Rutherford Laboratory

Technical leaflet

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1.4 METRE HEAVY LIQUID BUBBLE CHAMBER

This chamber was constructed as a joint project by the Rutherford Laboratory and University College London. The fluids used in this chamber are of much higher density than those used in the Laboratories cryogenic chambers. The use of heavy fluids makes this chamber a very powerful tool for studying interactions involving the production of gamma rays because there is a very high probability of conversion of the gamma rays into electron-positron pairs, which allow their direction and energy to be determined.

The fluids used are the Freons or Propane, or mixtures of the two. These fillings operate at 30°C to 60°C and at pressures of 300-400 psi.

The austenitic stainless steel bubble chamber which contains 450 litres of liquid, has inside dimensions 140 cms long by 68 cms high and 45 cms wide and is mounted between 2 subassemblies which include the poles of the magnet.

Looking from the cameras through the assembly the main components are the camera mounting plate, the front plate, a pole of the magnet hollowed for viewing the chamber, a 22.5m thick optically worked glass observation window, the bubble chamber body, a 6mm thick polyeurethane diaphragm which transmits the gas pressure cycle to the chamber, a perforated plate for its support and finally the rear pole of the magnet containing the high speed pressure cycling valves.

The front plate houses four windows, one for visual inspection of the chamber, and the other three for stereoscopic photography of the tracks. The photographic system consists of three separate cameras spaced a distance of about 2 metres from the chamber. Each camera holds 300 metres of 35mm unperforated film which is sufficient for about 2 hours in normal operation during an experiment. Illumination is by 12 500 joule Xenon flash tubes inside the liquid mounted close to the top and bottom walls.

Ten 7.5 cm bore pilot operated valves cycle the chamber and are stalk-mounted in holes bored through the rear pole in order to minimise the volume behind the diaphragm. When in position the valves open non-return valves set at the ends of the holes thus allowing valve replacement during operation. The high pressure gas is delivered by a 300 HP compressor via buffer vessels at 40 atmospheres and a rate of 204 standard cubic metres per hour. At the chamber end are pressure controlled vessels which define the pilot valve pressure and also the chamber compression and expansion pressures.

The magnet has a yoke weighing 140 tons made up of 12 mild steel members and the coils weighing 25 tons are vacuum impregnated with polyester resin. A 400 g.p.m. flow of cooling water is passed through the windings which dissipate 4 MW of power. The field over the chamber volume is then 21.4 kilogauss and uniform to 5.5 per cent.

The chamber is at present being modified for use with propane which presents considerable safety problems. A new control room will house all the necessary remote control equipment which allows the chamber to be operated in synchronism with NIMROD, comprehensive warning systems give the operator information about the state of the chamber and allow early diagnosis of possible faults to be made.