Status of the ZEUS Detector

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1. Introduction
2. Overview of the Zeus detector
(3. Recent results of calorimeter tests)
4. Summary

The ZEUS starts experiment in
Nov. 1990 !!

1. Introduction

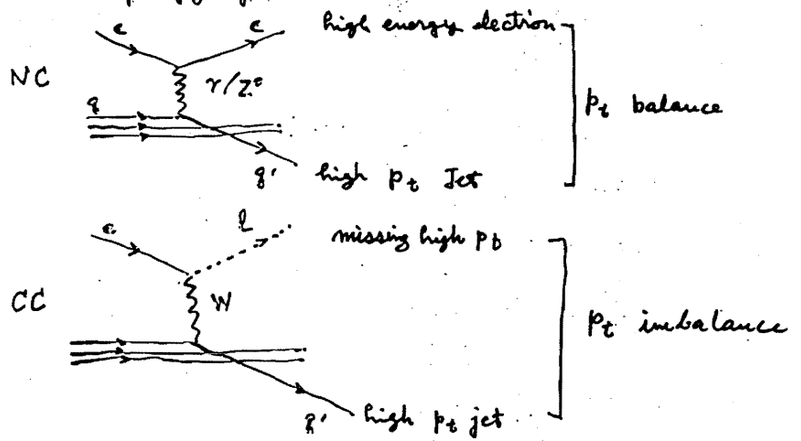
DESY (Hamburg, BRD)
HERA (See Fig. 1 and Table 1)
e (30 Gev) - p (820 Gev) collider

Electron-Quark collider ; Unique!!
$Q^2_{max} \simeq 10^5$ Gev^2

Interesting Physics
- Neutral and charged current reactions
⇒ Study of { the quark and gluon distributions of proton / the structures of the electroweak currents

NC and CC measurements up to
$Q^2 \simeq 30.000 - 40.000$ Gev^2

- Topology of NC and CC events



⇒ A calorimeter of the best known hadron energy resolution = ZEUS

- Measurement of the NC and CC cross sections
  - Electron and quark substructure
    structure as small as $3 \cdot 10^{-18}$ cm
  - Properties of the electroweak current
    deep inelastic cross section → New W/Z's up to 500 GeV
    possibility of longitudinally polarized $e^{\pm}$ beams
    → asymmetry measurements
  - QCD interactions
    measurements of the quark and gluon structure functions in a wider Q^2-range
    ⇒ $\alpha_s(Q^2)$

- The photon-gluon and W-gluon fusion
  (presence of heavy quarks, c, b, t)

- Search for Exotic Particles
  Leptoquarks, heavy leptons, SUSY particles ....
  mass scale up to 180 GeV

- Requirements for the Detector
  - hermetic electromagnetic and hadronic calorimeter
    $e/h = 1$ ⟺ the best possible hadron energy resolution
  - tracking detectors : high track densities in the proton direction
  - e/μ identification
  -
  -

2 Overview of the Zeus Detector

1. Central Track Detector (CTD)
   - Cylindrical jet type drift chamber (CDF)
   - Size 85 cm (r) × 240 cm (ℓ)
   - 9 stereo superlayers (≈ 4600 sense wires) { 5 super layers, 0° ; 4 super layers, 5° & 7°
   - Resolution ~ 100 μm
     $\Delta p/p = 0.0018\, p \oplus 0.0027$ (p in GeV/c)
     for $B = 1.8$ Tesla
   - Transition Radiation Detector (TRD)
   - Planer drift chambers (FTD, RTD)
   - Vertex chamber (VXD)
   - Thin solenoid magnet
     $B_{max}(z=0) = 1.8$ Tesla

2. Calorimeters
   - High resolution calorimeters (FCAL, BCAL, RCAL)
   - ‖ compensation $e/h \approx 1$
     best possible energy resolution for hadrons
   - 3.3 mm thick depleted uranium plate + 2.6 mm plastic scintillator
   - Read out by wave length shifter on left and right sides
   - Resolution for electron
     $\sigma(E)/E = 0.15/\sqrt{E} \oplus 2\%$ (E in GeV)
     for hadron
     $\sigma(E)/E = 0.35/\sqrt{E} \oplus 2\%$

