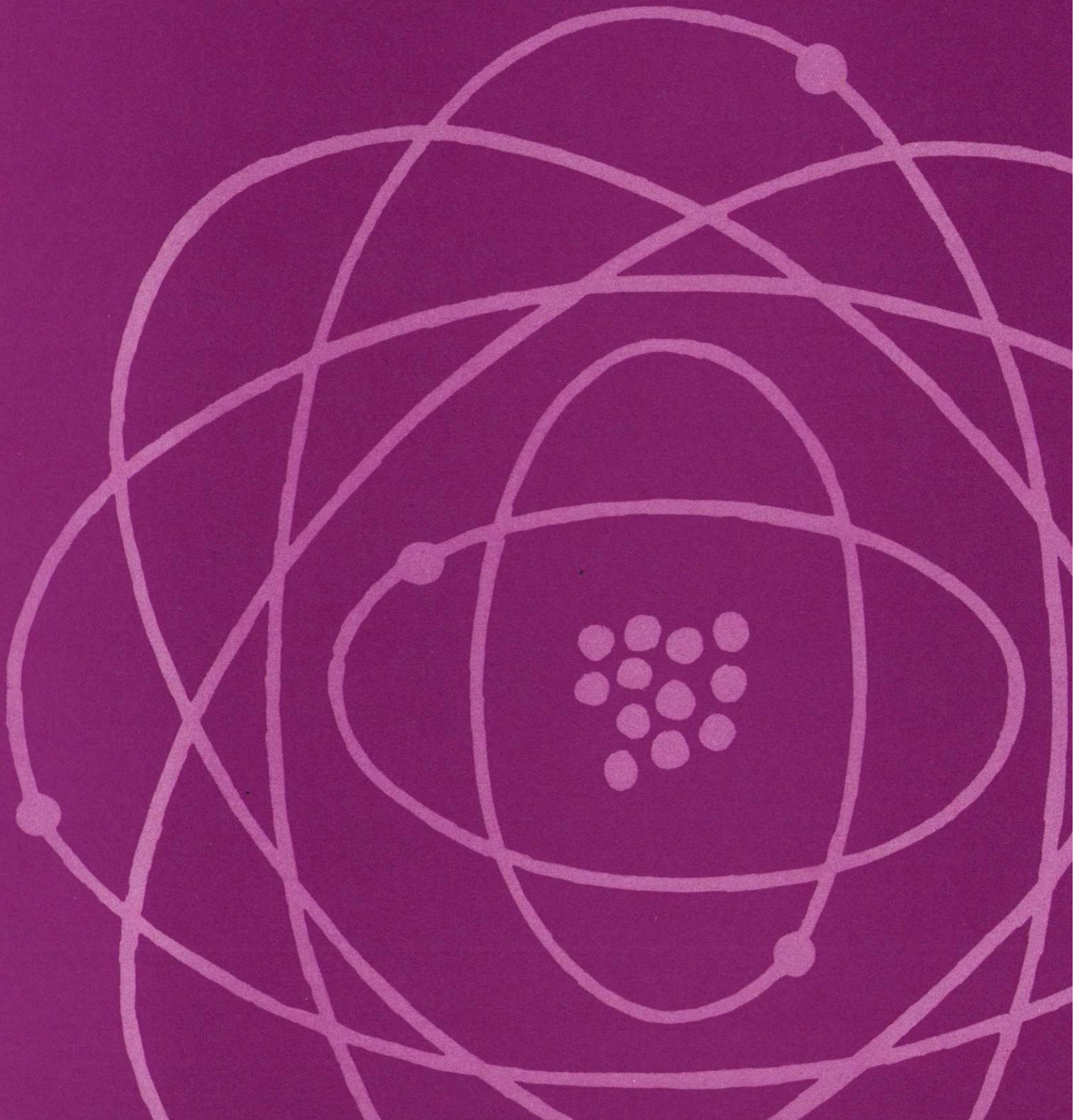
