INSTITUTE FOR HIGH ENERGY PHYSICS

REACTIONS DATA BASE MANUAL

A user's guide to the
Particle Physics Data System
under VAX/VMS

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Abstract

REACTIONS data-base contains information about various characteristics of reactions between elementary particles, such as total and differential cross-sections, multiplicities, polarizations and so on. The data are taken from various documents (journal articles, preprints, theses, etc.) and are cross-referenced with the DOCUMENTS data base which stores bibliographic, experimental and control information relating to these documents. All PPDS bases, including the REACTIONS data-base, the DOCUMENTS data-base, etc. are maintained, edited, extended and searched by a data base management system BDMS/4.

1   The REACTIONS Record - An Overview

The basic unit of information in a BDMS is the "record". In principle, a record for the REACTIONS data-base is defined to include all the encodable data presented in one particular document. In practice, data from one document may be subdivided into smaller sets and entered into several different records at the discretion of the data base manager or of the data encoder.

BDMS is a general-purpose data base management and information retrieval system which can handle hierarchically structured records of arbitrary complexity. In the following, we review some features of BDMS in the context of the REACTIONS data-base. For general description of BDMS, with more complete information, one should consult the BDMS User's Manual. In BDMS, when a value is to be assigned to a data element occurrence, it is done with an assignment statement whose general form is

```
        <Data Element Name>=<Data Element Value>;
 e.g.,
        SC = MORGAN 85;
```

The meaning of the special notation is an follows: Angle brackets $<>$ enclose semantic variables, i.e., form not enclosed in angle brackets should be present exactly as shown. Required[1]

blanks are denoted by the underline _ . Parts of a form which are optional are enclosed in square brackets [ ]. These notation symbols, $<>$, [ ] and _ , are not to be encoded. The character string follows the equals sign. A semi-colon must immediately follow each string to terminate it. Leading and trailing blanks in data element names and values and blanks in a numeric data element value are ignored by BDMS.

The REACTIONS data-base record is a collection of data elements whose names and meanings are given in Table 1. The hierarchical relationships between these data elements are presented in Fig.1.

---

[1]In general, zero or more blanks are allowed around delimiters such as ",", "=" and "TO". No distinction is made in PPDL between multiple blanks and a single blank.

DATA STRUCTURE IN REACTIONS DATA BASE

```
       +===========+=========+====================+=========+
       |  |  |  |  |  |    |        |        |  |          |        |
       SC PART|  |  | full | systematics  DEN DCH  ____table___    ERROR
       |     |||  |  |   |  |      |           / | |  | || ||  \
       |   DBN | DE |  cr  |     sysn          /  | ct || || DNE
       |      EXP   ab     |      |           / tfp  || ||
     ___R___             | alt-sysn  table-keys    || ||_syst-cov
     |  |  |  |           |      /|||||||||||  \ || |  /  | \
     D | |COMP       _____sys_____  RE ||||||||| OBS || | scn scv scc
       |  |          |   || |   |   | |   |||||||KIN  || |
      TY |       sys-err||cond | csys|   BP|||||||    || |_stat-cov
       |         |   ||   sysqn  |       ||||||OM   ||  /  | \
      SB        folded |corr  |    |     TP|||||     || rcn rcv rcc
                  |      sysqv  |         ||||NU    ||_____
              scale-factor      |        FSP|||      |       |
                  |           sys-id     ||Q2  loop-over    |
                applied              /  \   |    |       |
                                   PLAB   K    n    v       y
```

Fig.1. Key data elements are in upper case.

Logically, the data elements in the REACTIONS data-base fall into several groups. SC, R, TY and D give bibliographic information for the whole document, while STATUS gives the data encoding status for the data from this document.

The CR contains record-wide comments and the pair FULL, AB define abbreviations which can be used within other data elements.

Systematic errors, which may span all data within a document or only small subsets thereof, are encoded in the data elements linked by the SYSTEMATICS node.

The experimental data points and the names and values of the independent variables on which they depend form the fundamental information content of the REACTIONS data-base. This information is encoded in the data elements linked together under the TABLE node. We will refer to a single occurrence of TABLE along with the values of all subordinate data elements for that occurrence as "Table". Precise meanings of the various data elements in the "Table" will be presented in detail below. In general terms, TFP and CT contain general labeling information which characterizes a given table. The names (and units, if any) of all independent variables are given in N and their values (and errors, if any) in V.

In addition to numerical independent variables such as Plab, t and THETA, data in the REACTIONS are characterized by an observable name and reaction. These are encoded as

    N=RE; V=<first reaction>;<second reaction>; .....

and

    N=YN; V=<first observable name>;<second observable name>; ...

where the values are now strings.

2 Conventions for Encoding Numeric Quantities

As discussed in the previous section, the numerical values and errors of dependent variables (experimental measurements) and of the independent variables on which they depend are the primary quantities of interest

in the reaction-data file. Because of the great variety of ways in which experimental quantities are presented, we have chosen to input numeric quantities as strings to be written in a syntax which is very simple but allows great flexibility.

In principle, all experimental quantities, be they dependent or independent variables, are characterized by a measurement uncertainty or error. In practice, experimental quantities may be reported with no errors, symmetric errors or asymmetric errors. Errors may be presented either in the same units as the measurement or in percent. If we denote the value by V, the error by DELTA if symmetric and by DELTA+, DELTA-when asymmetric, then the various possibilities are presented as follows:

```
"V", "V +- DELTA", "V, +DELTA+, -DELTA-",
"V +- DELTA PCT", and
"V, +DELTA+ PCT -DELTA- PCT".
```

Again, any one of the above forms may be used whenever the experimental number appears.

