

which will become servo-controlled, for the charge induced by the passage of the beam in the 500 keV accelerating column;

- modifying the main r.f. supplies to the three linac cavities, to the buncher and to the debuncher;
- modifying the r.f. circuit used to compensate the beam charge in the cavities;
- modifying the supply to the pulsed quadrupoles of the first accelerating cavity;
- installing the beam transport line from the linac to the Booster and the beam line for beam emittance measurements (see vol. 10, page 279) — a magnet will be replaced allowing the beam to be directed either towards the PS or towards the Booster, where it can be further deflected towards the emittance measuring beam line;
- reorganizing the linac control room.

PS ring

The work here involves some necessary maintenance and improvements particularly in readiness for coming higher intensity beams:

- fitting ion pumps in sectors 5 and 6 of the ring (sectors 1, 2 and 4 are already almost fully equipped) involving modifications to nine straight sections and the vacuum chambers in five magnets;
- modifying the vacuum chamber of fast ejection beam 74 (for which magnet 74 must be removed);
- replacing magnet 8, which has been seriously damaged by radiation, by a spare one (see vol. 10, page 227);
- trials on a method (which could reduce the number of magnets to be removed) in which the vacuum chamber is cut out of the magnet and refitted by welding again in situ;
- installing new straight sections (100, 1 and 8) to supplement the number of ion pumps, and changing the vacuum chamber in magnet 100;
- replacing a septum in straight section 43 for slow ejection studies and fitting a prototype electrostatic septum in straight section 66;
- many cabling jobs, particularly in anticipation of the installation of new dipoles, the new r.f. acceleration system and slow ejection system 16 (to supply the West Experimental Hall);

- construction of a building above straight section 45 for the fast kicker power supply which will control the transfer of the Booster beams into the PS;
- bringing Booster controls into the main control room.

Experimental halls

Two major changes are under way in the East Hall. First, the spectrometer beam-line for secondary particles from a hydrogen target in e7 is being removed. Two new beam-lines are to be installed for the future. One of them, e9n, will feed a target from which a hyperon beam-line will emerge (see vol. 10, page 281); the other, e9s, will feed a target for a neutral kaon experiment comprising a spectrometer and large proportional spark chambers. Second, the b18 secondary beam-line which supplied particles for tests on detection systems is being removed.

Nearly all the work to be done on the 2 m chamber, situated at the end of the East Hall, will consist of normal maintenance, mainly because of the limited amount of time available (six to seven weeks) in view of the necessary re-heating after the shutdown and the recooling before start-up. The main items to be overhauled will be the expansion system (with which ten million expansions have been carried out since the previous overhaul about two years ago), the compressors, the vacuum systems, the cooling system and the hydrogen refrigerator.

There are no changes in the North Hall and experiments with the 81 cm hydrogen bubble chamber will continue until the middle of 1971.

The main change in the South Hall relates to beam q9, used until now for medium-energy pions. An electrostatic separator will be added to it to allow it to be used to select negative kaons and medium-energy antiprotons. The experiment which will use this beam also requires a very flat platform, to take a large analysing magnet.

Bubble chambers

On 5 November the BEBC group celebrated the completion of the first pole of the superconducting magnet for the large European hydrogen bubble chamber. In all,

23 pancakes of the superconducting coil had been wound (that is a few more than the 20 required to construct a pole). In addition to CERN staff members involved in the project, there were also representatives of the main suppliers at the celebration.

On this occasion it was noted that the rewinding of one part of the pancakes (see CERN COURIER vol. 10, page 278), had been carried out in less than six weeks, thanks particularly to the efforts of the coil winding section. At this rate, the total of 40 pancakes will have been reached by the middle of December.

This little meeting was entertained by the showing of two films taken during the manufacture of the 66 km of superconducting strip by each of the firms sharing production (Siemens and Thompson-Houston). It was possible to make an interesting comparison between the different methods used by the two firms to produce items of essentially similar specifications. The superconducting strip is one of many examples in the construction of this chamber of the very effective collaboration which research workers and industry have established for solving difficult technological problems.

In the next phase, the two poles (weighing 100 tons each) will be transported to the hall of the chamber. The pancake stacks will then be placed in the cryostats (delivered to CERN some weeks ago) early in 1971.

About four million photographs, including 2.1 million in deuterium under double pulsing conditions, have been taken in 1970 with the 2 m chamber. This period of operation has been marked, not only by the use of deuterium and double pulsing, but also by the excellent quality of the photographs and by the fact that the chamber was able to receive low-energy particles (0.8 GeV). The latter two features were the results of modifications to the chamber carried out during the 1969 shutdown.

The total number of photographs taken in the 2 m chamber by the end of October had reached the figure of 3.5 million distributed over twelve experiments with which twenty-one European research

A photograph taken in October during the winding of the coil of the superconducting magnet for the 3.7 m European hydrogen bubble chamber. The coil is built up of several strips (for cooling, insulation, reinforcement and heating). One pole of the magnet is now completed.

centres were associated, as listed in the table.

