THE 1.7 MV TANDETRON ACCELERATOR

The accelerator is a linear tandem type ion-beam accelerator, with a 1.7MV terminal voltage (TV), supplied by High Voltage Engineering Europa, Netherland. In this Tandem Accelerator system, negative ions with energy V_n are extracted from an ion source, analyzed, and then injected into the accelerator, where it accelerates ions in two steps. First, the injected negative ions are accelerated due to the applied electrostatic field (positive high voltage) on the terminal in the middle of accelerating tube. In the terminal, the injected monovalent negative ions are stripped of one or several electrons through charge exchange processes. The stripping of the ions is obtained by using Nitrogen gas, which is injected separately in the middle of the accelerating tube. The beam is now composed of positive ions with a distribution of charge states and these ions are accelerated towards ground potential. The acceleration of each ion depends on its charge state q. The final energy E of the emerging positive ions with charge state q is given by equation

$$E = V_n + (q+1)V_T \quad [\text{in MeV}]$$

where Vn is the energy of the injected negative ions and VT is the terminal voltage (in MV).

This means that particles can be accelerated to the higher energy by charge conversion during the acceleration.

The positive high voltage maintained on the terminal is achieved by a Cockroft and Walton type cascade generator consisting of identical stages of capacitors and rectifiers.

A Tandem accelerator achieves a two-step acceleration with a single voltage by converting the electric charge of a negative ion source on the high-voltage terminal. If a positive ion source is utilized, the ion source has to be placed within the positive high-voltage terminal, which makes the maintenance work very difficult. However, a negative ion is generally more difficult to produce than a positive ion, but the advantages outweigh the difficulties.

A pre-accelerating electrode (*Q-snout*) is mounted on the low energy side of the accelerator. This electrode works in parallel to the first stage of the acceleration voltage in order to collimate and focus the incoming negative particles towards the accelerator centre.

A focusing electrostatic quadrupole doublet is mounted at the end of the high energy side of the accelerator, together with an analyzing magnet and proper X and Y steering systems for focusing of the positive beam onto the samples.