Resonance Parameters

V.McLane
National Nuclear Data Center

Single-Level Resonance Parameters

Single level resonance parameters

- calculated from fit to measured cross section
- using a Breit-Wigner single-level formalism .

Single-Level Resonance Parameters

Resonance Energy (E_0)

- **Determined by the author**: assigned a `REACTION` code and entered into data table under `DATA`.

  `(...(N,0),,EN)`

- **Taken from other sources**: entered into data table as an independent variable with data heading `EN-RES`.

  In this case, the energy is entered for only those resonances for which the author has calculated other resonance parameters.

- **Negative energy resonances** should be coded with negative energy, as given.

Single-Level Resonance Parameters

Resonance widths (Γ_γ)

REACTION Coding:

`(…(N,TOT),,WID)` = total width (Γ)

- `(…(P,G),,WID)` = capture width (Γ_γ)
- **Units**: code with dimensions `E` (*e.g.*, `MILLI-EV`).

Reduced neutron widths (Γ_γ^l)

REACTION coding:

`(…(N,EL),,WID/RED)`

- angular momentum (*l*) should be specified under the data heading `MOMENTUM L.`
- **Units**: code with dimensions `E` (*e.g.*, `EV`).

Single-Level Resonance Parameters

Peak cross section: cross section at peak of resonance.

(…(N,TOT),,PCS) Total peak cross section

Eta and Alpha at resonance:

(…(N,ABS),,ETA,,RES)

(…(N,ABS),,ALF,,RES)

Single-Level Resonance Parameters

Resonance area

(…(N,EL),,ARE) Scattering area

Units: code with dimensions B*E (*e.g.*, B*EV).

$(\Gamma_n\Gamma_r)/\Gamma$ is proportional to the capture area

```
REACTION  (((…(N,EL),,WID,,G)*(…(N,G),,WID))/
          (…(N,TOT),,WID))
RESULT    (CAPTA)
```

Units: code with dimensions E (*e.g.*, EV).

Single-Level Resonance Parameters

Resonance strength

`(…(P,A),WID/STR)`

Units: code with dimension E, *e.g.*, `EV`.

Some special representations

- $\sigma_0\Gamma_f$ **`(.....(N,F),,WID,,S0)`**
- $\sigma_0\Gamma^2$ **`(.....(N,TOT),,WID,S0/SQ))`**
- $g\Gamma_n$ **`(.....(N,EL),,WID,,G);`** g = statistical weight factor
- $ag\Gamma_n$ **`(.....(N,EL),,WID,,AG);`** a = isotopic abundance

Single-Level Resonance Parameters

Example:

```
BIB
REACTION  1(…(N,0),,EN)
          2(…(N,0),J)
          3(…(N,0),L)
          4(…(N,EL),,WID)
ENDBIB
NOCOMMON
DATA
DATA      1DATA      2DATA      3DATA      4DATA-ERR  4
EV         NO-DIM     NO-DIM     MILLI-EV   MILLI-EV
…           …          …          …          …
ENDDATA
```

Multilevel Resonance Parameters

USED: for resonance analysis of fissile nuclides, to account for interference effects from neighboring resonances and also distant resonances.

Formalism generally used: Reich-Moore; derived from the R-matrix theory of Wigner and Eisenbud.

Multilevel Resonance Parameters

Reich-Moore Resonance Parameters:

• `(N,0),,EN`	Resonance energy
• `(N,TOT),,WID,,RM)`	Total width
• `(N,G),,WID,,RM)`	Capture width
`(N,F),1,WID,,RM)`	Fission width for channel 1
• `(N,F),2,WID,,RM)`	Fission width for channel 2
• `(N,F),,WID,,RM)`	Total fission width
• `(N,EL),,WID,,RM)`	Neutron width
• `(N,EL),,WID/RED,,RM)`	Reduced neutron width

- Relative phases of fission widths for channels 1 and 2 are 0 or 180 degrees; therefore, the parameter values are given with either a positive or negative sign.

Multilevel Resonance Parameters

R-Matrix Reduced Width (γ^2)

(…,WID/RED,,RMT)

Units: code with dimension E (*e.g.*, EV)

Reduced Width Amplitude (γ): square-root of reduced width.

(…,WID/RED,,RMT/AMP)

Units: code with dimension RE (*e.g.*, RT-EV)