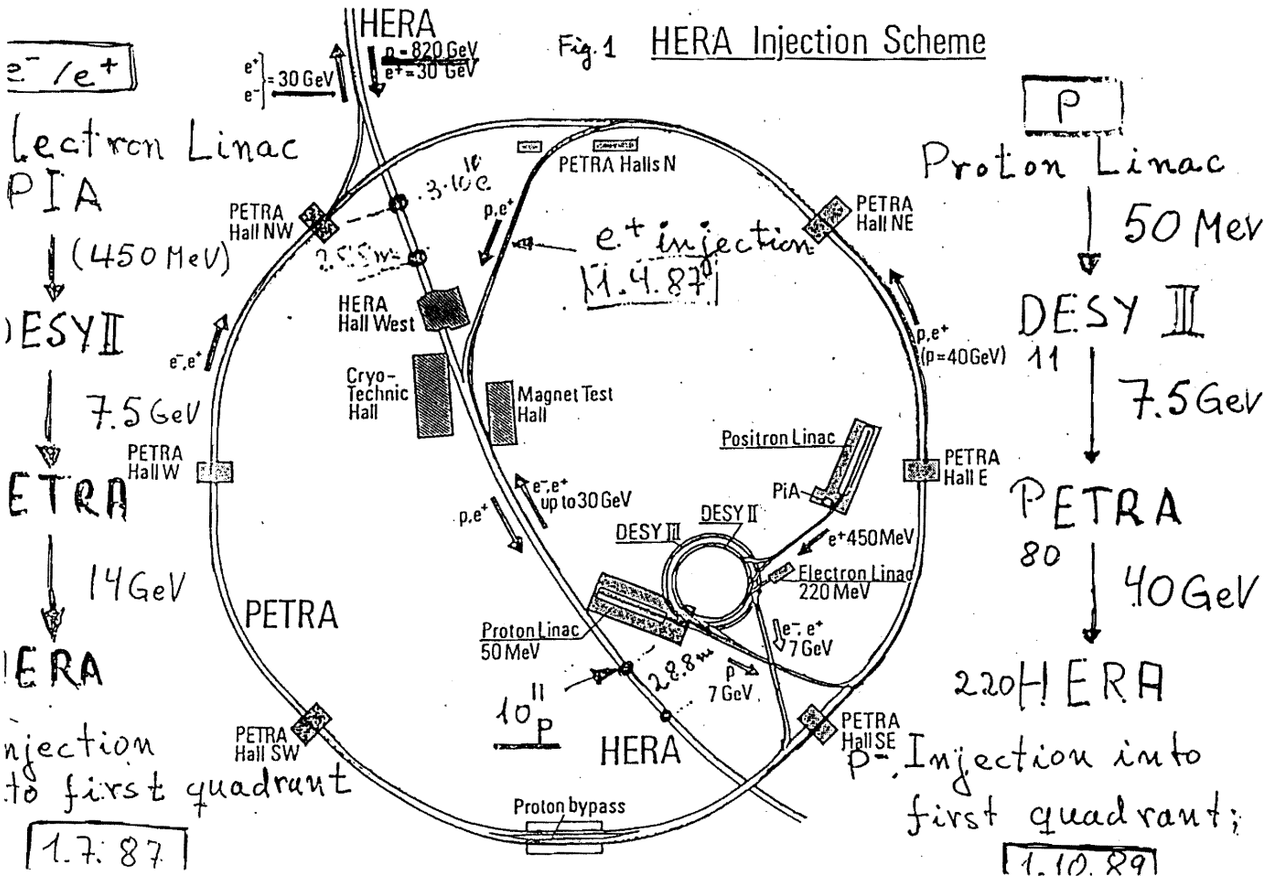


Fig. 1 HERA Injection Scheme

- Backing calorimeter (BAC)
  - Iron 7.5 cm Thick × 11 (Absorption $\sigma \ell \lambda$)
  - Limited streamer tube ... (Total area 2.8 × 10⁴ m²)

3. Muon detectors
   - drift chambers, limited streamer tubes scintillation counters
   - magnetized iron yoke and toroids
   - momentum resol. $\delta(p)/p \approx 30\%$ for 100 GeV/c muons

4. Forward proton detector
   - Roman pots at 20 m and 90 m
   - Electron/photon detector at 30 ~ 100 m
     ⇒ Luminosity monitor
     Small Q^2 tagging