When data are binned or integrated, two numbers representing the leading and trailing edge of the bin or the two integration limits are presented. In these cases, the two numbers (and errors, if any) are encoded by separating the two numbers by a "TO": e.g.

```
10.0 TO 30.0
```

If the errors on the two second numbers are the same the error is append to the second number only, e.g.,

```
10.0 TO  30.0  +-  5PCT;.
```

To distinguish binning from integration, the qualifier "(INT)" is appended as in the following example:

```
N=X; V=0.0 TO 0.5 (INT);.
```

An alternative way of binning information that can be found in documents is as a central value and a full, half or asymmetric bin width. These cases are encoded as in the following examples:

```
V = 10.0 (FW = 1.0);    V = 10.0 (HW = 0.5);
V = 10.0 (HW = +0.75, -0.25);
```

where FW refers to the full bin width and HW to the half bin width, with the third form being used when the bins are asymmetric. "BIN" if used if the bin limits are given as well as "central" value. E.g.,

```
V = 30.3 (BIN = 28.7 to 31.8);.
```

Upper and lower limits are encoded by preceding the numerical quantity by the appropriate relational as in the following examples:

```
Y = >3.0 (CL = 95 PCT); Y = <=7.0 (CL = 0.95);
```

where CL refers to confidence level.

If the systematic error is given for an individual data point "DSYS" is used. E.g.,

```
Y = 0.83+-0.06 (DSYS = 0.6);.
```

If the quoted error has systematic error folded in with the statistical error, but the later is also given, "STAT" is used. E.g.,

```
Y = 12.8 +- 2.6 (STAT = 0.6);.
```

The values of DSYS and STAT errors can apear more than once in the single point representing the different sources of the errors. If they are not symmetric the form

```
DSYS=+0.6,-0.5
```

can be used.

For an approximate value, encode, e.g.:

```
Y = 12 (C = APPROX);.
```

"ALL" can be used as the value of a numeric quantity. E.g.,

```
N = -T IN GEV**2; V = <1.0; ALL;.
```

"AND" can be used for data combined from more than one source. E.g.,

```
N = P IN GEV; V = 3.13 AND 3.30;.
```

"MIN" and "MAX" can be used as the (algebraic) minimum or maximum value of a variable, as at a kinematic boundary. E.g.,

```
N = -T IN GEV**2; V = MIN TO 0.1;.
```

Finally, comments on specific numeric values are encoded in parentheses after the number as illustrated in the following examples:

```
Y = 5 +- 2 (C=<comment>);
Y = >3.0 (CL=95 PCT,C=<comment>);.
```

Notice all qualifiers are enclosed in the same set of parentheses, separated by commas and, as always either the full comment or a previously defined abbreviation can be used.

3 REACTION - DATA base data element definition

3.1 Introduction

Following is a detailed discussion of the meaning and possible values of all the data elements permissible in the REACTIONS data-base. Figure.1 (and/or Table.1) should be referred to while reading this discussion; and it should be kept in mind that there actually is another dimension, so to speak, to the structure diagrammed in the figure. This dimension (which may be thought of as coming out of the paper) represents the multiple occurrence of data elements. For example, one record will generally have many TABLE's; one TABLE, many data points, Y's and so on.

3.2 Document identification

```
SC=<first author's last name>_<2 digit year>[<letter>];
```

called "short code", this is the unique identifier assigned to document from which the data are taken. This identifier is assigned when the document is entered into the document file.

```
R = <document reference>;
```

Allowed forms depend on the type of the document, i.e., on the value of TY. They are:

```
1) if TY = JOUR;
```

R =<PPDL journal abbreviation><volume number>,<page number>; for example:

```
R = NP B103, 255;
```

```
2) if TY = PREP;
```

R =<PPDL institute name abbreviation>-<year>-<preprint number>; for example:

```
R = JINR-75-128;
```

```
3) if TY = CONF;
```

R =<conference name abbreviation>-,<page number>; for example:

```
R = ROCHESTER-60, 1128;
```

```
4) if TY = PRIV;
```

```
R = PRIV;
```

```
D = <year>;
```

(D is subordinate to R). This is the document date.

```
TY = <document type>;
```

Allowed values are:

BART	-	article in book, conference proceedings or other bound collection of articles.
BOOK	-	book.
COMP	-	compilation, should be second entry of TY.
CPRE	-	conference preprint (not proceedings).Includes all meetings and talk writeups
ERR	-	used for erratum, should be second entry of TY.
JOUR	-	published article in journal.
PREP	-	preprint or report (not conference, not thesis).
PRIV	-	private communication.
PROP	-	experimental proposal.
RVUE	-	review or rapporteur talk, should be second entry of TY.
THES	-	thesis, even if also a lab report.

```
        SB = <data encoding status>;
```

this indicates whether the data from reference defined by the R data element have been encoded. This element has one of the following two forms:

```
        SB = ENCODED_<date>_BY_<initials>;
 or
        SB = VERIFIED_<date>_BY_<initials>;

        COMP = <compilation code>;
```

For existing compilations which are converted to PPDL, this data element is needed to indicate the origin of the data. Possible values are: LST6V4, FOX8V4, PDG3, LKN, GREG2, BIRM2, etc.

```
        RED = <integer>;
```

Unique document identification number assigned for record encoded at Durham.

```
        PART = <positive integer>;
```

Indicates that the data from a single document are for convenience entered in more than one record.

```
        DEN = <date record entered database>;
```

A fresh occurrence of this data element is inserted automatically by the system whenever the record is first entered.

```
        DCH = <date record last changed>;
```

A fresh occurrence of this data element is inserted automatically by the system whenever the record is modified.

