

**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

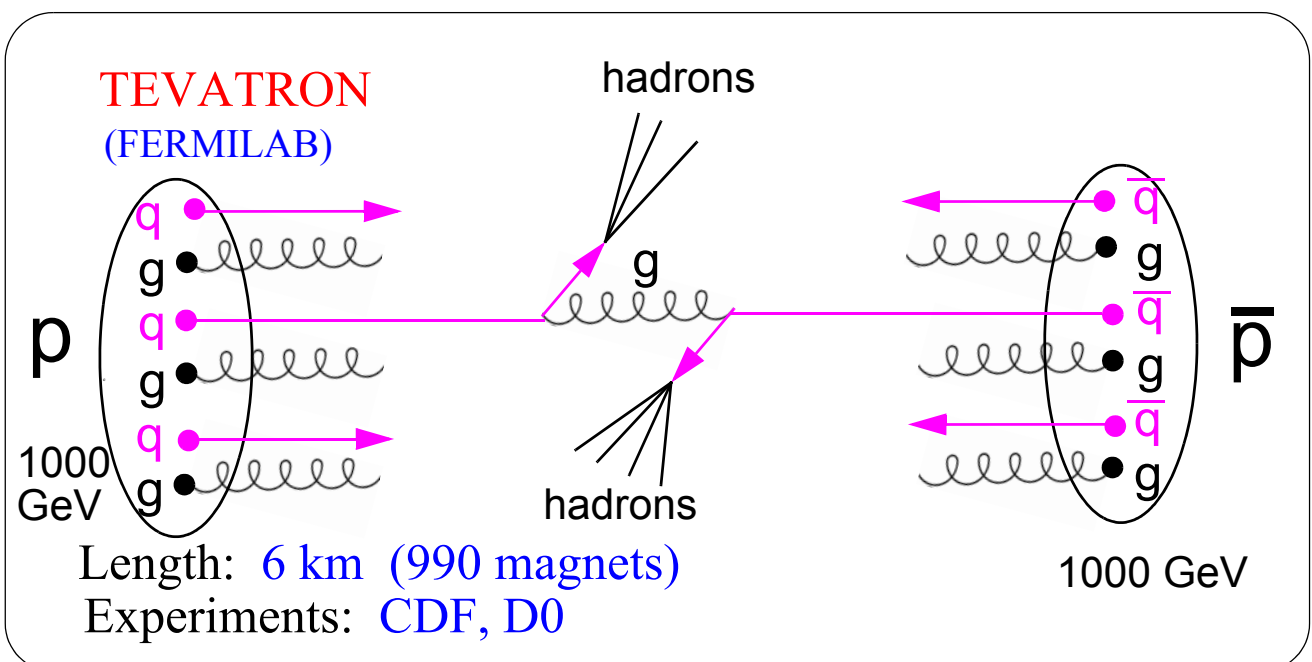
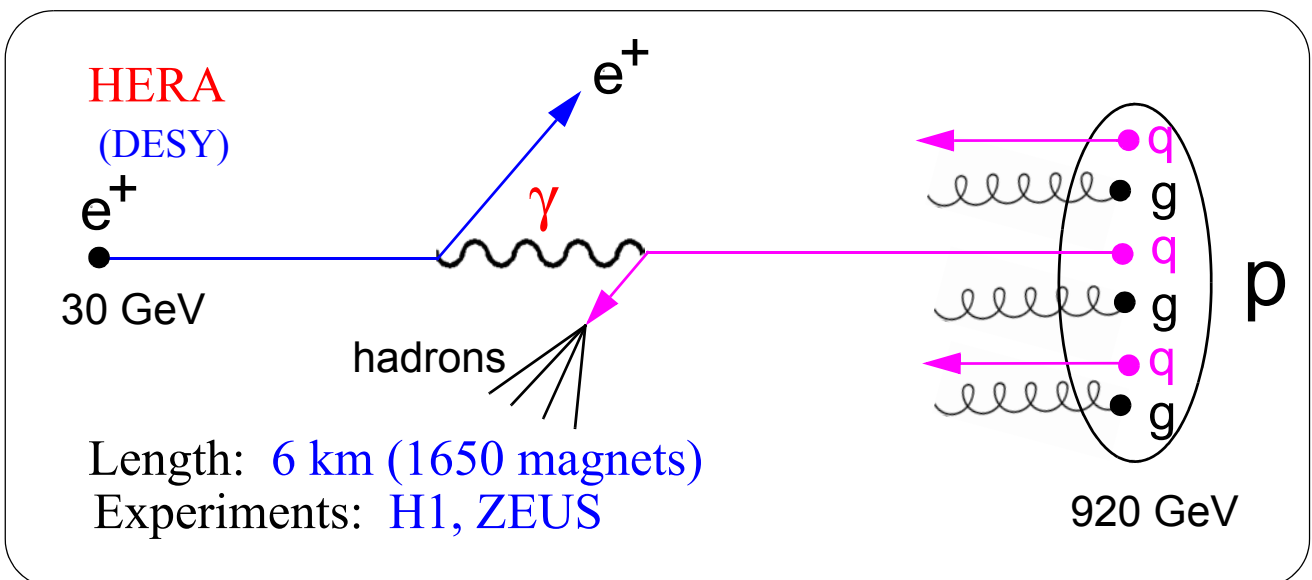
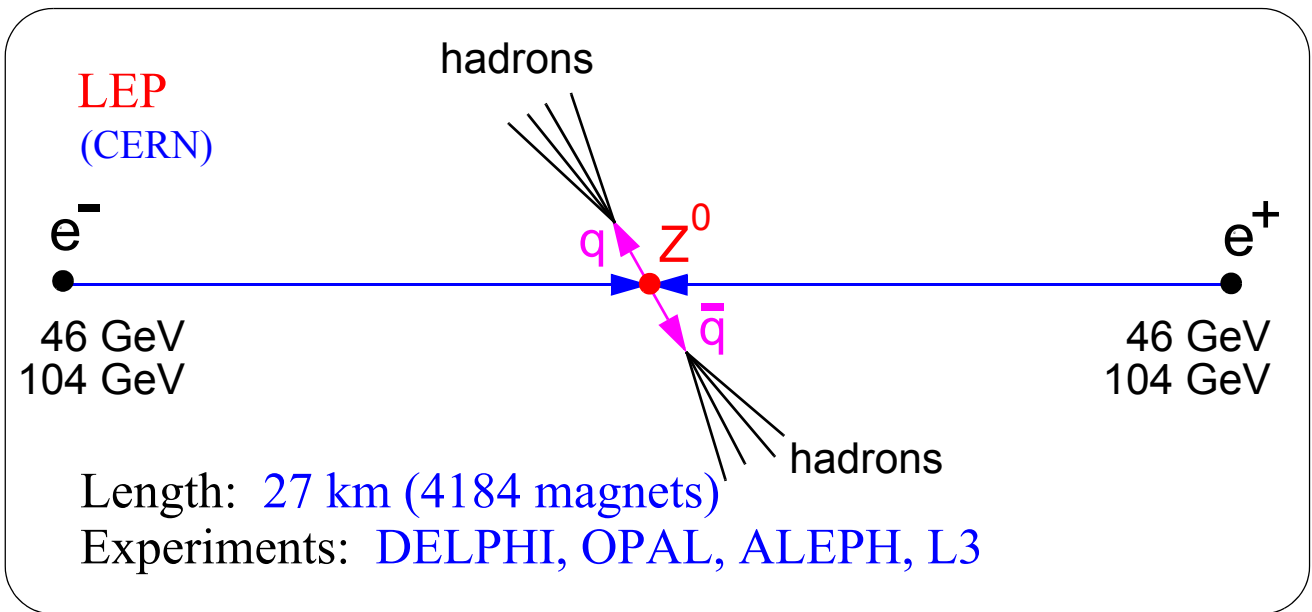
# The LEP accelerator

The study of collisions between electrons and positrons.

