

proposes to use the 50 GeV polarized electron beam of LEP and a polarized jet of hydrogen and deuterium.

Continuing the EMC tradition at CERN, the Spin Muon Collaboration (SMC) experiment (March 1990, page 3) was launched. Including specialists from a broad variety of fields in atomic, solid state, nuclear and particle physics, covering 26 institutions from Europe, Japan and the United-States, the SMC experiment will run from 1991 to 1993, using CERN's high energy (100-200 GeV) muon beam, recently upgraded by a dispersion-free transport system.

The polarized nucleon target is a large frozen spin target at 50 millikelvin using butanol for protons and deuterated butanol for neutrons. An important feature is the possibility of exploring x down to 0.005.

The experimental set-up is an upgrade of previous muon beam experiments. The principal modification to the spectrometer is the replacement of 16 planes of drift chambers by a 32-coordinate streamer tube system built by the Universities of Houston and Munich, and 12 planes of drift tubes built by Dubna.

A new polarimeter will determine the polarization of the muon with an accuracy of about 5%. This polarimeter, developed by a Rice-Trieste-Saclay collaboration, will use the measurement of the positron energy spectrum from the muon decay in flight and of the asymmetry in muon-electron scattering in a magnetized iron target.

Together, these experiments with muon and electron beams will probe in detail the spin structure of protons and neutrons over a broad range of x , providing comprehensive and accurate data on the spin structure of the nucleon.

Electron beams promise a high sta-

tistical accuracy in a short time while muons offer the unique possibility of exploring the very small x region. Together, these extensive measurements will reduce experimental uncertainties due to systematic effects since they use completely different techniques.

From 16-18 December, 100 physicists met in Paris for the SMC workshop on the spin structure of the nucleon. The meeting focussed on the first data on the deuterium longitudinal asymmetry, obtained last year at CERN. Highlights were presented by Vernon Hughes (Yale). A great achievement for the collaboration has been the success of the polarized target, an upgrade of the EMC apparatus. This was the first time that such a large quantity of deuterated material has been polarized to about 30 %. The development of new electronics and new methods of analysis enables deuteron polarization to be measured to within a few percent.

Anatole Abragam (Collège de France) captivated the audience with his graphic descriptions of early developments on dynamic nuclear polarization, recalling in particular the success of his collaboration with specialists J. Thirion at Saclay and M. Borghini and T. Niinikoski at CERN. He demonstrated that polarized targets require a variety of talents in physics, fine jewellery, plumbing, etc.

The review of the theoretical situation by R. Jaffe (MIT) emphasized the urgent need for accurate experimental information and discussed the importance of measuring the transverse asymmetry to provide new information on quark-gluon interactions.

In 1993 a new SMC polarized target, 50% longer, will be introduced. This includes a new dilution refrigerator built by CERN, Helsinki, Munich and NIKHEF (Amsterdam), and a

highly uniform field superconducting magnet built at Saclay. A dipole transverse field will allow rapid and frequent polarization switches as well as the measurement of transverse asymmetries.

This year the first results on the neutron spin structure should begin to shed further light on the puzzle of the origin of the nucleon spin.

Futurebus+

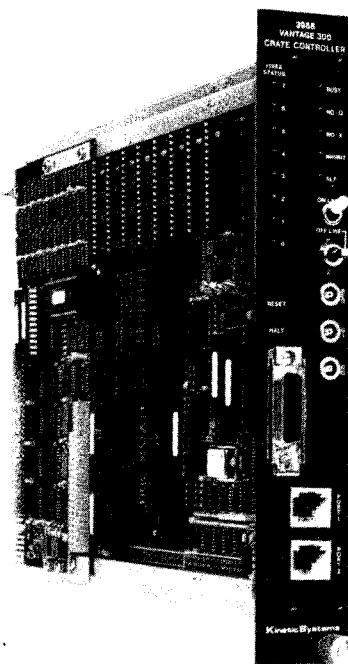
A special symposium held at CERN on 28-29 October, jointly organized by the ECP (Electronics and Computing for Physics) and CN (Computing and Networks) Divisions, and the most recent conference in the biannual US BUSCON series, held in Long Beach, California, from 4-6 February, reflected the status of Futurebus+, the most advanced backplane bus standard for physics data handling systems.

