EPIC COUNTRY MEETING - 11 JANUARY 1973

On 13 June 1969 the Nuclear Physics Board held what was called a TOWN meeting in this Lecture Theatre, first in order to bring the nuclear physics community completely up to date with its plans for nuclear physics - both high and low energy - and second to enable the community to express its views on these plans.

Professor Wilkinson, who was then Chairman of the Board, was in the chair. Since then a great deal has happened. Professor Wilkinson has been and gone, so too has Professor Gunn, his successor as chairman, but we have here with us the present chairman of the Board, Professor Matthews.

At this meeting we are only going to discuss the high energy physics part of the Nuclear Physics Board's programme, so let us call it - possibly more appropriately - a COUNTRY meeting.

However, by way of introduction it is worthwhile recalling what the situation was in June 1969 when Professor Wilkinson spoke to you. At that time the Government decision had been against joining the 300 GeV programme, although the Nuclear Physics Board maintained that a reversal of this decision was its top priority. This was also the period in which disenchantment with scientific research led to much lower growth rates than envisaged in the past for the SRC as a whole and doubt amongst many scientists about the value of high energy physics in particular or possibly because of our inability to communicate effectively led to even lower expectations for nuclear physics. Wilkinson introduced his famous ε growth factor and demonstrated the difficulty of planning any sort of programme with an ε which shrank annually with such rapidity that programmes became obsolete almost before they were in print.

However, that is all behind us now. In February 1971 we joined the reduced Project B at CERN Meyrin, but by then our financial situation was much worse than

at the time of the Wilkinson meeting, for not only were we operating from a much lower financial base, but we also had had to accept a zero growth rate for the construction period of the SPS. The consequence was that many new projects planned by the Board were cancelled. Of particular interest to this meeting were the high field bubble chamber (£3.25M) and the NINA booster (£10M). It was also accepted that the national programme would have to be cut by the closure of one of its two accelerators before it had reached the end of its effective life. During 1971/72 the Board reviewed its programme and regrettably came to the conclusion that NINA should be phased out first and in November 1972 the Council took the final decision on this. In accepting that Nimrod was to be the accelerator to be kept going, it also approved a proposal I had made to instal a new 70 MeV injector and this received final DES sanction just before Christmas.

The new injector will be in use by 1975. When it comes into use, we will have available ten times more beam than we have had up to the present and a predicted extracted proton beam of 10^{13} ppp. We believe that with this intensity we will be able to sustain a research programme for the next ten years or so which in the energy range we cover is competitive with anything that can be done elsewhere.

TRANSPARENCY OF YIELDS

Furthermore even though NINA closes down in 1977 with this intensity and two large Experimental Halls we are able to accommodate on Nimrod many more teams than we have at present. Northern groups should bear this in mind particularly as there is likely to be severe pressure on CERN at this time and there is every indication that Nimrod may be asked to take on from CERN some of the lower energy experiments. We are already beginning to think of beam layouts for 1975.

TRANSPARENCY OF BEAM LAYOUT

The high energy physics programme is therefore now in good shape until about 1980 and with Nimrod and the CERN accelerators there should be ample research time for

The main question to address ourselves to this afternoon is whether we should be planning a home based machine to take over when Nimrod reaches the end of its useful life.

We have been giving some thought to this for several years, but until quite recently no accelerator could be thought of which would be able to compete with the huge accelerator complexes at CERN and elsewhere. Now, however, I believe there is a possibility which would enable us to have in Britain a world class machine which we could build ahead of anything that is likely to be built elsewhere and which would not conflict with what should be done at CERN.

This change has been brought about through the following factors:

TRANSPARENCIES

THE GREAT SUCCESS OF ISR AT CERN AND HENCE THE REALIZATION THAT STORAGE RINGS ARE THE ROUTE TO EVEN HIGHER CENTRE OF MASS ENERGIES

NEW IDEAS IN THE DESIGN OF STORAGE RINGS LEADING TO HIGHER LUMINOSITIES-- LOW BETA INSERTIONS AND LONG STRAIGHT SECTIONS --

