



MODEL CENTRE FOR THE VARIABLE ENERGY CYCLOTRON

The Variable Energy Cyclotron is intended to accelerate protons and a range of heavier ions, a beam of any particular ions being available at an external experimental point. To extract the beam in this way requires that the internal beam be uniform in energy and direction of motion. This, in its turn, depends on conditions at the centre. The Model Centre is a working scale model of the central region of the machine which facilitates the design of the various electrodes and coils which shape the electric and magnetic fields at the centre.

In order to save power and reduce radiation the acceleration process of the model is interrupted periodically so that the ions are collected on the target in "bursts" 25 times a second. The duration of each burst is about 10,000 times the time taken to accelerate an ion to full energy, so the conditions as observed during the burst correspond to continuous operation.

The model consists of a large electro-magnet capable of maintaining a constant field adjustable up to 13,000 gauss in the vertical gap between two cylindrical poles. This volume is evacuated and an electric arc is struck in hydrogen gas which flows slowly into a vertical tube at the centre. Ions from the arc are attracted out and increased in energy by repeated acceleration across a horizontal gap. Under the combined influence of guiding magnetic - and accelerating electric field the ions describe approximately spiral orbits between the poles and are detected as current on targets. The electric field rapidly alternates in sign so as to present an accelerating field to the ions each time they cross the gap. The pole-faces are shaped to produce a guiding field which keeps the time of ion revolution constant as well as focussing the ions into a beam; this is a particular feature of the sector-focussing used in the Variable Energy Cyclotron which gives a continuous beam of accelerated ions. This continuous output is due to the constant revolution time, which enables the frequency of alternation of the electric field to remain fixed so that no waiting periods are required for re-starting a programme of frequency-change as in the synchro-cyclotron and synchrotron.

The model accelerates protons to an energy of 2.5 MeV in an orbit spiralling out to 7" radius in about 40 turns. This corresponds to the first 11" of radius of the Variable Energy Cyclotron. The beam can be observed as a signal level on an oscilloscope or by visual effects on targets viewed through windows in the vacuum enclosure.