3.3   Comments and Abbreviations

DBNAME   - name of subbase

For example:

DBNAME=D2;   - binary reactions
DBNAME=DE;   - E+ E- reactions   ll
DBNAME=DI;   - inclusive reactions
DBNAME=DL;   - leptonic reactions
DBNAME=DN;   - nuclear collection (ITEP group)
DBNAME=DS;   - encoded by Serpukhov group

The REACTIONS data base supports this data element to make easy the search for very large groups of record, covering the large branches of the physics. It also can contain some internal information.

```
PR = <proposal code (from EXPERIMENTS data base)>;
```

This data element contains the proposal code of the experiment the data produced by. It is extracted from the EXPERIMENTS or DOCUMENTS data-bases.

```
DE = <name of detector>;
```

The descrption of the detector used by the experiment.

```
CR = <comment applying to the entire record>;

FULL = <full expression>;
```

This is the full expression to be inserted at any place in any data element value in the record where the abbreviation defined in AB appears in single quotes. This is useful where the same comment, or indeed any character string, is found more than once in the record.

```
AB = <abbreviation>;
```

This is a short, arbitrary abbreviation of the corresponding value of FULL. It is defined by the encoder and can be used within single quotes as part of any data element value.

At various places in record, there are data elements which may be used to indicate a comment (CSYS, CT) and in addition, comments may be referred to within certain other data elements (e.g., Y=10+-2(C='A'); see discussion of Y below). On any these occasions, either the comment itself may be presented or just the defined abbreviation.

3.4   Systematic Errors and Corrections

SYSTEMATICS;

This is a pure node data element which links together all occurrences of SYS which each specify a given systematic error or correction on the variable(s) in SYSN.

```
SYSN =<name of variable(s)  to  which  the  systematic
       error or correction applies>;
```

The units may be omitted. If the same error or correction applies to several variables, multiple occurrences of SYSN under the same SYSTEMATICS node is used.

```
ALT-SYSN =<alternative variable name arising from  the
           use of a scale-factor>;
```

Used when the SCALE-FACTOR changes the name/units of a variable
(e.g., N_IN_EVENTS to SIG_IN_MUB). SYSN is the variable as tabulated in the record. ALA-SYSN is the variable before the scale-factor is applied if APPLIED is encoded; otherwise, it is the variable which would be obtained from using the scale-factor where it has not been applied to the data.

    SYS;

    This is a pure node data element which links together the set of data elements which are needed to specify a systematic error or correction on either a dependent or independent variable. All such sets are grouped an occurrence of SYSTEMATIC to the SYSN to which they apply.

```
        SYS-ERR =<systematic error>;
```

As was already discussed, errors are encoded in one of two forms: DELTA or +DELTA+, -DELTA- where DELTA is a symmetric errors and DELTA+, DELTA- are asymmetric errors. Again, if the error is quoted as a percentage of the measured quantity, "PCT" symols will appear at the end of the value. Otherwise, the units may be omitted if the same as wherever SYSN is used. If the contributions of various different effects to overall symmetric errors are given and the total is given, all sources and the overall errors as well are presented. Every source is explained in the appropriate CSYS.

    FOLDED;

    This is a pure node to indicate that the given systematic error has already been folded into the quoted error on the variable in question. If the systematic error has been folded-in but its value has not been given, this is indicated in CSYS or "?" sign is used as the value of SYS-ERR.

```
    SCALE-FACTOR=<SF [units]>[(OP=<operation>,C=<comment>)];
```

This is a scale factor applying to the data specified by SYSN (and, if necessary, by SYSQN/SYSQV). It acts multiplicatively (OP=*) unless OP is explicitly encoded. Main applications are:

    a)   conversion of numbers of events to cross section (see
          ALT-SYSN);
    b)   decay branching ratio correction factors;
    c)   renormalization of data;

At the end of this section are examples of its use.

    APPLIED;

This is a pure node data element whose presence indicates that its parent SCALE-FACTOR has been applied to the data values in question.

```
        CORR =<reaction corrections taken into account>;
```

These are either significant corrections applied to the data and thought reliable, e.g., understood background corrections or Glauber corrections, or corrections which convert the directly measured reaction into the reported reaction, e.g., corrections for known branching ratios. The specification of the corrections follow either controlled forms (for commonly occurring cases or are free format. The common corrections are:

```
1)       CORR = DECAY-BR(BRN =<branching ratio name>,
              BR =<value [and error]>, C=<comment>);
```

This form is used whenever the value(s) to be given for the dependent variable (e.g., cross section) have been corrected for some undetected decay mode(s) of a particle using known branching ratio(s). The arguments of DECAY-BR have the form:

```
a)       BRN=<decaying  particle> -->  <numerator  decay
         mode(s)>_/_<denominator decay mode(s)>.
```

The syntax for the numerator and denumerator decay modes is the same as that used in specifying decay modes in a reaction. In general, these modes may be any subset of the possible decay modes of the decaying particle. If no denominator is given, it is assumed to be all the modes given in RE (this may, or may not, be all possible decay modes of the particle in question; remember that if it is all possible modes, then no modes will appear in RE).

For example, if a cross section is to be given for PI- P $\rightarrow$ N A2(1320)0 including all K AK decays of the A2(1320)0, but only the K+ K- decay mode of the A2(1320)0 was detected, then the reaction would be written:

```
RE = PI- P→N A2(1320)0 <K+ K- + K0 AK0>;
```
and we might have a BRN of the form

```
BRN = A2(1320)0→ K+ K-;
```

```
b)       BR=<numerical value [and  error]  or  branching  ratio

         defined above in BRN>.
```

This is the value used by the author of the paper to undetected decay modes. If the correction factor is a Clebsh-Gordon coefficient, use zero, i.e.,
BR = 0 for C-G coefficient.

