Resonance Self-Shielding Considerations in WIMS

- Single resonance absorber, single scatterer
- More than one scatterer
- More than one resonance absorber (resonance interference)
- Heterogeneous cluster geometry
- CELL CLUSter
- NEWRes

Resonance Self-Shielding Calculation

Multigroup cross-section

$$\sigma_{x,g} = \frac{\int_{E_g}^{E_{g-1}} \sigma_x(E) \cdot \phi(E)\, dE}{\int_{E_g}^{E_{g-1}} \phi(E)\, dE}$$

Neutron slowing-down in homogeneous mixture of hydrogen and absorber

$$[\sigma_0 + \sigma_t(E)]\phi(E) = \frac{\sigma_0}{E} + \frac{1}{1-\alpha} \int_E^{E/\alpha} \frac{dE'}{E'} \sigma_s(E')\phi(E')$$

Dilution parameter

$$\sigma_0 = \frac{n_{hydrogen}}{n_{absorber}} \sigma_{p,hydrogen}$$

Equivalence principle

$$\sigma_0 = \sum_{i \neq a} \frac{n_i}{n_a} \mu_i \sigma_{p,i} + \frac{\Sigma_{esc}}{n_a}$$

Resonance Treatment of WIMS 2-5d

- Simplified cluster representation
- A single fuel region (it may be multi-connected, cluster for instance)
- The same material properties everywhere in the fuel
- The same spatially flat neutron flux everywhere in the fuel
- Resonance integrals differ between inner and outer pins
- Livolant-Jeanpierre method of resonance flux calculation

Resonance Treatment of WIMS 2-6a

- Two-dimensional calculation of fuel-to-fuel collision probability (insensitive to the extent of the spectral type coolant)
- Resonance self shielding separately in each fuel rod array. However, resonance cross sections are smeared into two groups of inner and outer pins to meet the current code structure.
- Resonance flux tables are included in the library and interpolated in the same manner as other resonance integrals.

Resonance Treatment of WIMS 3.0

- **Resonance self-shielding and resonance cross sections in each fuel rod array separately.**
- **Fuel smearing only within the same rod array.**
- **Different fuel composition in each rod array.**
- **Different fuel temperature in each rod array.**