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Data containers in GND

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Data types in GND are similar to ENDF types:

- f(x) data (like TAB1): for cross section, multiplicity
- f(y,x) (like TAB2): for angular or energy distributions. Each ‘y’ value contains f(x)
  - f(x) may be stored as Legendre coefficients
- f(z,y,x) (nested TAB2): for double-differential distributions. Each ‘z’ contains f(y,x)
- table / matrix: for covariances, resonance parameters, ...

Each data container comes with a description of its axes:

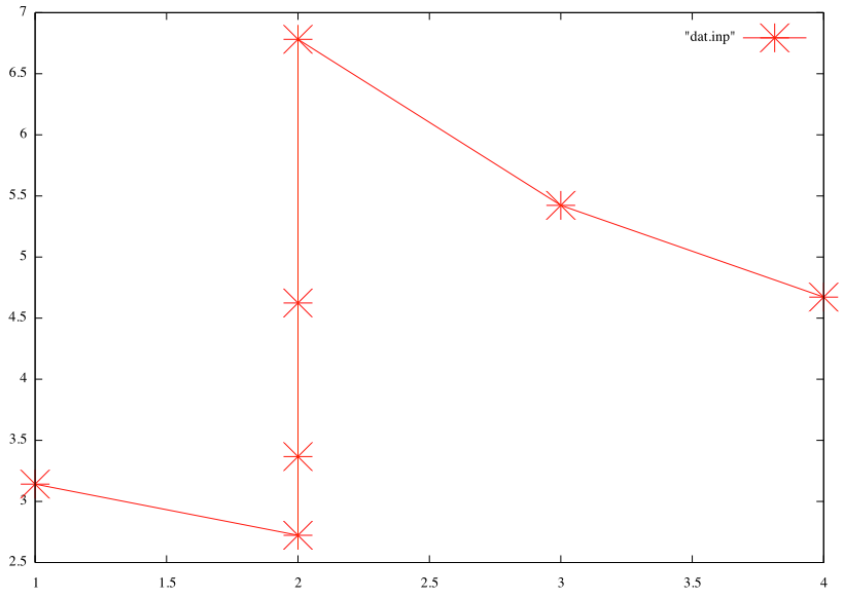
- Each axis contains data on label, unit, frame. Independent axes also contain interpolation data. For example, axes for a pointwise angular distribution could be:

- axes:
  - axis index="0" label="energy_in" unit="eV" interpolation="linear,linear" frame="lab”
  - axis index="1" label="mu” interpolation="linear,linear" frame="lab”
  - axis index="2" label="P(mu|energy_in)” frame="lab”

GND is more restrictive about discontinuous data:

- ENDF TAB1 and TAB2 allow duplicate points or discontinuities inside an interpolation region:

- In GND these can only occur at a boundary between regions. Also, more than 2 y-values for single x not allowed



- Discontinuities appear due to:
  - Limited precision
  - Switching between models
- ‘Extra points’ likely due to removing values

To handle discontinuities and multiple interpolations, define ‘regions’:

- The domain of any axis may be broken up into multiple regions.
  - Each region defines its own interpolation
  - Regions must abut each other, but discontinuities in the dependent variable are allowed

- Interpolation options: lin-lin, lin-log, log-lin, log-log, flat. Special types: unit base, corresponding points, ‘Coulomb’

- Multiple interpolation regions are supported

- axes:
  - axis index=“0” ... interpolation=“byRegion,byRegion”

    then, inside each region:

    – interpolationAxes index="0” interpolation="linear,log”

Interpolation options compared to ENDF, ENDL:

- For W_XY data, ENDF MF4/MF5 permit multiple regions along *both* W and X. This option is rarely used, however

multiple regions for single incident energy unused in ENDF-VII.1, but different incident energies sometimes have different interpolations

multiple interpolations along incident energy axis allowed, but used infrequently

incident energy #1: outgoing spectrum
incident energy #2: outgoing spectrum
...
incident energy #n-1: outgoing spectrum
incident energy #n: outgoing spectrum

- For double-differential distributions, multiple interpolation regions appear to only be used for uncorrelated data (i.e., combination of MF4/MF5 rather than MF6)

- ENDL has no support for multiple interpolation regions

Matrices and tables

- For some data types, best to use a uniform grid:
  - covariance matrix, transfer matrix
  - resonance parameters
  - thermal scattering: S(α,β)
- Requires a description of the axes (including columns for tables, group boundaries for matrices)
- Multiple interpolations not supported for this type of data (in either ENDF or GND)
- Save space with symmetric and sparse matrix representations

Do we need an N-D array data type?

- Some data is given on a 3-d grid:
  - thermal scattering data may be function of α,β, and T
  - Each unresolved width is given as function of L,J, and E

- axes:
  - axis index="0" label="T" ... values=0, 300, 600
  - axis index="1" label="α" ... values=0 0.1 0.2 0.3 0.4 0.5
  - axis index="2" label="β" ... values=0 0.02 0.04 0.06
  - axis index="3" label="S(α, β,T)"
  - data ... (could use 'sparse' array representation)

Conclusion

- f(x), f(y,x) and f(z,y,x) data types are similar to ENDF options: they support multiple interpolation regions and allow non-uniform grids
- table and matrix: uniform grid, only one interpolation
- may also need 3-d and possible N-d array type (similar to existing matrix type)