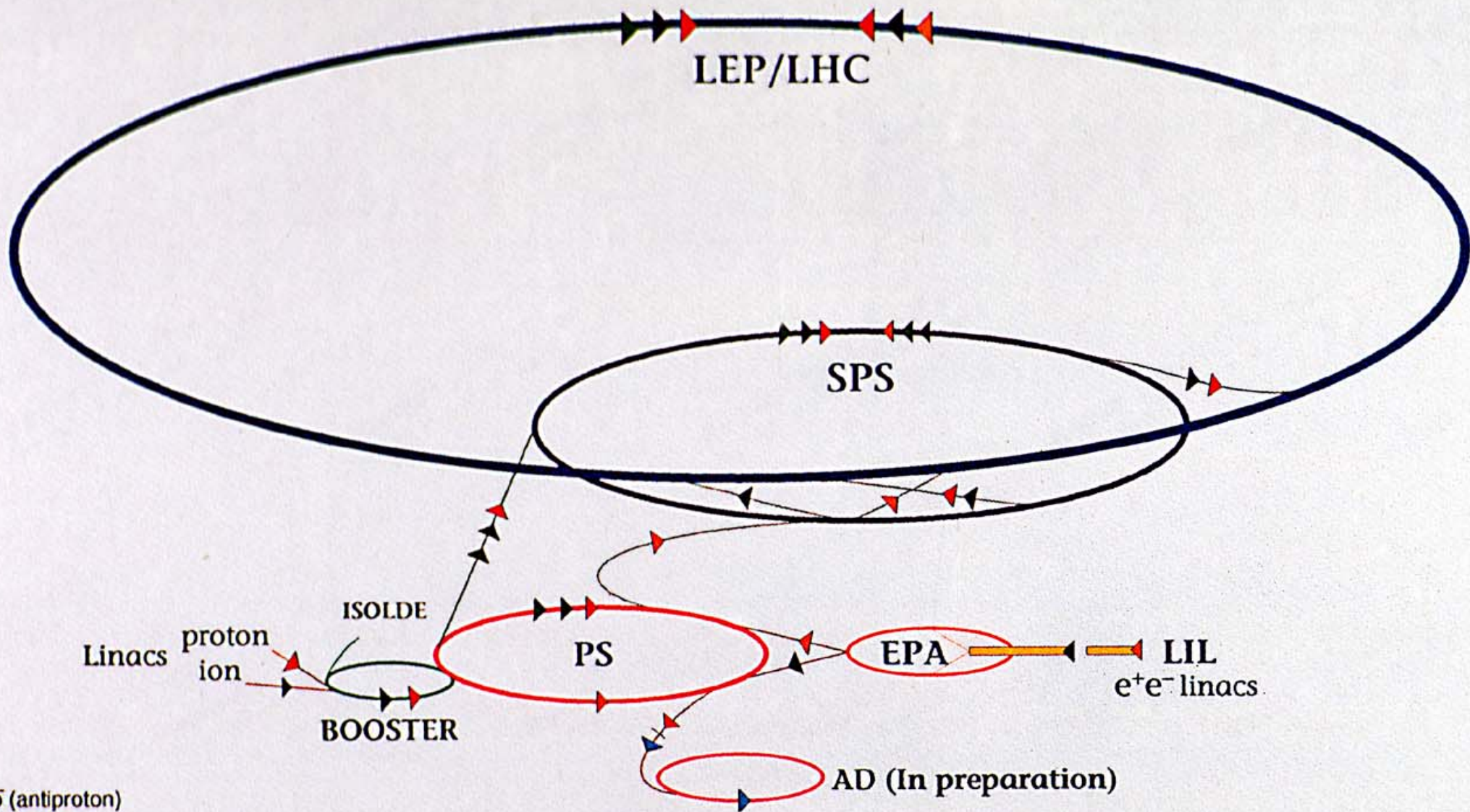
LEP 1 : The collision energy = 91 GeV = Z

LEP 2: The collision energy = 209 GeV > 2W

# The largest accelerators in the world



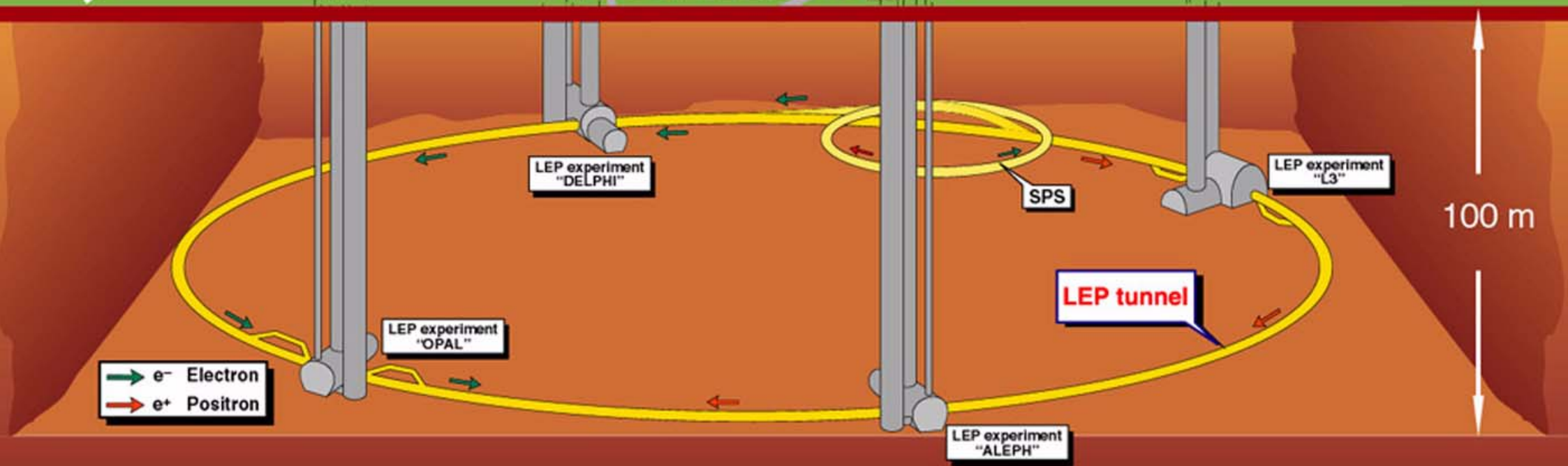
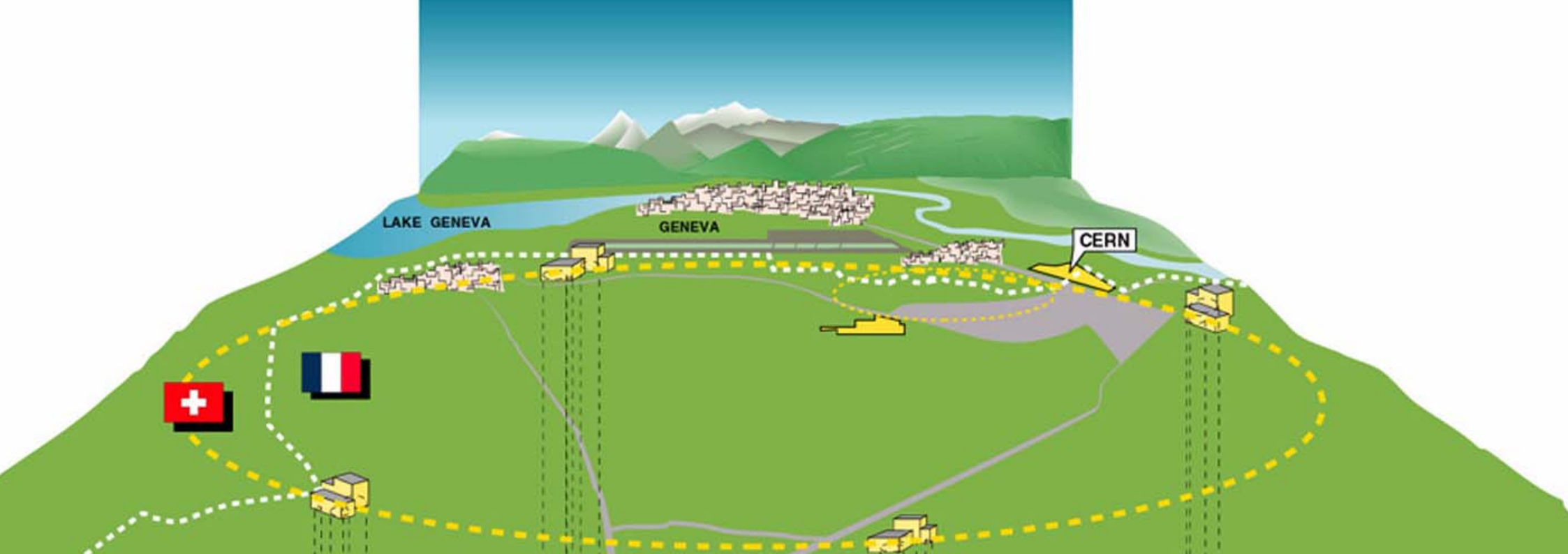
# CERN's Chain of Accelerators



