NATIONAL INSTITUTE FOR RESEARCH IN NUCLEAR SCIENCE

Working Party on Future Accelerator Policy

Minutes of Meetings held in Liverpool on
27th and 28th March, 1960.

Present: Chairman - Sir John D. Cockcroft
Prof. J. M. Cassels
Prof. S. Devons
Prof. B. H. Flowers
Dr. M.G. N. Hine
Prof. A. W. Merrison
Prof. P. B. Moon
Dr. R. C. Moorhouse
Mr. L. B. Mullett
Prof. R. E. Peierls
Dr. T. G. Pickavance
Prof. A. Salam
Prof. D. H. Wilkinson
Dr. W.S. C. Williams
Secretary: Dr. G. H. Stafford

Due to illness Professor Dee and Mr. Walkinshaw were unable to attend.

1. The Working Party met to discuss whether further high energy accelerators were necessary in the United Kingdom during the next ten years in order to enable the country to play a leading role in the field of elementary particle physics.

2. The Working Party had before it the following papers which were discussed at the meetings.

(a) Further Accelerators in the United Kingdom - Mullett. - an analysis of Accelerators which might be built in the next decade.

(b) Notes on A.G. Proton Synchroton - Hine.

(c) Some Factors in High Intensity Beams - Galbraith and Morgan.

(d) The Possibility of Neutrino Experiments - Salam and Matthews.

(e) Electron and Positron Linear Accelerators - Gunn and Moorhouse.

(f) A Note on the possible extension of the Rutherford Laboratory Proton Linear Accelerator - Stafford.

3. The conclusions of the Working Party were that there was a clear need for additional high energy accelerators, in order

(a) to maintain and expand those schools of high energy physics at Universities which were already working in this field of research and

(b) to extend our knowledge of the interaction between elementary particles.

In this connection the need for accelerators which would produce resolved beams of secondary particles of intensities ten or even one hundred times the presently available intensities was strongly emphasised and so was the need to give special attention to the design of accelerators which would yield intense beams of low energy secondary particles.

4. In connection with 3 (a) above, Professor Cassels proposed that an electron synchroton of energy between 3 and 4 Gev should be built. It was emphasised that there was a clear cut field of research that could be covered by such a machine, but it was important that the accelerator should be built as soon and as quickly as possible.

An alternative proposal supported in Paper No. 5 entitled "Electron and Positron Linear Accelerators" by Gunn and Moorhouse was for a linear accelerator with an energy of about 2 Gev. A higher primary intensity could be expected from this machine than from an electron synchroton but it would be at the expense of a poorer duty cycle and increased cost and complexity. The Working Party considered that although there was a very strong case for proposing that one of these two machines should be built as soon as possible, on the facts before it, it was not qualified to make a firm decision in favour of one or the other.

ACTION

The next step should be to proceed with preliminary design studies in order to estimate:

GUNN
MOORHOUSE
CASSELS
MULLETT

(a) the cost of building the accelerator,

(b) the running costs,

(c) the scale of effort required to build it,

and finally (d) to estimate when it could be started and how long it would take to build.

ACTION

PICKAVANCE

5. In connection with 3 (b), it was concluded that there was need to accumulate experimental information on the yields of secondary particles as a function of the primary proton energy in order to help to settle the energy of any future high intensity accelerator. Dr. Pickavance agreed to write to the N.I.R.N.S. staff working on the Bevatron and Cossmotron in the United States to ask them to obtain what information was available and possibly to initiate some experimental measurements. It was also suggested that a team should be sent to C.E.R.N. especially to make measurements of yields, but it was decided that these results would automatically come out of work already in hand there and that it was unreasonable to ask for time on the C.E.R.N. P.S. for this purpose. Professor Merrison agreed to provide the Working Party with the information as it became available.

ACTION

MERRISON

6. It was agreed that a more detailed study of possible high intensity proton accelerators should be pursued. The available effort should be devoted to a study of the following:

ACTION
Manchester Univ.)
Rutherford Lab. )

(a) A proton linear accelerator with an energy of a few Gev. (This is going on at Manchester University already).

WALKINSHAW
MULLETT

(b) A resonated alternating gradient synchroton with an energy of approximately 15 Gev.

(c) F.F.A.G. accelerators (Depending on energy)

This study should lead to a clarification of the practicability of such an accelerator and an estimate of the total cost, the manpower required to build it, the running costs, and when such a machine could be started.

ACTION

WILKINSON
GALBRAITH

While accelerators were being studied which could provide high intensity secondary beams it was agreed that parallel effort should be devoted to the problem of optimising the effective yield of selected particles of a specified momentum as a function of all the relevant parameters, consideration being given to detection of the particles and the recording of the information.

7. There were also two electron accelerators which it was considered should be investigated in greater detail.

ACTION
MULLETT
CASSELS

These are (a) a 12 Gev electron synchroton

and (b) an electron-positron linear accelerator with a peak energy of 6 Gev.

8. In all high intensity accelerators the need to improve the low duty cycle becomes of great importance. The most promising line of attack on this problem is the use of a Storage Ring and it was agreed that work should be pursued in this field of accelerator research.

ACTION

MULLETT

There are many problems that have to be solved before storage rings can be used and they are to a large extent peculiar to the particular application. For example, storage rings for protons involve problems distinct from those experienced in designing storage rings for electrons. A single turn injection ring is a relatively simple problem but a multi-turn injection device would require much more development work. Storage rings for beam stacking applications are more difficult still.

9. The need for high intensity secondary beams includes mesons of energies up to a few hundred Mev. It was agreed that the Rutherford Laboratory Proton Linear Accelerator was a possible method of providing such particles. Proton Linear Accelerators remain potentially very promising machines particularly if they can be used with storage rings so that research on and the development of machines of this type should be encouraged as valuable experience for the future.

10. Because of the long time it takes to build large accelerators an immediate step that should be taken is to ensure that the best use is made of existing accelerators, including those at CERN. This is likely, inter alia, to require the provision of additional staff for University Physics Departments.

11. It was felt that money could very profitably be spent during the next five years in improving the performance of existing accelerators.

12. In order to assist the Working Party in drafting its final report it was agreed that it would be of value to have available an estimate of the present and predicted annual expenditure on high energy physics in the United States (Note: I have written to Professor Bethe for information - G.H.S.) so that it could be compared with the expenditure in the United Kingdom. Further details are not given here but will be included in the report to the Physics Committee. In this report an attempt will be made also to forecast the probable increase in annual expenditure if the recommendations of the Working Party are accepted. This increase will be to allow for the following:

(a) the cost of improving existing machines,

(b) the cost of building a new electron accelerator,

(c) the annual cost of development work on a possible high intensity proton accelerator and associated techniques.

(d) the annual expenditure on building and operating a high intensity proton accelerator which, it is hoped, would be started during the second half of the present decade.

(Note by Secretary: Members of the Working Party are asked to provide me with forecasts of the money likely to be required by them under 12(a) and 12(d).

13. It should be stressed that if the United Kingdom is to continue to play a leading role in the field of elementary particle physics another major accelerator will be needed.

The electron accelerator which has been proposed in Section 4 should not be regarded as satisfying this requirement and if the smaller electron machine is built it should not jeopardise the possibility of our starting the construction of the high intensity proton accelerator in about 1965.

G. H. STAFFORD.
Secretary.

29th April 1960.