

MINISTRY OF SUPPLY,

Atomic Energy Research
Establishment,

HARWELL, DIDCOT,
BERKS.

15th September, 1952.

Sir James Chadwick, F.R.S.,
The Lodge,
Gonville and Caius College,
Cambridge.

Dear Sir James,

Thank you very much for your prompt reply to my letter. I realise that some of the points which I raised are contentious, and I hope that you may find time to tell me your views on these eventually. You have not commented upon the purely scientific arguments which I summarised, and I shall assume that in the main you agree with them.

The most recent development, as you will doubtless have heard, is a new idea from Brookhaven which, if successful, will greatly increase the energy obtainable from a proton synchrotron for a given expenditure of money. In essence the scheme aims at a large reduction of the amplitudes of betatron and synchrotron oscillations of the protons in their orbits, so that the beam may be confined within a vacuum chamber of small cross-sectional area (about 5 cms. square) with a corresponding saving of steel in the magnetic circuit. This saving might be as much as nine tenths. In all magnetic accelerators so far constructed the field exponent "n" ($n = -\frac{r}{H} \frac{\partial H}{\partial r}$) has been kept between 0 and 1, in order to achieve axial focussing and at the same time to confine the particles in closed orbits in the magnetic field. For $n < 0$ there is axial defocussing, and for $n > 1$ there is radial instability. In the new accelerator the orbit would be divided into numerous sections, alternating between large positive and large negative values of n (i.e. fields decreasing rapidly and increasing rapidly with radius, respectively). Values of + and -3000 or more are being discussed. The elementary theory of the device can easily be worked out, and in principle the scheme is feasible. The detailed effects on the synchrotron oscillations are less certain, and nothing is yet known about the importance of second and higher order derivatives of the magnetic field (i.e. varying values of "n" over the gap area). Much theoretical work needs to be done, and experimental tests will be needed at a later stage.

The members of the European proton synchrotron group are now talking in terms of a 30 GeV accelerator which would contain less steel than the existing 2.5 - 3 GeV machine at Brookhaven. This new idea seems to make high energy accelerators even more attractive, and produces the interesting situation that the Europeans now start level with the Americans. The idea was generously passed on by Brookhaven people within a few days of its conception.

I know that some advocates of high energy machines would like to see a separate British venture on account of the economic and political objections to our participation in the European scheme. I think that this course is not now open to us, if we wish to act honourably. The new Brookhaven idea was passed on to us through our unofficial connection with the European Laboratory; Goward was visiting Brookhaven on behalf of C.E.R.N., and the expenses of his trip were paid by C.E.R.N. There are only two possibilities for us. Either we must join the Europeans or do nothing in this field until the European scheme approaches fruition or failure.

I would not quarrel with a Treasury, Foreign Office or Parliamentary decision to stay out, provided that I could be sure that the scientific case had been adequately presented. A proper presentation of the case would

/include

include a considered scientific viewpoint on the probable harmful consequences of our failure to join, in addition to the positive value of joining. The case which I sketched in my earlier letter is of course a partisan one and is also incomplete. One of my aims in writing to you and in discussing the matter with others has been to find out whether there is a coherent opinion on the scientific side; I am convinced that there is a majority view among nuclear physicists along the general lines which I have indicated, and that the majority is a substantial one. The fact of our near-bankruptcy must be faced, and there may well be better cases for the limited expenditure which we can afford, but I am sure that these other projects have their advocates. I am concerned only that this one should be considered carefully along with the rest.

Yours sincerely,

T.G. PICKAVANCE.