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COMPILATION OF CURRENT HIGH-ENERGY PHYSICS EXPERIMENTS

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LAWRENCE BERKELEY LABORATORY
University of California

Prepared for the Department of Energy under contract W-7405-ENG-48

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Introduction

This is the fourth edition of our compilation of current high energy physics experiments. It is a collaborative effort of the Berkeley Particle Data Group, the SLAC library, and nine participating laboratories: Argonne (ANL), Brookhaven (BNL), CERN, DESY, Fermilab (FNAL), the Institute for Nuclear Study, Tokyo (INS), KEK, Serpukhov (SERP), and SLAC.

The compilation includes summaries of all high energy physics experiments at the above laboratories that (1) were approved (and not subsequently withdrawn) before about April 1981, and (2) had not completed taking of data by 1 January 1977. We emphasize that only approved experiments are included.

The contents of the compilation are:

Summaries of experiments -- These are on the microfiche in the pocket at the front of the report. An example from the summaries, with some explanatory notes, follows this introduction.

Indices -- These follow the example. One index lists experiments by initial-state particles and beam momentum, in order of increasing particle mass and beam momentum. Another index lists experiments by spokesman.

Vocabularies -- These follow the indices, and give names and abbreviations used in the summaries. There are vocabularies for accelerators, detectors, particles, institutions, etc.

Beam lists -- These list beams for fixed-target experiments at Brookhaven, CERN, Fermilab, KEK, Serpukhov, and SLAC.

Anyone wanting more information about a particular experiment should contact the experiment's spokesman directly, not us. Although the original experimental proposals are sometimes available in libraries, there are often subsequent letters, revisions, and addenda, or simply informal arrangements with the powers that be, that extend the aims or shift the emphasis of an experiment. There are also often changes of collaborators on an experiment. We try to keep up with such changes, but of course cannot entirely succeed. The spokesman is the authoritative source of information about an experiment.

We invite comments pointing out omissions, obscurities, out-of-date information, and outright errors. There are no doubt a number of each. Comments should be sent to:

Particle Data Group
Attn: PROPOSALS
Lawrence Berkeley Laboratory
Berkeley, CA 94720
USA

Requests for copies from the Americas, Australasia, and the Far East should go to the above address, while those from other areas should go to:

CERN Scientific Information Service
CH-1211 Geneva 23
Switzerland

[illegible]

INSTRUCTIONS SET A FORBIDARY FOR ABBREVIATIONS
AND A LITHOR, WITH SPORSPERSON NOTED.

WILLIAM K. ANDERSON AND PHILIP R. SIEGEL

APPENDIX INFORMATION

1111 AND/OR DISPOSITION 100 MILLER IN 36 WEEKS)

POLYMERIZATION INFORMATION (U. INO)

REACTIONS TO REINFORCED SELF-PARTICLE AND ARBITRARY BEAM
MOMENTUM FOR OTHER KINEMATIC VARIABLES (SEE VOL. ARBITRARY);
AND REACTION DATA DESCRIPTORS (SEE VOL. ARBITRARY)

PARTICLES AND PARTICLE PROPERTIES TO BE STUDIED
(SEE APPENDICES.)

BEAM-TARGET-MOMENTUM INDEX

[illegible]

BEAM-TARGET-MOMENTUM INDEX

[illegible]

FOR e^+e^- COLLIDING BEAM EXPERIMENTS, WE GIVE THE CENTER-OF-MASS (= LAB) MOMENTUM RATHER THAN THE EQUIVALENT LAB MOMENTUM FOR SCATTERING ON A STATIONARY TARGET.

BEAM AND TARGET	LAB. MOMENTUM OR MOMENTUM RANGE (GEV/C)		EXPERIMENT
E+ E-	?		SLAC-SP-031
E+ E-			DESY-119
E+ E-	1.1	1.3	SLAC-SP-028
E+ E-	1.5	3.0	SLAC-SP-029
E+ E-	1.5	4.0	SLAC-SP-024
E+ E-	1.5	4.2	SLAC-SP-030
E+ E-	1.5	4.3	DESY-144
E+ E-	1.6		JESY-119
E+ E-	1.6		DESY-138
E+ E-	1.6	2.5	DESY-143
E+ E-	1.8		DESY-143
E+ E-	1.9	2.5	DESY-39
E+ E-	1.9	2.3	DESY-140
E+ E-	3.7	5.6	DESY-LENA
E+ E-	4.0	5.0	DESY-146
E+ E-	4.0	18.0	SLAC-PEP-004
E+ E-	4.0	18.0	SLAC-PEP-004
E+ E-	4.0	18.0	SLAC-PEP-006
E+ E-	4.0	18.0	SLAC-PEP-009
E+ E-	4.0	18.0	SLAC-PEP-010
E+ E-	4.0	18.0	SLAC-PEP-011
E+ E-	4.0	18.0	SLAC-PEP-012
E+ E-	4.0	18.0	SLAC-PEP-013
E+ E-	4.0	18.0	SLAC-PEP-014
E+ E-	4.0	18.0	SLAC-PEP-015
E+ E-	4.0	18.0	SLAC-PEP-016
E+ E-	4.0	18.0	SLAC-PEP-017
E+ E-	4.0	18.0	SLAC-PEP-018
E+ E-	4.0	18.0	SLAC-PEP-019
E+ E-	4.0	18.0	SLAC-PEP-020
E+ E-	4.0	5.1	DESY-ARGUS
E+ E-	4.0	5.1	DESY-47
E+ E-	4.0	24.0	DESY-PETRA-3
E+ E-	5.0	20.0	DESY-PETRA-3
E+ E-	5.0	20.0	DESY-PETRA-4
E+ E-	5.0	20.0	DESY-PETRA-5
E+ E-	5.0	20.0	DESY-PETRA-6
E+ E-	5.0	20.0	DESY-PETRA-7
E+ E-	5.0	20.0	DESY-PETRA-8
E+ E-	5.0	20.0	DESY-PETRA-9
E+ E-	5.0	20.0	DESY-PETRA-10
E+ E-	5.0	20.0	DESY-PETRA-11
E+ E-	5.0	20.0	DESY-PETRA-12
E+ E-	5.0	20.0	DESY-PETRA-13
E+ E-	5.0	20.0	DESY-PETRA-14
E+ E-	5.0	20.0	DESY-PETRA-15
E+ E-	5.0	20.0	DESY-PETRA-16
E+ E-	5.0	20.0	DESY-PETRA-17
E+ E-	5.0	20.0	DESY-PETRA-18
E+ E-	5.0	20.0	DESY-PETRA-19
E+ E-	5.0	20.0	DESY-PETRA-20
E+ E-	5.0	20.0	DESY-PETRA-21
E+ E-	5.0	20.0	DESY-PETRA-22
E+ E-	5.0	20.0	DESY-PETRA-23
E+ E-	5.0	20.0	DESY-PETRA-24
E+ E-	5.0	20.0	DESY-PETRA-25
E+ E-	5.0	20.0	DESY-PETRA-26
E+ E-	5.0	20.0	DESY-PETRA-27
E+ E-	5.0	20.0	DESY-PETRA-28
E+ E-	5.0	20.0	DESY-PETRA-29
E+ E-	5.0	20.0	DESY-PETRA-30
E+ E-	5.0	20.0	DESY-PETRA-31
E+ E-	5.0	20.0	DESY-PETRA-32
E+ E-	5.0	20.0	DESY-PETRA-33
E+ E-	5.0	20.0	DESY-PETRA-34
E+ E-	5.0	20.0	DESY-PETRA-35
E+ E-	5.0	20.0	DESY-PETRA-36
E+ E-	5.0	20.0	DESY-PETRA-37
E+ E-	5.0	20.0	DESY-PETRA-38
E+ E-	5.0	20.0	DESY-PETRA-39
E+ E-	5.0	20.0	DESY-PETRA-40
E+ E-	5.0	20.0	DESY-PETRA-41
 
E+ E-	5.0		

[illegible]

[illegible]