- $\bar{p}$  (antiproton)
- p (proton)
- ion
- $e^+$  (positron)
- $e^-$  (electron)
- proton/antiproton conversion

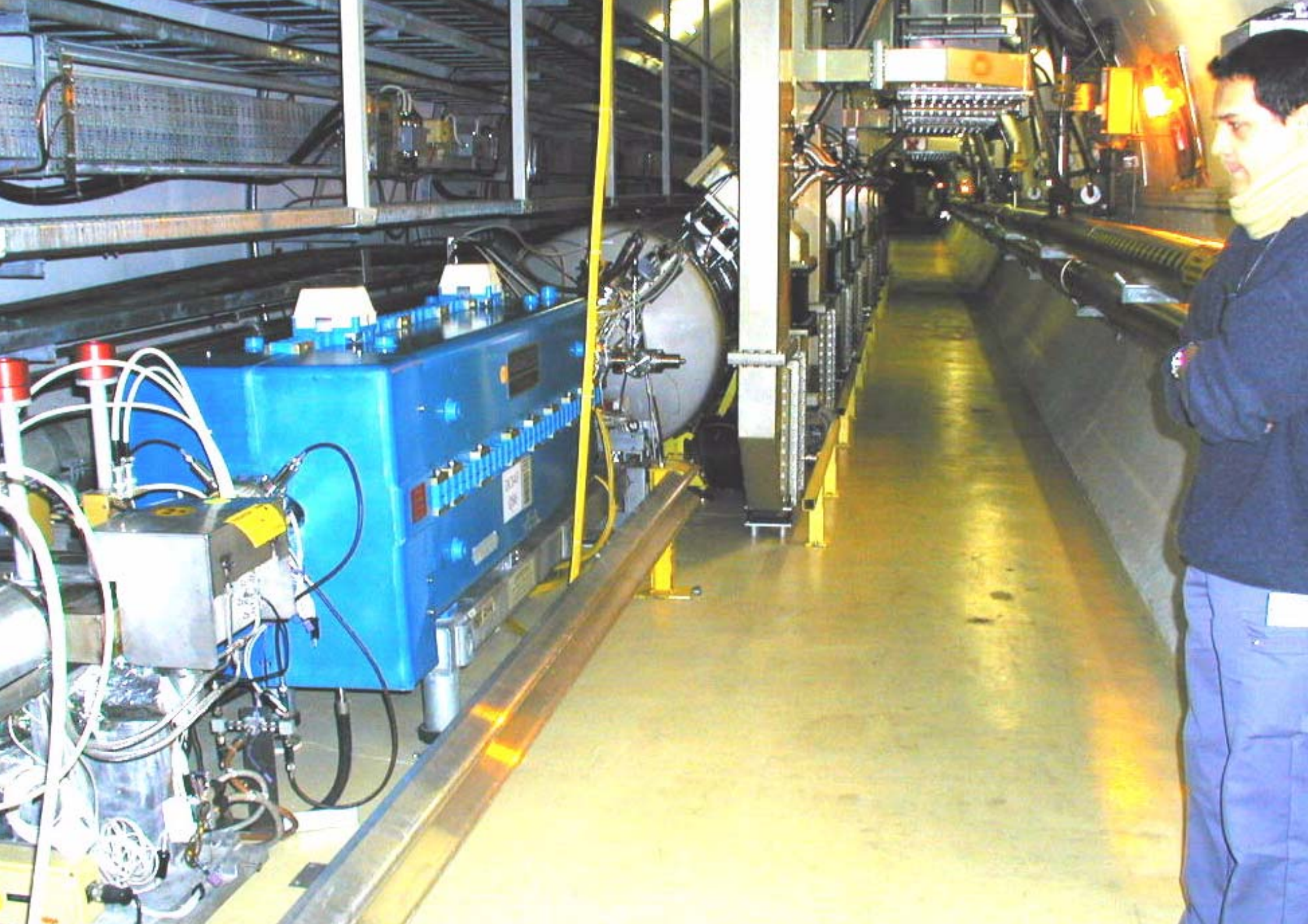
**LIL** : Linear Injector for LEP  
**EPA** : Electron-Positron Accumulator  
**PS** : Proton Synchrotron

