1 The Time Projection Chamber (TPC)

Description: Cylindrical drift volume with central electrode and planar wire chambers at the two ends. Electrons from ionization drift to the endplates along the electric field of 11 kV/m. Their charge is recorded by a system of proportional wires which are capacitively coupled to cathode readout pads. Each endcap has 6 inner sectors (type K) and 12 outer sectors (types M and W). Sectors have concentrical rows of pads for 3 dimensional coordinate measurement ($r\phi$ from pad position, z from drift time). Wires across the sectors are used for dE/dx measurements. Each sector is equipped with special trigger padrows.
Gas: $ArCH_4$ (91 % : 9%) at atmospheric pressure.

Dimension:

Radius:	R_{outer} = 1.8 m	R_{inner} = 0.31 m
Overall length	4.7 m	
Drift length	2 × 2.2 m	
Weight	3.6 t (with cables)	
Gas volume	$43m^3$	
Radiation length:	inner fieldcage	0.023 X_0
	outer fieldcage	0.048 X_0
	endplate	0.35 X_0

Sectors:	R_{min}	R_{max}	No. padrows	No. trig. padrows	No. wires
Type K	38 cm	91cm	9	8	148
Type W,M	100 cm	170cm	12	11	196

Pad size	$6.2 \times 30mm^2$
Pitch in r-ϕ	6.7 mm
Triggerpad size	6.8 mm $\times 15^0$
Sense wire spacing	4 mm
Sense wire diameter	20 μm
Field wire diameter	127 μm
Diameter of other wires	76 μm
Central electrode thickness	25 μm

Gas Properties:

Drift velocity	5.2cm/μs
Longitudinal diffusion	4mm/$\sqrt{m}$ per single electron.
Transverse diffusion (B=15kG)	0.8mm/$\sqrt{m}$ per single electron.
Specific ionization for min. i. p. (mean)	90 electrons/cm

Electronics:

Sampling rate of digitization	11.4 Mhz
Pulse width of shaped signal (FWHM)	300 ns for 1 m drift
Electronic errors for:	
Calibration (channel vs. channel):	gain = 1 %
	time = 6 ns
$r\phi$ - measurement (total)	$\leq 70\mu m$
z - measurement (total)	$\leq 0.5mm (\equiv 10ns)$

Readout:

	pads	wires	total
Channels	2×20502	2×3168	47340
TPDs	660	108	768
TPPs	36	36	72

Performance:

$r\phi$ spatial resolution	$180\mu m$ at 0^0 pad crossing angle
z spatial resolution	1.2 mm (wires) with "small" z dependence
	0.8 mm (pads) at $\theta = 90^0$
Momentum resolution	$\Delta p/p^2 =$
	TPC only: $1.2 \times 10^{-3} (GeV/c)^{-1}$ at 45 GeV
	ITC + TPC: $0.8 \times 10^{-3} (GeV/c)^{-1}$ at 45 GeV
dE/dx resolution	4.5% for Bhabha electrons