BEAM AND TARGET	LAB MOMENTUM OR MOMENTUM RANGE (GEV/C)	EXPERIMENT	BEAM AND TARGET	LAB MOMENTUM OR MOMENTUM RANGE (GEV/C)	EXPERIMENT
 	

BEAM-TARGET-MOMENTUM INDEX

[illegible]

SPOKESMAN INDEX

[illegible]

ACCELERATOR VOCABULARY

ANL	Argonne (ZGS) Proton Synchrotron (12.7 GeV plab)
BNL	Brookhaven (AGS) Proton Synchrotron (33 GeV plab)
CERN	CERN (PS) Proton Synchrotron (28 GeV plab)
CERN-ISR	CERN (ISR) Proton-Proton ISR (62 GeV ecm)
CERN-PBAR/P	CERN pp Collider (540 GeV ecm)
CERN-SPS	CERN (SPS) Super Proton Synchrotron (450 GeV plab)
DESY	Hamburg Deutsches Electron Synchrotron (7.5 GeV plab)
DESY-DORIS	Hamburg (Doris) Electron-Positron Ring (11.6 GeV ecm)
DESY-PETRA	PETRA e ⁺ e ⁻ Colliding Beams (40 GeV ecm)
FNAL	FNAL Batavia Proton Synchrotron (500 GeV plab)
KEK	KEK (Japan) Proton Synchrotron (13 GeV plab)
RHED	Rutherford (Nimrod) Proton Synchrotron (8 GeV plab)
SERP	IHEP Serpukhov Proton Synchrotron (76 GeV plab)
SLAC	Stanford Electron Linear Accelerator (33 GeV plab)
SLAC-PEP	SLAC Positron-Electron Project (36 GeV ecm)
SLAC-SPEAR	Stanford (SPEAR) Electron-Positron Ring (8.4 GeV ecm)
TOKY	INS Tokyo Electron Synchrotron (1.3 GeV plab)

DETECTOR VOCABULARY

For bubble chambers we use a construction such as
DBC-2M

or

HBC-15FT-HYB

or

HLR.-BERG-TST.

The first element, one of

HBC

DBC

HEBC

HLBC,

tells whether the chamber fill is hydrogen, deuterium, helium, or heavy liquid. The second element gives the size or name of the chamber. Where appropriate, a third element, one of

HYB

RAP

TST,

indicates that the chamber is part of a hybrid system, or that it is rapid cycling, or that it contains a track-sensitive target.

For non-bubble-chamber detectors the abbreviations are:

General:

CALO	calorimeter
CNTR	counters (no chambers)
COMB	combinations of different types of detectors, no particular one dominant
EMUL	emulsion or a detector like lexan where tracks are frozen in a solid medium
OSPK	optical spark chambers
OTHER	rare non-electronic detectors (e.g., moon, ocean floor)

DETECTOR VOCABULARY (CONT'D)

STRC	streamer chamber
TRAD	transition radiation detector
WIRE	wire chambers (proportional wire chambers, drift chambers). Includes all non-optical spark by convention
WAS	wide angle spectrometer

For a spectrometer system, including magnets for momentum analysis:

DAS	double arm spectrometer
SAS	single arm spectrometer
SPEC	general spectrometer system not fitting one of the above or where specific type not given

Acronyms for specific detectors:

ARGUS	DESY-DORIS detector system
ASTRON	IHEP wide angle spectrometer at Serpukhov
CCS	Chicago cyclotron spectrometer at FNAL
CELEO	DESY-PETRA spectrometer system
CRYS-BALL	SLAC-SPEAR and PEP large solid angle neutral detector
DASP	DESY-DORIS double arm spectrometer system
DELCO	SLAC-SPEAR and PEP detector system
FHS	European hybrid spectrometer at CERN-SPS
EMS	ANL effective mass spectrometer
FMPS	Fermilab multiparticle spectrometer
GAMS	gamma spectrometer at Serpukhov
HEW	HARV-PENN-WISC neutrino detector at BNL
HKS	SLAC-PEP high resolution spectrometer
IABF	DESY-PETRA spectrometer system
IAB-E	FNAL 1100-ton target-calorimeter muon-spectrometer detector for neutrino physics
LASS	SLAC large aperture solenoid spectrometer
LENA	DESY-DORIS detector system
MAC	SLAC-PEP magnetic calorimeter
MARK-1	DESY-PETRA spectrometer system
MARK-2	SLAC-SPEAR and PEP spectrometer system
MARK-3	SLAC-SPEAR spectrometer system (not related to MARK-2)
MPS	BNL multiparticle spectrometer
MPS-11	upgraded BNL MPS
NICA	non-magnetic precision spectrometer at Serpukhov
OMEGA	CERN OMEGA spectrometer
OMEGA-PRIME	upgraded CERN OMEGA spectrometer
PLUTO	DESY-DORIS and PETRA superconducting solenoid spectrometer
RMS	Rutherford multiparticle spectrometer, now at CERN
SASF	single arm spectrometer facility at FNAL
SFM	CERN-ISR split field magnet
SIGMA	CERN-IHEP magnetic spectrometer at Serpukhov
SPEC-nm	SERP n-m spectrometer system
SSF	SLAC spectrometer facility - 1.6, 8, and/or 20 GeV
TASSO	DESY-PETRA spectrometer system
TELAS	KEK target-embodied large-aperture spectrometer
TOKIWA	KEK spectrometer
TPC	SLAC-PEP time projection chamber
VAL	CERN-DORT-REID-SACL-BCSA neutrino detector at SPS
2-GAMMA	SLAC-PEP detector to study 2-gamma process

REACTION DATA DESCRIPTOR VOCABULARY

The data descriptors refer to the nature of the data to be taken in an experiment. Any of the variables below can also be understood to refer to functions (including averages or other moments, but not derivatives or integrals) of that variable, unless such functions involve other variables from the list. For data which are to be presented as a function of two variables, such as a scatter plot, combinations such as MASS/MASS are used.

GENERAL

- CS Cross section, cross section ratio, and cross section upper limit. Can also be listed for very rare reactions whose existence is being established, even though the number of events has not been converted to a cross section. Does not include parametrizations of the cross section, e.g., as a function of energy.
- ANGP Production angular distribution, i.e., of one or more of the outgoing particles relative to one of the incident particles. Includes $da/d\Omega$, da/dt , da/dt' , da/dQ^2 , etc. Also the equivalent, expressed as moments or polynomial expansion coefficients. Also invariant cross section as a function of production angle or t . By convention, does not include rapidity or its approximation, $y = -\ln \tan \theta/2$ (see P). Includes impact parameters and slopes of da/dt .
- ANG Angular distribution between or among particles in the final state. Includes also angular distribution involving decay product of particles listed in the reaction, even though those decay products are not themselves explicitly listed. Includes angles used to study the decay of a system produced in the final state, even though the coordinate system axes may be defined with respect to the incident particles (e.g., Jackson angles, etc.) Also the equivalent, expressed as moments, etc.
- MASS Mass spectrum, mass² spectrum, or invariant cross section as a function of mass or mass squared.
- PT Transverse momentum (p_T) spectrum, p_T^2 spectrum, or invariant cross section as a function of p_T . Does not include momentum transfer spectrum (see ANGP). Includes transverse mass = $(p_T^2 + m^2)^{1/2}$, unless the particle mass (m) is also variable.

REACTION DATA DESCRIPTOR VOCABULARY (CONT'D)

- P Any function of outgoing momentum or energy not included in any of the above. Includes, E , y (rapidity, also rapidity gaps), $x = (p_{||}^*/p_{||}^*{}_{\max})$, $p_{||}$, or other momentum or energy variable.
- FV (for proposals only) Experiment proposes to measure complete four-vectors, without specifying exactly what analysis of them will be done.

AMPLITUDES

- Functions linear in the amplitudes (i.e., involving the phases).
- PWA Partial-wave amplitudes. Includes formation partial waves and production partial waves. Any attempt to measure amplitudes of definite j (angular momentum). Includes scattering length and effective range.
- AM- Amplitude not decomposed into states of definite j . RE/IM ratio, helicity amplitude, etc.