Table 1. Parameters of HERA

	p-ring		e-ring	units
Nominal energy	820		30	GeV
c.m. energy		314		GeV
Q^2_{max}		98.400		GeV²
Luminosity		$1.5 \cdot 10^{31}$		$cm^2 s^{-1}$
Polarization time			28	min
Number of interaction points		4		
Crossing angle		0		mrad
Free space for experiments		±5.5		m
Circumference		6336		m
Length of straight sections		360		m
Bending radius	588		608	m
Magnetic field	4.65		0.165	T
Energy range	300–820		10–33	GeV
Injection energy	40		14	GeV
Circulating current	160		58	mA
Total number of particles	$2.1 \cdot 10^{13}$		$0.8 \cdot 10^{13}$	
Number of bunches		200		
Number of bunch buckets		220		
Time between crossings		96		ns
Emittance (ϵ_x/ϵ_y)	0.71/0.71		3.4/0.7	10^{-8} m
Beta function (β^*_x/β^*_y)	10/1.0		2/0.7	m
Beam tune shift (Q_x, Q_y)	0.0026/0.0014		0.023/0.026	
Beam size at crossing σ^*_x	0.27		0.26	mm
Beam size at crossing σ^*_y	0.08		0.07	mm
Beam size at crossing σ^*_z	11		0.8	cm
Energy loss /turn	$1.4 \cdot 10^{-10}$		127	MeV
Critical energy	10^{-6}		111	keV
Max. circumf. voltage	0.2/2.4		260	MV
Total RF power	1		13.2	MW
RF frequency	52.033/208.13		499.667	MHz
Filling time	20		15	min

≈ 52 Tev

Magnets ← Italy / Germany

S.C. Dipole (4.7T, 8.8m) ~420 t

S.C. Quadrupole (91 T/m, 1.86m, 1.52m) ~240 t

↑ France / Germany (Saclay)

The ZEUS Detector

ZEUS - COLLABORATION

Carleton, Manitoba, McGill, Toronto, York
CANADA — FCAL/RCAL

Bonn, DESY, Freiburg, Hamburg I, Hamburg II, Jülich, Siegen
GERMANY — Magnet, Yoke, DAQ

Weizmann Institute
ISRAEL — FCAL/RCAL, TRD, FTD, RTD

Bologna, Cosenza, ENEA - Rome, Florence, Frascati, L'Aquila, Lecce, Milan, Padua, Palermo, Rome, Trieste, Turin
ITALY — FCAL/RCAL, MUON, VXD

