SAMMY Workshop Part 4.1c

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Part 4.1c, Comments on Reich Moore

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U. S. DEPARTMENT OF ENERGY

Reich-Moore Approximation to Multilevel Multi-Channel R-Matrix Theory

F. H. Fröhner, "Evaluation and Analysis of Nuclear Resonance Data," JEFF Report 18 (2000), page 60:

"Experience has shown that with this approximation [Reich Moore] all resonance cross section data can be described in detail, in the windows as well as in the peaks, even the weirdest multilevel interference patterns … It works equally well for light, medium-mass and heavy nuclei, fissile and nonfissile."

When does Reich-Moore *not* work ?

(R-matrix is a description of *compound* nucleus effects.)

- For direct effects

  for example, $^{37}Cl(n,\gamma)$

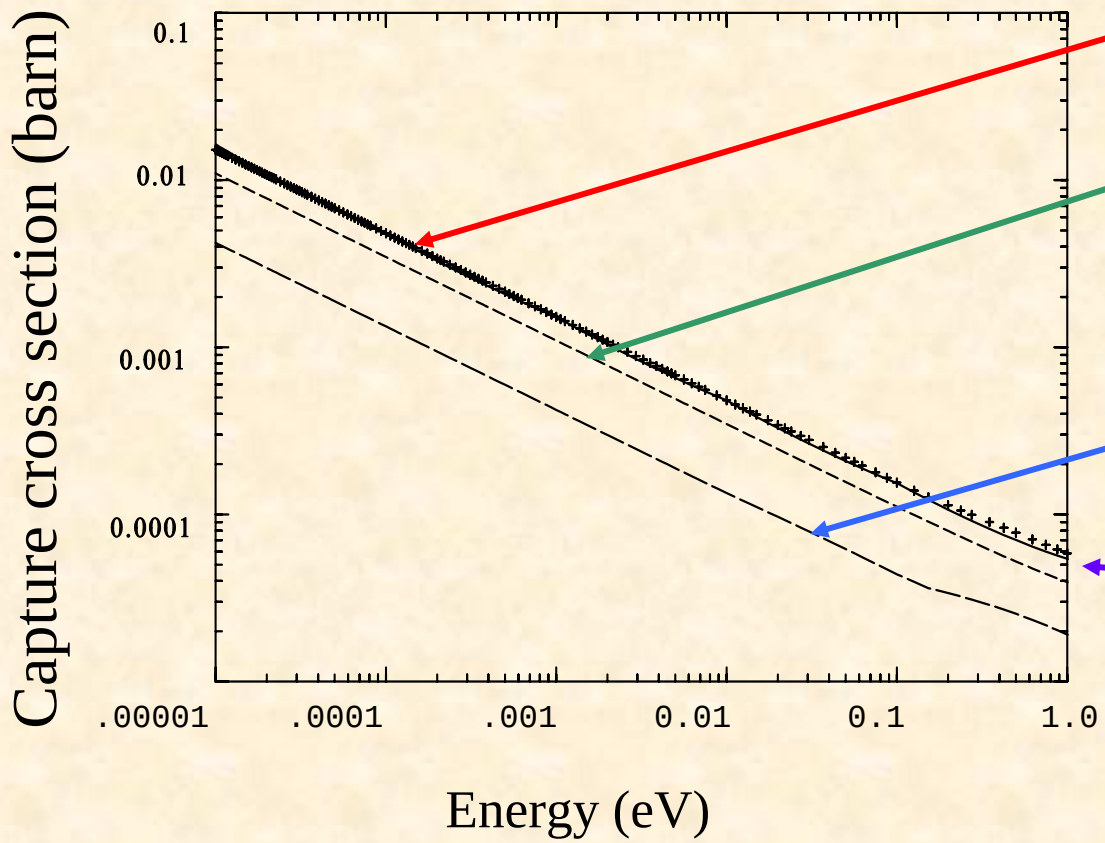
  – "R-Matrix Evaluation of Cl Neutron Cross Sections up to 1.2 MeV" Sayer, Guber, Leal, Larson, and Rauscher, ORNL/TM-2003/50, March 2003

- Direct effects must be added explicitly
- Options are available in SAMMY for fitting the magnitude of direct capture component

Example: ^{19}F

- Model calculations by Goran Arbanas, ORNL
- Analysis by Luiz Leal, ORNL
  - Multiplier initially at 1.0, fitted to 0.547
- Data on next slide are from ENDF files (Mughaghab)

^{19}F, continued



+ = data

dash = R-matrix contribution

long dash = direct component

solid line = sum of the two components

When does Reich-Moore *not* work ? (continued)