Alternatively, the branching ratio value can be encoded as a scale-factor.

```
2)       CORR = RES-DEF (RES=<resonance name>,  BACK=<either  "NONE"
              or "CORRECTED">,  DEF  =  <mass  cuts  defining
              resonance>, C =<comment>);
```

Whenever a reaction involves a resonance, RES-DEF is used to indicate if the resonance had no background consequence under it (BACK=NONE) or if background corrections were necessary and were in fact made (BACK=CORRECTED). In the latter case, CORR is used only if the background corrections are thought reliable; if the background corrections either were not made or are unreliable. If the resonance is defined by mass cuts, DEF is used. For example,

```
          CORR = RES-DEF(RES=G(1690)-,DEF=1.55<M(K- K0)<1.85-GEV);

3)        CORR = GLAUBER[<C=<comment>)];
          For Glauber corrections in deuterium.
4)        CORR = FERMI[<C=<comment>];
          For Fermi-motion corrections in deuterium.
5)        CORR = PAULI[<C=<comment>)];
          For Pauli exclusion principle corrections in deuterium.
6)        CORR = COULOMB[<C=<comment>)];
          For Coulomb scattering correction at very small angles.
7)        CORR = /<free format comment>;
          For any other corrections.

          COND  =  <reaction  corrections  not  fully  taken  into
          account>;
```

This data element is used if the numbers presented do not correspond precisely to the reaction quoted because of some significant corrections are known to be needed but could not be made for some reason, as for example, when a resonance cross section is quoted with no attempt at subtracting background or when particle identification is unreliable. For unsubtracted or unreliably subtracted background use

```
          COND=RES-DEF(RES=<resonance name>, BACK=<"UNCORRECTED">
                C=<comment>);
```

See discussion above under CORR=RES-DEF. Otherwise

```
          COND=/<Free field comment>;
```

is used.

```
          SYSQN=<qualifier of SYS-ERR>;
```

Name of a variable which is needed to define the domain of applicability of a specific systematic error. The name is constructed according to the same prescription as SYSN (see above). If more than one variable is required, use multiple occurrence of SYSQN. If a systematic error applies regardless of what value a given variable takes, then that variable is not included among the SYSQN.

   If the systematic error applies only to some subset of the reactions in the record, SYSQN=RE; is used and a list of the the reaction(s) in (multiple occurrences of) SYSQV is presented (see below).

```
          SYSQV=<value(s) of qualifier SYSQN>;
```

This data element contains the values, or range of values, for which the systematic error applies. If different discreet values are specified, multiple occurrence of SYSQV is used under one occurrence of SYSQN. If the range of values Vfrom to Vto is appropriate, the form SYSQV=Vfrom_TO_Vto; is used.

   As an example, consider the case where the systematic error in question applies when the variable named in SYSQN has the values A, B, C or is in the range D or F. Then encode SYSQV=A;B;C;D; to F;. If SYSQN is equal to "RE", then list the reactions in SYSQV.

```
          CSYS=<comment>;
```

Free format comment to further describe the systematic error.

```
          SYS-ID=<unique  identifier  for  a  given  systematic
                error>;
```

This is a string data element may be used to assign a unique identifier to any systematic error. It is to be used if the same error applies to data encoded in different records, as may happen, for example, if the amount of data in a given document is very large. However, repeating the information in each record forming part of the document is, in general, preferable.

Examples of Systematic Error Encoding

1)"Uncertainty in the target polarization gives is to an additional 6tabulated values."

```
SYSN=POL; SE=6 PCT;
CSYS=Due to target polarization uncertainty;
```

2)"Events are tabulated but the microbarn equivalent is also given."

```
SYSN=D(N)/D(T)\_IN\_EVENTS/GEV**2;
ALT-SYSN=D(SIG)/D(T)\_IN\_MUB/GEV**2;
SCALE-FACTOR=0.062;
```

3)"The OMEGA cross section is corrected for the 3PION branching ratio, and the error includes all systematic."

```
SYSN=SYG; SYS-ERR=?; FOLDED;
SCALE-FACTOR=89.9\_+-\_0.6\_PCT\_(OP=/, C=PDG\_TABLES\_1978);
APPLIED;
CORR=DECAY-BR(BRN=OMEGA\_  -->  \_PI+\_PI0\_PI-);
```

3.5 Numerical Data

In the REACTIONS data-base, each dependent variable, i.e., data point, is characterized by the reaction being studied, by the observable being measured, and by the values of some number of independent variables.

In general, the independent variable, Y, is reported for one or more reactions and for each reaction for one or more observables and for each reaction and observable as a function of one or more of the independent variables. To completely define each data point, Y, the name and value of every independent variable is given and the reaction and observable is specified.

In the literature, the most common way in which data are presented is in the form of Tables (a figure may be regarded as a simple type of Table). The column headings and row labels give the independent variables, including reaction and observable name, and the body of the table contains the data point themselves.

The REACTIONS data-base supports the structure of the data elements that can represent any kind of table. User need not to study all appropriate rules for the data encoding and representation of the complex tables inside the REACTIONS data-base. The applied program will helps to output any kind of table in readable form. The special modes of the output are designed to obtain the output that is easy-to-read for the FORTRAN programs. The only data elements that can be actively used by the users to retrieve the information from the data base are grouped under the TABLE-KEYS data element.

TABLE;

A pure node data element which links together all data from one table.

TABLE-KEYS;

A pure node data element which links together all keys associated with the data in a table.

```
        RE =<reaction name>;
```

The name of any reaction appearing in the table (as the value of V in a LOOP-OVER containing N=RE;)
is repeated here, except that the specification of any decay modes is omitted. Where final states are added
(e.g., where and are not distinguished experimentally), each will be entered as separate occurrence of RE.

```
        OBS=<generic observable name>;
```

The name of any observable in the table (appearing as the value of V in LOOP-OVER containing N=YN;)
is repeated here, except that any argument hits are omitted. For example,

```
        OBS=RHO; D(SIG)/D(COS(THETA));
```

```
        PLAB=<lowest momentum>,<highest momentum>;
```

This is real vector data element whose two components are the lowest and highest value of the laboratory
beam momentum in units of GeV/c which occurs in the table.

