CYCLOTRON INSTITUTE
TEXAS A&M UNIVERSITY

Determining Physical Continuum Background Using the Calculated Cross-Section of the Giant Monopole Resonance

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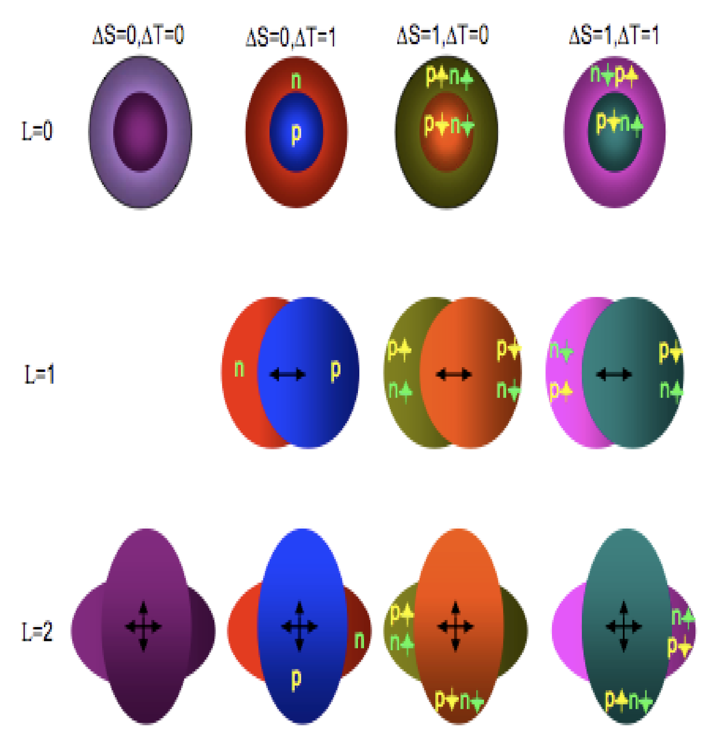
What is the Giant Monopole Resonance?

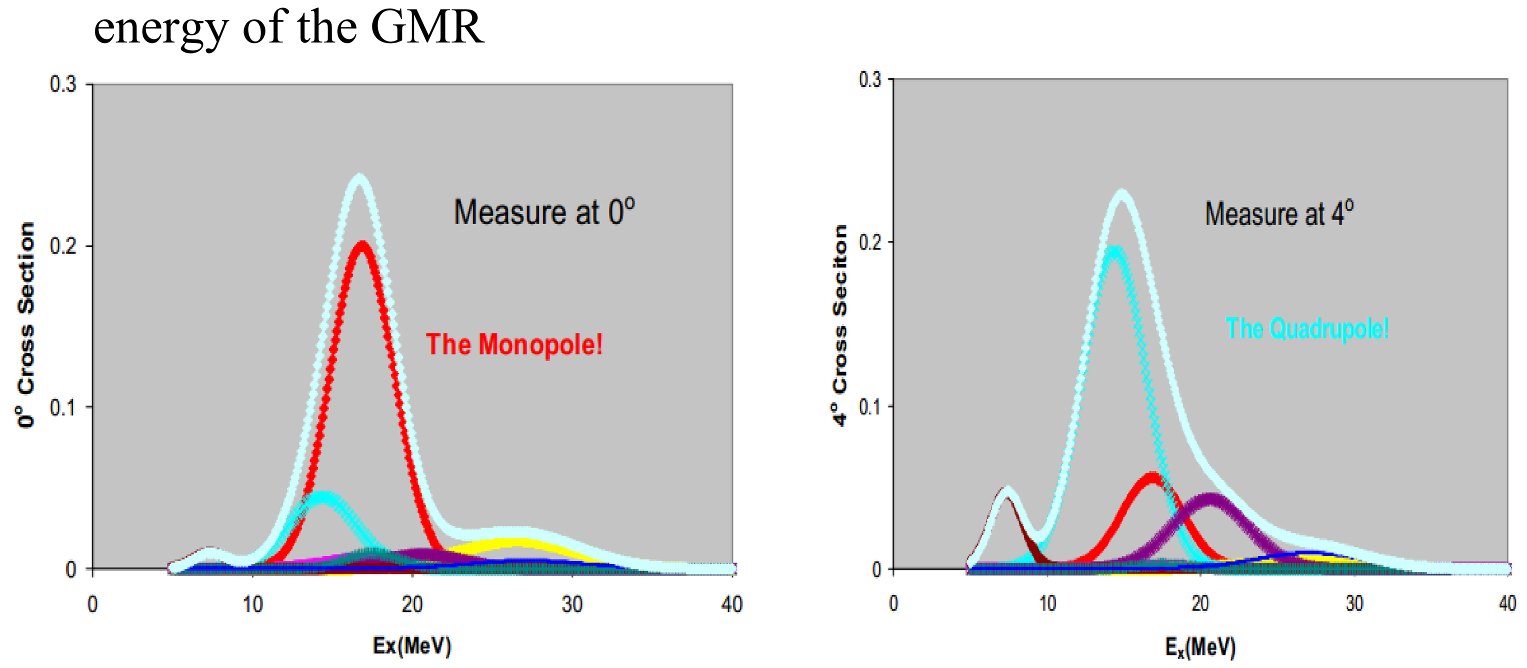
- Collective excitation of the Nucleus
- Isoscalar: Neutrons and protons in phase
- Isovector: Neutrons and protons out of phase
- Monopole
  - Breathing mode
  - L=0
- Resonances occur simultaneously



