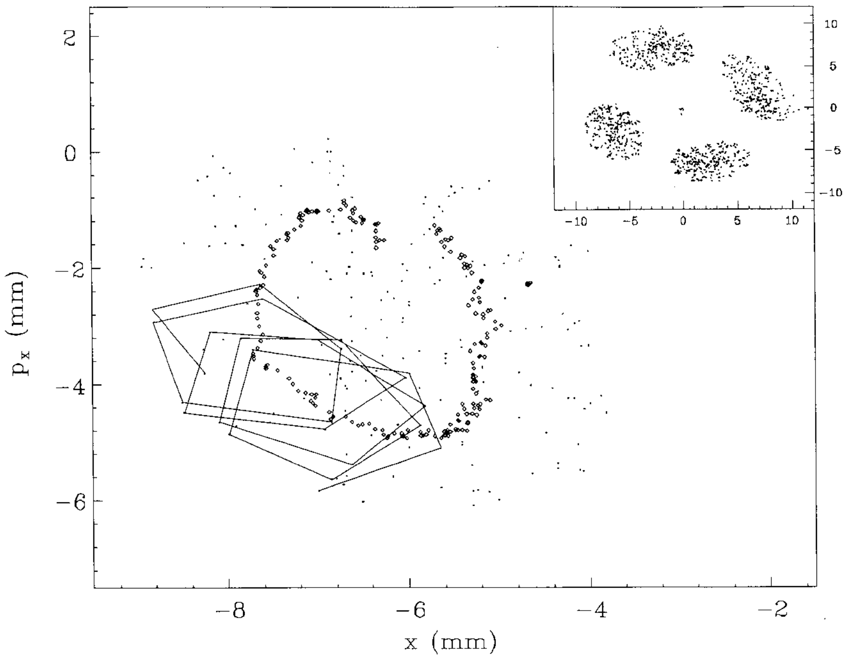
Therefore this method, normally used to calibrate polarimeters, could not be employed. At present the measured polarization value has a systematic scale uncertainty of about 50%, which should be decreased fivefold by further analysis.

During the fall six machine shifts were dedicated as prime time to the polarization measurement. For 80% of this time data was taken, demonstrating the excellent performance of HERA and the polarimeter. More polarization studies are expected this year. Exceeding 50% polarization will be the signal to install the spin rotators to rotate the polarization vector of the electrons into the beam direction and open up new physics opportunities.



Experiments at Indiana University last year looked at the detailed effects of multipole magnetic fields on protons in a synchrotron. The plot shows one of the resulting 'islands' in the plot of transverse particle momentum against position. (The inset, top right, shows the full plot, with four such islands.) The solid line shows the complicated evolution of transverse (betatron) oscillations, but by taking a moving average, the trend of the particle motion (large data points) can be seen more clearly.

INDIANA
Beam dynamics experiments

Beam dynamics experiments at the Indiana University Cooler Facility (IUCF) are helping to trace complicated non-linear effects in proton machines and could go on to pay important dividends in the detailed design of big new high energy proton storage rings.

The 87-metre circumference IUCF is one of the new generation of compact machines using electron cooling to obtain extremely well-behaved proton beams with a narrow momentum spread, ideal for such precision dynamics studies.

In previous work, particle tracking in proton beams was complicated by the complex internal motion of the particles. The other alternative is computer simulation, but these complicated calculations can keep even big supercomputers busy for several days!

In an ongoing experiment, specialists from Indiana, the Superconducting Supercollider (SSC), Fermilab and Brookhaven reconstructed the detailed tracking of the particles in the IUCF and inferred the effects of higher order (sextupole, octupole,...) magnetic fields.

The cooled beam bunches were given a sudden sideways kick and the resulting transverse (betatron) oscillations tracked turn by turn. The resulting multipole fields distort the classic elliptical envelope of transverse particle momentum plotted against transverse position, with resonance 'islands' being formed.

Last year's IUCF experiments traced the movement of several different such resonances and their effects on particle motion. Ongoing goals are to follow the protons in both transverse directions rather than just one, while more data storage will enable the protons to be tracked for longer, up to 128,000 turns.

