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NP/ExpT/8

19th March, 1963

Dr. Guy von Dardel,
C.E.R.N.,
Geneve 23,
Switzerland.

Dear Dr. von Dardel,

Thank you for your letter of 12 March. I am sorry I missed you during my visit to CERN.

As you say, it is risky to attempt to predict the usefulness of a 6-8 GeV machine 5 years before its completion, but I agree with you that there should be plenty of important work for 10 or 15 years. I remember that whenever we were asked the question we always predicted "about five years" useful life for the A.E.R.E. synchrocyclotron, which has the unfortunate energy of 170 MeV, but the machine is still going full blast and doing good work after 14 years.

As to the type of machine, one now has only the following possibilities for high energy physics:

- (1) A "pion factory"
- (2) An electron linear accelerator
- (3) An AG electron synchrotron
- (4) An AG proton synchrotron

I am not very enthusiastic about (1). The machine is expensive and difficult, and is aimed at a rather narrow field of physics which will probably be covered in Switzerland. We should always aim at a balanced programme in Europe, and learn to use each other's machines. One pion factory is probably enough to be going on with.

The French already have (2). This type of machine is not difficult to build, in the sizes which you could contemplate, but its cost per GeV is high. The French have the advantage of a good microwave industry on which the machine depends unless one wishes to set up a valve factory specially for the job. It is not a very versatile machine, and is poor for secondary beams.

Germany and U.K. will have examples of (3). I believe that in its energy range it is a more versatile machine than (2). The Hamburg machine is fairly accessible to Scandinavian countries.

(4) is the most versatile machine of all, and therefore it is reasonable to have more proton synchrotrons in Europe than any other type of machine. I agree with you that 6 GeV is the minimum worthwhile energy, and that 8 GeV would be much better for just the reasons you give

The thoughts we had when we decided to build Nimrod are not all relevant today. When we started, nobody expected the CPS to give more than 10^{10} protons per pulse, and we were looking for a factor of 100 in

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Dr. Guy von Dardel

intensity, for which we were prepared to sacrifice energy. We chose 7 GeV for the same general reasons that you now propose 6-8 GeV - they are still valid. We could guarantee our 10^{12} protons only by going to the C.G. design, and a further reason for this choice was the worry that the AG machine contained many unknowns and that therefore two big machines in the world were quite enough to risk at one time. Nowadays, of course, no one would build a C.G. machine.

Nevertheless, we still think that Nimrod will be a very powerful machine and that, despite the remarkable performance of the CPS and the AGS, the field is big enough and important enough to overwork all the machines for as far ahead as one can see. It is interesting that the Cosmotron, at only 3 GeV, is still used at full pressure with the AGS next door. The important point is that it is not now possible in this business to corner a bit of the field for ones self, and the experiments must be well supported and planned by first-class people. We are coming into the field late, and are competing with highly professional groups at Berkeley, Brookhaven and CERN. You will be coming in even later. On the other hand, we have trained several carefully picked people (e.g. Taylor, Murphy) by sending them to Berkeley and CERN before the start-up of our machine, and this has helped enormously.

On the parameters of your proposed machine I make only a few comments. I have passed your letter to a few others here who may have other comments.

1. I would be inclined to consider a higher injection energy than 10 MeV, because the intensity will presumably be limited by space charge. A higher energy would also ease the RF problem by reducing the frequency shift. I realise, of course, that the injection time would be reduced, making increased demands on injector performance. We inject at 15 MeV and the converted Bevatron at 19 MeV, but we have multi-turn injection.

2. You do not give the rise time. Presumably you will want to make this as short as you can, consistent with RF timing difficulties and power supply economies, to get a high mean intensity.

3. I am surprised by your guess of \$4-5 million for the running budget. This seems low to me. I do not believe that the Mervyn Hine "full exploitation" philosophy need apply to a national machine - to put it crudely, it is better for Scandinavia to have a half-used machine than no machine at all. But the half that is used must be well used, and your figure seems hardly enough when one remembers the growing sophistication of experimental hardware and data-reduction systems. I cannot be more specific; the Nimrod budget is more than twice your figure, and we think it is inadequate, but Nimrod is an expensive machine to operate and we have hordes of experimentalists looking for facilities.

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I am looking at some of our data which may help you,
and hope to bring it to CERN when I come to the April meeting.

With best wishes,

Yours sincerely,

T. G. Pickavance

c.c. Mr. L. B. Mullett
Mr. W. Walkinshaw