Tokyo - INS, Tokyo - Metropolitan
JAPAN — FCAL/RCAL

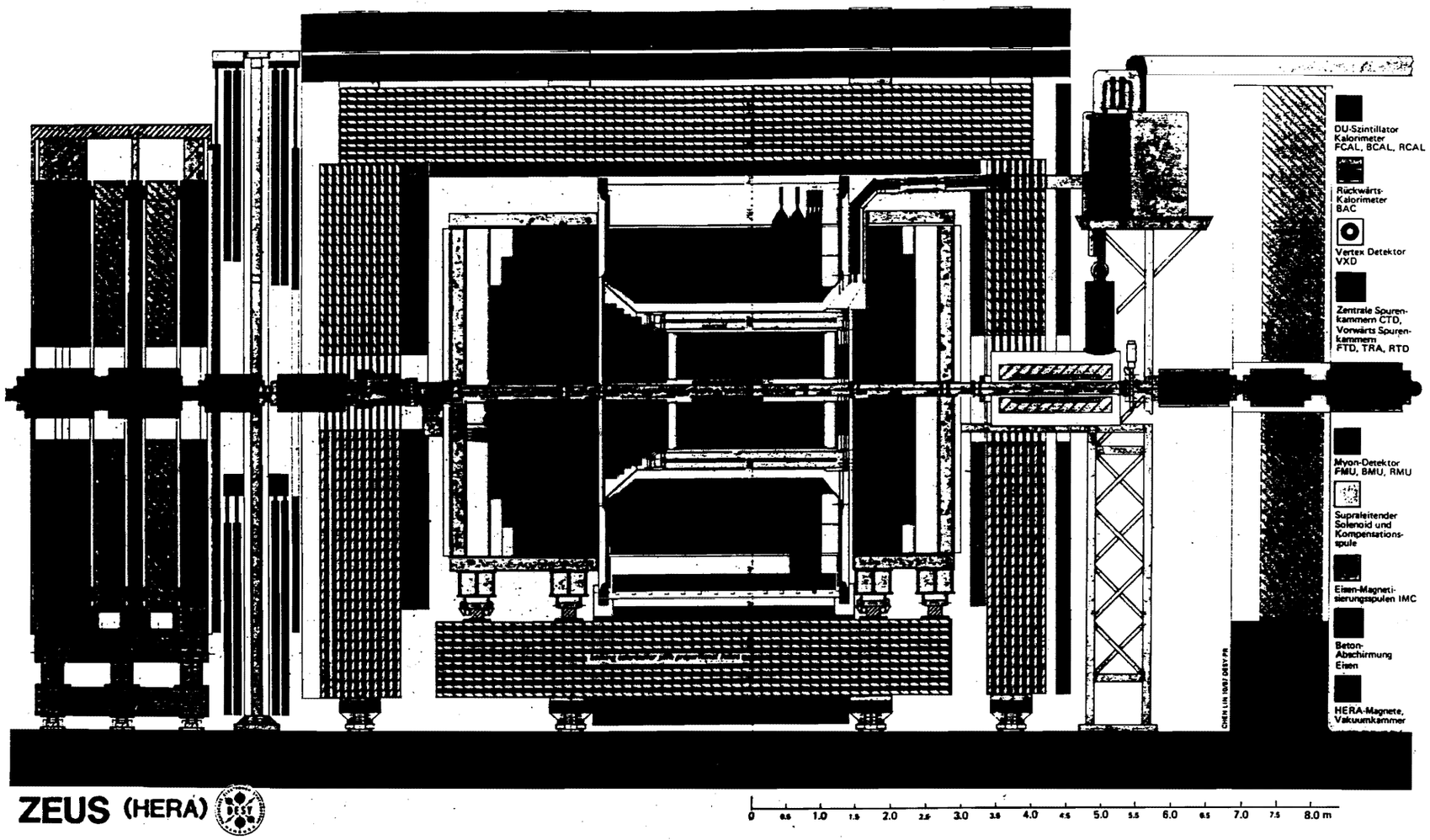
NIKHEF - Amsterdam
THE NETHERLANDS — FCAL/RCAL, DAQ