From the new knowledge of particle motion around non-linear resonances, new correction schemes can be explored. The results can also be compared with the computer simulation studies.

DUBNA
Member States

The political upheaval in what was the Soviet Union was reflected in an Extraordinary Plenipotentiaries Committee of Joint Institute for Nuclear Research (JINR) Member States, held in Dubna, near Moscow, on 10-13 December, with representatives of eleven sovereign republics of the former Soviet State taking part.

The main event of the meeting came when three sovereign republics – Byelorussia, Russia and Ukraine – became full and equal members of JINR. The Russian

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delegate from the Ministry of Science, Higher School and Technical Policy, B.Saltykov, pledged that, as host country, Russia will undertake all the corresponding obligations.

The delegations from Armenia, Azerbaijan, Georgia, Kazakhstan, Latvia, Lithuania, Moldavia and Uzbekhistan said their governments would take an active part in JINR activities and in the very near future would be ready to join the International Organization.

Director D. Kiss presented the Annual Report and reported on a new agreement signed between JINR and the German Ministry of Research and Technology. Vice-director A. Sissakian described the establishment of the Dubna International Centre for Development of Science and Technologies (Technopolis – Dubna).

The problems of JINR finance in 1991 and planned figures for 1992 were also discussed as well as ideas for developing the Laboratory and its science. The Proceedings of the meeting were adopted and signed by the representatives of the thirteen Member States.

Klaus Winter – neutrino physics

Some excellent books arrived on the CERN Courier desk last month, notably Klaus Winter's new tome on the neutrino, a 'must' for all enthusiasts of this enigmatic particle, and a collection of essays from Lev Okun, whose mind continually climbs above the clouds which fog lesser intellects.

A Winter's tale

'Though I am satisfied, and need no more
Than what I know, yet shall the oracle
Give rest to the minds of others such as he
Whose ignorant credulity will not
Come up to the truth.'

Leonides, King of Sicily, in 'The Winter's Tale', Act II, Scene 1, by William Shakespeare (1611).

It is over 60 years since Wolfgang Pauli sent his famous letter to the 'Radioactive Ladies and Gentlemen' gathered in Tübingen for a physics meeting. Unable to attend because of prior commitments, Pauli sent his excuses accompanied by the prediction of a new particle to explain missing energy in beta decay.

Pauli called this new particle the neutron, and predicted it would pass easily through matter. Two years later, James Chadwick in Rutherford's Cambridge Laboratory discovered heavy electrically neutral nuclear particles released when light elements are bombarded with alpha particles. He called these neutrons, and Pauli, whose particle had not yet been discovered, lost his place in the nomenclature queue.

Enrico Fermi came to the light particle's rescue, calling it the diminutive neutrino, and putting its theory in order. In 1956 the neutrino was finally seen in an experiment led by Clyde Cowan and Fred Reines at the Savannah River reactor.

Ever since, apart from a brief period in the early 60s when physicists were obsessed with strongly interacting particles, the neutrino has remained in the physics headlines, never far from the big discoveries.

The availability of high energy neutrino beams, the use of neutrinos as a fine probe of nucleon structure, and most recently, the advent of neutrino astronomy, have given new impetus to this physics. Born as part of nuclear physics, neutrino studies went on to make important contributions to particle physics, and most recently to astrophysics too, reflecting the growing interplay between particle physics, astrophysics and cosmology.

Paradoxically these new developments have still not been able to unveil many of the neutrino's innermost secrets.

This scientific saga is traced in a new book, 'Neutrino physics', edited by Klaus Winter of CERN and published by Cambridge University Press (Monographs on Particle Physics, Nuclear Physics and Cosmology, ISBN 0-521-36452-3). It is a collection of both reprinted and specially written contributions signposting the history and physics interest of this enigmatic particle.

The first chapter is devoted to neutrino history, and leads off with a 1957 Pauli paper, written just after Reines and Cowan first detected free neutrinos, and published in the book for the first time in English. The chapter also includes original reports (retypeset) on early neutrino discoveries – that of the neutrino itself; the 1962 observation by Leon Lederman, Mel Schwartz and Jack Steinberger of two distinct kinds of neutrino; and the 1973 sighting at CERN of neutral