SLAC/LBL BERKELEY

CONTINUED SUCCESS WITH THE DEVELOPMENT OF PULSED S/C MAGNETS

REPORTS

SLAC 146 LBL 750

RHEL/R 252

DRAG/SR/1 - G H REES

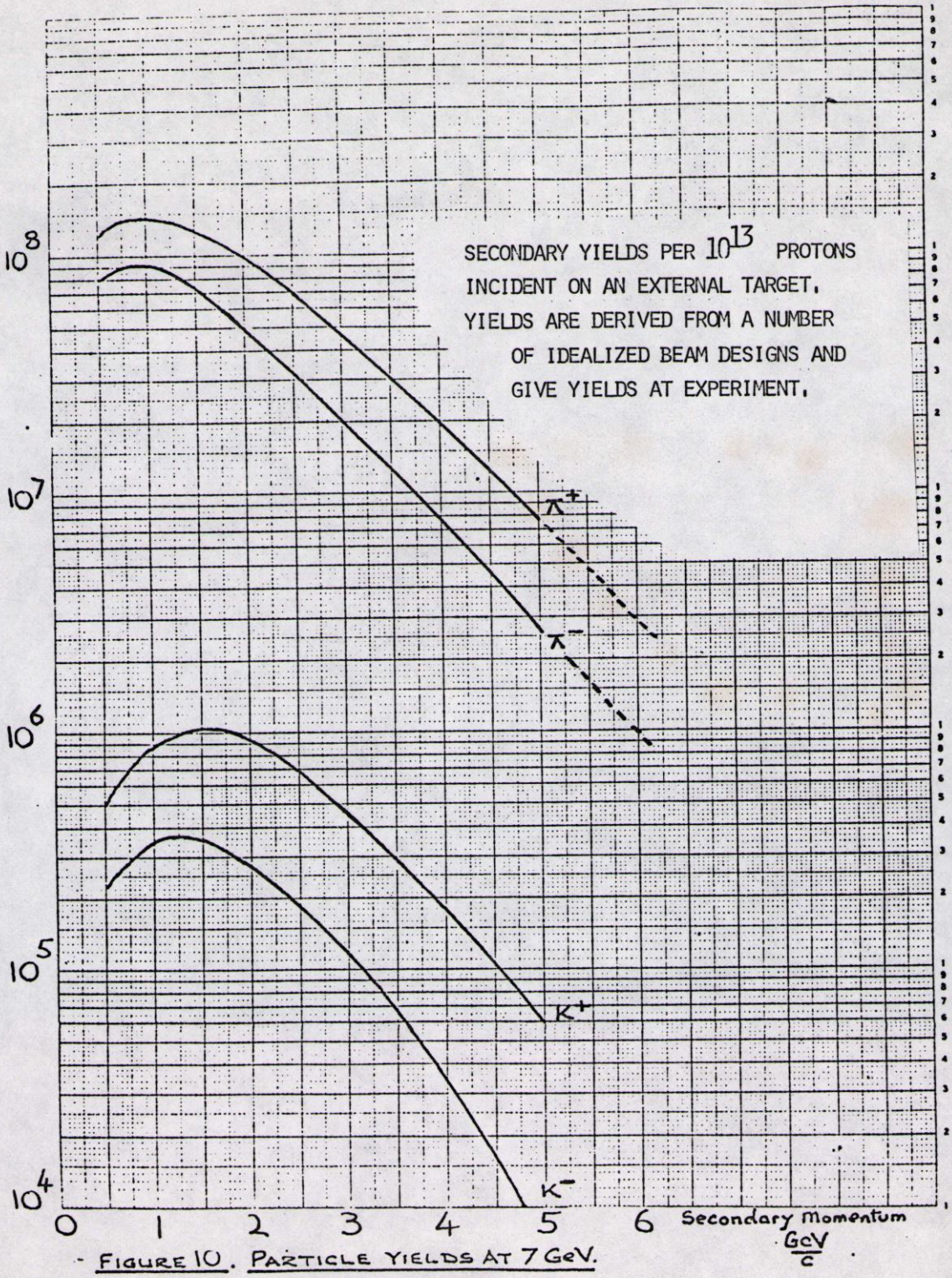

FIGURE 10. PARTICLE YIELDS AT 7 GeV.

G H REES - DRAG/SR/1

3 RINGS IN SINGLE TUNNEL

MEAN RADIUS 145 M

4 STRAIGHT SECTIONS L = 90 M

INTERACTION REGION 8 M

TOTAL LUMINOSITY 10^{32} CM^{-2} SEC^{-1}

LUMINOSITY PER INTERACTION REGION

0.25×10^{32} CM^{-2} SEC^{-1}

[ISR DESIGN FIGURE 0.4×10^{31} CM^{-2} SEC^{-1}]

(A) PROTON ENERGY = 60 GEV

LINAC	+	BOOSTER INJECTOR	+	CONVENTIONAL MAGNET
70 GEV		3-4 GEV		28 GEV

+ S/C MAGNET FOR STORAGE

60 GEV

(B) ELECTRON ENERGY = 8.5 GEV

LINEAR ACC	+	BOOSTER INJECTOR	+	CONVENTIONAL MAGNET FOR STORAGE
250 MEV		3-4 GEV		8.5 GEV

MAJOP DESIGN FEATURES

ELECTRONS

4 BUNCHES	$\sim 3.2 \times 10^{11}$	ELECTRONS PER BUNCH
TOTAL BEAM	1.3×10^{12}	ELECTRONS
FILLING TIME		3-4SECONDS
STORAGE TIME		2 HOURS
BUNCH LENGTH		8.4 cm

