Lattice Grammar

The grammar is context free[1] and the text is in free-format[2] style. However, the length of a statement is limited to 132 characters.

Comments

{<text>}

or

/*<text>*/

Statements

A statement may run over several lines and is terminated by ";":

<statement>;

Constants

Constants are defined by:

<constant name> = <arithmetic expression>;

Lattice File

The lattice file contains:

define lattice;
ringtype = <1 | 0>;

Energy=<beam energy [GeV/c^2] (for classical radiation, and quantum fluctuations)>;
codeps=<ε for the closed orbit finder (Newton search)>;
dp=<Δp/p>;

<element definition>
…
<element definition>

[1] Chomsky type 2: grammars that only allow one symbol on the left hand side of a production, e.g. Algol-60 (specified by the Bachus-Nauer Form), Pascal, C or C++ (but not Fortran, i.e. DATA statements).
[2] White space (space, tab, and newline) has no significance (except in strings), i.e., it can be inserted anywhere between tokens.

<section definition>
…
<section definition>
cell: <element | section> {,<element | section>}, symmetry=1;

end;

Elements

Marker

<element name>: Marker;

Example: M1 : Marker;

Beam Position Monitor

<element name>: Beam Position Monitor;

Example:

BPM1 : Beam Position Monitor;

Drift

<element name>: drift,
L=<length [m]>;

Example:

L1 : Drift, L=0.30;

Corrector

<element name>: Corrector,
[L=<length [m], default: 0 (thin kick)>,]
<direction: ‘horizontal’ | ‘vertical’>;

Example:
COH : Corrector, horizontal;

Dipole

<element name>: Bending,
L=<length (ρ [m] · φ [rad])>,
[Roll=<Design roll angle [°]>,]
T=<bend angle [°]>,
[T1=<entrance angle [°]>,]
[T2=<exit angle [°]>,]
[Gap=<gap [m]>,
[K=< b_2 [m^{-2}] (gradient)>,
N=<no of integration steps>,
Method=<integration method: '0' | '2' | '4'), default: '2' (matrix style, 2nd and 4th order symplectic integrator>;
[HOM=<list of systematic higher order multipole errors (random errors are assigned in the input file): n, bn, an, …(order, integrated skew- and normal multipole strengths)>;]

Example

B : Bending, L=0.70, T=10.0, T1:=5.0, T2:=5.0, K=-1.0, N=8, Method=2;

Quadrupole

<element name>: Quadrupole,
L=<length [m]>,
[Roll[3]=<Design roll angle [°]>,]
K=<b_2 [m^{-2}] (gradient)>,
N=<no of integration steps>,
Method=<integration method: '0' | '2' | '4'), default: '2' (matrix style, 2nd and 4th order symplectic integrator>;
[HOM=<list of systematic higher order multipole errors (random errors are assigned in the input file): n, bn, an, …(order, integrated skew- and normal multipole strengths)>;]

Example

QF : Quadrupole, L=0.5, K=2.2134, N=4, Method=4;

Sextupole

<element name>: Sextupole,

[L=<length [m], default 0 (thin kick)>,]
[Roll[3]=<Design roll angle [°]>,]
K=<b_3 [m^{-3}] (sextupole strength)>;
N=<no of integration steps>,
Method=<integration method: '0' | '2' | '4'), default: '2' (matrix style, 2nd and 4th order symplectic integrator>;
[HOM=<list of systematic higher order multipole errors (random errors are assigned in the input file): n, bn, an, …(order, integrated skew- and normal multipole strengths)>;]

Example

SF : Sextupole, K=-10.2363;

Multipole

<element name>: Multipole,
L=<length [m]>,
[Roll[3]=<Design roll angle [°]>,]
[T=<bend angle [°]>,]
[T1=<entrance angle [°]>,]
[T2=<exit angle [°]>,]
N=<no of integration steps>,
Method=<integration method: '0' | '2' | '4'), default: '2' (matrix style, 2nd and 4th order symplectic integrator>;
[HOM=<list of systematic higher order multipole errors (random errors are assigned in the input file): n, bn, an, …(order, integrated skew- and normal multipole strengths)>;]

Examples

B : multipole, L=0.70, T=10.0, T1=5.0, T2=5.0, HOM=(2, -1.0, 0), N=8, Method=2;

QF : multipole, L=0.70, HOM=(2, 2.50, 0.0, 4, 1.01e7, 0.0), N=8, Method=2;

Wiggler

<name> : Wiggler,
L=<length [m]>,
BoBrho=<B/Brho [m^{-1}]>,
Lambda=<period [m]>,
kx=<[m]>,

N=<no of integration steps>,
Method=<integration method: ‘0’ | ‘2’ | ‘4’), default: ‘2’ (matrix style, 2nd and 4th order symplectic integrator>;

Example

U143: wiggler, L=4.80, BoBrho=0.5, Lambda=0.15, N=20, Method=0;

Cavity

<name> : Cavity,
Frequency=<Frequency [Hz])>,
Voltage=<RF amplitude [V])>,
HarNum=<harmonic number (for absolute path length calculations)>

Example

CAV : Cavity, Frequency = 499.95e6, Voltage=1.22e6, HarNum=328;

Sections

<section name>: <element name> {, <element name>};

Operations

Reversal

inv(<section name>)

Note, this command reverses the list of elements, i.e., it does not change the parameters of the elements. In particular, the resulting list is only mirror symmetric if the individual elements are mirror symmetric.