**SPS** : Super Proton Synchrotron  
**LEP** : Large Electron-Positron Collider  
**LHC** : Large Hadron Collider







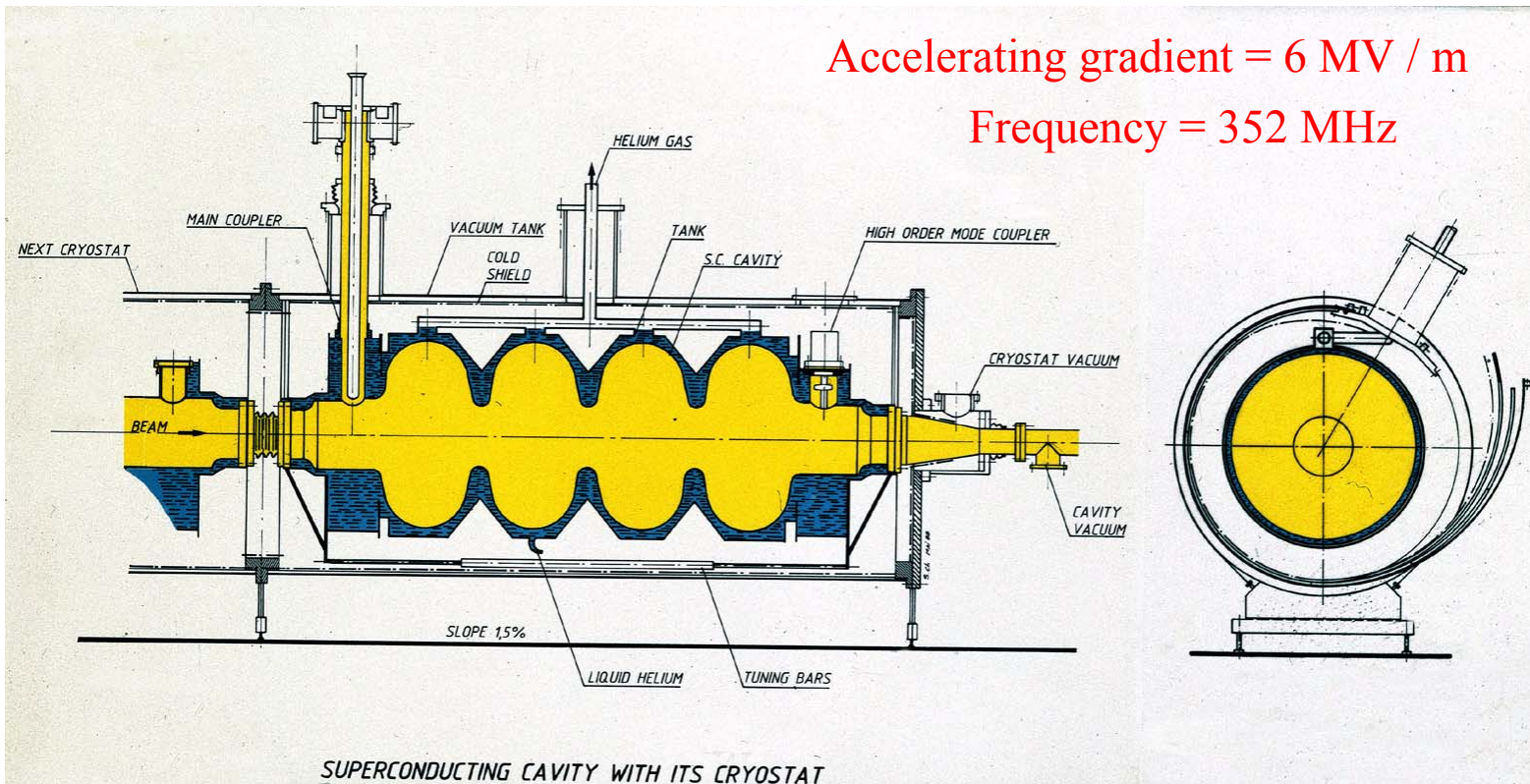






# LEP 1 $\longrightarrow$ LEP 2

In order to increase the collision energy one had to build 240 superconducting radio-frequency cavities.



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



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

Year:	1989-94	1995	1996	1997	1998	1999	2000
Collision energy: (GeV)	91	136	174	184	189	204	209



# The collision energy

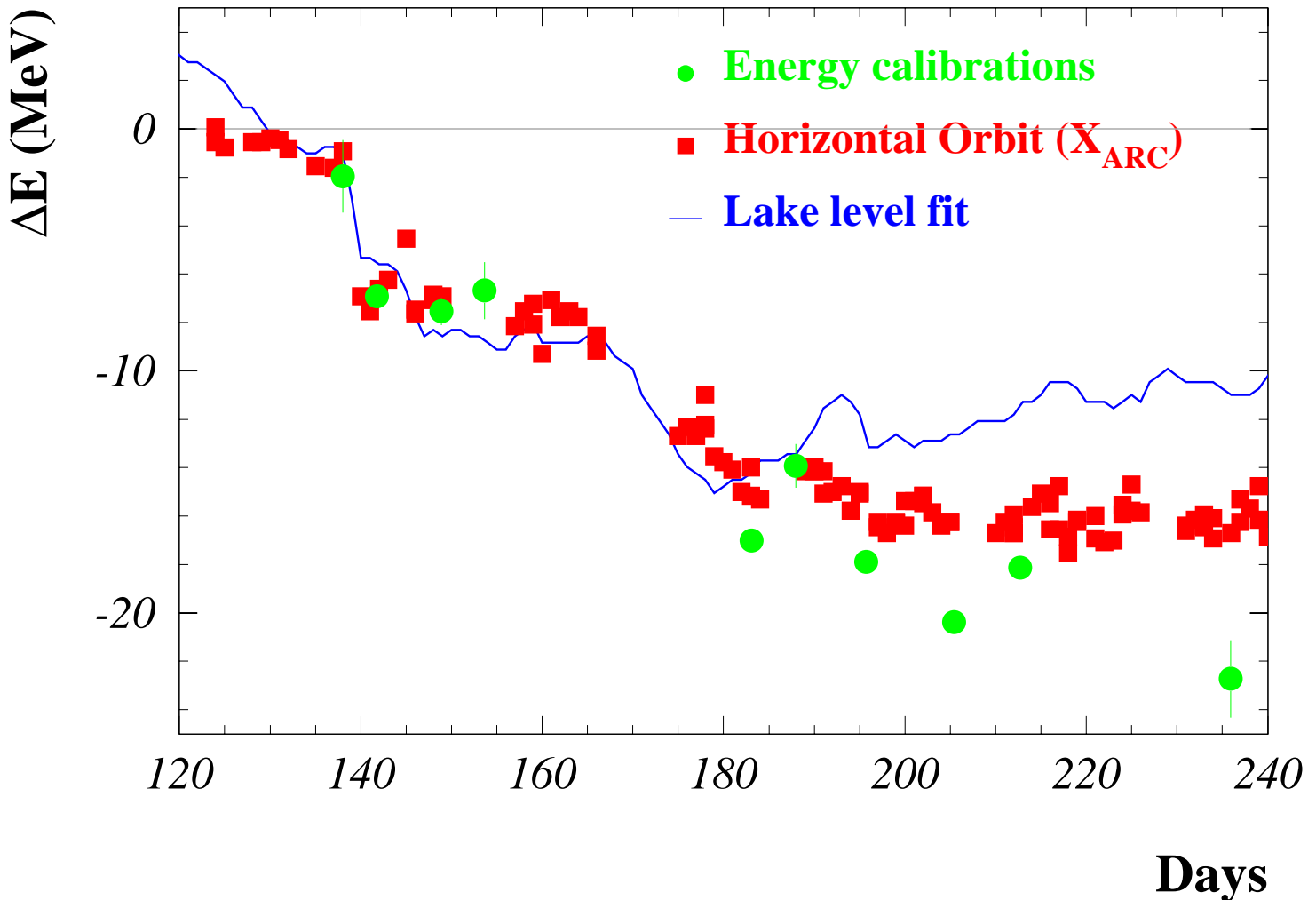
At LEP the collision energy could be determined  
with a very high accuracy:

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 !

# Geological shifts

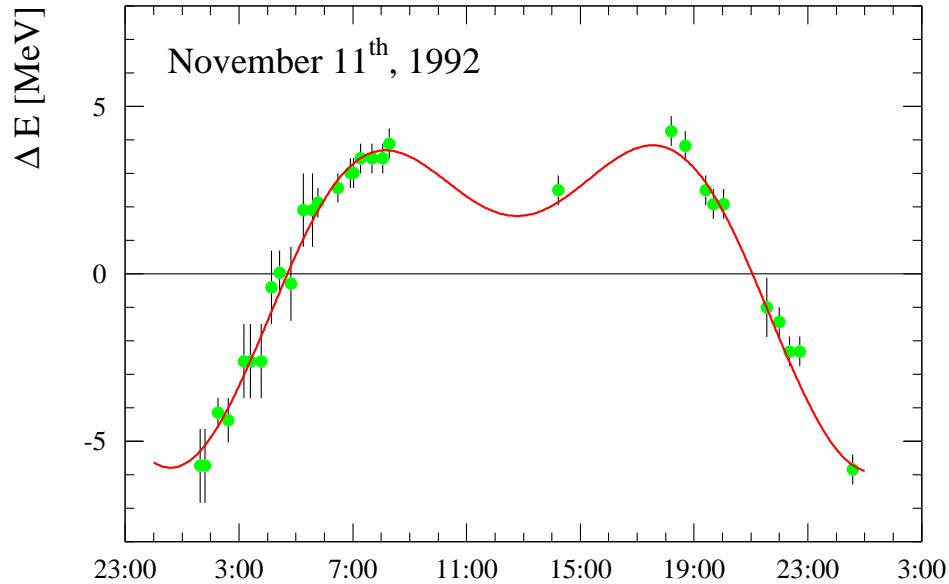


During 1993 the LEP energy was observed to change with time.