The 81 cm chamber has also worked very well without any sign of old age despite having now been in action at CERN for almost ten years, during which time it has clocked up over 15 million photographs. In 1970, 2.2 million photographs (668 000 of them in deuterium) were taken with the chamber — more than in any other year of its existence.

These photographs, taken using anti-proton and negative and positive kaon beams of between 600 and 800 MeV, supplied three experiments — those carried out by CERN-Collège de France, CERN-Heidelberg, and Bologna-Glasgow-Rome-Trieste groups.

The 1.1 m CERN heavy liquid bubble chamber has been wheeled into a corner after almost ten years of operation for physics. Its retirement from active service was feted at the beginning of November by the team which has operated it and carried out experiments with it.

The chamber took its first pictures in November 1960 and has clocked up over ten million since then. Major physics experiments have included the study of the κ zero and the identification of an excited state of this particle using one of the first high energy kaon beams, the observation of the decay of the long-lived neutral kaon into two neutral pions and a measurement of the decay rate in the elegant X4 experiment, and, of course, the two neutrino experiments in 1963 and 1967 which added a great deal to our current knowledge of neutrinos.

The heavy liquid bubble chamber has for long been the largest volume chamber in operation in the world. But now it gives way to the much bigger new generation of chambers — the large European hydrogen chamber and the heavy liquid Gargamelle at CERN, the large hydrogen chambers of Argonne and Brookhaven.

In describing the optical system of the Gargamelle heavy liquid bubble chamber in the last issue (page 312) we assigned the computer program used for optimization of the lenses to W.T. Welford. In fact the program was worked out by C.G.

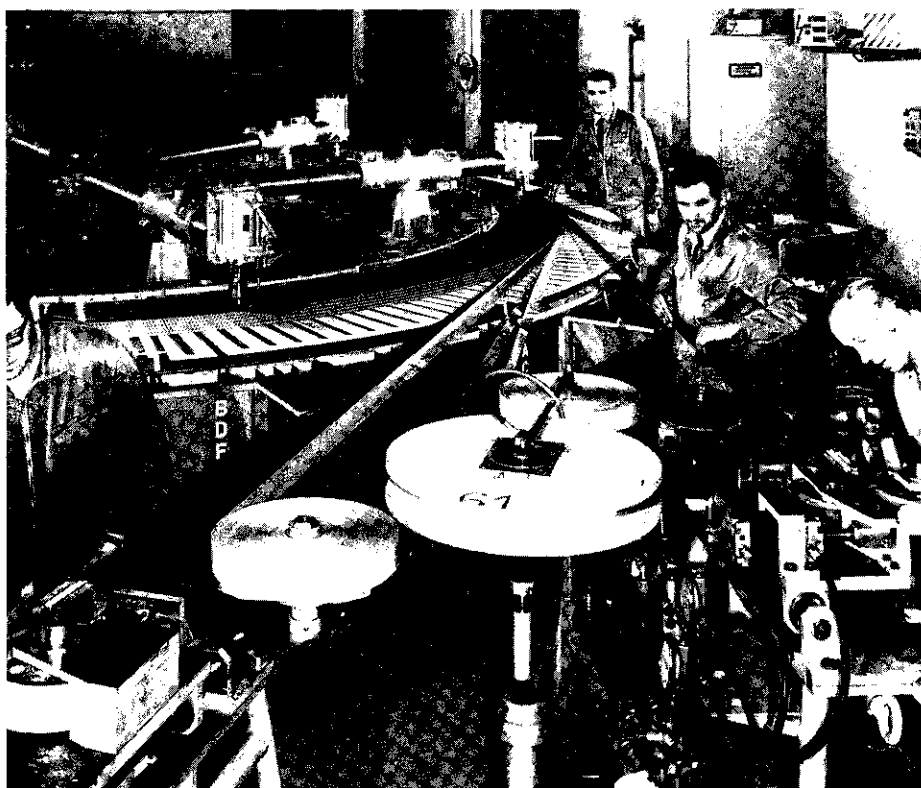
Operation of 2 m bubble chamber in 1970 (up to end of October)

Chamber filled with hydrogen

Beam	No. of photos	Laboratories
K^- , 1.4 - 1.7 GeV/c	100 000	CERN, Heidelberg
K^+ , 1.2 - 1.8 GeV/c	447 000	CERN, Saclay
K^- , 0.8 - 1.4 GeV/c	442 000	Rutherford
p^- , 1.5 - 2.0 GeV/c	449 000	Glasgow, IPN Paris, Lausanne, Liverpool, Neuchâtel
	1 438 000	