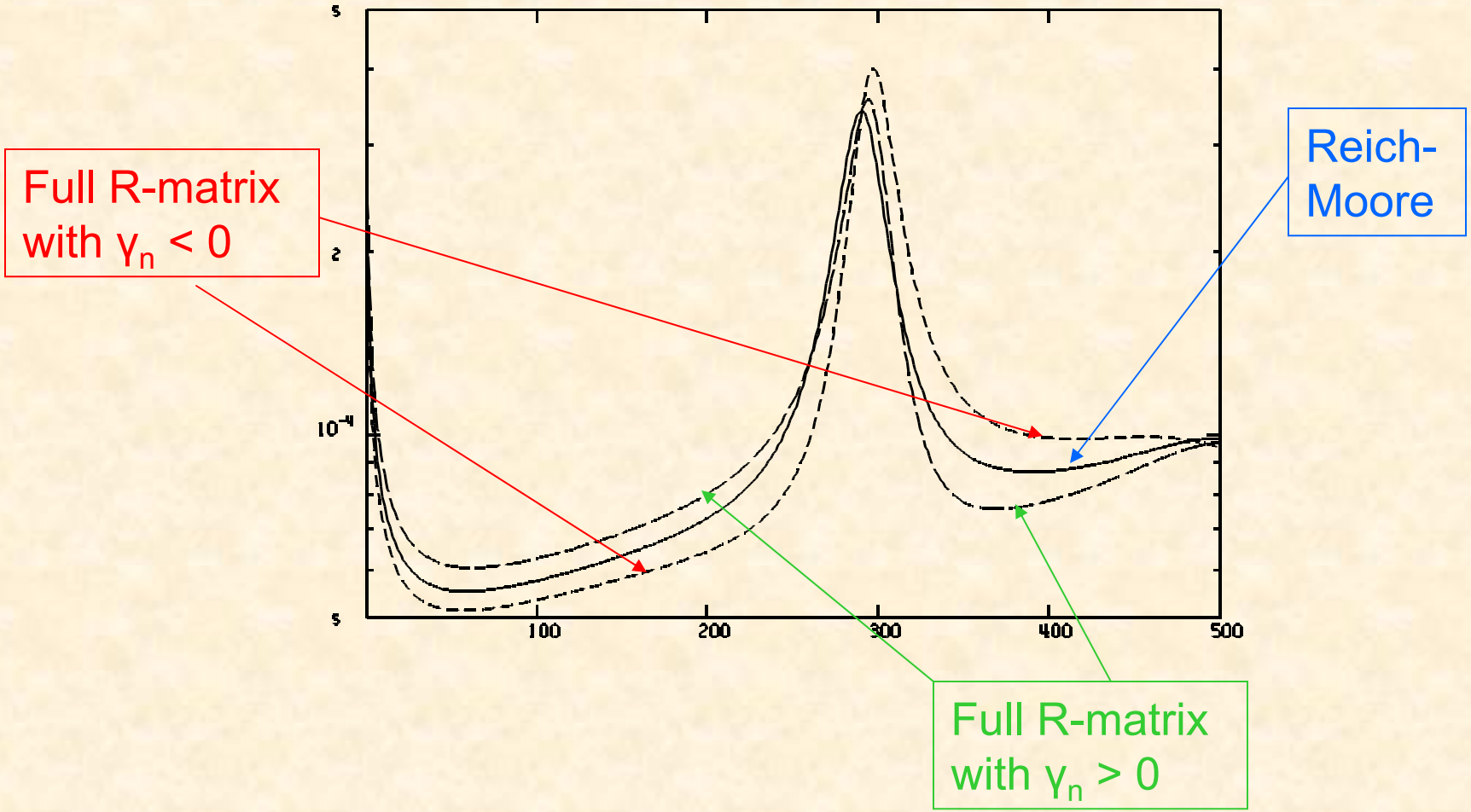
- When trying to describe interference effects in reactions like
  - $^{12}C(\alpha,\gamma)$
  - $^{15}N(p,\gamma)$
  - $^{21}Ne(p,\gamma)$
  - $^{22}Ne(n,\gamma)$

when there is level-level interference in the capture channel
because capture is treated "on average" in Reich-Moore approximation

