
Annual shutdown

Francis Perrin who was attending Council for the last time as delegate for France.

Professor Gentner said:

'We are very sorry to say goodbye to Francis Perrin after an association which has been so close, pleasant and fruitful.

Professor Perrin belongs to that small nucleus of energetic and enthusiastic people to whom we largely owe the coming into being of CERN. In his capacity as Haut Commissaire à l'Energie atomique, he was most active, from the very beginning, in the discussions held at UNESCO in December 1951 which led to the signature of the Agreement setting up the interim Organization, the European Council for Nuclear Research, on 15 February 1952. His signature is on that document as well as on the Convention establishing CERN.

From then on Professor Perrin has been one of us in the Council, and from 1959, also in the Scientific Policy Committee, where fortunately he will stay on for quite a number of years. For more than twenty years we have had the benefit of his wisdom, influence and unwavering faith in the daring venture called CERN. We could always rely on him whenever we were faced with difficulties to speak up for and defend the primacy of the physics activities of the Laboratory.

His dream has come true: the CERN of today and of tomorrow owes him a great deal. On behalf of all of us I wish to tell him how deeply grateful we are for all he has done for the Organization and how much we have appreciated his sound judgement, his brilliant spirit and his ever youthful enthusiasm.'

The 28 GeV proton synchrotron accelerated its last particles for 1972 on 23 December and the experimental teams who had been using the PS and the ISR went home. In their absence, however, the machines have not been the scene of peace and quiet. After allowing a week for the PS to cool down (for induced radioactivity levels to fall) annual shutdown work began in earnest and will continue there and at the ISR until 21 February with a list of a thousand jobs to be done.

Many of the jobs are of a routine maintenance nature. Anyone who periodically checks the electrical equipment in his home will be well aware that screws come loose and wires come adrift for no reason whatsoever. All the more so is this sort of check needed on highly complex equipment which has been effectively switched on and off many millions of times during the year as the synchrotron pulsed. But this routine maintenance is not what we will be concerned with here. We have simply picked out some of the major features of the shutdown work at the PS and ISR in the experimental areas and intersections regions.

At the PS

The 50 MeV linac is having a careful wash and brush-up to try to ensure greater stability and reliability. Everyone leans on the linac and its good performance is obviously crucial; in particular the 800 MeV Booster is a more demanding customer concerning linac beam quality than the PS.

The r.f. system in particular is being completely overhauled. New high stability charging circuits for the modulators and new phase and frequency stable circuits will be installed. Delay line pulses will be cleaned up and the r.f. will be brought on again for tests by 5 February so as to have it in good

shape in advance of the PS needing beams.

This will follow a complete overhaul of the vacuum system in the three linac tanks. The first drift tube in Tank I will be removed and repaired since it has been badly damaged by the beam. The alignment of all the drift tubes will be checked. Beams in the reassembled linac are scheduled for 9 February.

In the PS ring the touch of human hand will be felt on almost half the total circumference. 45 of the 100 straight sections will be opened up (16 for the installation of new correction magnets — dipoles, quadrupoles and sextupoles — ten for major modifications such as the installation of equipment to excite betatron oscillations for machine studies) and 15 magnets need attention (one of them — magnet No. 2 — is being replaced because of radiation damage and ten others need repair for the same reason).

Repair because of radiation damage is becoming a regular heading in describing PS shutdown work. We now seem to be losing a magnet a year and others need clamping because of deterioration of the adhesive holding the end block laminations where most radiation is received. When the laminations move as the magnet pulses, they can damage pole face windings. Other work in connection with radiation and to improve the machine vacuum is the completion of the change to metal joints in the vacuum system.

As the Booster begins to supply higher intensity beams during 1973 instabilities will need more attention. This is the reason for the correction magnets mentioned above to keep the beam in order and preparations for the installation of still more correction magnets, which have not yet arrived, will also go on during the shutdown.

The concrete jungle of the East experimental hall at the proton synchrotron. Only someone with a very good reason (or someone from whom all reason has departed) would start introducing changes in here. During the present PS shutdown beam-line modifications are limited to linking the m6 beam-line to the 2 m bubble chamber and to improving the feed to the hyperon beam.

The injection region will experience a major upheaval. Multiturn injection has been in satisfactory operation for some months now and it has therefore been decided to uproot the single turn injection inflectors in straight sections 27 and 28. A small kicker magnet will, instead, be installed in straight section 30 to come into action if problems occur with the multiturn system.

