

Last month at CERN

British bubble chamber reaches its first million pictures

At 2 p.m. on the afternoon of Saturday 13 February the 152-cm British national hydrogen bubble chamber registered its millionth photograph. This was during a run in which protons with momentum of 10 GeV/c were being directed into the chamber.

During February, also, statistics were published on all the bubble-chamber photographs taken at CERN during 1964. These, reproduced below, show that over 2½ million pictures were obtained altogether, including nearly half a million for the CERN neutrino experiment. More than a million pictures were solely for groups outside CERN, and no less than 34 universities and research institutes, mostly in the CERN Member States, participated in the bubble-chamber experiments.

PS operation

As mentioned in last month's *CERN COURIER*, the second two weeks of operation in January were used mainly by bubble chambers. During this time the 81-cm Saclay/Ecole Polytechnique chamber, filled with liquid deuterium, took 220 000 photographs

showing negative kaon interactions in the momentum range 800-1200 MeV/c. After being devoted to the radio-frequency separator tests during the first part of the run, the 152-cm British chamber was used to obtain some 65 000 pictures showing interactions in hydrogen of positive pions of momentum 11 GeV/c.

At the same time, the o_2 monitor beam (coming from the same target as the o_2 beam that passes through the 152-cm chamber) was converted to an electron beam of known energy and used to calibrate lead-glass Cherenkov counters and special scintillation counters (lead-Plexiglas sandwich counters) with electrons of energy between 400 MeV and 1 GeV. This formed part of the preparations for a new experiment at CERN on the anomalous magnetic moment of the muon. Similar calibrations, together with some on an experimental wide-gap spark chamber, in the same beam, were continued during the first part of February.

During February, the usual scheduling was used for the proton-synchrotron operation, with the first fortnight devoted primarily to counter experiments and the second to bubble-chamber runs. It is hoped to give

further information concerning this period of operation in the next issue of *CERN COURIER*.

What can be reported, however, is that in the last week of February, the first experiment to be carried out anywhere with a beam of separated kaons of momentum as high as 10 GeV/c was begun with the 152-cm bubble chamber. The kaons, of negative charge, were obtained by means of the new radiofrequency separator in the o_2 beam (as described in the article beginning on p. 35 of this issue). Although this separator had only recently completed its tests, its operation proved so successful that it could be controlled by the beam group in the normal way, from the annexe to the bubble-chamber building rather than from the r.f. stations themselves in the East hall. Some 77 000 pictures were obtained in this first run, with an average of nine tracks per photograph, about half of them of kaons and half of muons. The number of tracks of negative pions (the only particles that could cause serious confusion) was very small. It is planned to devote a further two weeks running time to this experiment, the photographs for which are being divided between groups in Aachen, Berlin, CERN and Vienna.

SUMMARY OF BUBBLE-CHAMBER RUNS IN 1964

Beam	Chamber	No. of pictures	Laboratories sharing films	Date
K^- , 6 GeV/c	Saclay HBC 81	70 000	Birmingham, Cambridge, Glasgow, Imperial College, Munich, Oxford, NIRNS	February
π^+ , 8 GeV/c	Saclay HBC 81	141 000	Aachen, Berlin, CERN, Krakow, Warsaw	February-March
p , 10 GeV/c	Saclay HBC 81	84 000	Cambridge, Hamburg, Stockholm, Vienna	February-March
K^+ , 5 GeV/c	Saclay HBC 81	90 000	Brussels, Cambridge, CERN	February-March
π^- , 20 GeV/c	Saclay HBC 81	14 000	CERN/TC	March
ν , CERN HLC 100		400 000	CERN/NPA	April-July
p , 1.2 GeV/c	Saclay HBC 81	300 000	CERN, Collège de France, Institut du Radium, Liverpool	June-July
K^- , 0.8-1.2 GeV/c	Saclay HBC 81	250 000	CERN, Heidelberg, Saclay	June-July
K^- , 5 GeV/c	BNHBC 152	140 000	Birmingham, Cambridge, Glasgow, Imperial College, Munich, Oxford	June-July
K^- , 6 GeV/c	BNHBC 152	398 000	Birmingham, Cambridge, Glasgow, Imperial College, Munich, Oxford	June-July + September-October
K^+ , 5 GeV/c	BNHBC 152	60 000	Brussels, Cambridge, CERN	June-July
π^+ , 5 GeV/c	BNHBC 152	65 000	Bonn, Durham, Ecole Polytechnique, Nijmegen, Turin	October + December
p , 19 GeV/c	Ec. Poly. 1-m HLC	90 000	CERN/NPA	October
π^- , 16 GeV/c	Ec. Poly. 1-m HLC	100 000	Ecole Polytechnique	October
K^+ , at rest	Saclay DBC 81	120 000	Bari, Berne, Genoa, Turin	October
p , at rest	Saclay DBC 81	70 000	Padua, Pisa	October
p , in flight	Saclay DBC 81	80 000	Rome, Trieste	October
K^- , 0.8-1.2 GeV/c	Saclay HBC 81	80 000	Argonne, CERN, Heidelberg, Saclay	December
p , 10 GeV/c	BNHBC 152	50 000	Cambridge, Hamburg, Stockholm	December
Total:		2 602 000		
Of these:				
		1 177 000 pictures were for groups outside CERN only		
		921 000 pictures were for groups outside CERN and for CERN		
		14 000 pictures were for CERN/TC (Track Chambers Division)		
		490 000 pictures were for CERN/NPA (Nuclear Physics Apparatus Division)		