Cracow, Warsaw
POLAND — BAC, LUMI

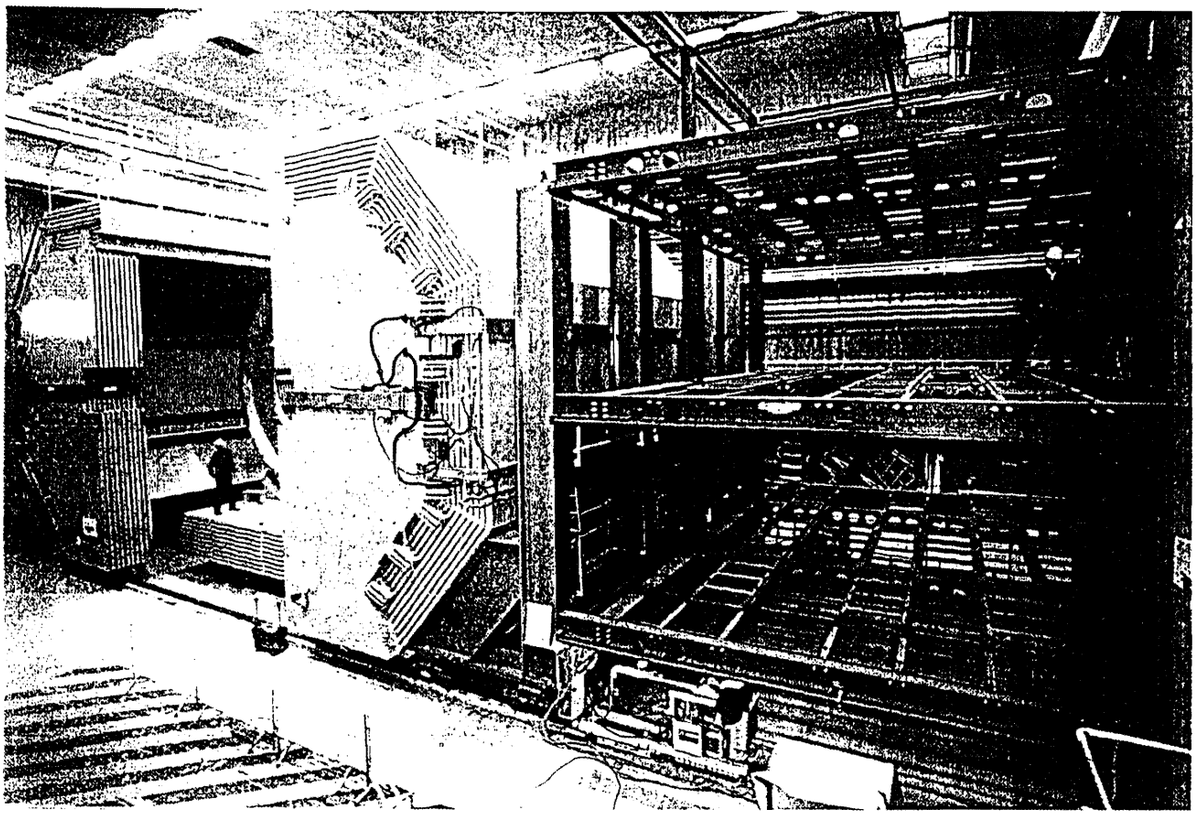
Madrid
SPAIN — FCAL/RCAL

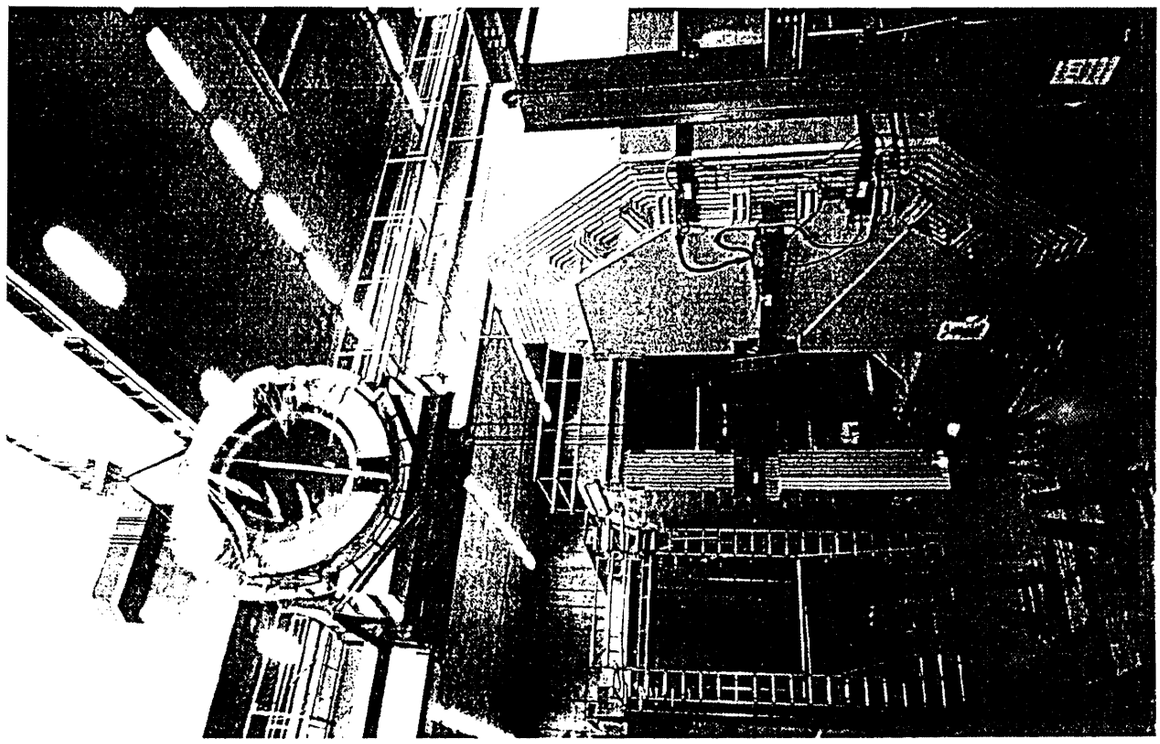
Bristol, London (I.C.), London (U.C.), Oxford, Rutherford
UNITED KINGDOM — CTD