For colliding beams, the equivalent laboratory beam momentum for a stationary target which would
produce the same center of mass energy is presented. An exception is for e+ ecolliding beams when the
laboratory momentum of one of the beams is taken.

Additional table-keys which can be encoded in lepton scattering are:

K	equivalent real photon energy $(s - m^2)/(2*m)$ in GeV
Q2	virtual photon mass squared $(Q^2 = -q^2)$ in GeV**2
NU	lepton laboratory energy loss $(\nu = E - E')$ in GeV
OM	scaling variable $(\omega = 2*m*\nu/Q^2)$

For all these, the appropriate range of the variable is encoded as a reel two-component vector similarly
to PLAB.

```
        KIN =<kinematic feature>;
```

This flag in a qualitative way the angular coverage of the data. Possible values are:

```
        LARGE_ANGLE, BACKWARD, HIGH_PT, COULOMB.
```

```
        FSP = <particle name>;
```

contains a list of particles in the final state. Particles produced in resonance decays are not included in FSP.
All particle names are codes which are given in PPDL. FSP is a virtual key, i.e. it is missing in the record
itself, but it is possible to retrieve the record with the given value of FSP.

It is possible to search for particles with desired properties, due to an on-line vocabulary of particles with
almost all general properties. FORMAT:

```
        FSP < PROP(...);**
```

where the ellipsis represents the desired property. The '¡' is necessary for the BDMS/4 query procedures, and should be understood to mean "contains" in this usage. The following properties are allowed:

HADRON	- no appended value allowed
LEPTON	- no appended value allowed
MESON	- no appended value allowed
NUCLEUS	- no appended value allowed
HYPERON	- no appended value allowed
BARYON	-
CHARGED	-
STRANGE	-
CHARMED	-
ISOMUL	-
BEAUTY	-
MASS	-

The meaning of each property is transparent. Most properties can have a value appended (with the exception of the first five properties), for example - CHARGED=-2, means particles with charge = -2. The value is connected with a property by some relational from the following list:

=	- equal to,
>	- greater than,
<	- less than (here it takes on its usual meaning),
<>	- not equal to.

The presence of any property in the query string means that this property is at least not equal to zero, unless zero is explicitly requested. So, the strings

```
FIND FSP < PROP(CHARGED<>0);**  and
FIND FSP < PROP(CHARGED);**
```

are equivalent.

One can list more than one property in a single query. In that case you must separate them by commas and they are understood to be "AND-ed" together.

EXAMPLES:
   to find all hyperons (FI:=FIND),

```
FI FSP < PROP(HYPERON);**
```

   to find all negative charged hyperons,

```
FI FSP < PROP(CHARGED<0,HYPERON);**
```

to find all mesons with mass greater than 2. GeV and with CHARGE=+1,

```
FI FSP < PROP(CHARGED=1,MASS>2.,MESON);**
```

Note, please! In the case of any contradictions in the query the only last value will be used! For example by the query

```
FI FSP < PROP(CHARGED=1,CHARGED=0,MESON);**
```

only mesons with CHARGE=0 will be found.

```
        BP = <particle name>;
```

beam particle code. It is similar to FSP. Search on particle properties is also allowed.

```
        TP = <particle name>;
```

target particle code. It is similar to FSP. Search on particle properties is also allowed.

```
        TFP=<table, figure or page number(s)  from  which  data
            taken>;
```

describes the location of the given table in the article.

```
        CT=<comment applying to this entire table>;
```

This may be either the comment itself or an abbreviation defined by a FULL-AB pair.

```
        LOOP-OVER;
```

Pure node data element which links the N and V data elements.

```
        N=<name of independent variable or "RE" or "YN">;
```

In the following, we include "RE" and "YN" when we refer to independent variable names.

Each independent variable on which the dependent variable y depends must have its name encoded in an occurrence of N with all the values that variable takes encoded in the corresponding V. For N not equal to "RE" or "YN", the value of this data element consist of a name (such as THETA, -T, E, etc) taken from a vocabulary list, in some cases followed by a series of arguments.

The arguments define the variable precisely by giving such quantities as which particle in system of particles this variable applies to and the frame in which the variable is presented. For details on constructing independent variable applies to and the frame in which the variable is presented.

If the independent variable has units, these are specified by following the name with "IN", where the "IN" is preceded and followed by a blank, and then giving the units.

```
        V=<value(s) (and errors) of independent variable>;
```

For N=RE; V contains the name(s) of the reaction(s) for which data are written.

Note that reaction here refers to the specific reaction for which the dependent variable applies, which may not be the reaction measured, the difference being, say, branching ratio corrections.

For instance, if a cross section is given for a final state involving a certain particle, and the cross section includes all "possible" decays of that particle (regardless of whether all decays were detected or whether some were corrected for through the use known branching fractions), then the reaction is written with no decays following the particle in question. For example, if all LAMBDA modes have been detected or corrected for in quoting a cross section for

```
        K- P  --> PIO LAMBDA;
```

one would obtain V=K-_P_–>_PI0_LAMBDA; but if the cross section is only for a specific decay (or decays) and not corrected for all other decays, then these specific decay(s) will be written following the particle. In the above example, if only the $p\,\pi^-$ mode of the Λ was detected and others were corrected for, one would obtain V=K-_P_–>_PI0_LAMBDA<P PI>.