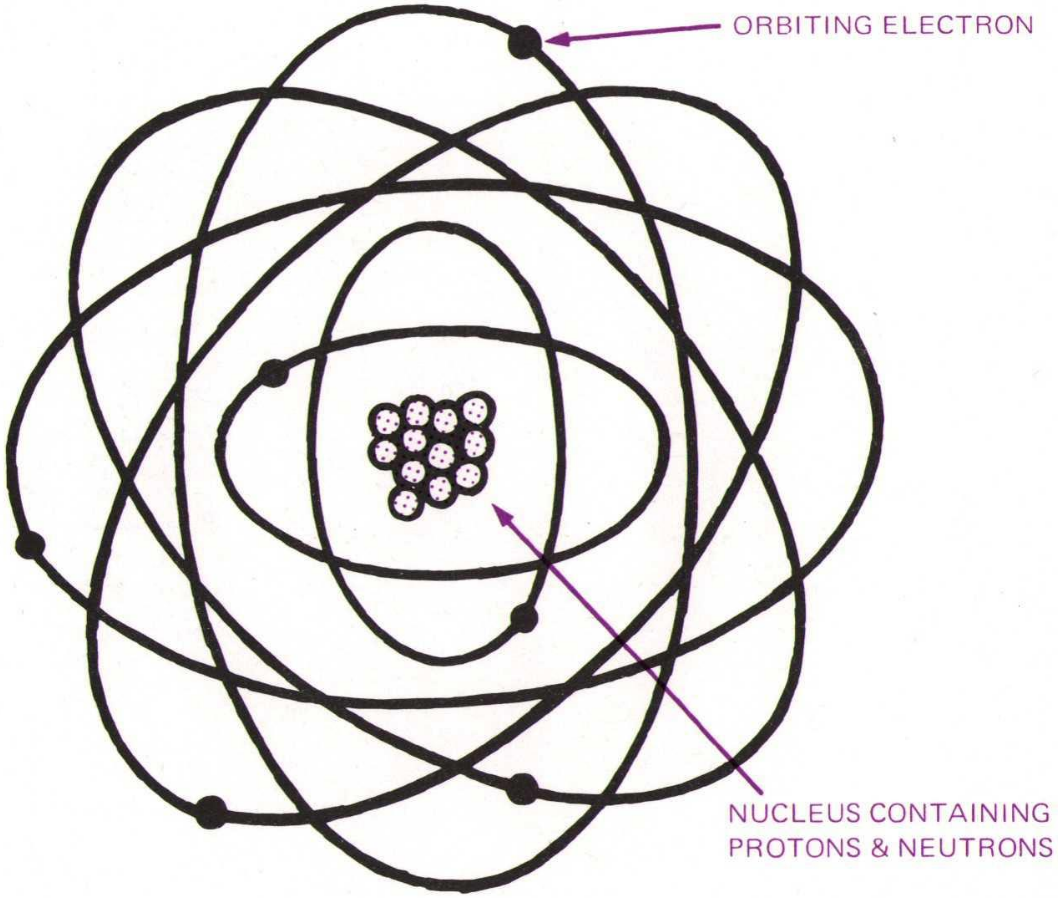
Daresbury Laboratory



