state may be formed in which the chiral condensate is disoriented from the true vacuum direction. This transient state would subsequently decay by emitting coherent pions within finite sub-volumes or domains of the collision region. This possibility of the formation of the disoriented chiral condensates (DCC) would lead to large imbalances in the production of charged and neutral pions.

The Indian team fabricated and installed a Photon Multiplicity Detector (PMD), based on the preshower principle and using optimized thickness of 17 mm lead as converter and with 8000 detection elements (pads) in the WA93 experiment at the CERN Super Proton Synchrotron (SPS) accelerator in 1991, to study photon production in the collision of sulphur ions with gold targets[4]. A few years later, a modified and enlarged version of the PMD having 53,000 pads, was fabricated and installed in 1994 in the WA98 experiment, to study photon production in the collision of lead ions with lead target[5].

The WA98 PMD at the CERN SPS, viewed from the lead converter side.



The STAR PMD in the wide angle hall at BNL, viewed from the RHIC tunnel side.

The SPS studies were made at a centre-of-mass energy of about 20 GeV per colliding nucleon pair.

The PMD for the WA93 and WA98 experiments was made using plastic scintillator as the sensitive medium and read out using wavelength shifting plastic optical fibres and image intensifier with charge coupled devices. It was the first large-scale instrumentation project of its kind in the country, where the detector fabrication work was carried out at all the collaborating institutes and all the groups actively participated in the assembly of the detector.

The early versions of the PMD made significant contribution to the physics of ultra-relativistic nuclear collisions at the CERN SPS. Using data from the first PMD in the WA93 experiment, the Indian team showed that the produced particles had significant azimuthal anisotropy, which was not explained by known processes of simple superposition of nucleon–nucleon collisions. This was the first observation of collective flow of produced particles at the SPS energy, being a possible manifestation of local thermal equilibrium in the reacting system[6]. This investigation paved the way for numerous studies of collective flow by other experiments and has since become one of the standard methods to probe the equation of state of de-confined matter.

Another important observation on the formation of disoriented chiral condensates, a manifestation of chiral symmetry restoration, came from the analysis of data from the PMD in the WA98 experiment. Using the PMD data on photon multiplicity in conjunction with data on charged particle multiplicity from another detector in the same experiment, the group studied charged–neutral correlations and set an upper limit on the formation of DCC in localized domains in phase space at the SPS energy[7].

The success of the PMD as an important detector component in the study of high energy nuclear collisions led to its immediate acceptance as an integral part of the next generation collider experiments at BNL and CERN.

A new PMD, based on gas proportional counter design with a novel honeycomb cellular structure and having 83,000 detection units (cells), has been already fabricated by the Indian groups and installed in STAR experiment at the Relativistic Heavy Ion Collider (RHIC) facility of BNL where the collision energies are ten times higher than those at the CERN SPS[8]. This time again, detector fabrication was undertaken at various collaborating institutions in the country. The detector is now commissioned and has started taking data during the RHIC operation beginning January 2004. A small set of the PMD data analysed so far has already produced significant result in terms of energy and centrality-independent behaviour of limiting fragmentation of produced particles, a particularly important result on the evolution of collision and transport of produced particles in the forward region[9].

A highly improved version of the STAR PMD, with almost three times larger number of cells, is under construction at various centres within India and will be installed in late 2006 in the ALICE experiment at the Large Hadron Collider (LHC) at CERN[10]. The LHC will provide yet another quantum jump in collision energy, reaching 5500 GeV per nucleon in the centre-of-mass, which will be more than a factor of 25 higher than available at the BNL RHIC. Such a high energy is expected to produce enormous number of particles in nuclear collisions. The ALICE PMD has been specially designed to handle almost 4000 photons falling on its 3 m^2 area and can acquire data at the rate of about 1000 events per second.

The Indian collaboration has since almost doubled, with the inclusion of IIT, Mumbai and Bhabha Atomic Research Centre, Mumbai joining the PMD effort in STAR and ALICE experiments, and Saha Institute of Nuclear Physics (SINP), Kolkata and Aligarh Muslim University, Aligarh joining the ALICE collaboration with responsibilities for new contributions. The SINP and Aligarh groups are engaged in the fabrication of cathode pad chambers for one complete tracking station for muons, with close to 100,000 readout pads, for the study of quarkonia production in the ALICE experiment at the LHC. These chambers will also be installed in ALICE in 2006. These will considerably enhance the physics aspects of QGP to be addressed by the Indian team.

The design of a low noise signal processing ASIC called MANAS by the SINP group, with fabrication support from Semiconductor Complex Ltd, Chandigarh, is a landmark contribution of this research programme not only to the ALICE collaboration, but also to our country's semiconductor industry. The MANAS chip will be used for signal processing in the whole of the muon tracking spectrometer in ALICE, consisting of some 1 million channels and also in the ALICE PMD consisting of about 200,000 channels.

The Indian team is now preparing for a large distributed computing environment, with a tier-2 centre at Kolkata run jointly by VECC and SINP, in order to handle the peta-bytes of data expected to be produced each year in the ALICE experiment.

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