VARIABLES RELATED TO SPIN

- DME Density matrix elements, including joint density matrix elements.
- POL Final state spin-1/2 polarization measurement. Includes Wolfenstein spin rotation parameters. Includes measurement of asymmetry off a polarized target when it is equal to the final state polarization.
- ASYM Asymmetry in scattering off a polarized target and/or with a polarized beam (with exception of special case noted under POL).

MULTIPLICITIES

- MULT Multiplicity distribution, its average, ratio, or moments. Generally used in association with final states of the form $N(\text{PRONC})$, $N(\text{HADRON})$, etc., so that the individual final states are usually not listed.

KINEMATIC VARIABLE VOCABULARY

The Beam "momentum" designation given in parentheses following the numerical value and units can be one of the following:

PLAB beam momentum in the lab frame.
ELAB beam energy in the lab frame.
TLAB beam kinetic energy in the lab frame.
ECH total energy in the CM frame.
S total CM energy squared.

For colliding beam experiments, the momentum of the second beam is given indented below that of the first. Alternatively, a single line with the total center-of-mass energy or equivalent lab beam momentum may be given.

For electroproduction or other reactions involving a virtual photon, the second and third lines indented below the beam momentum specify the equivalent of the mass and momentum of the virtual photon. These can have the following designations:

W mass of the target-virtual photon system.
W2 square of W.
Q2 absolute value of the mass squared of the virtual photon = absolute value of the squared 4-momentum transfer to the electron.
NU energy of the virtual photon in the lab frame = energy loss of the electron in the lab frame.

PARTICLE PROPERTY DESCRIPTOR VOCABULARY

The following descriptors are used to designate various types of particle property data:

MASS Mass or mass difference.

W Total width, total rate, mean life. Also differences and ratios of these.

PW Partial width, partial rate, as well as any ratio or product of these such as branching ratio or integrated cross section. Also upper limits on these. Also differences of these unless included in DEC (DEC includes charge asymmetry δ for $K_L \rightarrow \pi l \nu$, η for $K_L \rightarrow \pi^+ \pi^-$, χ for $K_S^0 \rightarrow \pi^+ \pi^-$).

MM Electric moment, magnetic moment, charge radius, moment ratios.

DEC Weak or electromagnetic decay parameter as defined by Review of Particle Properties, Rev. of Mod. Physics 52, No. 2, Part II, April 1980, Sec. VI.

$\rho, \eta, \xi, \delta, h, |g_A/g_V|, \phi_{AV}, g_S, g_T, g_P$ for μ decay
slopes g and slope difference ϕ (CP viol) for $K \rightarrow 3\pi$
form factors $f_+, f_-, f_0, \lambda_+, \lambda_-, \lambda_0, \xi, f_S, f_T$ for $K \rightarrow \pi l \nu$
CP violation parameter $\chi + i\gamma$ for $K_S^0 \rightarrow \pi^+ \pi^- \pi^0$
charge asymmetry δ for $K_L \rightarrow \pi l \nu$
CP viol. parameters $\eta_{+-}, \eta_{00}, \phi_{+-}, \phi_{00}, \epsilon, \epsilon'$ for $K \rightarrow \pi\pi$
 $\Delta S \neq \Delta Q$ parameter χ $\left\{ \begin{array}{l} \text{for } K^0 \rightarrow \pi^+ \pi^- \\ \text{or } K^0 \rightarrow \pi^+ \pi^0 \end{array} \right.$
charge asymmetry $\left\{ \begin{array}{l} \text{for } \eta \text{ decay} \\ \text{for baryon decay} \end{array} \right.$
 $|g_A/g_V|, \delta, a, b, \gamma, \phi, \Delta$

QN Quantum numbers.

EX Existence (e.g., particle search result, even if negative, or evidence for presence in a mass spectrum).

INSTITUTION VOCABULARY

AACH Phys. Inst. der Tech. Hochschule
AARR Aarhus Univ.
ABAD Abadan Inst. of Technology
AICH Aichi Educational Univ.
AIO Inat. Kernphysics Onderzoek
AKIT Akita Univ.
ALBA State Univ. of New York at Albany
ALMA Kazakh Inst. for High Energy Physics
AMER American Univ.
AMES Ames Lab
AMST Univ. of Amsterdam
ANIK Amsterdam Nikhef
ANKA Middle East Technical Univ.
ANL Argonne Nat. Lab.
ARIZ Univ. of Arizona
ATEN Nuclear Res. Centre Demokritos
AWRE Atomic Weapons Research Establishment
BARI Univ. di Bari
BASL Basle Univ.
BEDF Bedford College
BEIJ Beijing Univ.
BELG Inst. Interuniv. des Sci. Nuclear
BERG Fysisk Institut
BERL Inst. Hochenergiephys. DAW
BERN Univ. Bern
BGNA Univ. di Bologna
BHEP Inst. of High Energy Physics
BIEL Univ. Bielefeld
BIKK Birkbeck College
BIRM Birmingham Univ.
BNL Brookhaven National Lab.
BOHR Niels Bohr Institute
BOMB Bombay Univ.
BONN Univ. Bonn
BOST Boston Univ.
BRAN Brandeis Univ.
BRCC British Columbia Univ.
BRIS H. H. Wills Phys. Lab., U. of Bristol
BROW Brown Univ.
BRUX Univ. Libre de Bruxelles
BTL Bell Telephone Labs.
BUDA Central Research Institute of Physics
BUFF State Univ. of New York at Buffalo
CAME Cambridge Univ.
CALC Univ. of Calcutta
CARL Carlton Univ.
CASE Case Western Reserve Univ.
CAVE Cavendish Lab., Cambridge Univ.
CDFP College de France
CERN European Org. for Nuclear Research

Aachen, Germany
Aarhus, Denmark
Abadan, Iran
Toyota, Aichi Pref., Japan
Amsterdam, Netherlands
Akita, Japan
Albany, NY, USA
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Amsterdam, Netherlands
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Bari, Italy
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Cambridge, England
Calcutta, India
Ottawa, Canada
Cleveland, Ohio, USA
Cambridge, England
Paris, France
Geneva, Switzerland

INSTITUTION VOCABULARY (CONT'D)

CHIC Univ. of Chicago
CINC Univ. of Cincinnati
CIT Calif. Institute of Technology
CLFR Univ. de Clermont-Ferrand
CMU Carnegia-Mellon Univ.
COLO Univ. of Colorado
COLU Columbia Univ.
COPE Copenhagen Univ.
CORN Cornell Univ.
CRAC Inst. for Nuclear Research
CUNY City Univ. of New York
CURI Pierre et Marie Curie Univ., Paris VI
DARE Daresbury Nuclear Physics Lab.
DESY Deutsches Elektronen-Synch.
DOE Department of Energy
DORT Univ. Dortmund
DUKE Duke Univ.
DUUC University College
EDIN Univ. of Edinburgh
EFI Enrico Fermi Inst. for Nuclear Studies
ELMT Elmhurst College
EPOL Ecole Polytechnique
ERLA Univ. Erlangen
ETHZ Swiss Federal Inst. of Technology
FIRZ Univ. di Firenze
FNAL Fermi National Accelerator Lab.
FRAS Lab. Nazionali del Sincrotrone
FREI Univ. Freiburg
FSU Florida State Univ.
GENO Univ. di Genova
GESC General Electric R and D Center
GEVA Univ. de Geneve
GIT Georgia Inst. Tech.
GLAS Univ. of Glasgow
GMAS George Mason Univ.
GUIL Univ. of Surrey at Guilford
HAIF Technion - Israel Inst. of Technology
HAM' Univ. Hamburg
HARV Harvard Univ.
HAWA Univ. of Hawaii
HEID Univ. Heidelberg
HELS Helsingin Yliopisto
HIRO Hiroshima Univ.
HOUS Univ. of Houston
HRSK Hiroaki Univ.
IIT Illinois Inst. of Tech.
ILL Univ. of Illinois
ILLC Univ. of Illinois at Chicago
IND Univ. of Indiana
INNS Innsbruck Univ.