Introduction

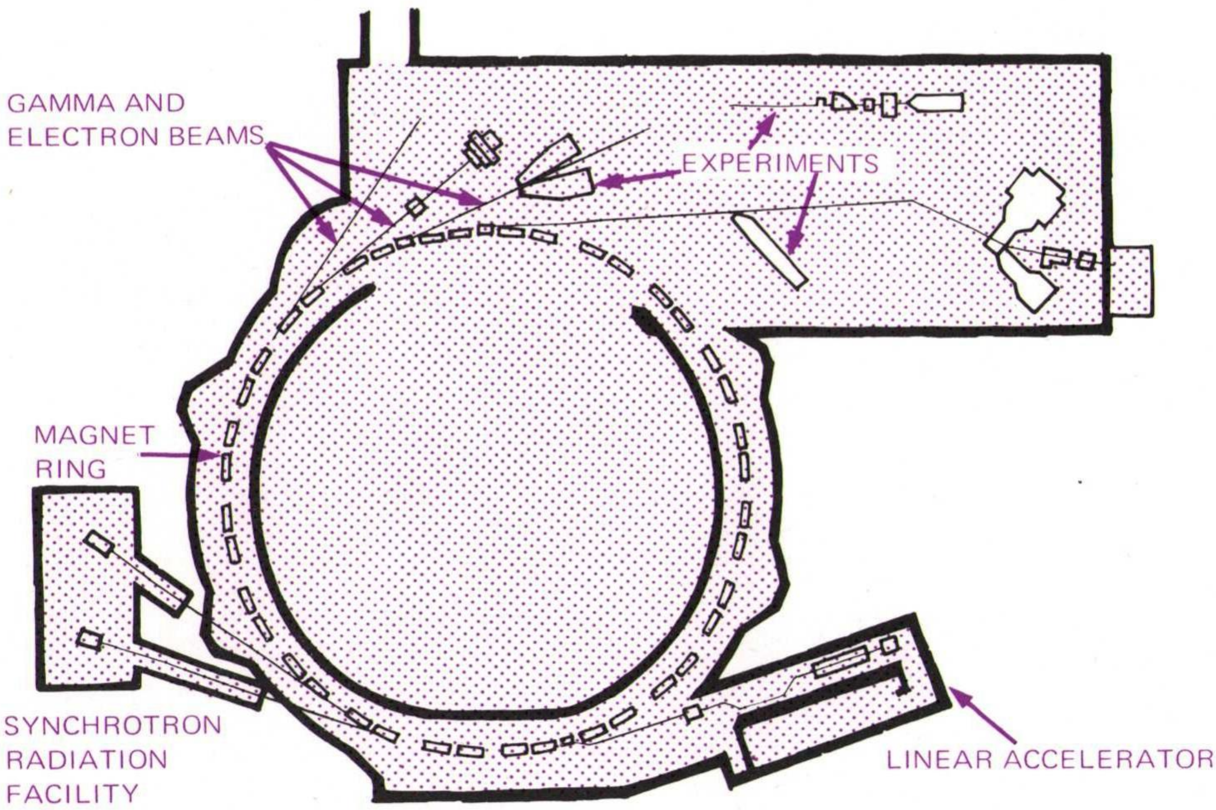
The Science Research Council's Daresbury Laboratory was established to provide research facilities in experimental and theoretical physics for the universities. About 500 people are employed at the Laboratory including, in addition to a permanent staff of physicists, many whose specialised knowledge and experience is essential to a large research facility of this kind, for example, electronics and computer experts, engineers, technicians, craftsmen and administrators. The Laboratory has close ties with similar establishments in other countries and attracts visitors from all over the world.

A wide range of research work is undertaken at Daresbury in the study of the atom, its orbiting electrons, its central nucleus and its individual nuclear particles. Studies in solid state and molecular physics give information about the behaviour of atoms and electrons in solids and in molecules. In low energy or nuclear structure physics the collective behaviour of assemblies of nuclear particles is examined, while in high energy or elementary particle physics the interactions between individual nuclear particles are studied. All of these types of research make use of beams of particles either neutral or electrically charged which are produced by particle accelerators. It is these accelerators together with the computers and detectors which are used in the experiments that are the main pieces of equipment to be seen at the Laboratory.