The standardization of Futurebus+ has made significant new progress. IEEE 896.1, the Logical Layer Specifications, and IEEE 896.2, the Physical Layer and Profiles Specification, are now official standards. A third document in the family of Futurebus+ standards, IEEE P896.3: Recommended Practices, has just been distributed for Sponsor Ballot.

Unlike other open bus specifications, Futurebus+ has a Logical Layer Specification independent of any specific implementation technology. The same logical protocols and functions can be implemented with different board, connector and bus driver technologies allowing Futurebus+ performance and cost to scale up and down according to user needs and technological development.

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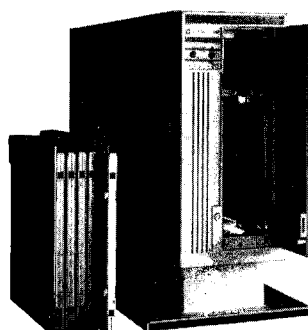
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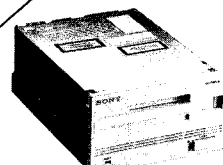


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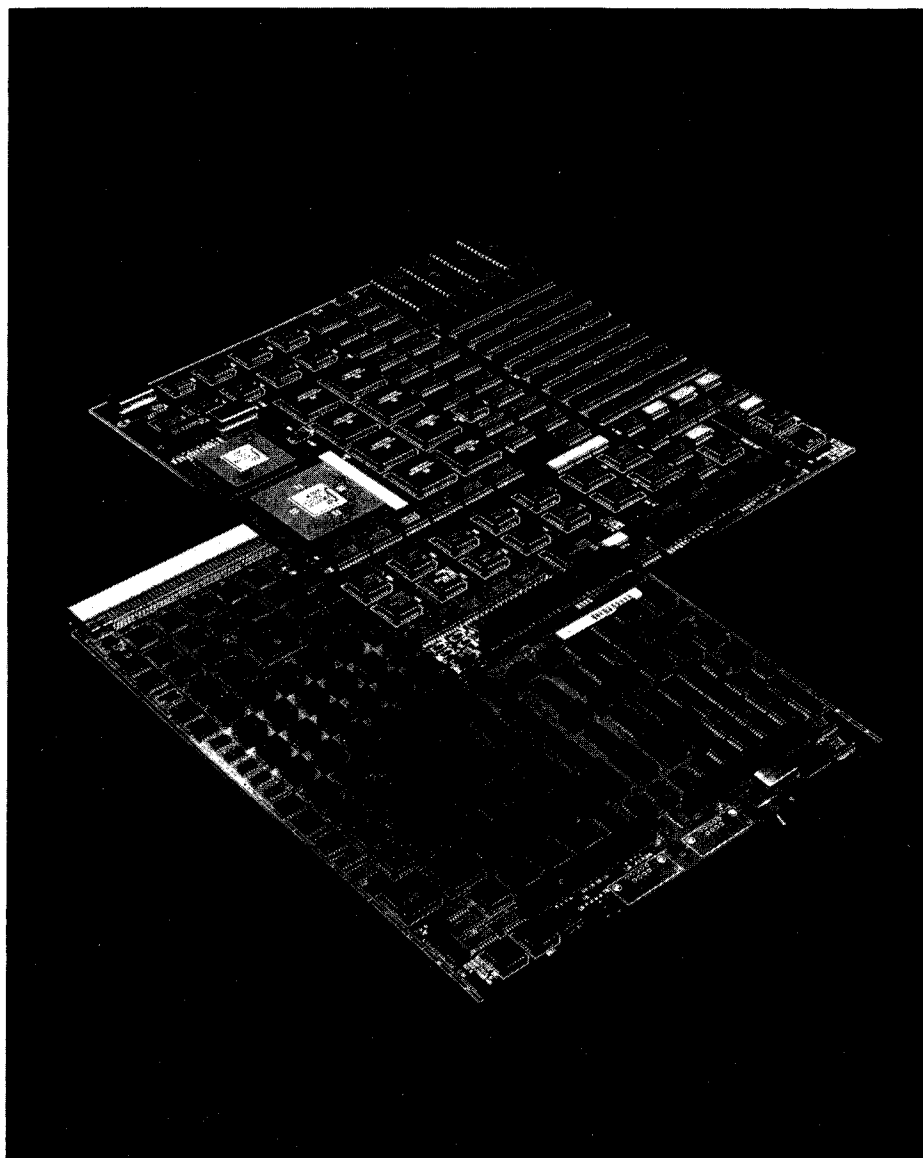
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New manufacturer-supplied electronics with (below) a Futurebus+ board, the most advanced backplane bus standard for physics data handling systems. A range of Futurebus+ board products should soon start to become available from major suppliers.

