DEPARTMENT OF
SCIENTIFIC AND INDUSTRIAL RESEARCH
State House, High Holborn, London W.C.1
Telegrams: Resciendus Westcent London *Telephone:* CHAncery 1262

NOTE TO EDITORS

THE BRITISH NATIONAL HYDROGEN BUBBLE CHAMBER

Background to the press visit at the N.I.R.N.S. Rutherford High Energy Laboratory, February 22, 1963

The most valuable experimental techniques for use with large particle accelerators are those which enable the actual paths, or tracks, of the particles to be photographed. Several techniques of this kind are now available, all depending on the fact that when a charged particle traverses matter the atoms along its path become ionized. Historically, the first is the cloud chamber, devised some fifty years ago, in which droplets are condensed on the gaseous ions and then photographed; this technique has been used extensively in cosmic-ray physics but it has several serious disadvantages for use with large particle accelerators. At the present time the most important visual technique, discovered in 1952 by D.A. Glaser, uses the fact that a trail of vapour bubbles can be formed when a charged particle passes through a superheated liquid: in effect the liquid boils along the line of ions. Glaser rapidly proved that this new technique had very important advantages over the cloud chamber, and it was soon realised that liquid hydrogen was a highly suitable liquid to use in these "bubble chambers" because it consists solely of protons.

In 1957 a working party drawn from Birmingham, Liverpool, London and Oxford Universities, with representation from the Rutherford High Energy Laboratory, Harwell, was formed to discuss plans for a 150 cm British hydrogen bubble chamber for use with the C.E.R.N. 25 GeV proton synchrotron and the N.I.R.N.S. 7 GeV proton sychrotron "Nimrod". A design study was initiated, a grant of £419,000 in support of the programme was announced by D.S.I.R. early in 1959 and work on the chamber began immediately.

The construction of the chamber has been a truly collaborative effort

/between

between Imperial College, London, and Birmingham and Liverpool Universities, together with the N.I.R.N.S. The greater part of the components have been manufactured under contract, but the design and model work has been carried out almost exclusively by the university groups concerned. The main parts of the apparatus are: (i) the chamber vessel itself, in forged aluminium alloy and fitted with two vertical glass windows, which has been designed in detail by the Liverpool group; (ii) the expansion system for the chamber, also designed by the Liverpool group; (iii) the hydrogen shield, used to contain the liquid hydrogen if a leak or fracture of a window should occur; (iv) the liquid nitrogen shield, used to screen the vessel from extraneous heat; (v) the vacuum tank, with associated pumping equipment, which encloses the above, and which has also been designed by the Liverpool group; (vi) the hydrogen liquefier, the plant for which was designed and installed by N.I.R.N.S; (vii) the electromagnet weighing over 300 tons including the coils, for which the design and model work has been carried out by the Birmingham group; (viii) the optical and photographic system, for recording the particle tracks, which has been designed in detail by a group at Imperial College, London; and (ix) the control arrangements for the whole apparatus, which have also been designed by Imperial College. The whole programme has required detailed organization and control, particularly as the contracts for some of the main components have had to be let in several parts. The smoothness and precision with which it has progressed is testimony to the work of the Management Committee, on which seven Universities are represented (see list attached), under the Chairmanship of Professor C. C. Butler, and to the collaboration between the individual groups concerned.

The chamber was assembled at the N.I.R.N.S. Rutherford High Energy Laboratory and successfully tested there for the first time towards the end of January. The special Laboratory to house the chamber and the various services required, in particular high pressure hydrogen and magnet power supplies, were provided by the Institute, which has spent

/over

over £200,000 on this project.

Experiments with the Chamber

The chamber will be operated initially with the C.E.R.N. 25 GeV proton synchrotron by a combined University/N.I.R.N.S. team. The magent was shipped to Geneva at the end of 1961 and it is expected that the chamber will begin operation there late in 1963. A further grant of £179,000 has been made by D.S.I.R. for the operation of the chamber at C.E.R.N. to the end of 1963, following which it will be taken over by N.I.R.N.S. and later returned to England for use with "Nimrod".

In the actual operation of the chamber the particle tracks will be photographed simultaneously by three separate cameras, giving a stereo-record of the event. The entire operation, from the expansion of the chamber, lasts about 1/50th second for each event, and it should be possible to photograph ten to twenty pictures per minute. It is expected that in a year's working of the chamber (about fifty days' actual operation) some four to five experiments of runs of about 250,000 pictures each will be made.

Exposures with pion and proton beams of high energy will be made to calibrate the chamber and also to study production processes for strange particle and π - mesons. The main, and most important, experiments will be on beams of antiprotons, and K-mesons of 5 GeV/c and higher momenta. Initially these will be produced in internal targets and transported over 180 m to the chamber.

In a parallel co-operative programme, the same group are working on the development of automatic film analysis equipment, available for use with bubble chambers. Ultimately an annual minimum of one million photographs of bubble tracks is expected to be available to the U.K. groups. A grant of £260,000 has been awarded by D.S.I.R. to the Universities for this development, bringing the Department's total support for the bubble chamber research programme to nearly £900,000.

The seven film analysis groups in universities and a group at the Rutherford High Energy Laboratory are devoting a considerable effort to

/the

the design and setting up of beams for the bubble chamber at C.E.R.N. In addition to the great intrinsic interest in this work, it will provide invaluable experience before "Nimrod" beams are commissioned at the Rutherford High Energy Laboratory.

British National Hydrogen Bubble Chamber

SCIENTIFIC REPRESENTATIVES ON THE MANAGEMENT COMMITTEE

Imperial College of Science and Technology, London

Professor C. C. Butler, F.R.S. (Chairman)
Mr. N. C. Barford

University College, London

Professor Sir Harrie Massey, F.R.S.
Dr. C. Henderson

Birmingham University

Dr. D. C. Colley
Dr. L. Riddiford

Glasgow University

Dr. I. S. Hughes

Liverpool University

Professor J. M. Cassels
Mr. M. J. Moore

Oxford University

Professor D. H. Wilkinson, F.R.S.
Dr. D. Roaf

Cambridge University

Professor O. R. Frisch, F.R.S.

National Institute for Research into Nuclear Science

Dr. T. G. Pickavance
Mr. L. B. Mullett

British National H ydrogen Bubble Chamber

DESIGN TEAM

Birmingham University

Mr. G. Guest
Dr. L. Riddiford
Dr. H. B. Van de Raay

Imperial College, London

Mr. N. C. Barford
Professor C. C. Butler
Mr. K. Carnell
Dr. D. McMullan
Mr. D. G. Miller
Dr. A. Thetford
Dr. D. B. Thomas
Dr. W. T. Welford

Liverpool University

Mr. A. Amery
Dr. W. H. Evans
Mr. M. J. Moore
Mr. M. C. Morris
Dr. R. W. Newport
Mr. P. Polak
late Professor H. W. B. Skinner
Dr. P. R. Williams

Oxford University

Dr. D. Shaw

N.I.R.N.S. Rutherford High Energy Laboratory

Mr. A. G. Ashburn
Mr. B. F. Colyer
Mr. M. Snowden
Mr. R. Wimblett