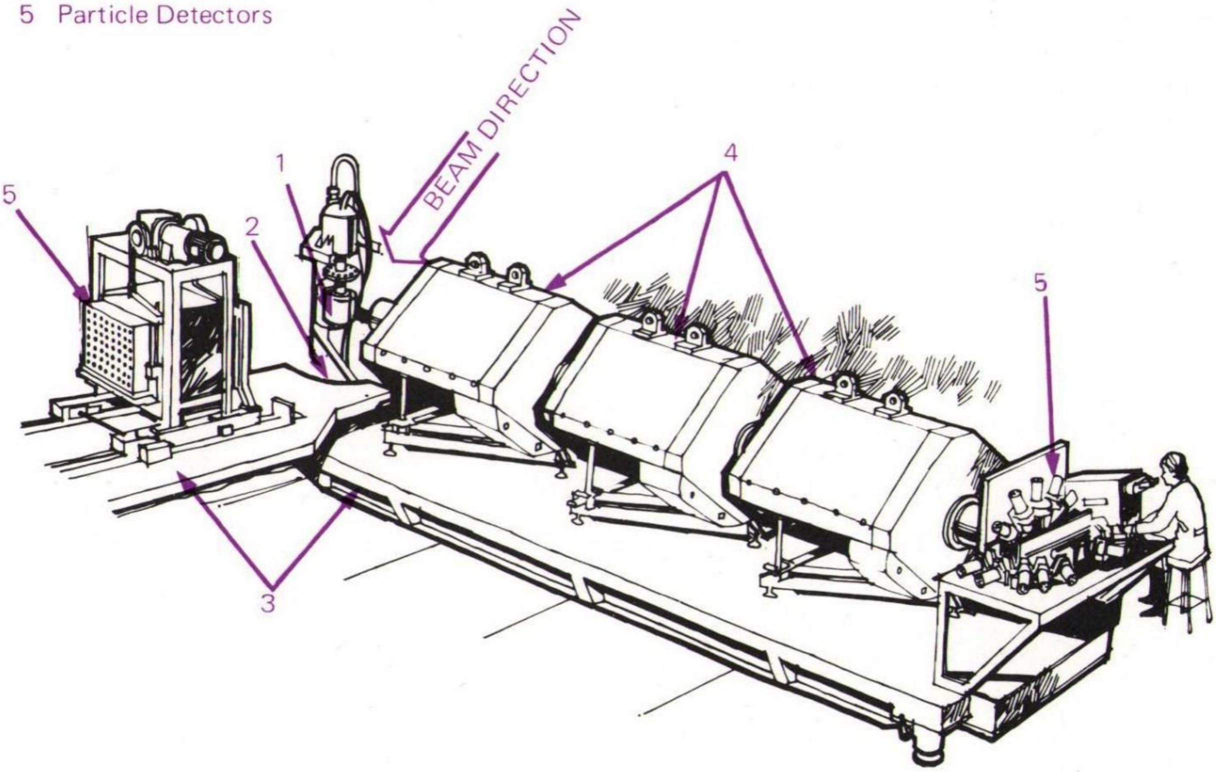
High Energy Physics

High energy electrons are produced by the electron synchrotron NINA. The electrons are initially accelerated by a linear accelerator to an energy of 40 MeV (million electrons volts). They are then introduced into NINA where they circulate many thousand times in a vacuum vessel whilst being accelerated to 5 GeV (1 GeV = 1000 MeV). The electrons are held in their circular orbit by a ring of electromagnets, the magnetic field getting stronger as the electrons gain energy. A burst of accelerated electrons is produced in this way about 50 times per second.



The electrons can be extracted from NINA for use in high energy physics experiments. Alternatively they may be allowed to strike a thin metal plate in order to produce photons (gamma rays) for use in the experiments. The electrons or photons are made to collide with a target, frequently made of liquefied hydrogen, and the angles and energies of the nuclear particles so produced are studied. The heavy equipment needed to detect and identify the particles is normally mounted on large platforms which can rotate about the target.