Another new resonance

A paper published in *Physics Letters* on 15 February (vol. 14, p. 338) under the names of 30 physicists from the Universities of Birmingham, Glasgow, London (Imperial College) and Oxford, together with the Rutherford High Energy Laboratory, gives the results of an analysis of 300 000 photographs taken with the Saclay/Ecole Polytechnique 81-cm liquid hydrogen bubble chamber at CERN in 1963.

The photographs showed interactions in the hydrogen caused by negative kaons of momentum 3.5 GeV/c and, in the results reported, those interactions giving a neutral antikaon, a negative pion and a proton (reaction: $K^- + p \rightarrow \bar{K}^0 + \pi^- + p$) had been selected — a total of 339 events.

From measurements made on the selected photographs, the physicists concluded that the most common way in which the reaction took place was through the 'peripheral' production of a well-known kaon resonance (K^*) with a mass of 890 MeV, this resonance then decaying almost immediately into the $\bar{K}^0$ and the π^- . Other common resonances were not in evidence, but a hitherto unobserved state with a mass of 1400 MeV (± 10 MeV) was found to be present. This also decayed into a neutral antikaon and a negative pion. The new resonance has an observed

'width' of about 160 MeV, corresponding to a lifetime of about 10^{-20} second. A detailed analysis of the events leads to the result that the spin and parity are more likely to be 2^+ (that is, a spin quantum number of 2 with positive parity) than 1^- , with 0^+ ruled out. Although the resonance was not observed by other groups in a similar experiment (also at CERN) using incident kaons of 3 GeV/c momentum, this is thought to be due to the slightly lower energy available in that case.

Italian Diplomat visits CERN

On Wednesday 3 February, CERN was visited by H. E. J. Giusti del Giardino, Head of the Permanent Delegation of Italy in Geneva, together with two other members of the Delegation. The visitors, who were accompanied on their tour by one of the senior Italian physicists at CERN, were shown both the Organization's accelerators, together with experiments in progress in the East and South halls of the proton synchrotron. The 2-metre bubble chamber was also visited, and some time was spent discussing the future projects under study in the Accelerator Research Division. The tour ended with a view of the CERN facilities for measuring and analysing bubble-chamber photographs, including the large new computer now being brought into operation ●

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With a storage ring for electrons in operation, and those for protons under active discussion, CERN is also constructing a storage ring for muons.

Essentially, this will consist of a large circular magnet, about 5 metres in diameter, in which high-energy muons produced in a vacuum tube inside the magnet will make many revolutions during their lifetime. Appropriate measurements on the decay electrons will enable the anomalous magnetic moment (9.2) of the muon to be evaluated to a much higher order of accuracy than before.

In this photograph, one of the excitation coils for the new storage-ring magnet is seen leaving CERN's main workshop on its way to the South experimental hall of the proton synchrotron, where the magnet will be assembled. Driving the transporter is Maurice Cartier and Maurice Chatel steadies the coil. In the background is the new laboratory 13 of Track Chambers Division.

BOOKS

Tracking down particles, by R. D. Hill and E. Gerjuoy (New York, W. A. Benjamin Inc., 1963; cloth \$5.45, paper \$3.25).

The Benjamin series to which this book belongs is intended principally for elementary students of science and provides introductions to each of a number of important fields. Non-scientists may also use these books in order to gain familiarity with the various subjects treated, though it is clear that the series is not specifically aimed at them.

This book is about high-energy physics and its authors have attempted to make it easier to read by dividing it into two parts. Thus there is first a systematic account of the most important discoveries, techniques and developments in this field, written by R. D. Hill, and this is followed by an analysis of the theoretical background, including an explanation of the basic relevant differences between classical and modern physics, by E. Gerjuoy, who is also the general editor of the series.

It is, of course, possible to justify a treatment of this kind, though it has the serious disadvantage, for the reader with little time to spare, of requiring at least two readings

before the book is fully understood. Since this is an introduction to the subject, rather than a detailed textbook, it would surely have been much simpler to raise the various theoretical issues while developing the main theme: particles and the means by which they are discovered.

Apart from this drawback, this is a lively and interesting summary of the present state of knowledge in high-energy physics. It is also a useful contribution to wider understanding of a field that, regrettably, remains inaccessible to all but a few initiates.

There are many diagrams and photographs, and the book is provided with an adequate index, a glossary and a world list of accelerators.

M.J.O.S.

Nuclear reactor theory, by Giovanni Lauza (London, McGraw-Hill Ltd., 1964; 39s.).

This book is the fifth in the series *Nuclear engineering fundamentals*, of which the other four deal with 'Atomic