JADE COMPUTER NOTE 72

MONTE CARLO DATA VALIDATION

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ABSTRACT. This note describes the M.C. Input Validation routines, what they check, what output they produce and how one can disable the tests if necessary.

1. Introduction.

It is a well-known law that if something can go wrong, it will. This is especially true for the business of tracking Monte Carlo 4-vector events through the JADE detector. It is all too easy for bugs to creep into 4-vector event datasets and cause a long-running tracking job to crash. Frequently the traceback points to an underflow in some routine that has long since been forgotten. Worse still, the bugs may go undetected for years. In a systematic attempt to trap these bugs before they do any damage, a set of 3 routines has been built into the standard JADE Tracking Program MCJADE. The principal routine has the name MCVALI and is called by BRVECT ("read next 4-vector event") which is itself called by JGETEV in MCJADE. When invalid data are detected in MCVALI, a call is made to MCVERR to print an error message and then the event is rejected. Finally, at the end of the tracking program, a call is made to MCVSUM to print a summary of the input errors detected.

2. The Tests made in MCVALI.

A total of 16 tests are performed on the input data by MCVALI. There are 9 tests of real values and 7 tests of integer values. These are as follows:

$$0 < E_{beam} < 1000 \ GeV \qquad \text{(Test 1)}$$

$$10^{-20} \ GeV/c < |p_i| \leq E_{beam} \quad \text{or} \quad p_i = 0 \quad \text{for } i = x, y, z \qquad \text{(Test 2)}$$

$$10^{-20} \ GeV < E \leq 2E_{beam} \qquad \text{(Test 3)}$$

$$|M - M_{true}| < 0.01 \ GeV/c^2 \qquad \text{(Test 4)}$$

$$|p^2 + M^2 - E^2| < 2.5 \times 10^{-3} E^2 \qquad \text{(Test 5)}$$

$$10^{-20} \ mm < |vertex_i| < 5000 \ mm \quad \text{or} \quad vertex_i = 0 \quad \text{for } i = x, y, z \qquad \text{(Test 6)}$$

$$vertex < 8000 \ mm \qquad \text{(Test 7)}$$

$$p \leq E_{beam} \qquad \text{(Test 8)}$$

$$10^{-20} \ GeV/c^2 < M \leq 2E_{beam} \quad \text{or} \quad M = 0 \qquad \text{(Test 9)}$$

$$particle \ code = 1, 2, \ldots, 6 \qquad \text{(Test 11)}$$

$$charge = 0 \ \text{or} \ \pm 1 \qquad \text{(Test 12)}$$

$$event \ number = 0, 1, \ldots, 9999999 \qquad \text{(Test 13)}$$

$$\# \ particles = 1, 2, \ldots, 300 \qquad \text{(Test 14)}$$

$$\# \ charged \ particles = 1, 2, \ldots, 300 \qquad \text{(Test 15)}$$

$$\# \ neutral \ particles = 1, 2, \ldots, 300 \qquad \text{(Test 16)}$$

$$\# \ particles = \# \ charged + \# \ neutral \qquad \text{(Test 17)}$$

Most of the tests shown on page 1 should be self-evident but some explanation may be helpful here. Test number 4, for example, checks whether the mass of a given particle agrees with the mass given in the particle data booklet for the given particle type code. The agreement has only to be better than 10 MeV/c^2. Test 5 checks that the Energy, Momentum and Mass are consistent to 5%. Tests 6 and 7 ensure that the production vertex for a given particle is reasonable.

Tests 1 and 13 to 17 are performed on the general event parameters. All the others are performed on every particle that is to be tracked, that is, on every particle that is placed in the VECT/0 bank with the exception of any partons that may be stored at the end.[1] The particles that are placed in the PALL bank are not checked.

Even if only a single particle fails any of the tests, the event is rejected.[2] This is necessary for safety reasons. For every error detected, a 1 line error message will be printed out which indicates which test was being performed and for which event and particle[3] sequence number. The event sequence number might not be the same as the event number created by the 4-vector generator incidentally. After the basic error message, additional information will be printed where appropriate. This will usually be a complete printout of the 10-vector of the bad track.

3. Disabling Tests in Special Circumstances.

When some non-standard data are to be tracked, for example, heavy stable particles, then it will be necessary to disable 1 or more of the tests. This is very easy to do. COMMON / CVFLAG / contains an array with 20 LOGICAL*4 flags which are block data set to .TRUE. . The n'th flag is associated with the n'th test. Thus to disable test 5, do the following in the main program that calls MCJADE:

```
      LOGICAL*4 VTEST
      COMMON / CVFLAG / VTEST(20)
          :
          :
C     Other declarations etc
          :
          :
      VTEST(5) = .FALSE.
          :
          :
      CALL MCJADE(0,1)
          :
          :
```

Please note that there are no tests with numbers 10,18,19 and 20 so manipulating these flags will have no effect. In order to avoid accidents, a warning message is printed before tracking commences if any of the flags are found to be set to .FALSE..
It should be stressed here that the tests performed by MCVALI are very fast and should not normally be disabled.

The TEX source of this note is in 'JADEPR.TEXT(JADECN72)'.

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[1] See JADE Computer Note 69, last page.
[2] Except when the only error is a photon of energy $E \leq 200\ MeV$ failing test 5. In this case the event is kept.
[3] For tests 1 and 13 to 17, the particle sequence number is printed as zero ('0')