

## PARTICLE ACCELERATORS

Particle physics is one of the main disciplines in physics (and one which even receives some attention in the media from time to time). When CERN (*Centre Européen pour la Recherche Nucleaire*) opened its doors to the general public last year, they were surprised by the vast number of people who wanted to have a closer look at the impressive facilities crossing the border between Switzerland and France.

But how is it possible to accelerate particles much smaller than a needlepoint to almost the speed of light?

### Linear Accelerators (LINACs)

Charged particles can be accelerated in an electric field. The kinetic energy picked up by the particle is proportional to the voltage traversed. The final speed of the particles can be increased by either increasing the electric field or building longer accelerators. Both options are limited, the former by technical limitations, the latter by the budget.

The Linear Accelerator at Stanford (USA) can accelerate electrons to an energy of up to 50 GeV over a distance of 3 km.

### Cyclotrons

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(Source: Bryan Milner, Nuclear and Particle Physics, Advanced Sciences, Cambridge University Press 2001)

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Read the following texts on the main types of particle accelerators (linear accelerator, cyclotron and synchrotron) and answer the following questions.

### Linear Accelerator (LINACs)

- How are charged particles accelerated in a linear accelerator?

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- The tubular electrodes must be longer and longer as the electrons travel down the length of a linear accelerator. Explain why.

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### Cyclotrons

- Draw the top view of a cyclotron accelerator showing the directions of the electric and magnetic field and the forces acting on a proton moving through these fields. What are the respective roles of the electric and the magnetic field in a cyclotron accelerator?

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- Why is it possible to accelerate particles at different points in the accelerator using the same accelerating potential difference?

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### Synchrotron

- Describe the principal differences between a cyclotron and a synchrotron.

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- What is the major drawback of synchrotrons if compared to linear accelerators?

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