1 Liquid Hydrogen Target
2 Pivot Point
3 Turntables
4 Magnets
5 Particle Detectors



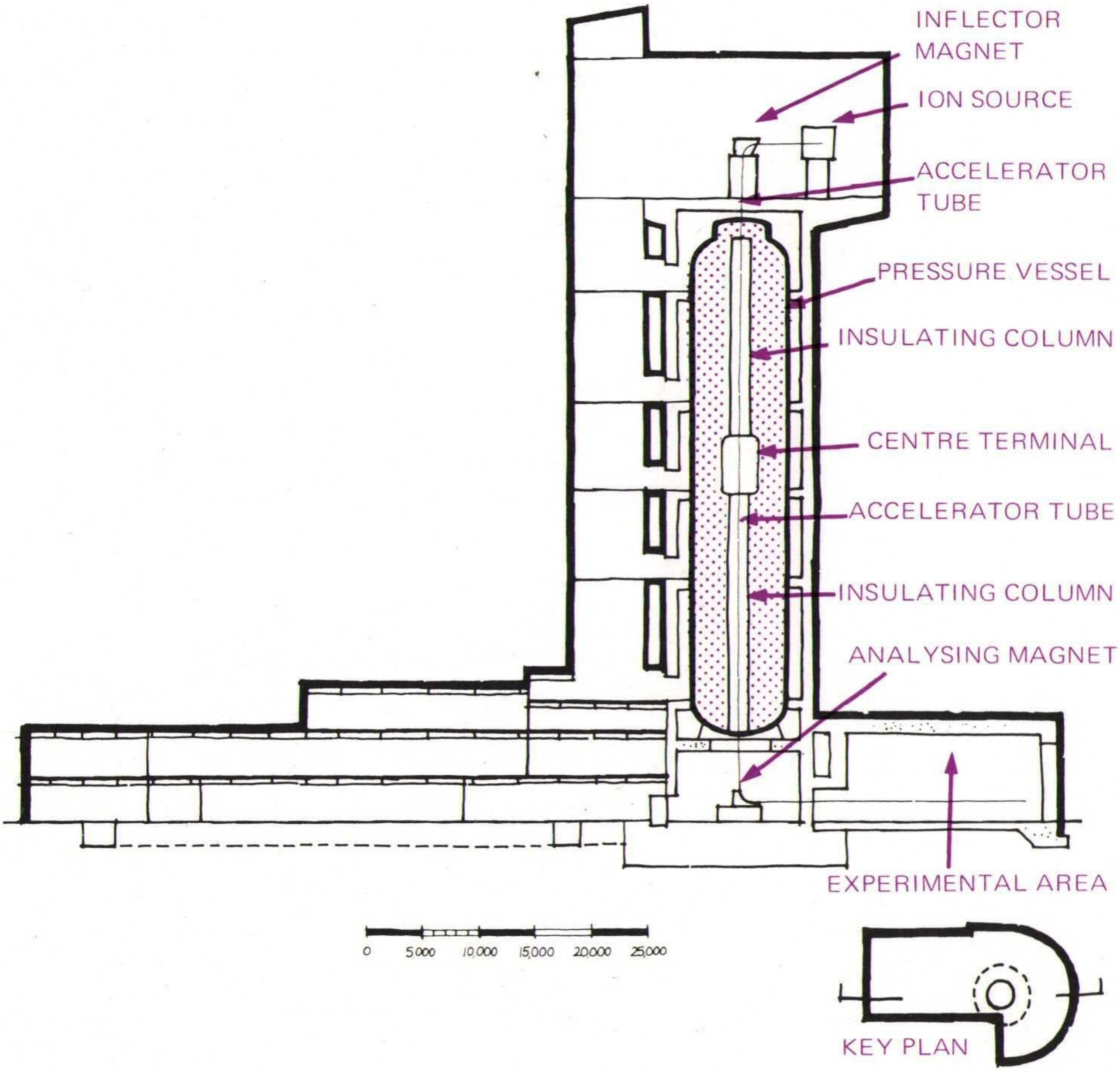
Synchrotron Radiation

The beam of electrons circulating in NINA gives off synchrotron radiation which consists of a continuous spectrum from the x-ray region through ultra-violet to the visible region. These rays are used in a wide range of experiments in atomic, molecular and solid state physics. The rays are emitted tangentially to the synchrotron and are used in a special experimental hall located close to NINA. One of the vital parts of many of the experiments is the monochromator which is used to select synchrotron radiation in a narrow wavelength range.

A special accelerator called an electron storage ring is now being designed for use as a synchrotron radiation source. This machine will operate at 2 GeV and have a magnet ring like that of NINA though somewhat smaller. After acceleration, a very intense beam of electrons will be kept circulating for many hours in the ring at constant energy while its synchrotron radiation is being used in experiments.

Nuclear Structure

A Van de Graaff accelerator is at present under construction for use in nuclear structure research. In this type of accelerator the beam of charged particles is accelerated in a straight line by a single large constant voltage. The machine at Daresbury will have an accelerating potential of 30 MV (million volts), more than double that of any accelerator of this type at present in operation. It will be able to accelerate all varieties of ions (charged atoms) from hydrogen to uranium. The accelerator, which is vertical, contains many thousands of glass insulators and is contained in a steel pressure vessel containing insulating gas at high pressure.



Computing & Electronics

Daresbury contains a very large and advanced computer installation. This is needed to control the accelerators and their experiments and to extract the information from the experiments. A powerful central computer is connected to a number of smaller computers which are used to gather and display information from the experiments and to control equipment. Punched cards and typewriter-type keyboards can be used to feed programs and data into the computers. The results are displayed on electronic screens or can be produced by fast printers and graph plotters. In conjunction with the computers, a wide range of electronic equipment including ultra-fast electronics is used in experiments.

Facts & Figures

NINA produces 53 beam pulses per second at energies up to 5 GeV. The 40 magnets are located on the circumference of a circle of mean radius 35 m to an accuracy of 0.25 mm. The accelerating r.f. is 408 MHz while the 40 MeV injector operates at 2.856 GHz. The total electrical power needed to operate NINA and its experiments is 5 MW.

The Synchrotron Radiation Facility uses radiation in the wavelength range from a fraction of an Angstrom up to several thousand Angstroms. A number of experiments are located along two beam lines.

The Nuclear Structure Facility Accelerator will operate at up to 30 MV, producing 60 MeV protons and 800 MeV heavy ions. It is located in a steel pressure vessel 45 m high and 8 m in diameter, holding over 100 t of insulating gas at high pressure. The machine is due for completion in 1978.

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