(Photo Nanotek Inc.)



The Physical Layer and Profiles Specification(s) are the means to guarantee interoperability and interchangeability of boards from different manufacturers for a chosen technology and application area. The Recommended Practices document gives valuable information for the system integrator on how to use the rich set of basic Futurebus+ features for, amongst other areas, system initialization, fault management, test

and maintenance. Of prime importance is also a detailed discussion of real-time schedulability (prompt execution) support in the Futurebus+ environment.

At the CERN symposium, participants first heard a tutorial on Futurebus+ by Joe George, President of Nanotek Inc, followed by talks on requirements for future bus systems in the high energy physics community, and presentations by Digital

Equipment (DEC), Force Computers, Kontron Elektronik, and Nanotek on Futurebus+ products and developments. A lively panel discussion closed the event.

Several points emerged during these two days. First, among the profiles defined so far, Profile F is the hardware environment of Futurebus+ most likely to fulfil the needs of high energy physics. But Profile B, which will be used extensively by DEC as the input-output bus standard for their high-end systems, will be the Futurebus+ hardware environment most widely used and produced initially.

This apparent clash was deemphasized when DEC assured that cache-coherent profile F domains can still operate inside their profile B crates as long as data to be transferred to their system memory across the DEC bridge to Futurebus+ will not rely on cache coherency across this bridge.

The panel discussion revealed a first tentative timescale for the establishment of a real Futurebus+ market. Between them, more than ten companies should be offering more than 50 different board level products sometime during 1993. A big step in this direction will be the availability of good bus interface VLSI, expected this year.

The BUSCON conference displayed the geographical extent of Futurebus+ activities. The development of the standard was mainly pushed from the US with some participation from Europe. Yet Japanese companies announced more than 20 Futurebus+ projects, followed by the US with 12-14 and finally Europe with 2-3 projects.

Considerable effort is going into the definition of a desktop profile, mainly driven by DEC, Hewlett-Packard and Sun, with IBM as observer. This pro-

file aims at distributing stacks of credit-card-sized processor boards interconnected via cache-coherent Futurebus+ bridges on a workstation motherboard.

The chosen bus technology, CTL, should allow operation of the local buses at up to 400 MHz leading to overall performance of the stations in the 1000 Specmarks range (a Specmark is approximately equal to 1 original VAX Mips).

(From Christoph Eck)