Chicago, Ill., USA
Cincinnati, Ohio, USA
Pasadena, Calif., USA
Clermont-Ferrand, France
Pittsburgh, PA, USA
Boulder, Colo., USA
New York, NY, USA
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Bloomington, Ind., USA
Innsbruck, Austria

INSTITUTION VOCABULARY (CONT'D)

INUS Inst. for Nuclear Study at Tokyo Univ. Tokyo, Japan
 IPN Inst. de Phys. Nucleaire Orsay, France
 ISU Iowa State Univ. Ames, Iowa, USA
 ITEP Inst. for Teor. and Exp. Physics Moscow, USSR
 JAPN Japan Univ. Group Collaboration Japan
 JHU Johns Hopkins Univ. Baltimore, Md., USA
 JINR Joint Inst. for Nuclear Research Dubna, USSR
 KANS Univ. of Kansas Lawrence, Kansas, USA
 KARL Technische Univ. Karlsruhe Karlsruhe, Germany
 KEK Nat. Lab for High Energy Phys., Japan Tsukuba-gun, Japan
 KEKZ Kernforschungszentrum, Karlsruhe Leopoldshaven, Germany
 KHAR Physico-Tech. Inst., Acad. Sci., Ukr.SSR Kharkov, USSR
 KIAE Kurchatov Inst. of Atomic Energy Moscow, USSR
 KIEL Kiel Univ. Kiel, Germany
 KIMC Industrial Medical College Kitakyushu, Japan
 KUBE Kobe Univ. Kobe, Japan
 KONA Konan Univ. Kobe, Japan
 KOSI Czech. Acad. Sci. Inst. Exp. Phys. Koscice, Czechoslovakia
 KWAN Kwansai Gakuin Univ. Hyogo-ken, Japan
 KYOT Kyoto Univ. Kyoto, Japan
 LALO Linear Accelerator Lab, Orsay Orsay, France
 LANC Lancaster Univ. Lancaster, England
 LAPP Lapp Univ. Annecy, France
 LASL U. C. Los Alamos Scientific Lab. Los Alamos, NM, USA
 LAUS Univ. of Lausanne Lausanne, Switzerland
 LBL U. C. Lawrence Berkeley Lab. Berkeley, Calif., USA
 LEDD Lebedev Physics Inst. Moscow, USSR
 LEHI Lehigh Univ. Bethlehem, PA, USA
 LENI Inst. of Nucl. Phys., Akad. Nauk USSR Leningrad, USSR
 LENU Leningrad State Univ. Leningrad, USSR
 LIHB Lab Interuniv. Belge High Energy Brussels, Belgium
 LISB Nova Univ. de Lisbon Lisbon, Portugal
 LIVER Liverpool Univ. Liverpool, England
 LJUB Univ. of Ljubljana Ljubljana, Yugoslavia
 LOIC Imperial Col. of Science and Tech. London, England
 LOQM Queen Mary College London, England
 LOWC University College London, England
 LOWC Westfield College London, England
 LGPG Lab. de Phys. General, Univ. Paris Paris, France
 LPNP Paris Univ. VII, LPNHE Paris, France
 LSU Louisiana State Univ. Baton Rouge, LA, USA
 LUND Lund Univ. Lund, Sweden
 LVN Univ. Catholique de Louvain Louvain-la-Neuve, Belg.
 LYON Inst. de Phys. Nucl., Univ. de Lyon Villeurbanne, France
 MADR Junta de Energia Nuclear Madrid, Spain
 MAINZ Univ. Mainz Mainz, Germany
 MASA Univ. of Massachusetts Amherst, Mass., USA
 MCGI McGill Univ. Montreal, Canada
 MCSH Univ. Manchester Manchester, England
 MELB Univ. of Melbourne Parkville, Australia

INSTITUTION VOCABULARY (CONT'D)

MEXU Univ. Nac. Autonoma de Mexico Mexico City, Mexico
 MIAM Miami Univ. Miami, FL, USA
 MICH Univ. of Michigan Ann Arbor, Mich., USA
 MILA Univ. di Milano Milano, Italy
 MINN Univ. of Minnesota Minneapolis, Minn., USA
 MINR Institute for Nuclear Research Moscow, USSR
 MIT Massachusetts Inst. of Technology Cambridge, Mass., USA
 MONS Univ. de l'Etat, Mons Mons, Belgium
 MOSU Moscow State Univ. Inst. of Nucl. Phys. Moscow, USSR
 MPEI Moscow Phys. Eng. Inst. Moscow, USSR
 MPIM Max-Planck-Inst. fur Phys.-Astrophys. Heidelberg, Germany
 MPIM Max-Planck-Inst. fur Phys.-Astrophys. Munich, Germany
 MSU Michigan State Univ. East Lansing, Mich., USA
 MTHO Mt. Holyoke College South Hadley, Mass., USA
 MUNI Munich Univ. Munich, Germany
 MURA Midwestern Univ. Research Assoc. Stroughton, WI, USA
 NADI Mohamed El-Nadi Research Center Cairo, Egypt
 NAGO Nagoya Univ. Nagoya, Japan
 NANC Univ. de Nancy Nancy, France
 NAPL Univ. di Napoli Napoli, Italy
 NARA Nara Women's Univ. Nara, Japan
 NARU Nara Univ. Nara, Japan
 NCCI North Central College Naperville, IL, USA
 NDAM Univ. of Notre Dame Notre Dame, Ind., USA
 NEAS Northeastern Univ. Boston, Mass., USA
 NEUC Univ. of Neuchatel Neuchatel, Switzerland
 NEVI Nevis Lab. Irvington-on-Hudson, NY, USA
 NIIG Niigata Univ. Niigata, Japan
 NIHN Nihon Univ. Tokyo, Japan
 NIJM R. K. Univ. Nijmegen Nijmegen, Netherlands
 NILU Northern Illinois Univ. Dekalb, Ill., USA
 NORD Nordisk Ins. for Teor. Atomfys. Copenhagen, Denmark
 NOVO Inst. of Nuclear Physics Novosibirsk, USSR
 NRL Naval Research Laboratory Washington, D.C., USA
 NRLO Naval Research Lab. Orlando, FL, USA
 NSF National Science Foundation Washington, D.C., USA
 NTUA National Technical Univ. of Athens Athens, Greece
 NWES Northwestern Univ. Evanston, Ill., USA
 NYU New York Univ. New York, NY, USA
 OAKM Jakland Univ. Oakland, Mich., USA
 OKAY Okayama Univ. Okayama, Japan
 OPEN Open Univ. Milton Keynes, England
 ORNL Oak Ridge National Lab. Oak Ridge, Tenn., USA
 ORSA Univ. de Paris, Fac. des Science Orsay, France
 OSKA Osaka Univ. Osaka, Japan
 OSKC Osaka City Univ. Osaka, Japan
 OSLO Oslo Univ. Oslo, Norway
 OSSE Science Educ. Inst. of Osaka Pref. Osaka, Japan
 OSU Ohio State Univ. Columbus, Ohio, USA
 OTTA Univ. of Ottawa Ottawa, Canada

INSTITUTION VOCABULARY (CONT'D)