Argonne, Brookhaven, Columbia, Illinois, Ohio State, Pennsylvania State, U.C. Santa Cruz, Virginia, Wisconsin
USA — BCAL, DAQ


DU-Szintillator Kalorimeter FCAL, BCAL, RCAL
Rückwärts-Kalorimeter BAC
Vertex Detektor VXD
Zentrale Spurenkammern CTD, Vorwärts Spurenkammern FTD, TRA, RTD
Myon-Detektor FMU, BMU, RMU
Supraleitender Solenoid und Kompensationsspule
Eisen-Magnetisierungsspulen IMC
Beton-Abschirmung Eisen
HERA-Magnete, Vakuumkammer
0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0 7.5 8.0 m

ZEUS (HERA)





PROGRAM

September 28 (Thu)

Color-sextet condensation	I. Watanabe
Calculating the decay constants in dynamical symmetry breaking	K.-I. Aoki
The equivalent photon approximation vs. exact calculation for the single weak boson production in e^+e^- collision	H. Iwasaki
Production and decay of superheavy quarkonia in multi-TeV colliders	T. Morii
Higgs boson production in γ–γ collision in TeV region	R. Najima
Signal and background of standard Higgs particle	M. Biyajima
New physics signals and QCD backgrounds in TeV collider experiments†	H.-U. Bengtsson
Higgs physics	K. Hikasa
(Lunch Break)	
SUSY search at supercolliders*	K. Hidaka
SUSY search at HERA	T. Kon
Single W production associated with SUSY particles in longitudinally polarized e^+e^- collisions	M. Jimbo
CP-violation in SUSY and T-odd asymmetry	Y. Kizukuri
Flipped left-right gauge model with τ-gaugino mixing	K. Yamamoto
Superstring phenomenology	T. Matsuoka
Purely stringy model building with lower-rank gauge groups*	H. Sato
Search for realistic orbifold models	Y. Ono
The fifth force†	Y. Fujii

September 29 (Fri)

Report of the SLAC Lepton-Photon Symposium (Experimental)†	A. Maki
Report of the SLAC Lepton-Photon Symposium (Theoretical)†	T. Morii
Rare decays and CP violation in K and B systems	C. S. Lim
CP violation in B meson decays in 3- and 4-generation models	S. Wakaizumi
Quark mass matrix and B_d^0–$\bar{B}_d^0$ mixing	M. Tanimoto
(Lunch Break)	
Estimations of long-distance effects on K^0–$\bar{K}^0$ mixing by chiral Lagrangian	T. Kurimoto
Rare kaon decays	T. Shinkawa
Present status and future of Kamiokande	K. Nakamura
Present status of neutrino oscillation experiments*	A. Suzuki
Coherence condition for resonant neutrino oscillation	H. Anada
Dark matter search by scintillating fiber gamma ray satellite	R. Enomoto
New physics at TeV scale II	H. Terazawa
Recent topics on technicolor theory	M. Bando
Extra composite W and Z bosons implied by complementarity	M. Yasuè
Effects of exotic composite particles in the TRISTAN, SLC, and LEP energy region	K. Akama

September 30 (Sat)

Neutrino mass matrix and double beta decay	T. Kotani
Double beta decays of ^{100}Mo and double weak decays with $\Delta S = -2$	H. Ejiri
Recent results from AMY at TRISTAN	Y. Sakai
Recent results and future prospects of TOPAZ experiment	I. Adachi
Recent results from VENUS	M. Daigo
(Lunch Break)	
Recent results from CDF*	K. Yasuoka
Present status of LEP	H. Takeda
Verification of the quantum electroweak effects through the weak boson mass relation	Z. Hioki
B physics with an asymmetric collider at KEK	K. Abe
Present status and physics prospects of SSC	S. Sugimoto
Detection of heavy particles—quarks and Higgs	Y. Asano
Status of the ZEUS detector*	R. Hamatsu

† Manuscript not available.

* Copy of transparencies included in the Appendix.

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