Daresbury Super Linac Status Report

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Introduction

Daresbury Laboratory houses a 20 MV tandem which has been in operation for over 4 years. Various proposals have been made to upgrade the facility by the addition of a post accelerator. One of these involved the addition of a large superconducting heavy ion linac capable of accelerating all masses up to the coulomb barrier (1). Because of financial restrictions it was not possible to proceed with this scheme, so that when the resonators and cryostats which were to have been installed on the Oxford University folded tandem became available it was decided to install these as a post accelerator on the Daresbury machine.

These modules will add about 5 MeV/charge to the ion energy and this will extend the range of nuclear physics experiments possible by a useful factor. The addition of further linac modules is an obvious possibility and this has been kept in mind in the design and specification of the layout and the helium refrigeration system.

Modules

The linear accelerator, i.e. resonators, cryostats, controls and R.F. systems were purchased from Associated Superconductivity Inc. (A.S.I.) . A total of four cryostats were delivered to house 10 resonators. One contains a single superbuncher cavity and the other three each contain 3 accelerating cavities.

All are of the split ring type with beta = 0.1. They are manufactured from lead plated copper and operate at 150 MHz. The specified rating for each cavity is 2.5 MV/m at a power loss of 6 Watts. The resonators are electromagnetically similar to those installed at Stony Brook (2) with modifications to allow the use of lead gaskets on the end plates rather than indium to eliminate the initial frequency drift after assembly and doubling of the inductor wall thickness to allow bending without using filler material.

The cryostats were constructed in the US, and disassembled and shipped to the UK for assembly at Oxford. The resonant cavities were shipped unplated. The contract also included updated microprocessor controlled resonator controllers and R.F. amplifiers.

Assembly and plating facilities were constructed at Oxford ready for delivery of the components from A.S.I., and the first plated resonators were assembled and R.F. tested in March 1985.

Resonator Performance

Three resonators were used to test plating procedures. Of the methods tried, which were all variations of that defined by Delayen, the best results were obtained with a plating thickness of 1.5 micron and without any chemical polishing (3). A low level Q of 3.6x10**8 was achieved with a power dissipation of 3.5 Watts at 2.5 MV/m. Following a period of testing up to August 1985, the assembled resonators were kept under vacuum while refrigerator and transfer line tests were carried out. The resonators were recently retested and the Q curves obtained are shown in figure 1. Curve 1 is for a plating thickness of 10 microns with subsequent chemical polishing, and curves 2 and 3 are for thicknesses of 1.5 and 10 microns respectively without polishing. Two cavities are well within specification while the third will require further conditioning to restore its performance. Lead plating of the remaining cavities has recently been resumed at Oxford. A further 3 cavities have been plated to a thickness of 1.5 micron and these have been assembled ready for R.F. testing.

Preparations at Daresbury.

The layout of the linac modules at Daresbury has been finalised. The linac and its beam lines are shown in figure 2.

Beam from the tandem will be stripped and the required charge state bent on to the linac axis. Following superbunching and acceleration the beam will be transported back to the existing experimental stations and also to two new stations as shown.

The rebuncher/debuncher required for this arrangement is at present out to tender and should be ordered shortly. This will consist of a cavity with beta=0.1 identical to the existing resonators.

A new refrigerator, Model TCF50, has been ordered from Sulzer. This delivers 320 W of helium without liquid nitrogen precooling and should be capable of handling up to three further cryostats in addition to the present load.

Tests on the helium transfer line to the superbuncher and the three accelerating modules, manufactured by L'Air Liquide have been successfully carried out at Oxford and this will be transferred to Daresbury for use virtually unchanged.

Building modifications at Daresbury are now under way and all long delivery items such as the refrigerator and the beam line magnets are now ordered.

It is expected, if all goes to plan, to inject beam into the linac in 1988.

References

(1) T.W.Aitken et al, Daresbury Technical Memorandum TM65.

(2) J.M.Brennan et al, IEEE Trans on Nucl Sci, Vol NS-32, No 5 pp 3122-3124 Oct 1985.

(3) J.R.Delayen, Rev Sci Inst Vol 57, No 5, May 1986.