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

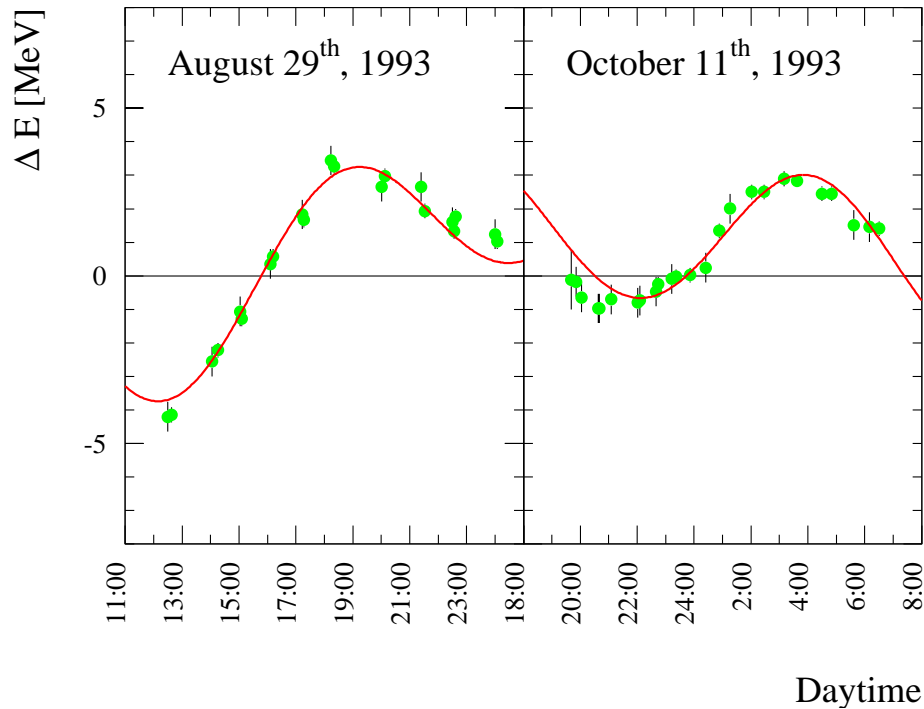
Rainfalls and the water table in the Jura mountains also affected the LEP energy.

# 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.

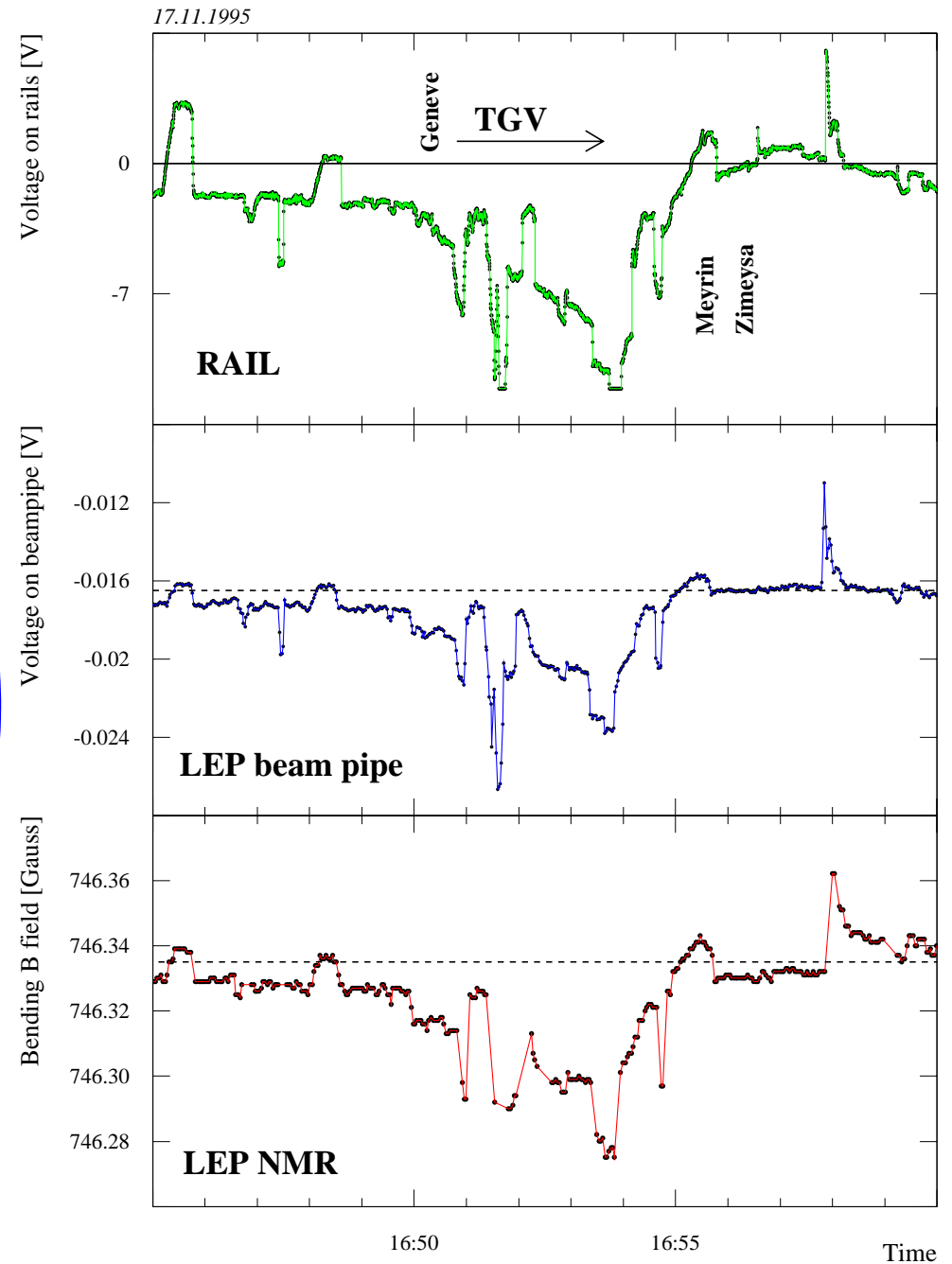
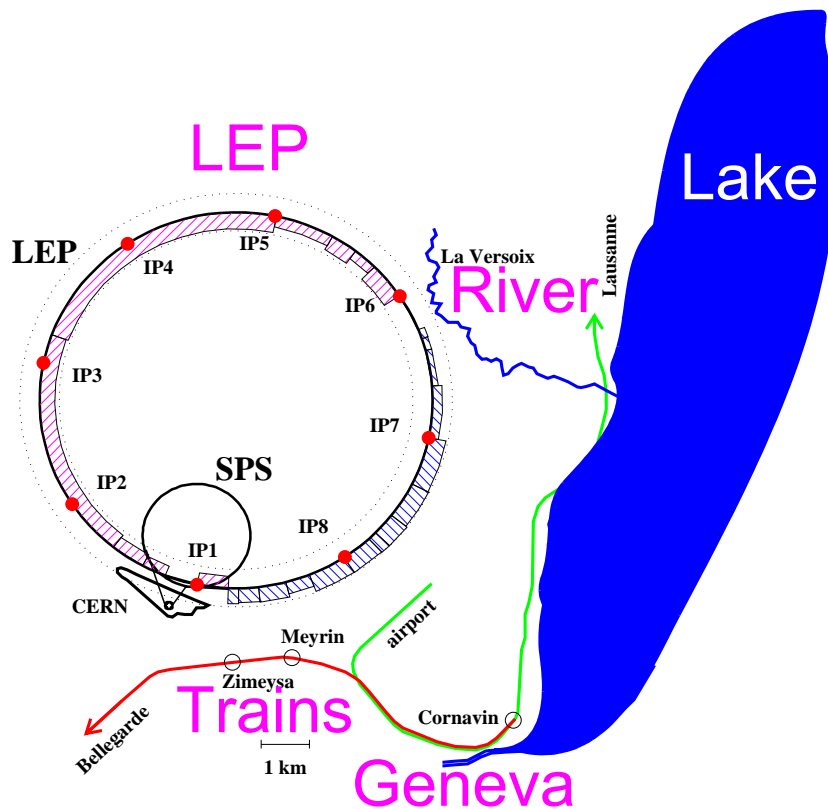


An orbit change of 1 mm will change the energy with about 10 MeV.