PROTONS

4 BUNCHES	$\sim 4 \times 10^{11}$ PROTONS PER BUNCH
TOTAL BEAM	1.6×10^{12} PROTONS
FILLING TIME	3-4 SECONDS
STORAGE TIME	2 HOURS
BUNCH LENGTH	90 cm

POSSIBILITIES

	CM ENERGY (GEV)
$E^+ + E^+$	17
$E^- + E^-$	17
$E^+ + E^-$	17
$E^- + P$	45
$E^+ + P$	45
$P(28) + P(46)$	72
CONVENTIONAL 60 GEV PROTON ACCELERATOR	

A 2 RING SYSTEM WOULD EXCLUDE THE FIRST TWO POSSIBILITIES

TECHNICAL AND EXPERIMENTAL ADVANTAGES

(A) HIGH LUMINOSITY $2.5 \times 10^{31}\ \mathrm{CM}^{-2}\ \mathrm{SEC}^{-1}$
(ISR 4×10^{30})

(B) LOW BACKGROUND

ISR STORES $\sim 10^{14}$ PROTONS (CF 10^{12})

SIGNAL/NOISE 10^{3} BETTER

(C) BACKGROUND MEASUREMENTS SIMPLE

(D) COLLINEAR CROSSING

(E) SHORT FILLING TIME

SLAC REPORT Nº 146
LBL REPORT Nº 750

(1) LARGE MOMENTUM TRANSFER REACTIONS

  (A) DEEP INELASTIC

  (B) WEAK INTERACTIONS

(2) PHOTOPRODUCTION

(3) ELECTRON-POSITRON COLLIDING BEAMS

  (A) TOTAL $E^+ E^-$ HADRONIC CROSS SECTION WITH ENERGY

  (B) INCLUSIVE PRODUCTION WITH DETECTION OF ONE HADRON

  (C) INCLUSIVE PRODUCTION WITH DETECTION OF TWO HADRONS

  (D) HEAVY LEPTONS

  (E) WEAK INTERMEDIATE BOSON PAIRS

  (F) TWO PHOTON PROCESSES

DEEP INELASTIC SCATTERING

	SLAC	EPIC
	GEV	GEV
VIRTUAL PHOTON ENERGY	20	1000
MASS	5	45

WEAK INTERACTIONS

WI CROSS SECTIONS GROW WITH ENERGY.

EM CROSS SECTIONS DECREASE WITH ENERGY.

BECOME EQUAL AT 50-60 GEV CM ENERGY.

CONFRONTED WITH A PARADOX SO THAT OBSERVATION OF WI CONTINUING TO GROW OR OF BREAKDOWN OF FERMI THEORY OR DISCOVERY OF THE W MESON WOULD BE A SPECTACULAR RESULT.

SOME NEW PHENOMENON OR INSIGHT BOUND TO ARISE.

CONCLUSIONS

(1) WITH A 2 RING EPIC WE WOULD HAVE A WORLD CLASS MACHINE FOR THE FIRST TIME IN THE UK SINCE COCKCROFT AND WALTON

(2) IT COULD BE BUILT BY ABOUT 1981 AND BEFORE OR AS SOON AS ANY COMPARABLE MACHINE ELSEWHERE ASSUMING APPROVAL IN 1975/76

(3) CONSISTENT WITH AND COMPARABLE TO WHAT ARE LIKELY TO BE THE DEVELOPMENTS AT CERN.

IS IT PRACTICABLE?

SCHEME STUDIED BY REES MAKE MAXIMUM USE OF EXISTING ASSETS IN BOTH LABORATORIES AND HENCE REQUIRES MINIMUM OF NEW MONEY

CAPITAL COST £20M BUT IT CAN BE BUILT SEQUENTIALLY TO FIT VARIETY OF BUDGET PROFILES

IT USES

(1) NIMROD POWER SUPPLIES

(2) NEW 70 MEV INJECTOR

(3) NIMROD BUILDINGS WITH HALL 3
AS ONE OF INTERACTION REGIONS

(4) NINA MAGNETS

(5) OUR EXPERTISE IN S/C MAGNET
TECHNOLOGY

REES PROPOSAL IS FIRST LOOK AT POSSIBLE SYSTEM

HIGHER ENERGIES DESIRABLE

NOW INVESTIGATING

(1) NEXT LARGER RADIUS MACHINE

340M MEAN RADIUS

$E_E \sim 14$ GEV

$E_P \sim 200$ GEV

(2) LARGEST MACHINE ON EXISTING SITE

$E_E = 9$ GEV

$E_P = 75$ GEV

(3) MISSING MAGNET OR MISSING RF POWER MACHINE

STILL AT FEASIBILITY STAGE

REQUIRE TO INVESTIGATE

(1) PHYSICS POTENTIAL

(2) OPTIMIZATION OF ENERGIES

(3) EXPERIMENTAL UTILIZATION