OXF Oxford Univ.
 PADO Univ. di Padova
 PARI Paris Univ. before division in early 70's
 PAVI Univ. di Pavia
 PENN Univ. of Pennsylvania
 PISA Univ. di Pisa
 PITT Univ. of Pittsburgh
 PRAG Institute of Physics, CSAV
 PRIN Princeton Univ.
 PURD Purdue Univ.
 REHO Weizmann Inst. of Science
 RHEL Rutherford High Energy Lab.
 RICE William Marsh Rice Univ.
 ROCH Univ. of Rochester
 ROCK Rockefeller Univ.
 ROMA Univ. di Roma
 RUTG Rutgers Univ.
 SACL Center d'Etudes Nuclear Saclay
 SAGA Saga Univ.
 SAIT Saitama Univ.
 SAINT Univ. de Santander
 SCUC Univ. of South Carolina at Columbia
 SEOU Korea Univ. at Seoul
 SERP Inst. of High Energy Physics
 SHEF Univ. of Sheffield
 SHIN Shinshu Univ.
 SIMP Univ. of Southampton
 SIEG Siegen Univ.
 SIEM Siemens Schuckertwerke AG
 SLAC Stanford Linear Accel. Center
 SMAS Southeastern Massachusetts Univ.
 SOFC High Inst. of Chem. Tech.
 SOFI Bulgarian Acad. of Science
 SRIP State Res. Inst. Photochem. Proj.
 STAN Stanford Univ.
 STEV Stevens Inst. of Tech.
 STOH Stockholm Univ.
 STON State Univ. of New York at Stonybrook
 STRB Centre des Res. Nucleaires
 SUFF Suffolk Univ.
 SYDN Univ. of Sydney
 SYRA Syracuse Univ.
 TATA Tata Inst. of Fundamental Research
 TBIL Inst. of Phys., Acad. Science
 TBSU Tbilisi State Univ.
 TELA Univ. of Tel-Aviv
 TEMP Temple Univ.
 TENN Univ. of Tennessee
 THES Univ. of Thessaloniki
 TMSK Nucl. Phys. Inst., Tomsk Polytech. Inst.
 TMU Tokyo Metropolitan Univ.

Oxford, England
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 Pavia, Italy
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 Pisa, Italy
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 New Brunswick, NJ, USA
 Gif-sur-Yvette, France
 Saga, Japan
 Saitama, Japan
 Santander, Spain
 Columbia, SC, USA
 Seoul, S. Korea
 Serpukov, USSR
 Sheffield, Yorks., England
 Matsumoto, Japan
 Southampton, England
 Huttental, Germany
 Erlangen, Germany
 Stanford, Calif., USA
 North Dartmouth, Mass., USA
 Sofia, Bulgaria
 Sofia, Bulgaria
 Moscow, USSR
 Stanford, Calif., USA
 Hoboken, NJ, USA
 Stockholm, Sweden
 Stonybrook, LI, NY, USA
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 Syracuse, NY, USA
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INSTITUTION VOCABULARY (CONT'D)

INFO Univ. of Toronto
 TOGA Tohoku-Gakuin Univ.
 TOHO Tohoku Univ.
 TOKY Univ. of Tokyo
 TORI Univ. di Torino
 TRIU TRIUMF, Univ. of British Columbia
 TRST Univ. di Trieste
 TSUK Tsukuba Univ.
 TUAZ Tokyo Univ. of Agriculture and Tech.
 TUFT Tufts Univ.
 TWAS Waseda Univ.
 UATH Univ. of Athens
 UBEL Univ. of Belgrade
 UCB Univ. of Calif. at Berkeley
 UCD Univ. of Calif. at Davis
 UCI Univ. of Calif. at Irvine
 UCLA Univ. of Calif. at Los Angeles
 UCR Univ. of Calif. at Riverside
 UCSB Univ. of Calif. at Santa Barbara
 UCSC Univ. of Calif. at Santa Cruz
 UCSD Univ. of Calif. at San Diego
 UMAD Univ. de Madrid
 UMD Univ. of Maryland
 UNM Univ. of New Mexico
 USPS US Naval Postgraduate School
 UTAH Univ. of Utah
 UTRU University of Utrecht
 UTSU Utsunomiya Univ.
 UUPP Univ. of Uppsala
 VALE Univ. de Valencia
 VAND Vanderbilt Univ.
 VASC Virginia State Coll.
 VASS Vassar College
 VICT Victoria Univ.
 VIEN Inst. for High En. Phys., A. A. S.
 VIRG Univ. of Virginia
 VPI Virginia Polytechnic Inst.
 WARS Univ. of Warsaw
 WASH Univ. of Washington
 WIEN Univ. Wien
 WILL College of William and Mary
 WINK Warsaw Inst. of Nuclear Research
 WISC Univ. of Wisconsin
 WUPP Univ. Wuppertal
 WURZ Wurzburg Univ.
 WYOM Univ. of Wyoming
 YALE Yale Univ.
 YERE Yerevan Physics Inst.
 YOKO Yokohama National Univ.
 YORK York University
 ZURI Zurich University

Toronto, Canada
 Miyagi, Japan
 Sendai, Japan
 Tokyo, Japan
 Torino, Italy
 Vancouver, Canada
 Trieste, Italy
 Ibaraki, Japan
 Tokyo, Japan
 Medford, Mass., USA
 Tokyo, Japan
 Athens, Greece
 Belgrade, Yugoslavia
 Berkeley, Calif., USA
 Davis, Calif., USA
 Irvine, Calif., USA
 Los Angeles, Calif., USA
 Riverside, Calif., USA
 Santa Barbara, Calif., USA
 Santa Cruz, Calif., USA
 La Jolla, Calif., USA
 Madrid, Spain
 College Park, MD, USA
 Albuquerque, New Mex., USA
 Monterey, Calif., USA
 Salt Lake City, Utah, USA
 Utrecht, Netherlands
 Utsunomiya, Japan
 Uppsala, Sweden
 Valencia, Spain
 Nashville, Tenn., USA
 Petersburg, VA, USA
 Poughkeepsie, NY, USA
 Victoria, BC, Canada
 Vienna, Austria
 Charlottesville, VA, USA
 Blacksburg, VA, USA
 Warsaw, Poland
 Seattle, Wash., USA
 Vienna, Austria
 Williamsburg, VA, USA
 Warsaw, Poland
 Madison, Wisc., USA
 Wuppertal, Germany
 Wurzburg, Germany
 Laramie, Wyoming, USA
 New Haven, Conn., USA
 Yerevan, Armenia, USSR
 Yokohama, Japan
 Downsview, Ont., Canada
 Zurich, Switzerland

PARTICLE VOCABULARY

ACHARM particle with negative charm
ADELO antiparticle of DEL(1232P333)
ADEUT antideuteron
ADO charmed meson (C=-1)
AG silver nucleus
AME anti-helium-4 nucleus
AME3 anti-helium-3 nucleus
AKO S=-1 KO
AK*(UNSPEC)0 S=-1 neutral K* of unspecified mass
AK*(892)0
AL aluminum nucleus
ALAMBDA antilambda
AN antineutron
ANNIHIL pure annihilation final state in
nucleon-antineutron scattering
narrow nucleon-antinucleon state
ANN(1935)0
ANN(1935)+ ANN(1935)-
ANN(2020)0 very narrow p-pbar resonance
ANN(2200)0 very narrow p-pbar resonance
ANUCLEON antinucleon
ANUCLEUS general antinucleus
ANUE electron antineutrino
ANUMU muon antineutrino
ANYTHING
AN(SPECT) spectator antineutron
AP antiproton
AP(SPECT) spectator antiproton
AR argon nucleus
AR37 argon-37 nucleus
ASICHAO ASICHA+ ASICHA-
ASTRANGE unspecified strangeness +1 particle
AT anti-tritium nucleus
AU gold nucleus
AXION hypothesized light Higgs scalar boson
AXIO AXI+
AO charmed baryon
A1(1100)0 A1(1100)+ A1(1100)-
A2(1310)0 A2(1310)+ A2(1310)-
A3(1660)0 A3(1660)+ A3(1660)-
BARYON baryon of unspecified charge, S, I, mass
BARYONIUM mesons that couple predominantly to
baryon-antibaryon
beryllium nucleus
BE generic name for any particle with naked beauty
BEAUTY B(1235) B(1235)+ B(1235)-
B(1235)0 B(1235)+ B(1235)-
C carbon nucleus
CA calcium nucleus
CD cadmium nucleus
CENTAURO new type of final state with 50 or more charged
particles, no pi0's

PARTICLE VOCABULARY (CONT'D)

