Physics monitor

magnet beamlines 6.1 and 6.3, and the longitudinal kickers for the feedback system were installed to provide energy stability in the ring. In addition to continuing user experiments on undulator beamlines 7.0 and 8.0 and on bend-magnet beamline 10.3, commissioning of undulator beamline 9.0 and bend-magnet beamline 9.3.2 is underway. Light will soon be become available in bend-magnet beamlines 6.1, and 6.3.

ALS information is now available electronically via World Wide Web - go directly to the Universal Resource Locator (URL) for the ALS home page - http://beanie.lbl.gov:8001/als/als_homepage.html. Information available includes the schedule for operations and information about ALS performance.

Quark matter

Precisely one decade ago the GSI (Darmstadt)/LBL (Berkeley) Collaboration at the Berkeley Bevalac reported clear evidence for collective sidewards flow in high energy heavy ion collisions. This milestone observation clearly displayed the compression and heating up of nuclear matter, providing new insights into how the behaviour of nuclear matter changes under very different conditions.

This year, evidence for azimuthally asymmetric transverse flow at ten times higher projectile energy (11 GeV per nucleon gold on gold collisions) was presented by the Brookhaven E877 collaboration at the recent European Research Conference on "Physics of High Energy Heavy Ion Collisions", held in Helsinki from 17-22 June.

Such flow is predicted to show up also in experiments at the CERN SPS when lead beams become available this year. Strong changes due to the phase transition threshold are expected if the thermodynamics of the long-awaited phase transition to Quark-Gluon Plasma (QGP) is strongly first order.

Phase transition

Not only the existence of a QGP phase transition, but also the thermodynamical nature of the transition itself is crucial. Lattice calculations, reviewed by Hildegard Meyer-Ortmans and Helmut Satz, are presently limited to small volumes, where naively no phase transition can exist or be detected.

However the probability distribution of the energy density may reveal the expected behaviour even in finite volume calculations. In experiments, large colliding systems - heavy beams and high energy - provide the most favourable conditions.

For QGP formation, phase transition dynamics is also a key issue. As Keijo Kajantie pointed out, neither

Hans Bøggild, centre, convener of the nightly Helsinki 'Quark Matter' poster sessions, with performance winners Yingchao Zhang (right, of Stony Brook, best poster presentation) and Leonid Razumov (Marburg, best entertainment value).

Johann Rafelski dispenses wine during heavy ion discussions at Helsinki.

finite volumes nor short time scales hinder the application of the theory to the early Universe.

At Helsinki, Miklos Gyulassy discussed fluctuations in a phase transition in a small system, where the initial quark and particularly gluon distributions may vary strongly. This could also lead to observable signatures - fluctuations in the neutral/ charged pion ratios or through pion interferometry. H. Satz recommended the J/psi, broken up by deconfined gluons, as a probe.

No transition?

Until it is convincingly proven experimentally, the phase transition remains a suggestion. Some theorists attempt to describe all observed phenomena in terms of conventional hadronic behaviour. The decrease of effective hadronic masses in dense matter is a central assumption of this approach. Robert Pisarski pointed out that the expected decrease of effective masses may be false, and presented an example where the rho mass increases with increasing density and temperature. Such variations can be uniquely studied by lepton-pair experiments, where Roberto Salmeron summarized the experimental data on vector meson production.

Strangeness

The increased strangeness signal is well and alive, particularly where strange antibaryons are concerned. Several groups measured strangeness enhancement or performed strangelet searches. The excess over proton data is obvious and rather consistent between different experiments, and discussions revealed that even the most sophisticated models cannot reproduce the strange antibaryon production unless exotic behaviour is incorporated. Although QGP scenarios are supported by the data, as pointed out by Jan Rafelski, a detailed dynamical model still needs to be worked out.

Interferometry

With the advent of second generation experiments on both sides of the Atlantic, two particle correlation studies now focus on high statistics as well as on clean particle identification, leading to detailed comparisons of pion and kaon correlations.

The substantial experimental data, presented by Hans Bøggild, needs proper treatment of various dynamical processes and contributions from resonances. New attempts in this direction may help unravel the information from many different correlations.

Photons and leptons

Electromagnetic probes - measured as real and virtual photons - are the only QGP signal that would reach the detectors directly, but are very rare, pointed out Vesa Ruuskanen.

Four experiments at CERN aiming to look for this signal were reviewed by Karl-Heinz Kampert. Preliminary data indicate an excess over known hadronic sources in central collisions, and are compatible with background in peripheral and proton-nucleus collisions.

This dominant photon contribution is believed to originate from the hadronic phase, with some additional lepton pair contribution, possibly due to enhanced charm production.

To account for the photon yields, the system is required to rest for a significant time at a temperature close to the critical one, a picture supported by the observed slope of the prompt photon transverse momentum spectrum. If this signal persists, it could be an indication for hadronic matter at its boiling point.

