

# References and exercises

# Material

- Brochures published by the Division of Physics of Beams of the American Physical Society (APS/DPB): "Accelerators and Beams: Tools of discovery and Innovation"

[http://www.aps.org/units/dpb/upload/accel\\_beams\\_2013.pdf](http://www.aps.org/units/dpb/upload/accel_beams_2013.pdf)

- Interesting movie, built for the ASP2010, explaining the LHC operation. See it at:

<https://indico.esss.lu.se/event/378/contribution/25/material/video/0.m4v>

- More materials used for the previous ASP edition are available at:

ASP2010: <http://indico.cern.ch/event/78565/other-view?view=standard>

ASP2012: <http://indico.cern.ch/event/145296/other-view?view=standard>

ASP2014: <https://indico.cern.ch/event/276481/other-view?view=standard>

ASP2016: <https://indico.cern.ch/event/528094/other-view?view=atlas>

- The link to the Nordic particle Accelerator School and Program:

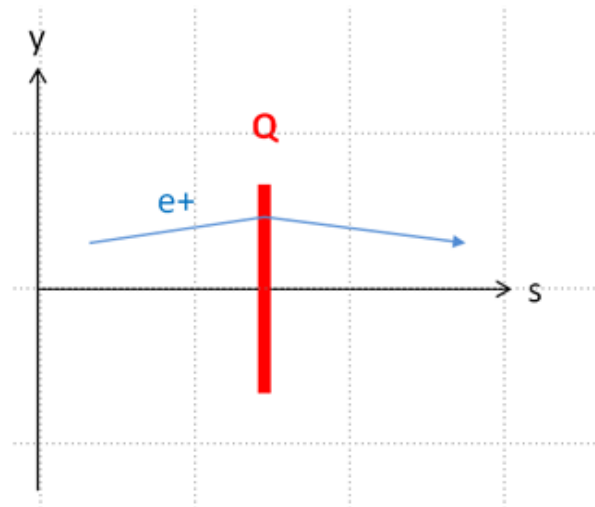
<https://npap.eu/>

# Homework

- The velocity of a 1 GeV proton with respect to the velocity of a 1 MeV electron is
- A – larger
- B – the same
- C - smaller

A positron is focused in the vertical plane by the quadrupole of the figure. An electron with the same energy enter the quadrupole in the opposite direction with coordinates  $(x, x', y, y') = (-0.1 \text{ mm}, 1.2 \text{ mrad}, 0 \text{ mm}, 0.0 \text{ mrad})$

- A – is horizontally focused
- B - is horizontally defocused



The horizontal emittance in a linac for protons is accelerated from 200 keV to 2 MeV. Its horizontal emittance, disregarding space charge,

A – increases

B – decreases

C - remains constant

A synchrotron for electrons at 3 GeV has a magnetic structure with 36 dipoles. The magnetic field in the dipoles is 1.5 T. The bending radius in the dipoles is

sincrotrón para electrones de 3 GeV tiene una estructura magnética con 36 dipolos.

A – less than 10 m

B – equal to 10 m

C – larger than 10 m