In some cases, the quantity measured may involve two or more reactions; it may for instance, be a cross-section ratio or it may refer to a definite I-spin state. In that case, each individual reaction involved will be associated with a separate occurrence of RE qualified with a Q argument. The name of the dependent variable (see YN below) will indicate how these reactions were combined for the measurement quoted.

```
   For N=YN; V contains the name(s) of the observables.
```

```
        V=<dependent variable name (and units)>;
```

This data element is constructed from a list of basic observable names (such as SIG, YLM, POL) combined with independent variable names (such as THETA, E, P, T) by use of operators (such as +, -, /, * and **). As in the case of independent variable names, the basic observable names may require arguments. Finally, certain FORTRAN functions such as SQRT, ABS, SIN, COS are also allowed. If the dependent variable has units, the dependent variable name is followed by "IN" and the units in exactly the same way as for XN(see above).

For all values of N other than RE or YN, V contains the numerical value(s) of the corresponding independent variable and errors, bin specifications and such, if necessary. See discussion concerning encoding of numerical quantities abowe.

```
Y=<value of dependent variable, error, (and comments)>;
```

The conventions for encoding numeric quantities are presented above. Finally, if a comment is associated with a particular Y value, use the form illustrated in the following:

```
Y=10 +- 3; 5 +- 1 ( C=<COMMENT> ); 2 +- .5;
```

where the comment applied only to the second data point and, as always, either the full comment or a previously defined abbreviation may be used.

STAT-COV   -   pure node data element.
                 Used to join data and comments on the statistical
                 covariance martix from one source or group of
                 sources if combined by authors.

RCN   -   Random-Covariance-Name.
                 Contains name and units of the statistical
                 covariance matrix (see PPDL thesaurus).

RCV   -   Random-Covariance-Value.
                 Contains value of the statistical covariance
                 matrix element encoded as:
                 RCV = COV(1,1); COV(1,2); ... COV(N,N);
                 in sequence line by line.

RCC   -   Random-Covariance-Comment.
Source description and other comment to the
contents of RCN and RCV.

SYST-COV   -   pure node data element.
Used to join data and comments on the systematic
covariance martix from one source or group of
sources if combined by authors.

SCN   -   Systematic-Covariance-Name.
Contains name and units of the systematic
covariance matrix (see PPDL thesaurus).

SCV   -   Systematic-Covariance-Value.
Contains value of the systematic covariance
matrix element encoded as:
SCV = COV(1,1); COV(1,2); ... COV(N,N);
in sequence line by line.

SCC   -   Systematic-Covariance-Comment
Source description and other comment to the
contents of SCN and SCV.

Examples of covariance data presentations in publications:

```
COV(I,J) = DY(I,J)
COV(I,J) = DY(I)*DY(J)*RHO(I,J)
```

where I[J] is sequencial numder of Y(I)[Y(J)], DY(I) - variance of Y(I).

```
COV(I,J) = DY(I,J)/Y(I)/Y(J)          [ IN PCT ]
COV(I,J) = SQRT(DY(I,J)/Y(I)/Y(J))    [ IN PCT ]
COV(I,J) = RHO(I,J)                   [ IN PCT ]
```

Majority of covariance data presentation one can ascribe by the following names:

```
ACOV - covariance in absolute units   = D(I,J)
RCOV - relative  covariance           = D(I,J)/Y(I)/Y(J)
NCOV - normalized covariance RHO(I,J) = D(I,J)/D(I)/D(J)
```

Model of encoding for three Y values with two sources of correlated systematics:

```
 ...
Y. = Y(1) +- ST(1) (DSYS=SY1(1),DSYS=SY2(1));
Y. = Y(2) +- ST(2) (DSYS=SY1(2),DSYS=SY2(2));
Y. = Y(3) +- ST(3) (DSYS=SY1(3),DSYS=SY2(3));
RCN = RCOV IN PCT;
RCV = V11; V12; V13;
      V21; V22; V23;
      V31; V32; V33;
SCN = NCOV;
SCV = R11; R12; R13;
      R21; R22; R23;
      R31; R32; R33;
```

```
 SCN = NCOV;
 SCV = R11; R12; R13;
       R21; R22; R23;
       R31; R32; R33;
```

NOTE: all observables with correlated uncertainties must be encoded in one table.

```
     DATA-NOT-ENCODED;
```

This node data element is used to flag that no Y values are encoded. This can arise when the presence of a figure or table in document is to be noted (particularly for indexing or for comment), but the actual data are not recorded. (Perhaps tabulated values are awaited from the authors, or the data are also presented elsewhere - possibly in a revised form.)

```
     CEN =<comment on the encodings of the record>;
```

This is for the convenience and benefit of the reaction data file managers.

4 Document Output

4.1 General commands

The current set of records created with the GET and FIND commands can be displayed at the terminal with the command

```
     LIST
```

This command can have 2 types of parameters. The first is a list of record numbers and the second is a list of displayed data elements. For example,

```
     LIST,1,5,10:13,-1,-3,SC,R.
```

This command lists the values of data elements SC and R. The records in the current set for which these elements will be listed are 1,5,10,11,12,13,N and N-2, where N is the number of records in the set. Note that the current record is given the number -1.

Each data element (DE) will be listed starting on a new line.It will be numbered if several occurrences of that data element are linked to the same parent occurrence, or if it is a record level data element which occurs more than once. Subordinate data elements will be listed following the parent occurrence to which they are linked. They will appear indented according to their level in the record structure.

If the list of data element names is omitted, the last DISPLAY or SUPPRESS command issued controls which data elements are displayed (see below). If no DISPLAY or SUPPRESS command has been issued, all data elements are displayed.

Next output command:

```
     PRINT
```

This is identical to LIST, except that the output goes to the system file
<base name>.PRN.

```
     DUMP
```

This command is similar to PRINT, except that the output is dumped on the system file<base name>.DUM in a format convenient for loading or adding to the database (see ?MODE).