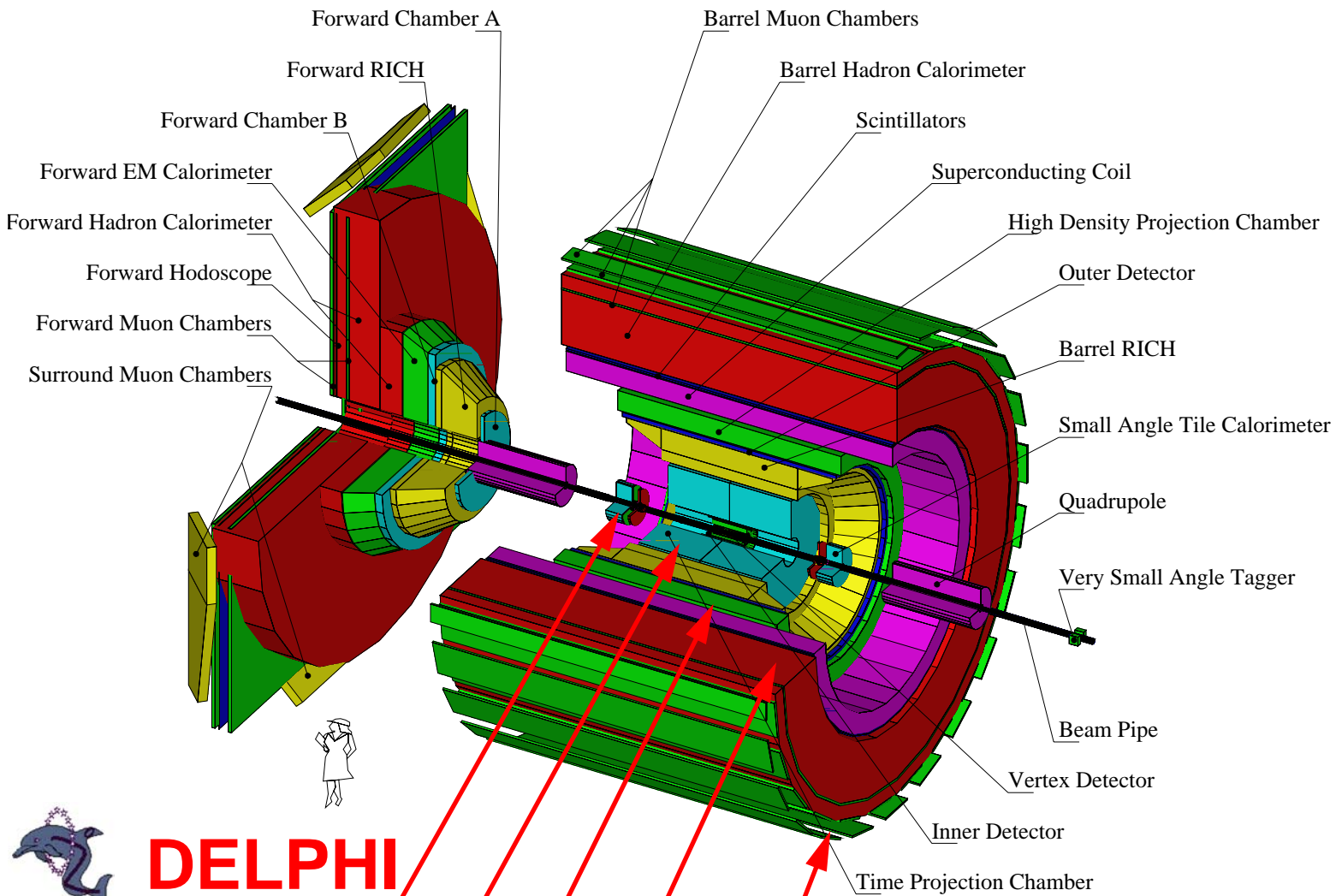
# Beampipe current

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**  
**Tracking detector**

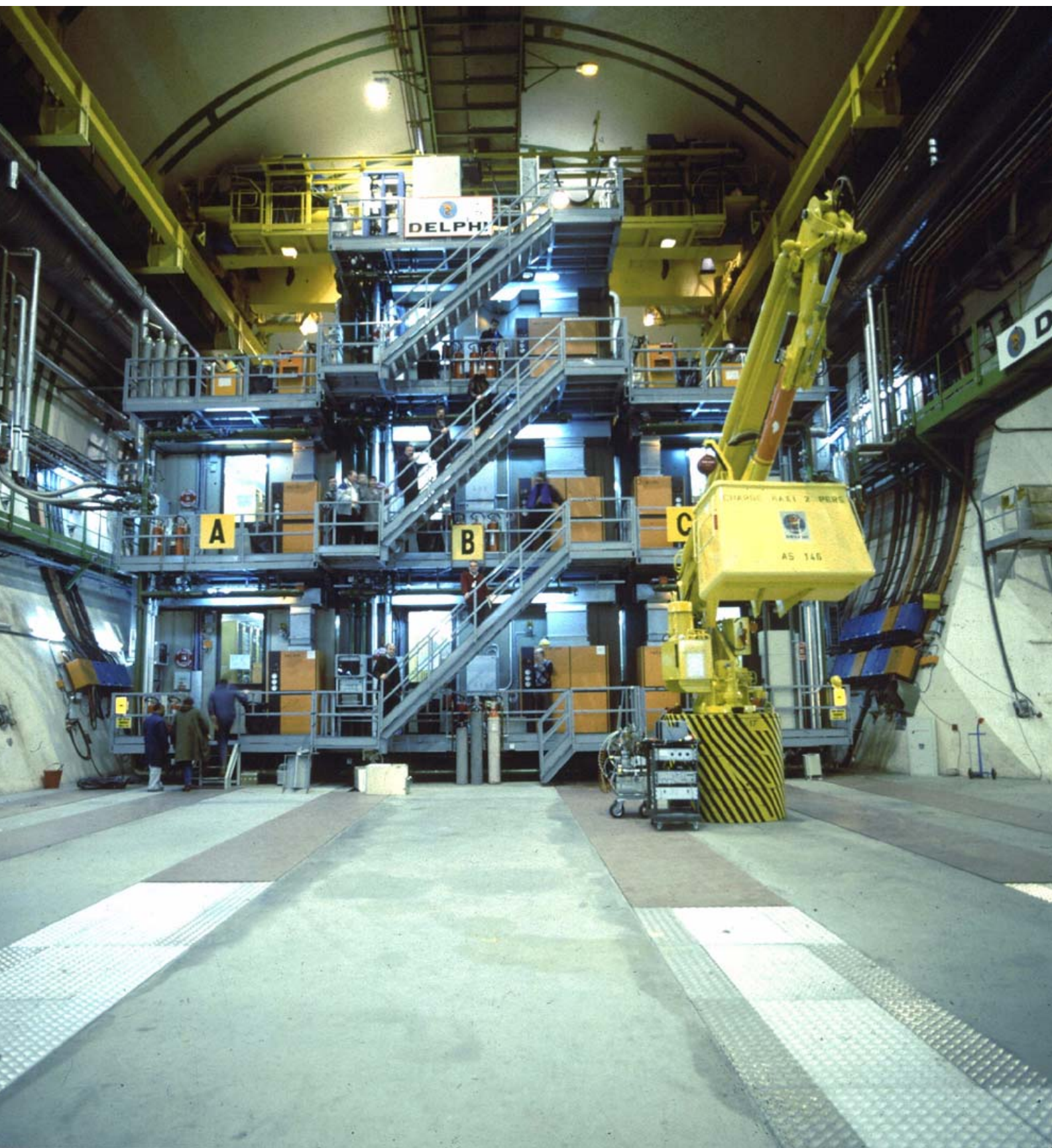
**Electromagnetic calorimeter**

**Hadronic calorimeter**

**Muon detector**

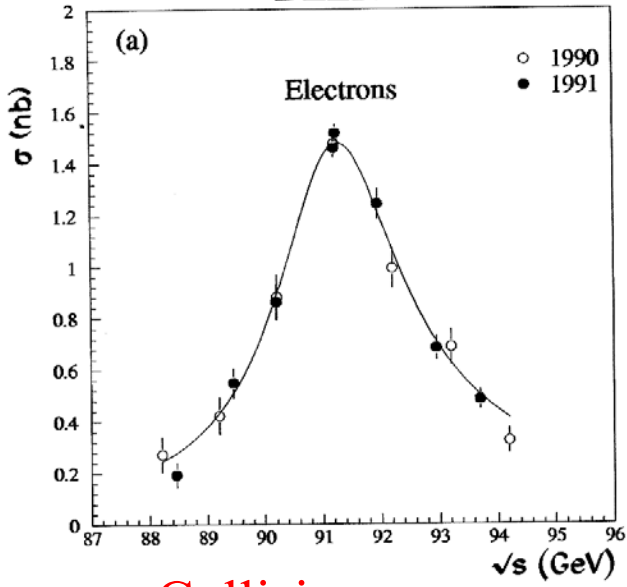




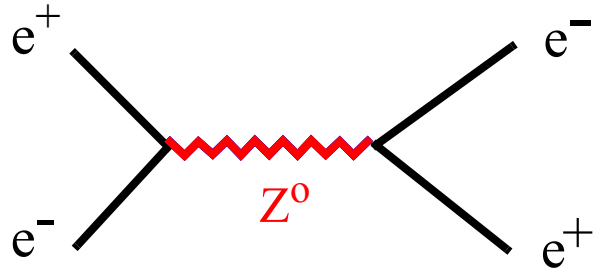