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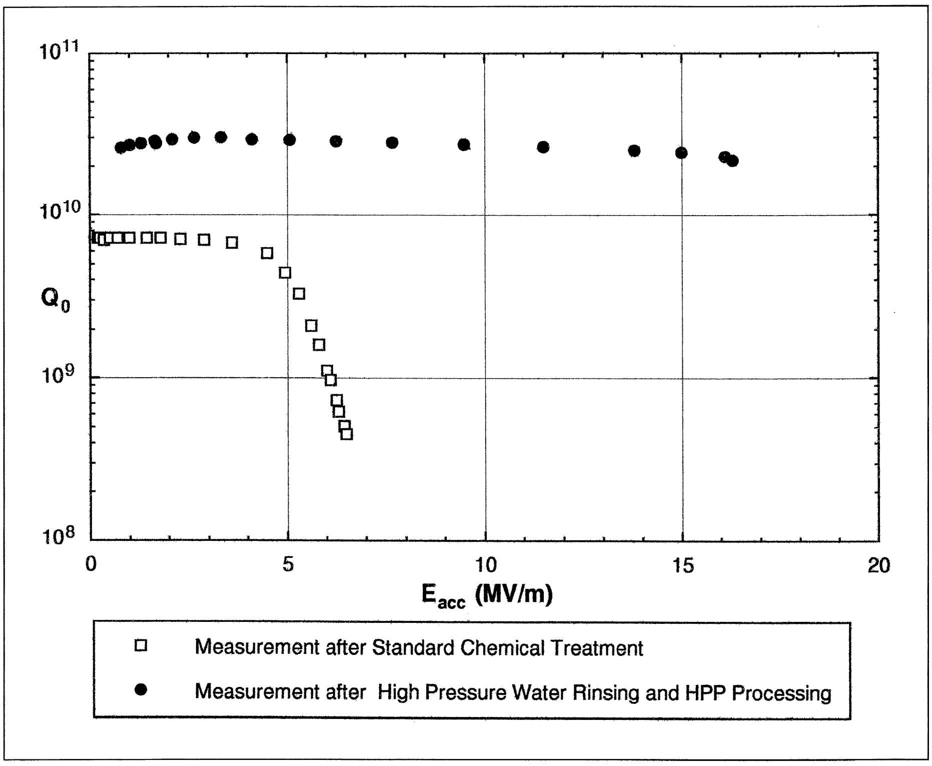
The existence and particularly the experimental verification of a phase transition should be easier to see in larger nuclear systems and/or higher beam energies. The next round is the lead beam experiments which begin at CERN's SPS this year, with a longer term view at Brookhaven's RHIC collider and subsequently the LHC at CERN.

As Ingvar Otterlund pointed out in his opening address, the European Research Conference could also demonstrate the healthy age distribution in the field. Among the 110 participants, almost half of the researchers were still below 35.

From L. Csernai and K.H. Kampert

After high pressure water rinsing and high peak power (HPP) radiofrequency treatment at DESY's TESLA Test Facility, promising accelerating fields have been produced by prototype superconducting cavities for a proposed TeV Superconducting Linear Accelerator (TESLA).



Linear Colliders TESLA

The aim of the TESLA (TeV Superconducting Linear Accelerator) collaboration (at present 19 institutions from seven countries) is to establish the technology for a high energy electron-positron linear collider using superconducting radiofrequency cavities to accelerate its beams. Another basic goal is to demonstrate that such a collider can meet its performance goals in a cost effective manner.

For this the TESLA collaboration is preparing a 500 MeV superconducting linear test accelerator at the DESY Laboratory in Hamburg. This TTF (TESLA Test Facility) consists of four cryomodules, each approximately 12 m long and containing eight 9-cell solid niobium cavities operating at a frequency of 1.3 GHz.

The infrastructure to process and test these cavities has already been installed. This heroic work calls for scrupulously clean conditions to avoid contamination which would otherwise mar performance. The facility thus includes a complex of clean rooms, an ultraclean water plant and a chemical etching installation for cavity surface preparation and cavity assembly. To improve the cavity performance a firing procedure at 1500 C in an ultrahigh vacuum furnace is foreseen.

Radiofrequency power will be provided by a 4.5 MW klystron (pulse length 2ms) in connection with a modulator, built by Fermilab. This system is also used for a high peak power radiofrequency treatment (HPP) to further improve cavity performance by eliminating potential sources of field emission. For cavity testing, an existing cryogenic plant has been modified to cool the cavities to 1.8 K and measure them in vertical and horizontal test cryostats, provided by Fermilab and Saclay respectively.

Prototype cavities have been already delivered to DESY and are presently being used to commission the complete infrastructure. First measurements indicate that cavity performance can be drastically improved by advanced surface processing techniques like high pressure water rinsing developed at CERN and high peak power radiofrequency treatment developed at Cornell. Further improvements are expected from high temperature cavity annealing in the UHV furnace. The initial TTF goal is an accelerating field of 15 MV/m at a resonance (Q) value of 3×10^9.

The first series cavities for the TTF arrived in September and initial beam tests of a complete TESLA cryomodule (constructed by INFN Frascati/Milan/Rome) with an injector