Nuclear Structure Facility: Ten Years On

THE construction of an electrostatic accelerator capable of generating a potential of 20 million volts (MV) is now feasible, according to a design study team which has been looking at the viability of such a machine for the past fourteen months. Dr R. G. P. Voss, deputy director of Daresbury Nuclear Physics Laboratory and leader of the team, said last week that a favourable report would be made to the Science Research Council in August when the contract for the design study expires.

Dr Voss thinks that building the accelerator will cost £4 million over a five year period. This sum will include a building to house the accelerator and also some equipment to start the experimental programme. The cost of the design study has been between £300,000 and £400,000.

The accelerator—a tandem Van de Graaff—will, it is hoped, eventually produce a voltage of 30 MV on its centre terminal, although several technical developments will have to be made before the highest voltage is achieved. There are no comparable machines available and the nearest in performance are manufactured by the High Voltage Engineering Corporation (HVEC) of Burlington, Massachusetts, and give 15 MV.

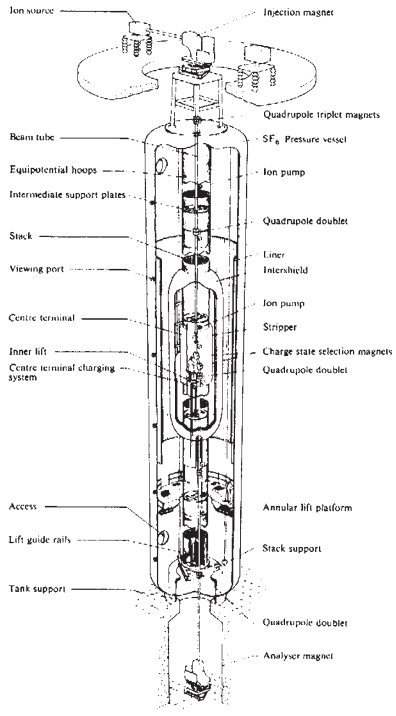
If the Science Research Council decides to allocate money for the accelerator, it will end a decade of frustration for nuclear structure physicists in Britain. Since the early 1960s political squabbles over where the accelerator should be sited, together with lean times for the finance of nuclear physics, have delayed decisions on this new generation of low energy nuclear physics accelerators.

Even now it has not been decided where the accelerator is to be sited. The Nuclear Physics Board of the SRC has recommended that it be built at Daresbury but this decision has to be ratified by the council. The signs are, however, that the SRC will not ignore this advice.

The successful outcome of the design study is a feather in the cap of Dr Voss. When the study was initiated a year ago, it was far from clear whether the study team should be investigating the viability of an electrostatic accelerator or whether it should have been devoting its attention to the possibility of building a superconducting accelerator for heavy particles. Time has shown, however, that the chosen course was the correct one, for progress on the electron superconducting accelerator now being built at Stanford University is painfully slow and several fundamental problems remain to be solved.

Dr Voss's plans for the Van de Graaff accelerator pander to the tastes of the people who favour a superconducting accelerator, because the building is designed so that a linear accelerator of this kind could be added at the end of the Van de Graaff at some future date.

The proposed accelerator will be built vertically—in contrast to the HVEC machines which are all positioned horizontally. The accelerator pressure tank will be 41.3 m high and more than 8 m in diameter, and will be incorporated in a tower 63.5 m high (see Figure).



It is planned that the accelerator will be operated in an atmosphere of pure sulphur hexafluoride held at a pressure of several atmospheres to decrease the possibility of electrical breakdown through the gas. One of the chief problems associated with the construction of an accelerator operating at such high voltages is the building of parts capable of withstanding the electrical surges caused by sudden discharges of high voltages.

Dr Voss's confidence that the accelerator can now be built is based on the work that the design study team has carried out on the electrical properties of those components that will be placed at high potentials within the accelerator; in particular the supporting pillars, or stack, of the accelerator have been specially designed with this in mind. More important, the design is such that the individual component parts of the stack can be replaced if they do fail.

Another innovation is the system for carrying charge to the high voltage terminal of the accelerator. In most machines of this type, charge is transferred to a continuous rubberized fabric belt wound around two pulleys. The shortcomings of this system are that the transfer of charge is irregular —resulting in a voltage ripple—and that the belt tends to disintegrate and produce dust within the accelerator when breakdown occurs.

The first improvements in the method of carrying charge were suggested a few years ago by Professor R. Herb, of the University of Wisconsin, and eventually incorporated by him in electrostatic accelerators built for the University of São Paulo and the Australian National University. The fabric belt is replaced by a series of metal beads connected by an insulating string. This system—called a pelletron—has now been further developed by the Daresbury team into a system dubbed the laddertron, which has a much greater current carrying capacity than either the conventional belt or the pelletron and has the advantage of greater mechanical rigidity.

Professor Alick Ashmore, director of Daresbury Nuclear Physics Laboratory, said last week that even if the Nuclear Structure Facility is built at Daresbury the chief function of the laboratory would still be to carry out research in high energy physics. Professor Ashmore pointed out that the future of high energy physics within Britain after 1976 is to some extent undecided and that once the 300 GeV accelerator at CERN goes into operation, decisions would have to be made about the future of the two British national accelerators —Nina at Daresbury and Nimrod at the Rutherford Laboratory. Britain cannot both keep two accelerators of this size fully operational and maintain a full programme at CERN, chiefly because of the lack of sufficient qualified physicists.

One of Professor Ashmore's concerns is that if the SRC gives the go-ahead to the Nuclear Structure Facility, design and engineering support would principally come from the present staff at Daresbury and the high energy work would suffer as a consequence. Even so, he said that he would welcome the project enthusiastically if it is decided to house it at Daresbury.

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