Quark radiation from LEP

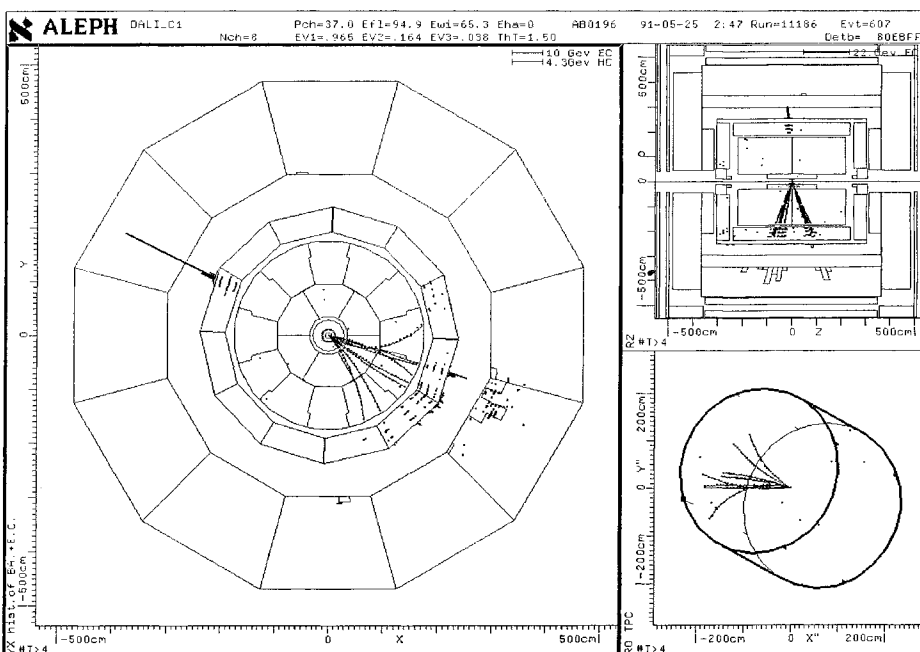
Like any other electrically charged particles, quarks should give out electromagnetic radiation (photons) when they vibrate. One of the physics results from CERN's LEP collider is the first clear observation of this quark radiation from electron-positron collisions. At lower energies this radiation could only be inferred.

This new evidence was a natural focus at the recent workshop on Photon Radiation from Quarks, held at LAPP, Annecy, attracting almost 100 theorists and experimentalists, including representatives from all four LEP experiments.

The meeting set out to summarize the status of experimental data and theoretical understanding, and to consider the prospects for improving both in the fairly near future.

Although single photon radiation from quarks has been studied in proton collisions for more than ten years, the clean conditions in LEP electron-positron collisions provide a new bonus.

The 1989-90 data from all four LEP experiments have been analysed and the results, although differing in fine



Radiation from quarks seen at CERN's LEP electron-positron collider by the Aleph experiment. The spike, upper left, is about 45 GeV deposited in the electromagnetic calorimeter by a single photon. The charged tracks and hadronic energy lower right are what emerges from the quark-antiquark pair resulting from a Z decay.

detail, are in excellent agreement. Including data collected last year each LEP experiment has now recorded about a thousand examples of single photon radiation.

Although still comparatively rare, this process is a sensitive probe of what happens after a Z particle decays into a quark-antiquark pair, testing current quark field theory (quantum chromodynamics - QCD) models of this process and subsequently measuring quark couplings to the Z.

All experiments observe more events than predicted when the standard JETSET simulation of what happens when quarks materialize into hadrons is tuned to unbiased hadronic Z decays.

The related ARIADNE simulation, which uses the same (Lund) hadronization scheme but a different formalism to describe the quark/gluon cascade which precedes the final hadronization, gives around 30-40% more photons, in better agreement with the data.

The sensitivity of this electromag-

netic process to QCD details, surprising at first sight, can be explained by the competition between gluon and photon radiation. Isolated photons thus provide a unique window on to the quark-gluon cascade before the hadronization stage.

This was discussed by proponents of the three principal simulation models (ARIADNE, JETSET and HERWIG). Explicit calculation of photon radiation from quarks provides a basis for QCD tests reported by the Opal collaboration in which the effective QCD coupling strength has been determined and the algebraic (non-Abelian) structure of the theory tested.

Based on this knowledge, both Opal and Delphi reported separate measurements of the electroweak couplings of up- and down-type quarks to the Z. The details of hadronization are also probed in the studies of neutral hadrons to assess the background to the photon signal: both L3 and Aleph show that current simulations considerably underesti-