# Cross-section

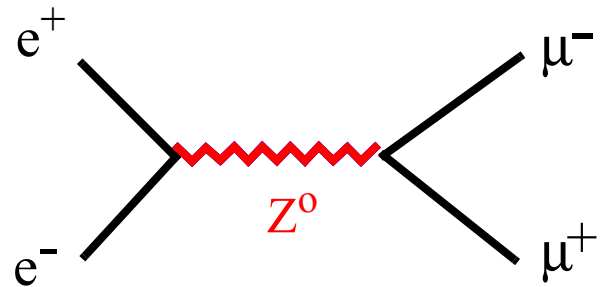
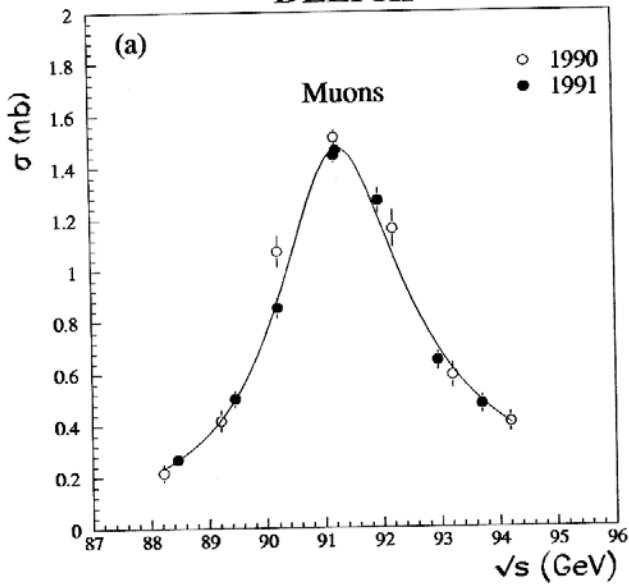
DELPHI



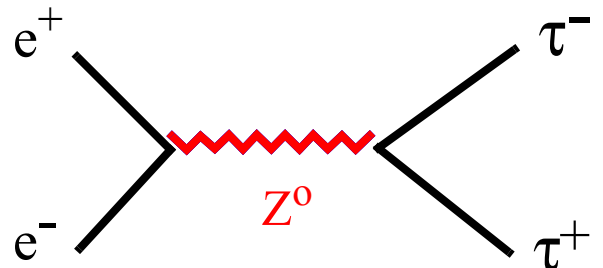
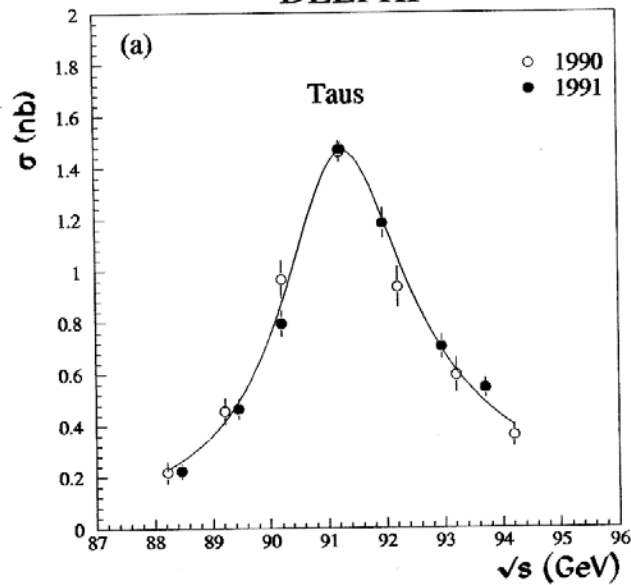
Collision energy

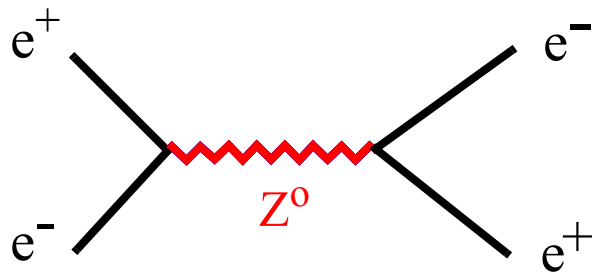


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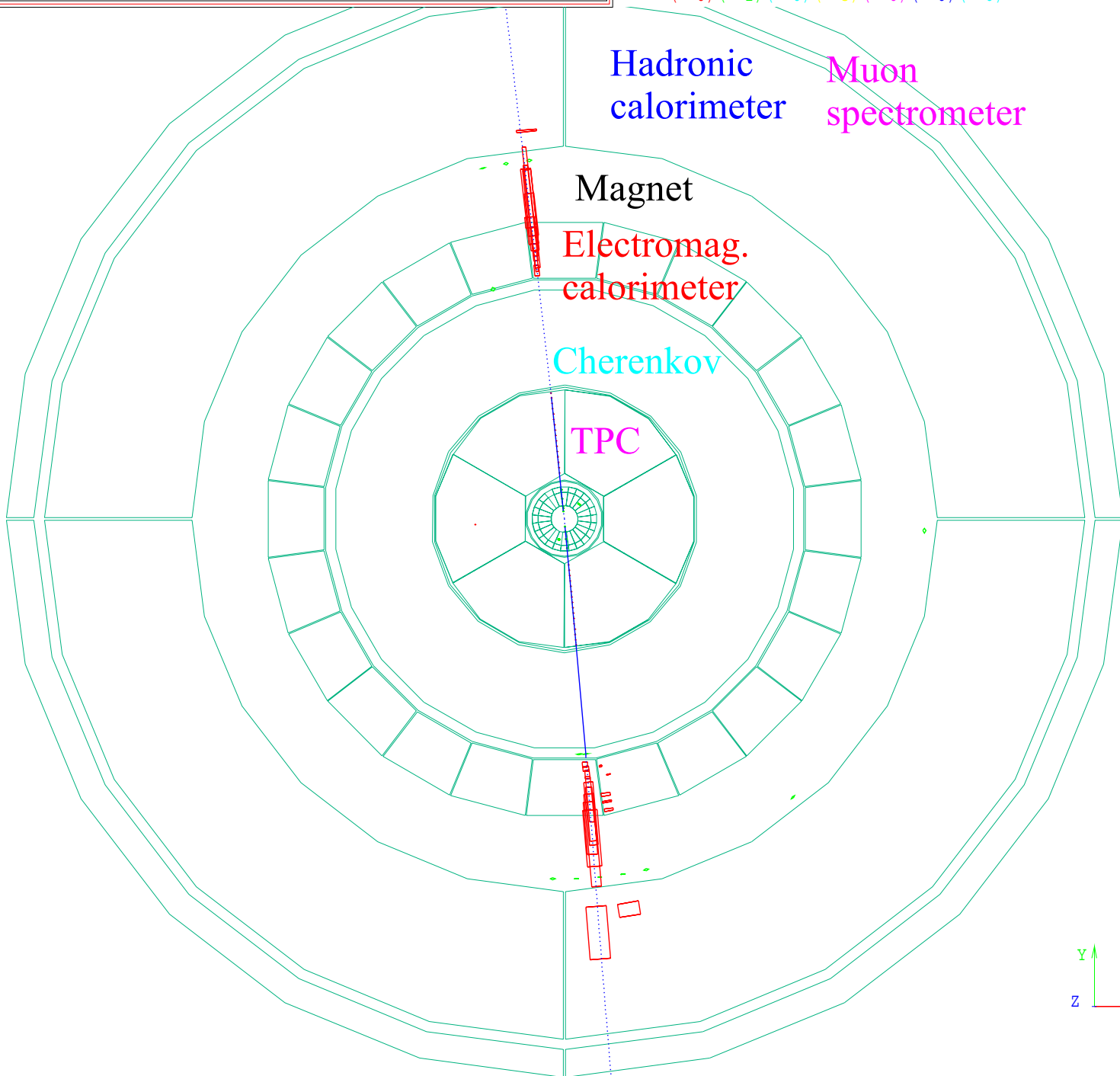