Chamber filled with deuterium

K^- , 1.2 - 1.8 GeV/c	456 000	Birmingham
π^- , 9.0 GeV/c	324 000	Bari, Bologna, Florence, Paris
K^+ , 8.25 GeV/c	298 000	Brussels, IPN Paris, Saclay
π^+ , 4 GeV/c	458 000	Birmingham, Durham, Rutherford
p^- , 19.2 GeV/c	81 000	Alma Ata
p^- , 9.0 GeV/c	153 000	Strasbourg
K^+ , 5.45 GeV/c	246 000	Oxford
p^- , 19.2 GeV/c	60 000	Scandinavian collaboration
	2 076 000	



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On the right:

Hand-plotted results on the shape of a closed orbit (radial to the left and vertical to the right) from data given by the fifty-three probes in the ring. The values were individually recorded for each probe on photographs of type 1. The estimated accuracy is ± 1 mm vertically and ± 1.5 mm radially.

Wynne. Welford as stated, has worked on the Argonne 12 feet chamber being responsible for the overall optical system.

The administrative computer

CERN first considered the use of computers in administration in 1965-66 (see CERN COURIER vol. 6, page 157) when the foreseeable growth of the administrative load was examined in conjunction with the possibility of using a computer to shoulder much of the load. The study came down clearly for the acquisition of a computer specifically for administrative purposes — it became known as the ADP project (Administrative Data Processing).

In 1967 an IBM 360/30 was installed at CERN and it was planned to bring into use an integrated information system by 1972. By 'integrated' is meant that the wide variety of tasks to which the computer can be applied will be as inter-related as possible in their use of the computer so that, for example, a piece of information fed in from one source will be accessible

for other needs without need of duplication. Such a system is characterized by 'one-time data capture' where the information is fed to the computer ideally from the point where it is first generated and by means of data links then becomes accessible for many purposes.

The aim of the ADP project is twofold: 1) to provide better (faster and more accurate) information at the various levels of management and administration; 2) to absorb the increasing workload of the growing Laboratory without need to increase the clerical staff in the same proportion.

Achieving the final goal has been planned in two phases. The first phase, scheduled to last from two to four years, consists of progressively converting the computer system on a batch processing basis to tackle administrative processes previously handled by conventional methods. The second phase will carry the conversion further to achieve an integrated system.

The first phase will be completed this year when all the major CERN adminis-

trative applications will make use of computers. The Table lists these applications, the computer currently in use, and the date when the integrated version using the ADP computer is scheduled.

The present situation is only the basis for phase two of the overall plan. It is intended to design and implement, mainly in the course of 1971, new versions of several applications which are already computerized, in order to reach a substantially integrated system in the course of 1972. If this programme succeeds as expected, CERN will have built up an integrated information system over about five years (a time which is considered to be good by major management consultants in this field).

Concerning the economy in clerical staff, which it was hoped would be achieved by having the ADP computer, CERN counted 92 man-years in 1966 which could be directly affected by the ADP computer system. It was then predicted that these 92 man-years would grow to 165 in 1971 if no computer was available and only to 110 if a computer was installed. The actual figure for 1969 was 111 man-years and this figure, which includes 25 people in the ADP group itself, should not increase.

Application	Computer used now	Year of implementation	Year foreseen for integrated version on IBM 360/30
1. Stock control (stores)	IBM 360/30	1968	1971
2. Personnel records	IBM 360/30	1968	1971
3. Medium-term planning procedure (FPP)	IBM 360/30	1969	1971
4. Overall purchasing, accounting and budgetary control	IBM 360/30	1970	1971
5. Salaries	NCR 390	1966	1971
6. Job cost control	IBM 360/30	1970	—
7. Scientific documentation (reports and preprints)	IBM 360/30	1969	—
8. Project planning (PERT)	CDC 6600 and IBM 360/30	1969	—
9. Buildings and space inventory	CDC 6600	1969	1971
10. Electronic instruments inventory	CDC 6600	1968	—
11. Machine-tools inventory and loading	CDC 6600 and manual	1970	1971
12. Personnel monitoring/radiation (health physics)	CDC 6600	1965	(1972) ?
13. Various technical applications	manual and CDC 6600	—	1971/1972

Beam observation in ISR

The Intersecting Storage Rings are equipped with a beam observation system based on electrostatic pick-ups similar to those used in the PS (see CERN COURIER vol. 9, page 304). They produce a measurement of the beam position during the first turns following injection, and, with higher precision the orbits averaged over many turns. The system is indispensable to ensure maximum efficiency in the stacking process. It consists of 106 detectors (53 per ring), whose signals can either be seen on an oscilloscope giving information on the wide-band signals, or can be analysed by computer to achieve more precise information.

Each pick-up consists of two combined pairs of electrodes on which signals are received when a proton bunch passes directly proportional to the charge in the bunch. Moreover, the electrodes have been so designed that each pair gives a signal directly proportional to the position,