Other PS work includes new cooling plant at the centre of the ring so that r.f. equipment, ejection equipment and correction magnets will no longer rely on experimental hall cooling water supplies. Two more of the old type r.f. cavities will be removed. Finally, all 100 magnets will be realigned (involving six weeks work) and the PS is scheduled to be ready for action again on 21 February.

PS Experimental Areas

It is the South Hall which will see most upheaval (for a rundown on the previous situation see vol. 12 page 272). The k17 beam which feeds the Karlsruhe, Stockholm experiment on mesic atoms is being modified. The converted beam will be known as k18 and will have about twice the acceptance of its predecessor which will be particularly useful in augmenting the negative kaon flux.

Magnets will be installed in preparation for the Birmingham, CERN, Genoa, Rutherford, Stockholm experiment on two body interactions

$$(\pi^+p \rightarrow \Sigma^+K^+, K^-p \rightarrow \Sigma^+\pi^-),$$

which will later use the beam-line d31. A complete transformation is taking place in the m beam-line, m7 becoming m13. A further separator will be installed and it will be used by the Geneva, Saclay team to study kaon decay into four particles including an electron.

The beam-line to the HYBUC bubble chamber in the North Hall remains untouched as also does the

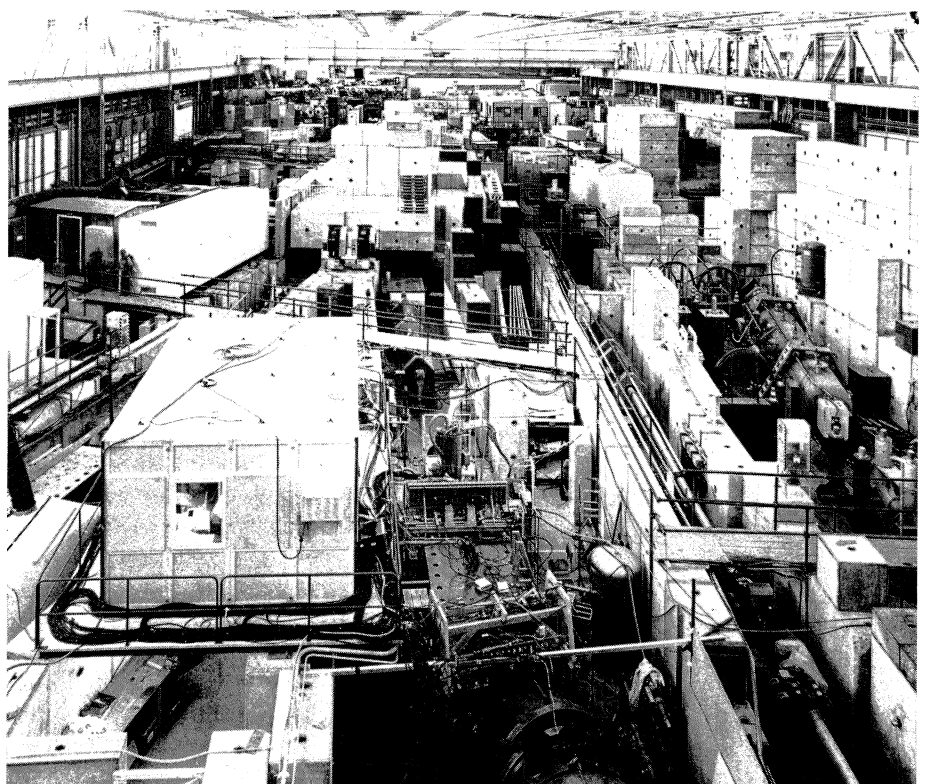
beam-line to Omega (apart from small modifications) and to BEBC in the West Hall. In the concrete jungle of the East Hall the big transformation is to bring the beam-line m6 to the 2 m bubble chamber rather than the r.f. separated beam-line u5. Also the e9n region will be revamped to improve the hyperon beam.

Storage Rings

The ISR has had a year of intensive use since the last shutdown and therefore a programme of rather routine maintenance tasks is under way both on the rings and in the control room where the layout is being reorganised. There are also machine improvements being implemented and most of them concern the vacuum system — underlining yet again the importance of the pressure and surface cleanliness in the rings in determining the machine performance.

Titanium sublimation pumps are being installed in 82 more positions, including some located for the first time so that they can pump from the centre of the long magnets. This brings their total in the ISR to 400 and another 100 are intended for installation later. In fact, during the shutdown cabling is being done for all 500 sublimation pumps.