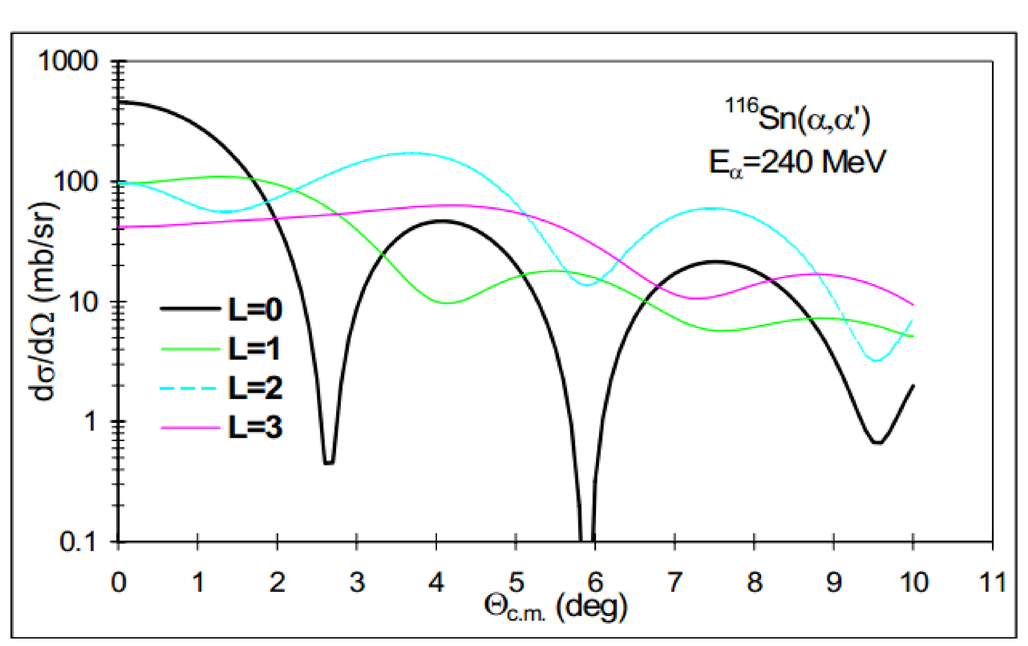
http://cyclotron.tamu.edu/pics/structure_01.bmp

Cross Section of the GMR

- By scattering at different angles we are able to excite different resonances
- We can then subtract out the other resonances to find the energy of the GMR