CHARGED a charged track originating from the primary
interaction
CHARGED+ positive charged particle
CHARGED- negative charged particle
CHARM charmed particle
CHARMED-BARYON charmed baryon of unspecified C, S, I, or charge
CHI(UNSPEC) unspecified radiative decay product of psi(3700)
CHI(UNSPEC)0 unspecified radiative decay product of psi(3700)
CHI(3510) radiative decay of psi(3700)
CHI(3550) radiative decay of psi(3700)
CR chromium nucleus
CU copper nucleus
C12 carbon-12 nucleus
C*(4.44) 4.44 keV excited state of carbon
DD diffraction dissociation. To be followed by
names of particles which were so-produced,
e.g. DD <P PI0>
DELTA(980)0 DELTA(980)+ DELTA(980)-
DELO DEL(1232P33)0
DEL+ DEL(1232P33)+
DEL- DEL(1232P33)-
DEL(1232P33)-
DEL(UNSPEC)0 I=3/2 baryon of unspecified mass
DEL(UNSPEC)+ I=3/2 baryon of unspecified mass
DEUT deuteron
DIBARYON S=0 dibaryon resonance of unspecified mass
DIHYPERON S=-2 dihyperon resonance of unspecified mass
DO charmed meson
D+ charmed meson
D- charmed meson
D*(2010)+ charmed meson
D*(2010)- charmed meson
D(UNSPEC) unspecified charmed meson
D(1285)
EPSILON(700) pi-pi S-wave (near 700 MeV)
ETA
ETAPRIME
ETAPRIME/C recurrence of ETA/C
ETA/C JP=0- charmonium state
ETA(1780)
EXOTIC-MESON cannot be formed of quark-antiquark
EXOTIC-NUCLEON cannot be formed of qqq
E+ positron
E+S two or more positrons
E+(S) one or more positrons
E- electron
E-S two or more electrons
E-(S) one or more electrons
E(1420)
F f(1270) meson resonance
FE iron nucleus

PARTICLE VOCABULARY (CONT'D)

FFRIME		
F(1540)0	F(1540)+	F(1540)-
F+		charged strange meson
F-		charged strange meson
GAMMA		
GAMMAS		two or more gammas
GAMMA(S)		one or more gammas
CLUBBALL		
C(1700)0	C(1700)+	C(1700)-
HADRON		single hadron, any charge or mass
HADRONS		two or more hadrons
HADRON+		positive hadron
HADRON-		negative hadron
HADRON(S)		one or more hadrons
HDIBARYON(2130)+		S=-1 dibaryon resonance
HE		helium-4 nucleus
HE3		helium 3
HIGGS		Higgs boson
HYNUCLEUS		hypernucleus
HVY-LEPTON		general heavy lepton
HVY-LEPTON0		heavy lepton
H(2040)		I=0, JP=4+ meson resonance
H(990)		
INELASTIC		same as ANYTHING, except elastic excluded
IR		iridium nucleus
JET		jet detected as a whole
JETS		two or more jets, each detected as a whole
JET(S)		one or more jets, each detected as a whole
J/PSI(3100)0		
KAON		one kaon or antikaon of unspecified charge
KAONS		two or more unspecified kaon.
KAON(S)		one or more unspecified kaons
KL		K long
KS		K short
K0	K+	
K+(S)		one or more K+
K-		
K-(S)		one or more K-
K*(UNSPEC)		unspecified K*
K*(UNSPEC)0		unspecified K*
K*(UNSPEC)+		unspecified K*
K*(UNSPEC)-		unspecified K*
K*(1430)0	K*(1430)+	K*(1430)-
K*(892)0	K*(892)+	K*(892)-
LAMBDA		
LAMBDA/C+		charged baryon
LAM(UNSPEC)		I=0, S=-1 baryon resonance
LAM(1330B)		bump at 1330 Mev
LAM(1520D03)		
LEPTON		unspecified lepton

PARTICLE VOCABULARY (CONT'D)

LI6	LI7	
LONGLIVED		
MESON		lithium nuclei
MESONS		stable under strong or electromagnetic decay;
MESON(S)		mass and other quantum numbers not specified
MESON(UNSPEC)0		single meson of unspecified type
MESON(UNSPEC)+		two or more mesons
MESON(UNSPEC)-		one or more mesons
MESON(2950)		neutral meson of unspecified mass
MG		charge+1 meson of unspecified mass
MM, GE. 2		charge-1 meson of unspecified mass
MONOPOLE		bump seen in p pbar pi-
MUON		magnesium nucleus
MUONS		two or more undetected neutral particles
MUON(S)		magnetic monopole
MU+ MU-		any mu+ or mu-
N		two or more muons
NE		one or more muons
NEUTRAL		neutron
NEUTRALS		neon nucleus
NEUTRAL(S)		single neutral particle
NEUTRONS		two or more neutral particles
NEUTRON(S)		one or more neutral particles
NIT12		two or more neutrons
NU		one or more neutrons
NUCLEON		nitrogen-12 nucleus
NUCLEONS		
NUCLEON(S)		two or more unspecified nucleons
NUCLEUS		one or more unspecified nucleons
NUE		general nucleus
NUMU		electron neutrino
NUMAU		muon neutrino
N*5/2(UNSPEC)		neutrino associated with tau-
N*(UNSPEC)		I=5/2, Y=1 baryon of unspecified mass and charge
N*(UNSPEC)0		S=0 baryon of unspecified mass and isospin
N*(UNSPEC)+		S=0 baryon of unspecified mass and isospin
N*(UNSPEC)-		S=0 baryon of unspecified mass and isospin
N(PROG)		a collection of reactions with different numbers of prongs, e.g. 0(prong), 2(prong), 4(prong), etc.
N(SPECT)		spectator neutron (not number of spectators)
N(UNSPEC)G		I=1/2, Y=1 baryon of unspecified mass
N(UNSPEC)+		I=1/2, Y=1 baryon of unspecified mass
N(1470B)0	N(1470B)+	
N(1470P11)0	N(1470P11)+	
N(1520B)0	N(1520B)+	
N(1520D13)0	N(1520D13)+	
N(1670D15)0	N(1670D15)+	
N(1700B)0	N(1700B)+	
O		oxygen nucleus

PARTICLE VOCABULARY (CONT'D)

OMEGA meson resonance
 OMEGA- S=-3 baryon
 OMEGA* (UNSPEC) S=-3 baryon resonance of unspecified isospin and mass
 OMEGA* (UNSPEC)- S=-3 baryon resonance of unspecified mass
 P lead nucleus
 PHI unspecified recurrence of the phi
 PHIPRIME one pion of unspecified charge
 PION two or more pions
 PIONS one or more pions
 PION(S)
 P10 two or more pi0's
 P10S one or more pi0's
 P10(S)
 P1+ two or more pi+ 's
 P1+S one charged pion
 P1+- (S) one or more pi+ 's
 P1- two or more pi- 's
 P1-S one or more pi- 's
 P1-(S)
 PRONGS two or more prongs
 PRONG(S) one or more prongs
 PROTONS two or more protons
 PROTON(S) one or more protons
 PSI (UNSPEC) unspecified JP=1- charmonium state
 PSI(3685)
 PSI(3770)
 PSI(4415)
 PT platinum nucleus
 P(SPECT) spectator proton
 QUARK quark of unspecified charge
 QUARK(1/3) quark of charge 1/3
 QUARK(2/3) quark of charge 2/3
 Q(1240-1400)0 Q(1240-1400)+ Q(1240-1400)-
 RHOPRIME(1250)0 RHOPRIME(1250)+ RHOPRIME(1250)-
 RHOPRIME(1550)0 RHOPRIME(1550)+ RHOPRIME(1550)-
 RHOPRIME(1600)0 RHOPRIME(1600)+ RHOPRIME(1600)-
 RHO0 RHO+ RHO- silicon nucleus
 SI
 SIGMA0 SIGMA+ SIGMA- charmed baryon
 SIGMA/C(2430)++
 SIG(UNSPEC)0 I=1, Y=0 particle of unspecified mass
 SIG(UNSPEC)+ I=1, Y=0 particle of unspecified mass
 SIG(UNSPEC)- I=1, Y=0 particle of unspecified mass
 SIG(1385P13)0 SIG(1385P13)+ SIG(1385P13)-
 SIG(1670B)0 I=1, Y=0 bump
 SIG(1670B)+ I=1, Y=0 bump
 SIG(1670B)- I=1, Y=0 bump