The list of the DEs to be displayed may be given beforehand.

```
            SUPPRESS - point to data elements  which  are  not  to  be
                       printed by the LIST, PRINT, and DUMP commands.

            SUPPRESS,DE1,...,DEn.
   or
            SUPPRESS,ALL-DE.

            DISPLAY - point to data elements which ARE to  be  printed
                      by the LIST, PRINT, and DUMP commands.

            DISPLAY,DE1,...,DEn.
   or
            DISPLAY,ALL-DE.
```

By default, all DE's are opened for output commands. The DISPLAY command is used if the command SUPPRESS was used previously.

```
            LINE,<n>
```

This command sets the input/output line length to <n> characters. The default is 80 characters.

```
            DOCUMENT - prints information from the  current  set  onto
                       the  system  file  <base  name>.DOC in a format
                       convenient for reading or for special handling.

            DOCUMENT,n
```

where n is the number of record in current set. If n is omited all records will be printed. The next command selects the desired document format:

```
            MODD,n
```

where n is the mode number.

At present, there are several modes of DOCU outputs. The main one (default) is MODD,1 and other two modes MODD,2 and 4 are used to work with the graphic system ATLAS. The MODD,4 was designed to work with correlated observables, see section devoted to specific outputs. They also have the possibility to make some selections and reorganization of the output.

The typical output of the DOCUMENT with MODD,2 is presented below:

```
 TITLE    AMALDI 79B                NP B166, 301
 TITLE    SQRT(S) IN GEV    23.5
 TITLE    RE                      P P --> P P
 X-AXIS  -T IN GEV**2
 Y-AXIS  D(SIG)/D(T) IN MB/GEV**2
 4.2E-2                                   48.7              +-  1.27
 4.6E-2                                   44.5              +-  1.2
 END               2
```

This kind of DOCUMENT outputs the mean X-value and statistical errors in Y-value. The general format of the numerical values in REACTIONS data base can represent much more complex values (see description of the REACTIONS data base). To give the user the access to the complete number the MODD,3 and MODD,4 were designed.

MODD,3 outputs the mean X-value and left- and right edges as well. The error in Y-value is the quadratic combination of the statistical and systematic ones. The typical output looks like this:

```
TITLE   AMALDI 79B              NP B166, 301
TITLE   SQRT(S) IN GEV    23.5     0.        0.
TITLE   RE                P P --> P P
X-AXIS  -T IN GEV**2
Y-AXIS  D(SIG)/D(T) IN MB/GEV**2
 4.2E-2   0.        0.                    48.7      1.27      1.27
 4.6E-2   0.        0.                    44.5      1.2       1.2
END             2
```

MODD,4 gives in addition the values of X-bins if BIN or INT qualifiers have been used during encoding (see REACTIONS manual). The statistical and systematic errors are given separately. This mode outputs the values of the correlation matrix (if any) as well.

MODD,4 output for table with single observable is the flat file with following structure named for the moment as (ONE-YN-MODD4-TABLE):

```
TITLE <SC> <R> <D> <DE> <EXP>;
T-NAME <YN-VALUE-MODEL-NAME>,<MAP-DATA-NAME>,<DATA-SET-NUMBER>
TITLE <XN-PARAM>    <VALUE>
 .
 .
TITLE <XN-PARAM>    <VALUE>
X-AXIS XN
Y-AXIS YN-VALUE
XV
YV, ST
DSYS.1
DSYS.2
XV
YV, ST
DSYS.1
DSYS.2
 .
 .
END
```

For correlated data following structure of output file is used

```
START-SEGMENT-OF-CORRELATED-DATA
ONE-YN-MODD4-TABLE
 .
 .
ONE-YN-MODD4-TABLE
START-SEGMENT-OF-COVARIANCE-MATRICES
<SOURCE-NUMBER>,<COVARIANCE-NAME>,<TYPE>
<COVARIANCE-MATRIX>
END-ERRORMATRIX
 .
 .
<SOURCE-NUMBER>,<COVARIANCE-NAME>,<TYPE>
<COVARIANCE-MATRIX>
END-ERRORMATRIX
END-SEGMENT-OF-CORRELATED-DATA
```

Modes 2,4 can be used anyway to obtain the output that can be easy red by the FORTRAN programs. This mode also has some specific possibilities that are explained below. One can return to the main mode with the command MODD,1

Output documents can have an optional title:

```
TITLE  text
```

This command, if used, must be issued before the DOCUMENT command.

4.2   Specific reactions output document

The command DOCUMENT may have special parameters which control output. A space separates the command and the first parameter. The parameters are separated one from another with a semicolon. The symbol "#" closes the list of parameters. There are four types of parameters:

```
1) RESTRICTED OUTPUT
```

The parameters of this type specify the name of a data element and its value, in the format:

```
:<DE name>=<DE value>
```

For example,

```
:RE=<code of reaction>
```
 or
```
:YN=<code of observable>
```

where the observable must be coded without its parameters.

The tables which do not contain these codes will not be printed on the output file.

```
2) PARTIAL REORGANIZATION OF TABLES
```

```
!<code of observable>;
```

A multidimensional table can be rearranged so that values of corresponding observables will be changed most frequently.

```
3) CHANGING OF UNITS
```

```
$<description of units>;
```

A scale factor which is determined by ratio of the user's units and the units in the database is applied to the data values.

```
4) MARKING OF OBSERVABLES
```

```
%<code of observable>
```

The corresponding observables will have marks%A (%B, %C, ...) in the output document.

The marking affects modes MODD,2 and MODD,4 only.