In positions where it is at present difficult to install these pumps such as the physically difficult regions around the injection septa, the chambers are being demounted and cleaned by running an argon glow discharge in them for several hours combined with bake-out (see vol. 12 page 361). This is also being done in the four arms of the new vacuum chamber at the I-6 intersection region and in some parts of the inner arc of Octant 5. Four new fast acting valves are being installed around I-8 and those around I-6 are being replaced. The valves enable a



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Late news: The Omega superconducting magnet, with two coils in action, reached design performance on 10 January. On 16 January it was successfully tested with the yoke configuration for the first experiments. The refrigeration plant is performing well.

section of the rings to be shut off in 20 ms should it experience a serious leak. The valves can shut before the pressure wave reaches them.

New installations for beam observation and control include the sodium curtain equipment for Ring 2. This type of beam profile monitor was described in vol. 11 page 324. It involves a jet of sodium, crossing the beam at an angle of 45° , from which liberated electrons give an image on a fluorescent screen. Also the last of four deflectors which will help improve the stability of stacked beams has been installed. They will operate in a feedback loop to damp out beam oscillations, either in the vertical or horizontal plane when their build up is observed.

Ion chambers are being installed at 170 positions and will serve to locate beam loss to within about 10 m. The computer read out for these detectors is not yet complete and they will be used in conjunction with an oscilloscope display system initially.

Intersection Regions

Five intersection regions used for experiments up to now are seeing major changes in the course of the shutdown and an additional region is receiving detectors for the first time. Let us go round them in sequence:

I-1 Complete clear out. The massive dilepton searchers (CERN, Columbia, Rockefeller) have completed their experiment and their detectors are wheeled out to make room for the Saclay team to return to extend their study of high transverse momentum particles. They will have a large aperture magnet (installed at 90°), Cherenkov and shower chamber, as they had in this region before, but this time with an almost identical detection system on the opposite side to see what they can learn about correlation of their high momentum particles with

particles emerging from the collisions in the opposite direction. They are likely to be there throughout 1973 and may be joined by the CERN, Columbia, Rockefeller contingent who would add their lead glass counters to the detection system making it almost symmetric.

I-2 The CERN, Holland, Lancaster, Manchester study of stable particles at small angles will have the spectrometer realigned. The Bologna experiment on particle production at medium angles stays virtually as it is until March (when the Argonne septum magnet will be repatriated). The same goes for the Scandinavian, UK experiment mentioned in the last issue (page 418). There is however a proposal to suspend a magnet up in the air from their equipment to serve for calibration in the UK Universities intermediate boson search on the opposite side of the beams. They want to calibrate their large muon detector using the cosmic rays passing through this analysing magnet.

I-4 This region is being cleared ready for the installation of the Split Field Magnet (see vol. 12, page 235), probably about May. In the meantime it will be used for testing the multiwire proportional chambers (MPCs) which will be installed in the magnet and all their data collection chain right through to the computer.

I-6 Complete clear out also. The CERN, Rome elastic scattering measurements at very small angles are complete (the well known Roman pots are therefore being taken out) and the complementary Aachen, CERN, Genoa, Harvard, Turin experiment is being radically modified. They will now study the Δ^{++} joined by UCLA and their two magnets will be rebuilt into a single unit with an aperture extending above and below the downstream side of one of the beams. This will not be ready for installation during the shutdown and

the team will therefore start with more elastic scattering measurements using a new thin-walled bicone chamber at the intersection point and adding MPCs to their detection system as they become available.

I-7 This region will be used for experimentation for the first time and will see the first application of a 'visual' detection technique all around one intersection of the ISR. A streamer chamber is to be used by an Aachen, CERN, Munich team. It will be wrapped around a bicone vacuum chamber and triggered by counters. We will be coming back to this streamer chamber soon after it starts recording particles. It is likely to stay in I-7 for about a year; later on this intersection is needed for low beta insertion studies aiming for higher luminosity.

I-8 The present inhabitants (Pisa, Stony Brook team) will stay virtually undisturbed except for the addition of lead converters to help in the detection of neutrals in their measurement of total cross-section. They will be joined by the CERN, Rome team with an exotic detection system which has posed some intriguing installation problems. They will study particle production in the forward direction using a single arm spectrometer taking negative particles emerging beyond the first magnet of the ring after the collision region. A special vacuum chamber is being prepared for this magnet and the location of the spectrometer requires the reversal of another ring magnet (this had been anticipated and reverse yoke magnets, with special vacuum chambers because of the aperture configuration, are available). A septum magnet followed by four Cherenkovs, a neutral detector and shower counter will all be movable by remote control.

When the ISR comes on again after the shutdown, its experimental programme will be renewed as a result of all this new installation.