PARTICLE VOCABULARY (CONT'D)

SN tin nucleus
 STRANGE unspecified strange particle
 STRANGEONIUM meson whose quark content is dominantly s-sbar, such as the phi
 STRANGE(S) one or more unspecified strange particles
 S+ intermediate scalar boson
 S- intermediate scalar boson
 S*(280) pi-pi or K-Kbar S-wave
 S(1935)0 S(1935)+ S(1935)-
 T tritium nucleus
 TA tantalum nucleus
 TAU heavy lepton
 TAU+ positive heavy lepton
 TAU- negative heavy lepton
 TI titanium nucleus
 TOPONIUM top-antitop state
 TRUTH generic name for any particle with naked truth
 U uranium nucleus
 UNSPEC particle of unspecified type
 UPSI (UNSPEC) unspecified upsilon particle
 UPSI(10020)
 UPSI(9460)
 VEE(S) one or more unspecified neutral strange particle decays
 VMESON vector meson of unspecified mass and charge
 VMESONO vector meson of unspecified mass
 W intermediate vector boson
 WI tungsten nucleus -- note name is not same as chemical symbol
 W0 intermediate vector boson
 W+ intermediate vector boson
 W- intermediate vector boson
 X10 XI-
 XI*(UNSPEC) S=-2 baryon of unspecified mass
 XI(UNSPEC) I=1/2, S=-2 baryon of unspecified mass
 XI(UNSPEC)0 I=1/2, S=-2 baryon of unspecified mass
 XI(UNSPEC)- I=1/2, S=-2 baryon of unspecified mass
 XI(1530P13)0 XI(1530)-
 XI(1820)0 XI(1820)-
 XI(1940)0 XI(1940)-
 X(2830)
 Y*(UNSPEC) JP=0- charmonium state
 Y*(UNSPEC)0 S=-1 baryon of unspecified isospin and mass
 Y*(UNSPEC)+ S=-1 baryon of unspecified isospin and mass
 Y*(UNSPEC)- S=-1 baryon of unspecified isospin and mass
 Z0 neutral weak gauge boson
 Z*(UNSPEC)0 exotic Y=2 baryon of unspecified mass

up to 10^{11} protons per pulse are accelerated typically to 28.5 GeV kinetic energy (11 GeV has been obtained). At 28.5 GeV, the period is 2.4 sec for slow extraction (with a 1-sec flattop), or 1.4 sec for fast extraction (not for neutrino beams). Fluxes below are calculated using the 2.4 sec period. Counting rates may be estimated using the nominal beam spill time of 1 sec.

	Beam	Momentum Range (GeV/c)	θ Ap/p (°)	Production angle (°)	Solid angle (msr)	Beam length (m)	Particles	Flux in thousands per sec per 10^{12} protons on target	θ (GeV/c)	Comments
Separated	B4	1.5-6	3	3	0.2	81	K^+/K^- $\bar{p}$ π^+/π^-	210/120 300 $4 \times 10^4/3 \times 10^4$	4	Usually 2×10^{12} ppp on target; $\pi/K \sim 3$ in π beam
	B2						Same characteristics as B4 above			To multiparticle spectrometer
	C7, C4	8-11	2	10.5	2.0	15	K^+/K^- $\bar{p}$ π^+/π^-	140/90 2 8×10^4	0.75	Usually 2×10^{12} ppp; $\pi/K \sim 10$ in K beam
	C6, C8	8-0.8	2.5	5	15	15	K^+/K^- $\bar{p}$ π^+/π^-	1000/560 14 6×10^5	0.75	Usually 2×10^{12} ppp
Unseparated	A1	5-24	1.7	0	0.3	130	K^+/K^- $\bar{p}$ π^+/π^-	100/17 1.5 $10^4/3000$	18	To multiparticle spectrometer; 10^{12} ppp
	B1	5-24	1.7	0	0.3	75	K^+/K^- $p/\bar{p}$ π^+/π^-	2500/700 $1.5 \times 10^5/200$ 3×10^4	10	Usually 2×10^{12} ppp
	C1	5-24	5	0	0.8	61	$K^+/\bar{K}$ $p/\bar{p}$ π^+/π^-	3000/400 $3 \times 10^6/30$ $10^5/3 \times 10^4$	16	Usually 2×10^{12} ppp; $\mu/\pi \sim 3\%$ in π beam
	A3	8-4	12	0	9.5	8	K^+/K^- $p/\bar{p}$ π^+/π^-	$8 \times 10^4/4 \times 10^4$ $2 \times 10^5/6 \times 10^4$ $10^6/8 \times 10^5$	4	Typically 10^{11} ppp; alternates with A1
	B5	6-20		4	0.1	2.6	K_S^0 K_L^0	$300/2 \times 10^5$ $27/2 \times 10^4$	6-20	Typically 10^{10} ppp
	U	1.5 (peak)					γ	$10^7/7 \times 10^6$ per cm^2		Typically 2×10^{12} ppp, flux averaged over 0.7 m radius

TABLE 1. PHASE I: Results of Experiment 1. (a) Frequency of the 100 trials in the dependent variable.

Note. A significant difference between the two phases was found for the frequency of the 100 trials in the dependent variable. The frequency of the 100 trials in the dependent variable was significantly higher in the first phase than in the second phase. The frequency of the 100 trials in the dependent variable was significantly higher in the first phase than in the second phase. The frequency of the 100 trials in the dependent variable was significantly higher in the first phase than in the second phase.

Phase I				
Phase	Frequency	Frequency	Frequency	Frequency
1	100	100	100	100
2	100	100	100	100
3	100	100	100	100
4	100	100	100	100
5	100	100	100	100
6	100	100	100	100
7	100	100	100	100
8	100	100	100	100
9	100	100	100	100
10	100	100	100	100

TABLE 2. PHASE II: Results of Experiment 2. (a) Frequency of the 100 trials in the dependent variable.

Phase II				
Phase	Frequency	Frequency	Frequency	Frequency
1	100	100	100	100
2	100	100	100	100
3	100	100	100	100
4	100	100	100	100
5	100	100	100	100
6	100	100	100	100
7	100	100	100	100
8	100	100	100	100
9	100	100	100	100
10	100	100	100	100

Note. A significant difference between the two phases was found for the frequency of the 100 trials in the dependent variable. The frequency of the 100 trials in the dependent variable was significantly higher in the first phase than in the second phase. The frequency of the 100 trials in the dependent variable was significantly higher in the first phase than in the second phase. The frequency of the 100 trials in the dependent variable was significantly higher in the first phase than in the second phase.

Phase II				
Phase	Frequency	Frequency	Frequency	Frequency
1	100	100	100	100
2	100	100	100	100
3	100	100	100	100
4	100	100	100	100
5	100	100	100	100
6	100	100	100	100
7	100	100	100	100
8	100	100	100	100
9	100	100	100	100
10	100	100	100	100

[illegible]

 

[illegible]