  - re Michael Heil, Karlsruhe

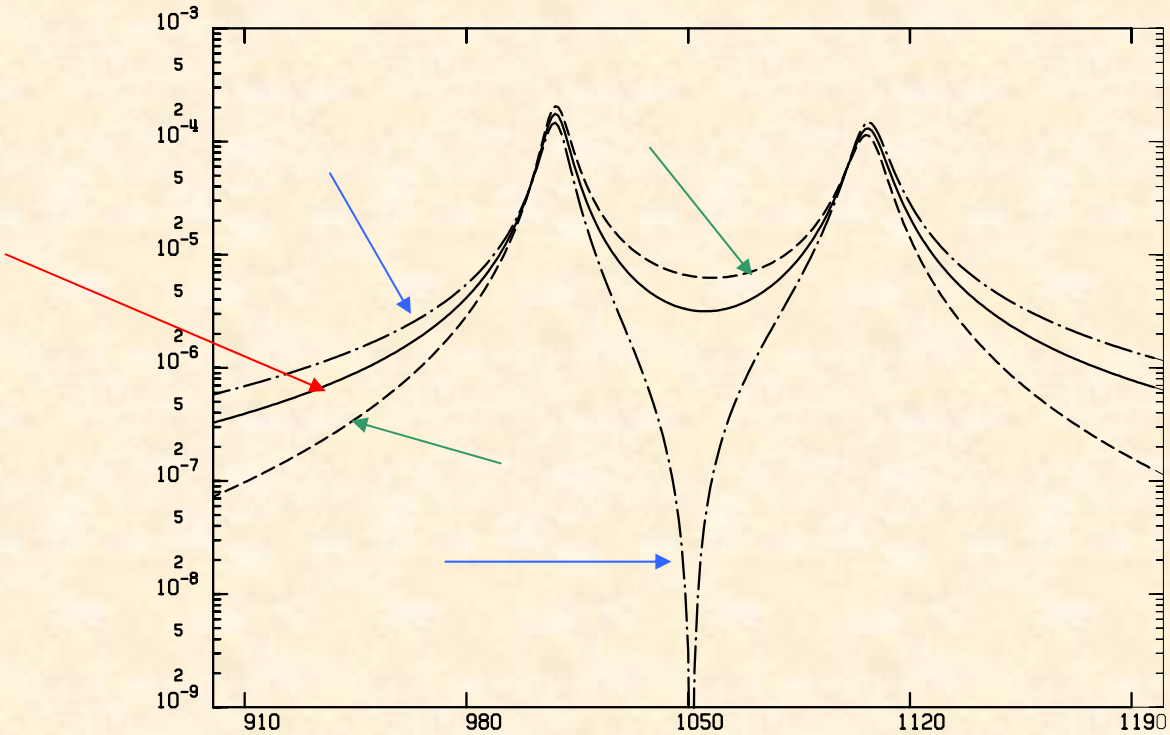
  - Example from Michael is shown on next slide

Different versions of s-wave $^{22}Ne(n,\gamma)$



Another example…

- Interference can be even more dramatic, at least in theory
- Artificial example is shown on next slide

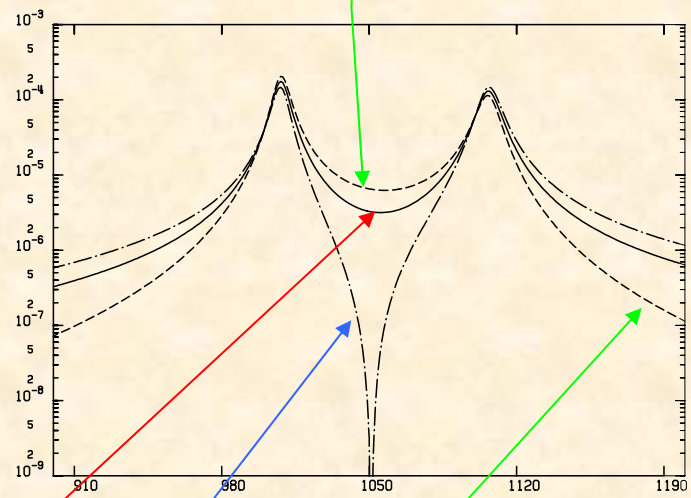


Solid line = Reich Moore

Dot-dash = full R-matrix # 1

Dash = full R-matrix # 2

Note: can use Reich-Moore to approximate the full R-matrix



	Energy (MeV)	Γ_γ (eV)	Γ_n (eV)	Γ_{react} (eV)
Reich Moore	1.0	1.0	10 000	
	1.1	1.1	11 000	
fake full R-matrix # 1	1.0	10^{-8}	10 000	1.0
	1.1	10^{-8}	11 000	1.1
fake full R-matrix # 2	1.0	10^{-8}	10 000	1.0
	1.1	10^{-8}	11 000	-1.1

Comparisons with true R-matrix codes have shown that this works well