Example:

```
MODD,2
FIND SC=POUCHER 73;**
DOCU %E IN GEV;%THETA IN DEG;:YN=D2(SIG)/D(E)/D(OMEGA);:RE=E- P --> E- X;#
DOCU %E IN GEV;%THETA IN DEG;:YN=D2(SIG)/D(E)/D(OMEGA);:RE=E- DEUT --> E- X;#
STOP
```

TABLE.1 PPDS Reaction-Data File Data Elements (FDT)

DATA ELEMENT NAME (SYNONIM	PARENT NAME	TYPE	KEY LENGTH	MULT.	FORMAT	DATA ELEMENT MEANING
SC (AUTH)	-	C	16	O	C	short code
R (REF)	SC	C	12/20	O	C	reference
D (YEAR)	R	C	4	S	C	document date
TY (TYPE)	R	C	-	M	C	document type
STATUS (SB)	R	C	-	O	C	data encoding status
COMP	R	C	8/10	S	C	compilation of origin
RED	-	I	1	S	C	Durham referen.numb.
PART	-	I	-	S	C	part number
DCH	-	C	12/20	O	C	te/time record entered/changed
DBNAME	-	C	1	M	F	name of subbase
DE	-	C	5	M	F	detector's name
EXP	-	C	5	M	F	proposal code
CR		C	-	M	F	record comment
FULL	-	C	-	M	F	full text of abbrev.
AB	FULL	C	-	M	F	abbreviation
<FE>	AB	C	-	S	F	
<CID>	-	C	-	M	C	
<C>	CID	C	-	M	F	
SYSTEMATICS		N	-	M	-	start block of systematic errors/correct.
SYSN (DSYSN)	SYSTEMA-TICS	C	-	M	C	observable name
ALT-SYSN	SYSN	C	-	S	C	(un)scaled observable name
SYS	SYSTEMA-	N	-	M	-	start systematics sub-block
SYS-ERR (SE)(SYS-) (DSYS)	SYS	C	-	M	R	systematic error
FOLDED	SYS-ERR	N	-	S	-	error folded-in flag
SCALE-FACTOR (SF)		C	-	M	R	scale factor
APPLIED	SCALE-FACTOR	N	-	S	-	scale factor applied
CORR (RE-CORR)	SYS	C	-	M	C	corrections made
COND (RE-COND)	SYS	C	0	M	C	significant correct. not fully made
SYSQN <(DSYSQN)>	SYS	C		M	C	variable name for qualified SYS-ERR
SYSQV <(DSYSQ)>	SYSQN	C	-	M	R	value of qualifier SYSQN
CSYS <(CDSYS)>	SYS	C	-	M	F	comment on error/corre-
SYS-ID <(DSYSID)>	SYS	C	-	M	C	identifier for SYS-ERR

DATA ELEMENT NAME (SYNONIM	PARENT NAME	TYPE	KEY LENGTH	MULT.	FORMAT	DATA ELEMENT MEANING
TABLE(TABL)		N		M	-	start table block
TABLE-KEYS		N	-	S	-	start table keys sub
(TABK)					-	block
RE (REAC)	TABLE-KEY	C	20	M	C	reaction key
OBS (YN)	TABLE-KEY	C	8/10	M	C	observable key
PLAB	TABLE-KEY	R	2	S	V	PLAB key
K	TABLE-KEY	R	2	S	V	K)
Q2	TABLE-KEY	R	2	S	V	Q**2)> lepton
NU	TABLE-KEY	R	2	S	V	NU) scattering
OM	TABLE-KEY	R	2	S	V	OMEGA) keys
KIN	TABLE-KEY	C	4/10	M	C	kinematic feature key
FSP	TABLE-KEY	IV	1	M	C	final state particle
BP	TABLE-KEY	IV	1	M	C	beam particle
TP	TABLE-KEY	IV	1	M	C	target particle
TFP	TABLE	C		S	C	table/fig/page ref.
CT	TABLE	C		M	F	comment on table
LOOP-OVER		N		O	-	
(LOOP)						
N	LOOP-OVER	C		O	C	independent variable name
V	LOOP-OVER	C		O	R	independent variable value
DATA-NOT-EN		N	0	S	-	no data coded flag
CODED(DNE)						
MASS		C		M	C	particle mass
CEN		C	4/10	M	F	encoders comment
SPARE		C		M	F	spare data element
EXTERNAL		CV		M	F	ignored input
(VIRTUAL)						

Notes on the File Definition Table.

Data Element Name (DE) - name in "<>" are obsolete and should not be used.

SYNONYMS (SYN) - these exist for several reasons:

a) to ease searching (e.g., AUTH, REF, YEAR)

b) to ease encoding (e.g., SE, DNE)

c) name changed after encoding started (e.g., DSYSN, CDSYS, etc.)-old name is given in "<>" and is no longer to be used in encoding.

Parent (PAR) - a dash indicate a second level data element. TYPE (TY) - In BDMS, may be either character (C), integer (I), real (R) or pure node (N). Virtual (V) data element are not stored in the data base.

KEY Length - a dash indicates that data element is not keyed. Otherwise, the entry in this column is the suggested key length. This is in words for numeric data elements (I or R), and in characters for character string data elements (C). (Two numbers separated by a slash refer to IBM/CDC suggested implementation.)

M (Multiplicity) - BDMS allows all data elements to be multiple occurring. However, in the reaction-data file, it is sometimes not meaningful to have multiple occurrences of a given data element and for others the reaction-data file assumes a special significance to multiple occurrences not implied by BDMS. The various possibilities are noted in Column M where the meanings are as follows:

S)   only single occurrences make sense

M)   multiple occurrences make sense and order is not significant

O)   multiple occurrences are allowed but special significance is ascribed to the order of the occurrences (see Text).

F   (Format) - character string type data elements are entered in one of three formats:

C)   controlled vocabulary string (see individual data element description)

F)   free format string

R)   logically real number entered as strings according to syntax described in Section 1.4. (See also individual data element description.) If the independent variable is YN or RE, this category includes the Y-NAMES and reaction strings written according to the appropriate syntaxes.

The format of an integer or real data element value may be:

C)   controlled numeric value (see individual data element description)

V)   two-component vector representing a range of numeric values.

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