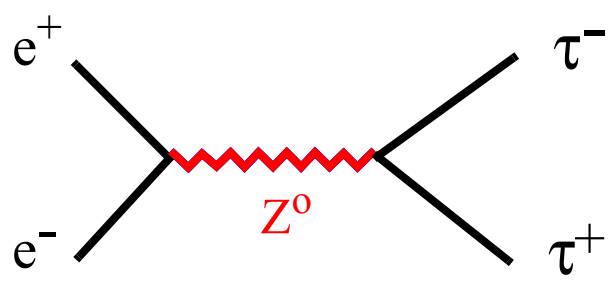
### DELPHI Interactive Analysis

Beam: 45.6 GeV    Run: 26154    DAS : 25-Aug-1991  
 21:46:38  
 Proc: 1-Oct-1991    Evt: 2958    Scan: 4-Dec-1992

	TD	TE	TS	TK	TV	ST	PA
Act	1	35	0	2	0	0	0
	( 37)	( 35)	( 0)	( 4)	( 0)	( 0)	( 0)
Deact	0	0	0	0	0	0	0
	( 0)	( 1)	( 0)	( 3)	( 0)	( 0)	( 0)







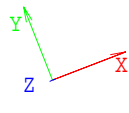
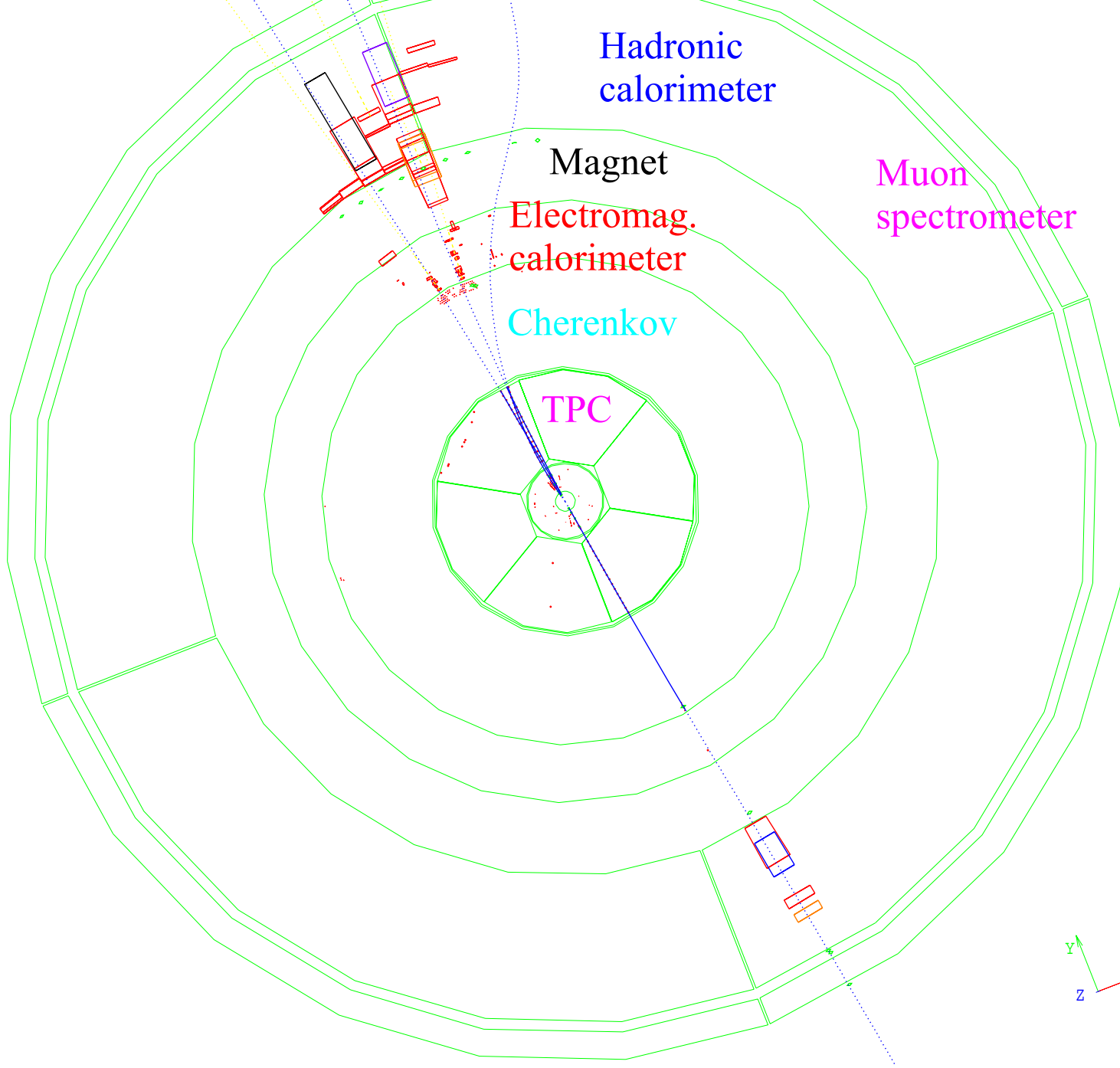
**DELPHI Interactive Analysis**

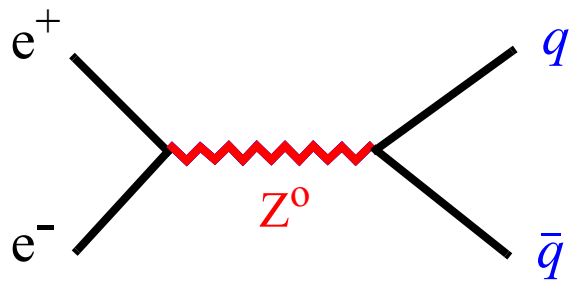
Beam: 45.6 GeV    Run: 23438    DAS : 18-Jun-1991

Proc: 8-Mar-1992    Evt: 581    03:22:19

Scan: 29-Apr-1992

	TD	TE	TS	TK	TV	ST	PA
Act	44	45	0	8	0	0	0
	( 44)	( 48)	( 0)	( 9)	( 9)	( 0)	( 0)
Deact	0	0	0	0	0	0	0
	( 0)	( 4)	( 0)	( 6)	( 5)	( 0)	( 0)





## DELPHI Interactive Analysis

Beam: 45.6 GeV    Run: 26154    DAS : 25-Aug-1991  
 21:47:02  
 Proc: 1-Oct-1991    Evt: 3018    Scan: 19-Feb-1992

	TD	TE	TS	TK	TV	ST	PA
Act	14	72	0	17	0	0	0
	( 93)	(133)	( 0)	( 23)	( 18)	( 0)	( 0)
Deact	0	0	0	0	0	0	0
	( 0)	( 13)	( 0)	( 23)	( 12)	( 0)	( 0)

