The DELPHI experiment
at
the LEP accelerator
at
the CERN laboratory

Part 1. The LEP accelerator
Part 2. The DELPHI experiment
Part 3. Particle physics research at LEP
The LEP accelerator

The study of collisions between electrons and positrons.

LEP 1: The collision energy = 91 GeV = Z
LEP 2: The collision energy = 209 GeV > 2W
The largest accelerators in the world

**LEP**
(CERN)

- **Length:** 27 km (4184 magnets)
- **Experiments:** DELPHI, OPAL, ALEPH, L3

**HERA**
(DESY)

- **Length:** 6 km (1650 magnets)
- **Experiments:** H1, ZEUS

**TEVATRON**
(FERMILAB)

- **Length:** 6 km (990 magnets)
- **Experiments:** CDF, D0
CERN's Chain of Accelerators

LEP/LHC

SPS

Linacs, proton, ion

ISOLDE

BOOSTER

PS

EPA

LIL, $e^+e^-$ linacs

AD (In preparation)

$p$ (antiproton), $\bar{p}$ (proton), ion

$e^+$ (positron), $e^-$ (electron)

proton/antiproton conversion

LIL : Linear Injector for LEP
EPA : Electron-Positron Accumulator
PS : Proton Synchrotron

SPS : Super Proton Synchrotron
LEP : Large Electron-Positron Collider
LHC : Large Hadron Collider
In order to increase the collision energy one had to build 240 superconducting radio-frequency cavities.

Accelerating gradient = 6 MV / m
Frequency = 352 MHz

The energy lost due to synchrotron radiation is 2.3 GeV / turn

Radio-frequency accelerating voltage has to be 2.3 GV / turn

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Collision energy (GeV)</td>
<td>91</td>
<td>136</td>
<td>174</td>
<td>184</td>
<td>189</td>
<td>204</td>
<td>209</td>
</tr>
</tbody>
</table>
The collision energy

At LEP the collision energy could be determined with a very high accuracy:

91.187 GeV with an error of 0.002 GeV

Things which affected the energy of LEP:

1. The level of the water in the lake!
2. The moon!
3. The trains to Paris!
During 1993 the LEP energy was observed to change with time.

Part of the change was due to the water level in lake Geneva which caused small geological shifts of the accelerator.

Rainfalls and the water table in the Jura mountains also affected the LEP energy.
Tides

Earth tides caused by the moon will produce small distortions of the earth’s crust.

This can affect the accelerator so that the electrons orbit change.

An orbit change of 1 mm will change the energy with about 10 MeV.
Beampipe current

The trains from Geneva to France caused parasitic currents on the LEP beampipe.

These currents (1 A) affected the magnetic field in the LEP magnets and this changed the energy.
The DELPHI experiment

- Delphi
- STIC
- Electromagnetic calorimeter
- Hadronic calorimeter
- Muon detector
- Tracking detector
- Barrel Muon Chambers
- Barrel Hadron Calorimeter
- Scintillators
- Superconducting Coil
- High Density Projection Chamber
- Outer Detector
- Barrel RICH
- Small Angle Tile Calorimeter
- Quadrupole
- Very Small Angle Tagger
- Beam Pipe
- Vertex Detector
- Time Projection Chamber
- Inner Detector
- Forward Chamber A
- Forward RICH
- Forward Chamber B
- Forward EM Calorimeter
- Forward Hadron Calorimeter
- Forward Hodoscope
- Forward Muon Chambers
- Surround Muon Chambers
Cross-section

Collision energy