Cryostat No. 2 10/9/87

- • Resonator 310, position no. 1, after 2h of helium conditioning
- + Resonator 305, position no. 2, after 1h power conditioning
- o Resonator 306, position no. 3, — " —

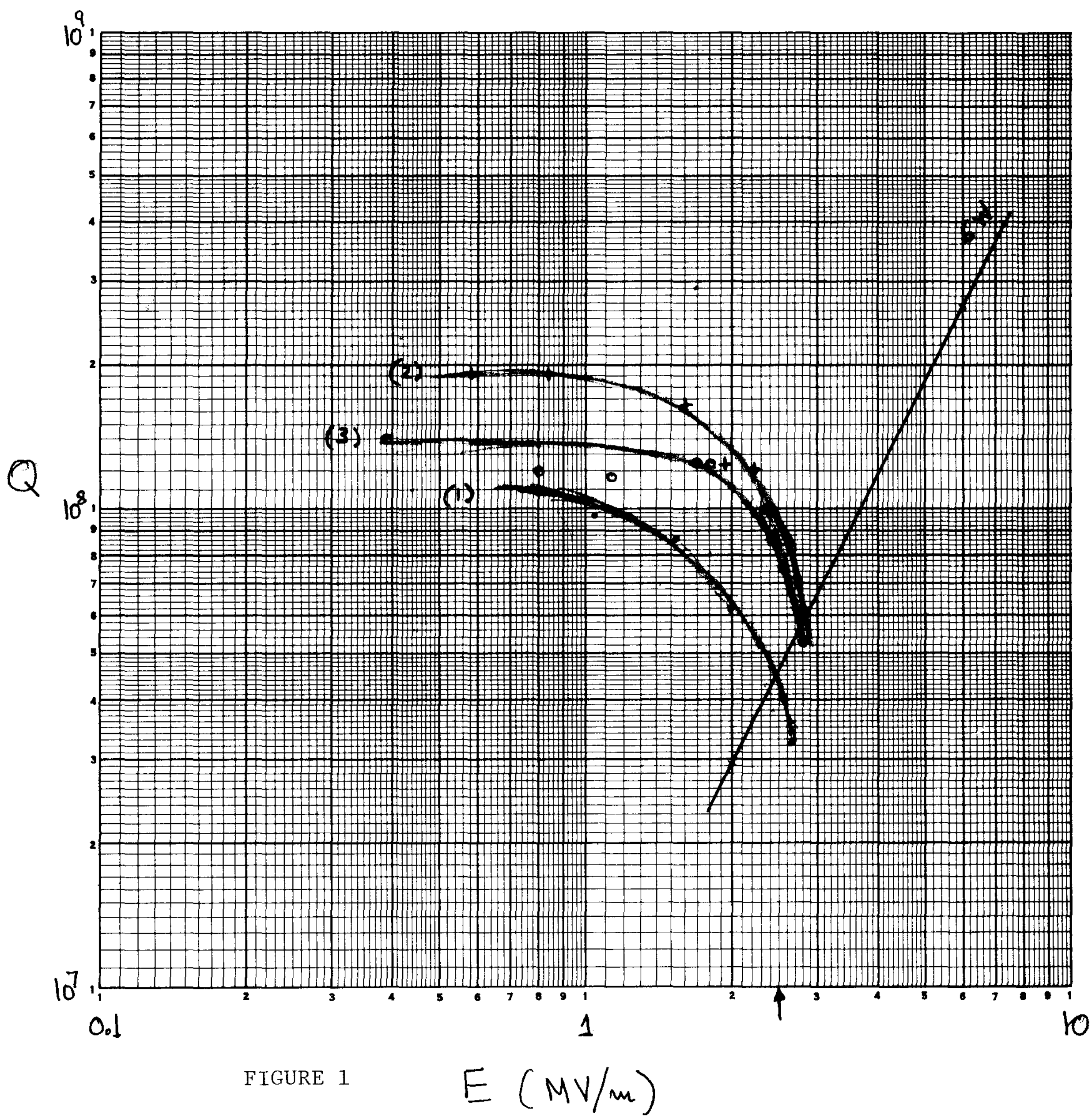
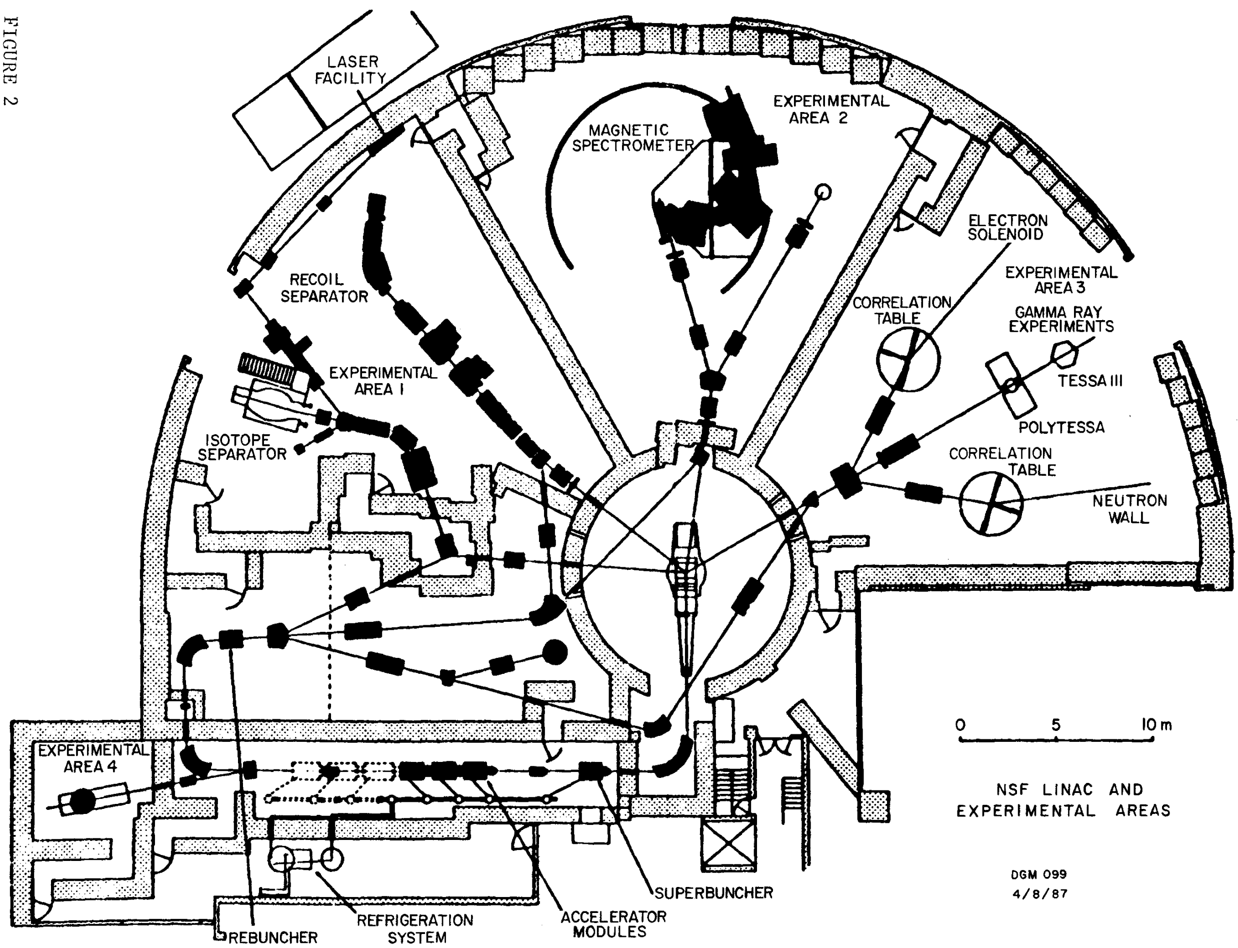


FIGURE 1

FIGURE 2


LASER FACILITY
EXPERIMENTAL AREA 2
MAGNETIC SPECTROMETER
ELECTRON SOLENOID
EXPERIMENTAL AREA 3
RECOIL SEPARATOR
CORRELATION TABLE
GAMMA RAY EXPERIMENTS
EXPERIMENTAL AREA I
TESSA III
POLYTESSA
ISOTOPE SEPARATOR
CORRELATION TABLE
NEUTRON WALL
0
5
10 m
EXPERIMENTAL AREA 4
NSF LINAC AND EXPERIMENTAL AREAS
DGM 099
4/8/87
SUPERBUNCHER
REBUNCHER
REFRIGERATION SYSTEM
ACCELERATOR MODULES