1990-1991		1991-1992		1992-1993		1993-1994		1994-1995		1995-1996		1996-1997		1997-1998		1998-1999		1999-2000		2000-2001		2001-2002		2002-2003		2003-2004		2004-2005		2005-2006		2006-2007		2007-2008		2008-2009		2009-2010		2010-2011		2011-2012		2012-2013		2013-2014		2014-2015		2015-2016		2016-2017		2017-2018		2018-2019		2019-2020		2020-2021		2021-2022		2022-2023		2023-2024		2024-2025		2025-2026		2026-2027		2027-2028		2028-2029		2029-2030		2030-2031		2031-2032		2032-2033		2033-2034		2034-2035		2035-2036		2036-2037		2037-2038		2038-2039		2039-2040		2040-2041		2041-2042		2042-2043		2043-2044		2044-2045		2045-2046		2046-2047		2047-2048		2048-2049		2049-2050		2050-2051		2051-2052		2052-2053		2053-2054		2054-2055		2055-2056		2056-2057		2057-2058		2058-2059		2059-2060		2060-2061		2061-2062		2062-2063		2063-2064		2064-2065		2065-2066		2066-2067		2067-2068		2068-2069		2069-2070		2070-2071		2071-2072		2072-2073		2073-2074		2074-2075		2075-2076		2076-2077		2077-2078		2078-2079		2079-2080		2080-2081		2081-2082		2082-2083		2083-2084		2084-2085		2085-2086		2086-2087		2087-2088		2088-2089		2089-2090		2090-2091		2091-2092		2092-2093		2093-2094		2094-2095		2095-2096		2096-2097		2097-2098		2098-2099		2099-2100		2100-2101		2101-2102		2102-2103		2103-2104		2104-2105		2105-2106		2106-2107		2107-2108		2108-2109		2109-2110		2110-2111		2111-2112		2112-2113		2113-2114		2114-2115		2115-2116		2116-2117		2117-2118		2118-2119		2119-2120		2120-2121		2121-2122		2122-2123		2123-2124		2124-2125		2125-2126		2126-2127		2127-2128		2128-2129		2129-2130		2130-2131		2131-2132		2132-2133		2133-2134		2134-2135		2135-2136		2136-2137		2137-2138		2138-2139		2139-2140		2140-2141		2141-2142		2142-2143		2143-2144		2144-2145		2145-2146		2146-2147		2147-2148		2148-2149		2149-2150		2150-2151		2151-2152		2152-2153		2153-2154		2154-2155		2155-2156		2156-2157		2157-2158		2158-2159		2159-2160		2160-2161		2161-2162		2162-2163		2163-2164		2164-2165		2165-2166		2166-2167		2167-2168		2168-2169		2169-2170		2170-2171		2171-2172		2172-2173		2173-2174		2174-2175		2175-2176		2176-2177		2177-2178		2178-2179		2179-2180		2180-2181		2181-2182		2182-2183		2183-2184		2184-2185		2185-2186		2186-2187		2187-2188		2188-2189		2189-2190		2190-2191		2191-2192		2192-2193		2193-2194		2194-2195		2195-2196		2196-2197		2197-2198		2198-2199		2199-2200		2200-2201		2201-2202		2202-2203		2203-2204		2204-2205		2205-2206		2206-2207		2207-2208		2208-2209		2209-2210		2210-2211		2211-2212		2212-2213		2213-2214		2214-2215		2215-2216		2216-2217		2217-2218		2218-2219		2219-2220		2220-2221		2221-2222		2222-2223		2223-2224		2224-2225		2225-2226		2226-2227		2227-2228		2228-2229		2229-2230		2230-2231		2231-2232		2232-2233		2233-2234		2234-2235		2235-2236		2236-2237		2237-2238		2238-2239		2239-2240		2240-2241		2241-2242		2242-2243		2243-2244		2244-2245		2245-2246		2246-2247		2247-2248		2248-2249		2249-2250		2250-2251		2251-2252		2252-2253		2253-2254		2254-2255		2255-2256		2256-2257		2257-2258		2258-2259		2259-2260		2260-2261		2261-2262		2262-2263		2263-2264		2264-2265		2265-2266		2266-2267		2267-2268		2268-2269		2269-2270		2270-2271		2271-2272		2272-2273		2273-2274		2274-2275		2275-2276		2276-2277		2277-2278		2278-2279		2279-2280		2280-2281		2281-2282		2282-2283		2283-2284		2284-2285		2285-2286		2286-2287		2287-2288		2288-2289		2289-2290		2290-2291		2291-2292		2292-2293		2293-2294		2294-2295		2295-2296		2296-2297		2297-2298		2298-2299		2299-2300		2300-2301		2301-2302		2302-2303		2303-2304		2304-2305		2305-2306		2306-2307		2307-2308		2308-2309		2309-2310		2310-2311		2311-2312		2312-2313		2313-2314		2314-2315		2315-2316		2316-2317		2317-2318		2318-2319		2319-2320		2320-2321		2321-2322		2322-2323		2323-2324		2324-2325		2325-2326		2326-2327		2327-2328		2328-2329		2329-2330		2330-2331		2331-2332		2332-2333		2333-2334		2334-2335		2335-2336		2336-2337		2337-2338		2338-2339		2339-2340		2340-2341		2341-2342		2342-2343		2343-2344		2344-2345		2345-2346		2346-2347		2347-2348		2348-2349		2349-2350		2350-2351		2351-2352		2352-2353		2353-2354		2354-2355		2355-2356		2356-2357		2357-2358		2358-2359		2359-2360		2360-2361		2361-2362		2362-2363		2363-2364		2364-2365		2365-2366		2366-2367		2367-2368		2368-2369		2369-2370		2370-2371		2371-2372		2372-2373		2373-2374		2374-2375	
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Accelerator mode	Particles	Momenta (GeV/c)	Particles per pulse	Pulse length (ns)	Repetition rate (Hz)	Comments
Normal	e^-	≤ 23.5	$\leq 5 \times 10^{11}$	1.6	≤ 360	To conserve power, repetition rates rarely exceed 180 Hz. The e^+ beam would require reinstallation of a high-power source.
	e^+	≤ 15.0	$\leq 2 \times 10^{10}$	1.6	≤ 90	
SLED	e^-	≤ 33.5	10^{11}	0.2	≤ 360	

Colliding beams	Particles	C.m. energy (GeV)	Peak luminosity ($\text{cm}^{-2} \text{sec}^{-1}$)	Average luminosity ($\text{cm}^{-2} \text{sec}^{-1}$)	Comments
SPEAR	e^+e^-	2-7.4	2×10^{31} at 3.2 GeV	8×10^{30}	SPEAR has 2 interaction regions, PEP 6. At PEP, the luminosity scales as E^{-2} (E^{-1}) for c.m. energies below (above) that at the weak.
PEP	e^+e^-	8-36	7×10^{30} at 29 GeV	1×10^{30}	

Beam	Momentum range (GeV/c)	$\Delta p/p$ (%)	Production angle ($^\circ$)	Solid angle (msr)	Particles	Maximum particles per pulse	γ at (GeV/c)	Repetition rate (Hz)	Facility	Comments
21	1-16	≤ 4.0	1	0.03	K^+/K^-	17/8	10	≤ 180	LASS	Separated: $\pi/K \approx 1/30$ $\pi/p \approx 1/14$
					p/p	40/6				
					π^+/π^-	10^3				
					e^-	10^4				
27	1-8	9.0 FWHM	0	10^{-7}	e^+	10^4	2.5	≤ 20	40" b.c. hybrid facility	Backscattered laser beam
					e^-	10^4				
					γ	10^5				
					γ	10^5				
3	≤ 15	0.1-1.0	0	0.03	e^+	2×10^{10}	All	< 90	ESA 1.6, 8, and 20 GeV/c spectro- meters	e^+ beam requires high power source; all fluxes at $\Delta p/p = \pm 0.25\%$ + High intensity source; longitudinal polarization = 0.4 + Low intensity source; longitudinal polarization = 0.85 + 0° bremsstrahlung + Coherent bremsstrahlung, linearly polarized (10^9 EQ without collimation) + Linearly polarized at maximum energy by coherent pair production in graphite
	≤ 23.5	0.1-1.0			e^-	5×10^{11}				
	3.237 j	0.1-1.0			e^-	5×10^{11}				
	(j = 1, ..., 6)	0.1-1.0			e^-	10^9				
	3.237 j	≥ 0.5			e^-	10^9				
	(j = 1, ..., 6)	≥ 0.5			e^-	10^9				
	≤ 21.5	Brems.			γ	4×10^9 EQ				
	5-15	7-10			γ	5×10^7 EQ				
6	≤ 21.5	Brems.	0	0.03	γ	2×10^8 EQ	All	≤ 360	Test beam	
	1-16				γ	2×10^8 EQ				
19	≤ 21.5	Brems.	0	0.03	e^-	10^9	All	≤ 360	Test beam	
	1-16				e^-	10^9				
19	≤ 21.5	Brems.	0	0.03	e^+	10^9	All	≤ 360	Test beam	Very pure; $\sigma_x = 1$ mm
	1-16				e^+	10^9				