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Progress at the Rutherford Laboratory

Note by T. G. Pickavance

1. Proton Linear Accelerator

Over 5000 hours of operation have been devoted to nuclear research since October 1963. This exceeds by several hundred hours the best previous performance in a period of 12 months. The machine was available for research for 86 per cent of the scheduled time.

The quality and reliability of the proton beam have been improved steadily during this time. For example, the average energy spread at 50 MeV has been reduced from 400 KeV to 200 KeV.

A large single-gap spectrograph magnet has been commissioned and is being used in experiments.

Eight university physics departments have used the machine. A long programme of experiments on proton-proton scattering has been completed with the determination of triple scattering parameters at 30 and 50 MeV.

2. Nimrod

The first six months' period of scheduled operation for research ended on 10th August, 1964. A 7 GeV beam was produced for 1280 hours, or 69% of the maximum possible time, and approximately 850 hours were used for high energy physics research. The remaining operating time was used for machine and target development. Towards the end of the period the beam intensity was usually about 5×10^{11} protons per pulse, and 9×10^{11} was reported on one occasion.

The average intensity during the research runs was 2.7×10^{11} protons per pulse and, as the original allocations to particular experiments were based on an assumed intensity of 10^{11} , very good progress was made with the experiments. A further improvement in efficiency was achieved by serving more than one experiment at a time. The average number of experiments simultaneously taking data was 1.5, but often other teams were "parasiting" on the machine and using this free time to set up their equipment and to develop their techniques. In this way, often four or five teams were working at the machine simultaneously.

Nimrod was shut down as planned from 11th August until 6th September, to allow components of a separated K-beam to be installed on the machine and in the neighbourhood of the main shield wall (where major changes were needed). This beam is needed for experiments with the French bubble chamber. Other beam lines were rearranged to suit the research programme.

One of the alternators of the magnet power supply was stripped and examined during the shutdown. After 4×10^6 pulses, there is now more rocking movement in the pole assembly. We are satisfied that the alternator is fit to run, and have reassembled it and put it back into service, but have arranged discussions with Lloyds and the contractor to decide when the next examination should be made.

A preliminary study has been made of radiation dosimeters which were placed inside the vacuum vessels during commissioning last year. The results are difficult to interpret accurately, but indicate a maximum dose of a little over 10 megarads, or about 1 per cent of the estimated "serious damage dose".

Nimrod is now operating again. The performance of the injector and the associated beam equipment has been improved, and 24 milliamperes of protons have been observed at the exit of the inflector (cf 16 milliamperes before the shutdown). At the time of writing the intensity at 7 GeV is only just over 10^{11} protons per pulse, but adjustments are not yet complete. Operation for high energy physics will start again on 21st September, with 14 days' running in every 21 instead of the $10\frac{1}{2}$ in 21 scheduled until now. The initial allocation is for 30 per cent of running time on machine development and 70 per cent on high energy physics, instead of the 50-50 allocation in Period I.

3. Nimrod apparatus

The Saclay 80 cm bubble chamber has arrived in the Laboratory and is being erected.

The British National bubble chamber has completed a satisfactory run at the CERN 28 GeV accelerator.

4. High Energy Physics

Eight experiments were started in Period I, and on six of them data-taking has been completed to the stages approved in this period:

1. p-p scattering in the Coulomb interference region

8,000 events over the angular range 4-14 m rad at 7 GeV

(AERE, Queen Mary College, Rutherford Laboratory)

2. n-p charge exchange scattering

2,000 events over the angular range 0-45 m rad at 7 GeV

(AERE, Birmingham, Bristol, Rutherford Laboratory)

3. π^+ -p differential cross sections

8,000 elastic events at each of 25 energies in the range 750-1450 MeV

(Rutherford Laboratory)

4. π^- -p differential cross sections

6,000 elastic events at each of 5 energies near 2 GeV

(University College and Westfield College, London)

5. π^- -p charge exchange scattering

1,000-2,000 events at each of 5 energies near 2 GeV

(Oxford University, Rutherford Laboratory)

6. Search for the Z^+

An upper limit determined in $\pi^- + p \rightarrow Z^+ + K^-$, at 50μ barns - sterad⁻¹ in the forward direction.

(University College and Westfield College, London)

Preliminary results of experiments 1, 2 and 3 were reported at the International Conference in Dubna in August.

The other two experiments in Period I have had setting-up time only.

The third session of the Experiments Selection Panel (Professors Dalitz, Merrison, and Salam, Dr. Murphy, Dr. Stafford and myself) approved extensions to five of the existing experimental programmes, and three new experiments, to start in Period II. Three further experiments, expected to start in Period III, were given provisional approval; these need the extracted proton beam. 140 research physicists, 17 of whom are Laboratory staff, are now engaged in running or preparing experiments.

5. Appointments

Dr. R. C. Hanna, a permanent member of the research staff, has been appointed Head of the P.L.A. Division.

Dr. P. G. Murphy has been transferred from the fixed term to the permanent research staff and has been promoted to a Banded post.