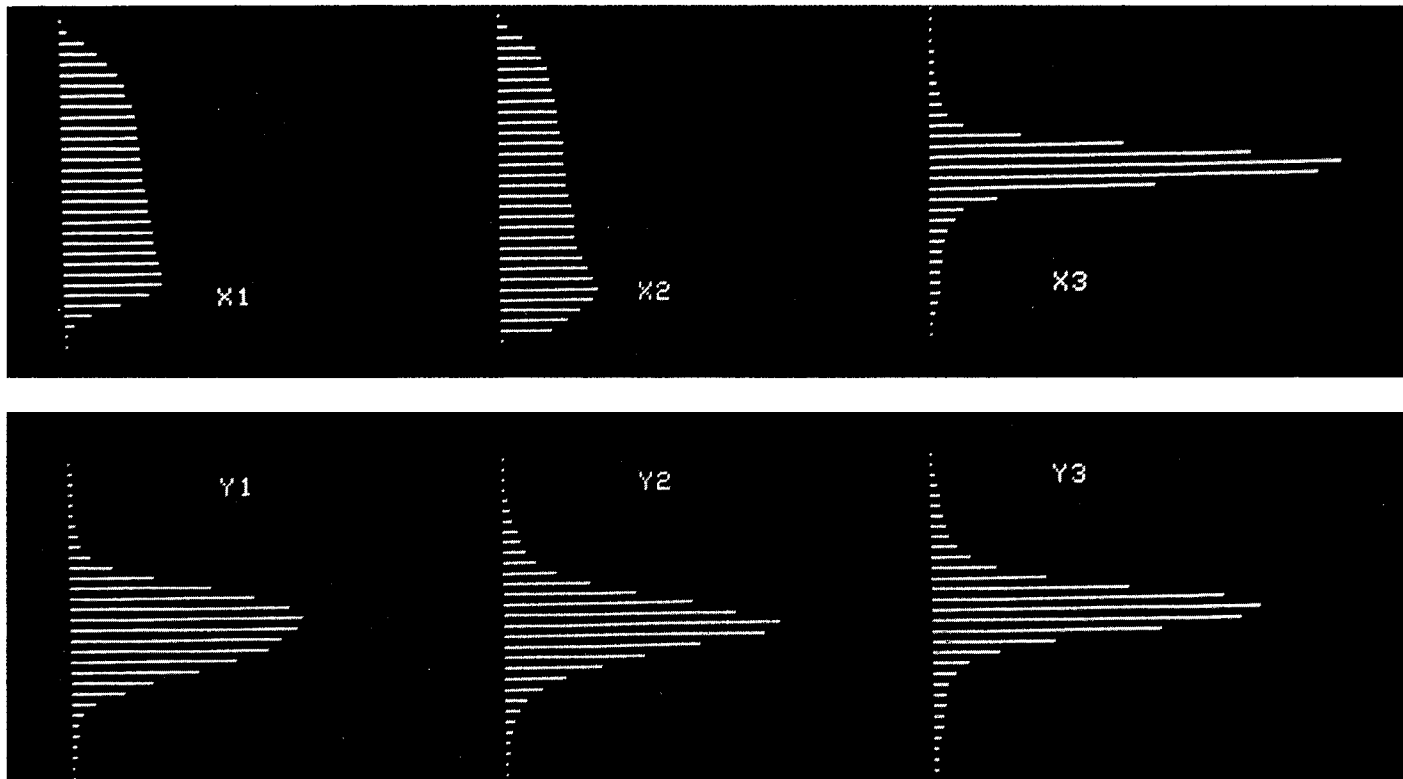




beam-line called m12, to take probably 400 000 photographs in the time between the two neutrino exposures. It will be aimed at the observation of neutral mesons and especially at the study of the decay into two gammas (about which little is known because, up to now, it has been difficult to observe) and the decay into positive and negative pions and a gamma (which will help clear up the question of the quantum numbers of the neutral meson).

ISR magnets powered

Commissioning of the main magnet power supply for the Intersecting Storage Rings began on schedule on 3 August. Current was passed through both complete magnet rings (268 magnet units) for the first time. The design peak current is 3750 A to produce a peak field of 12 kG which will hold 28 GeV protons in the magnet rings. The power is then 7 MW per ring.

Unlike conventional accelerator magnet power supplies, the ISR system does not need to provide pulsed current. It does, however, have quite exceptional stability criteria to satisfy in order that the beams can be retained circulating in the magnet field for many hours. The magnet current has to be held stable to $\pm 3 \times 10^{-5}$ of its nominal value over ten minutes and to within $\pm 10^{-4}$ over two months. This applies over the full current range needed to store beams with energies from around 8 GeV to 28 GeV. Two big power supply units, of 7 MW each, having refined regulation systems have been manufactured by Smit-Brentford (Netherlands-UK).

The initial tests went very smoothly which is no small achievement when the

Intersecting Storage Rings are the biggest accelerator magnet system ever built up to now. Tests are continuing every weekday from 16.00 h to 06.00 h when the ISR tunnel is closed.

During the rest of the time, work in the tunnel continues. Long sections of the ultra-high vacuum system have been installed, baked out and pumped down. The vacuum system for the ISR is another 'biggest ever' and we must return to it in a later issue since it is one of the great achievements in connection with the project. The two beam transfer lines to feed the rings are under vacuum and tests on the beam transport magnets have been under way for some time. The crucial r.f. system for both rings has also successfully passed its first tests.

Beam monitoring

Since June the Beams Group of the Nuclear Physics Division has had a new tool to help in the setting up of the beams feeding experiments. It consists of a beam monitor based on proportional multiwire chambers (PMC) coupled to a computer, which provides almost instantaneous information on the main features of the beam, i.e. energy spectrum, divergence spectrum, beam profile, emittance, etc.

The main advantages of this equipment, developed by H. Verweij and G.B. Lindsay (electronics) and J. Baele (programs), result from the properties of the PMC and include:

a) operation with relatively intense beams (a few million particles per second) without becoming saturated — thanks to the very short resolution time of the PMC (60 ns);

b) being unaffected by magnetic fields;
c) providing a high degree of spatial resolution allowing small sections of the beam to be analysed.

The proportional multiwire chamber which is used has wires in two planes (horizontal and vertical), each plane containing thirty-two wires three millimetres apart (the distance between the wires can be changed as needed). A pulse amplification, shaping and storing system is connected to each wire (the system being of the type described in CERN COURIER vol. 10, page 151). The information thus provided is read off sequentially in groups of four wires and passed to the computer. A measuring system usually comprises three or four chambers of this type installed at points along a beam-line, usually in association with focusing lenses and bending magnets.

The assembly operates on a sample basis (taking about 100 to 1000 readings per burst of particles down the beam-line). The data are handled by an HP 216/B computer equipped with a keyboard, a write-in unit, a tape-punch reader and a screen. The operator can thus interact with the computer as the beam is being adjusted. Data handling is virtually simultaneous, and the results can be either displayed on a cathode ray screen or printed out on tape in a number of different ways.

It is possible, by means of such a system:

1) to obtain a very complete description of the beam after only a few bursts, which would previously have been possible only after several hours;

2) to understand the behaviour of the beam better and to set it up more easily

Around the Laboratories

— in the more complicated cases, this will greatly reduce the time formerly wasted in trial-and-error settings;

3) to calibrate the beam easily, thus helping the experimenters considerably.

The equipment was first used in June to calibrate the p5 beam in the East Hall, and gave an accuracy of 0.5% on the momentum measurements. Some improvements have since been made in order to increase the flexibility and to provide even better accuracy.

Linac troubles

From the beginning of July the performance of the 50 MeV linac feeding the proton synchrotron became erratic and in the middle of the month the PS was stopped (from 17 to 19 July) in an attempt to find and cure the source of the trouble. It was brought back on the air at reduced power. The output current at 50 MeV was limited to about 55 mA rather than the usual hefty beam of 110 mA. This was because the beam loading in tank 3 could not be compensated for an intense accelerated beam. Fortunately the effect on the PS accelerated intensity was comparatively small causing a reduction in the average beam from 1.5 to 1.4×10^{12} protons per pulse.

The difficulties seem to have been caused initially by a detecting loop which was protruding too far into an r.f. power line by about 1 mm. The extent of the sparking damage at this point suggested that breakdown had occurred steadily for some time, and had progressively broken down cables and components by reflection over-voltages. It had also indirectly led to further breakdown elsewhere by requiring other parts of the r.f. system to run at voltages higher than normal in order to compensate for the loss of power.

Contributing to the problems also was the slightly lower power capacity of a new set of cables from a different manufacturer, and low gain in one of the beam loading compensation power amplifiers. The system was tuned up again satisfactorily at the beginning of August, but it has been decided to replace the amplifier during the next maintenance period.

SERPUKHOV Experimental programme

At the beginning of August several scientists from the Institute of High Energy Physics at Serpukhov visited CERN. They saw the progress on the items of equipment (fast ejection system, r.f. separators) being prepared for use on the 76 GeV synchrotron at Serpukhov and studied other aspects of CERN's work, particularly the data handling facilities for bubble chamber film. While they were at CERN, Professor A.A. Logunov, Director of the Institute, gave a special seminar to theoreticians and a general seminar, together with Dr. V.A. Yarba, on the experimental programme at Serpukhov. The following information was drawn from the general seminar.

Professor Logunov began by expressing his great satisfaction with the progress of the CERN-Serpukhov collaboration both in terms of the joint experiments and of the development of machine equipment. He expressed his confidence that the

collaboration which has begun so very well will prove still more fruitful for both Laboratories in the future.

Performance of the accelerator

In 1969 the 76 GeV proton synchrotron operated for 3700 hours of which 3000 hours were used for the physics research programme. The peak beam intensity was 1.5×10^{12} and the average per cycle was 0.6×10^{12} . The magnet cycle flat-top at all energies up to 70 GeV was up to 1.5 s long and usually two or three experiments were taking data simultaneously with a spill time of 0.3 to 0.5 s. A fast spill suitable for bubble chamber physics has also been achieved. The machine schedule was 20 days of continuous operation followed by a 10 day shutdown.

In the first half of 1970 the accelerator operated for 2000 hours and the reliability of all components is being steadily improved. A long shutdown began on 20 July (it will extend to 15 October) and will be occupied mainly in preparations for the fast ejection system.

EXPERIMENTS AT SERPUKHOV

<i>Beam channel</i>	<i>Experiment</i>
Beam 2 (30-65 GeV/c)	1. Total cross-section measurements 2. Elastic scattering 3. 6 m spectrometer
Beam 4 (20-45 GeV/c)	4. Pion-proton charge exchange 5. Pion-neutron backward scattering 6. Search for heavy particles and antinuclei 7. CERN-Serpukhov missing mass spectrometer 8. 2 m heavy liquid bubble chamber from Dubna
Neutral Beam	9. Neutral kaon, regeneration on hydrogen
Internal Beam	10. Elastic proton-proton and proton-deuterium scattering