Inelastic α scattering E_α=240MeV



*Unpublished images taken from REU Lecture, DH Youngblood 2012

GMR & the Compressibility of Nuclear Matter

- Nuclear matter is found in Neutron stars
- Compressibility of nuclear matter required to calculate equation of state
- By knowing the energy of the GMR we can find the compressibility of the nucleus

$$E_{GMR} = \hbar\left(\frac{K_A}{m<r^2>}\right)^{1/2}$$

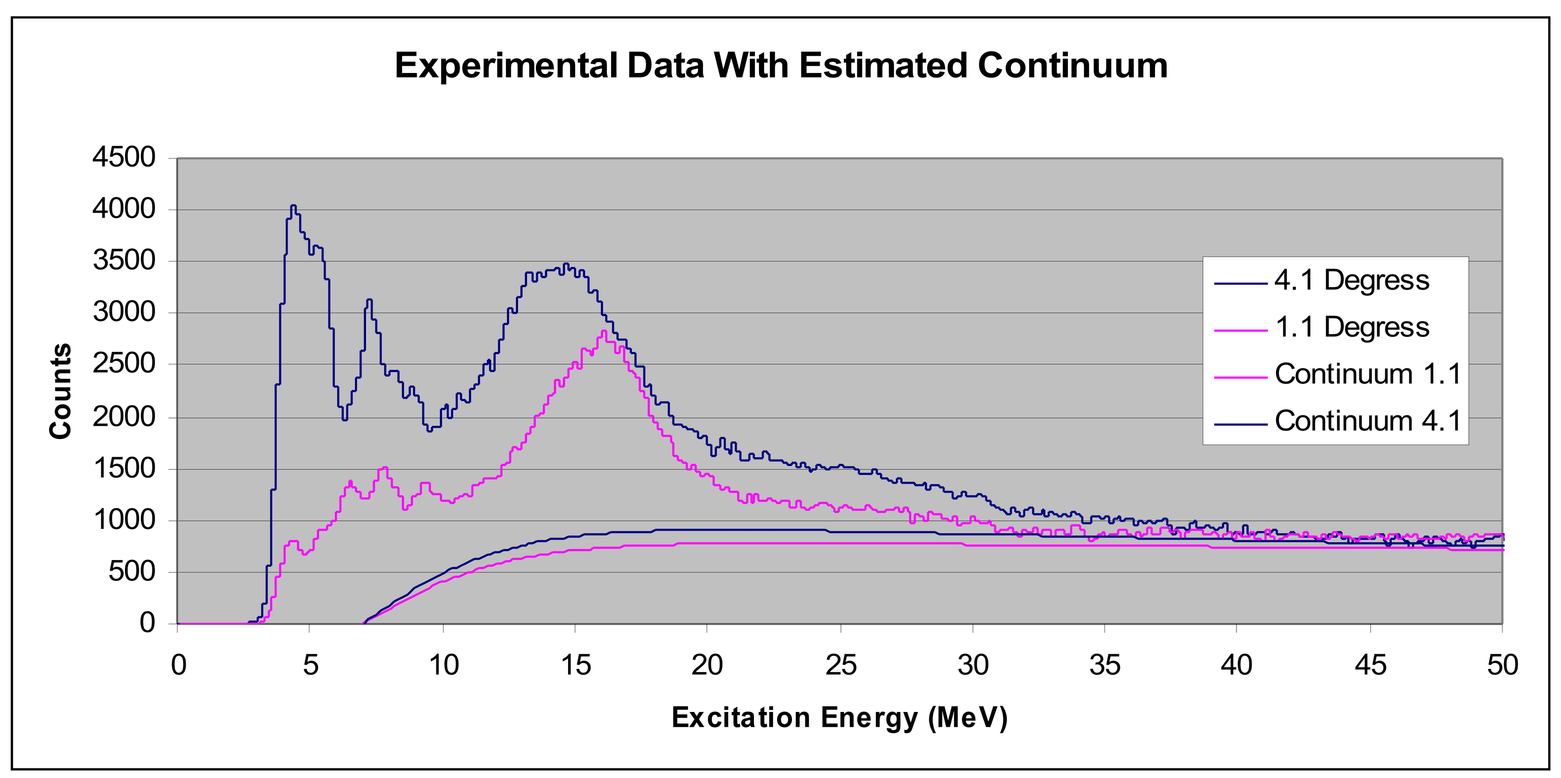
  - Compressibility of nucleus: K_A
- From the compressibility of nuclei we can calculate the compressibility of nuclear matter
- Leptodermous Expansion:

$$K_A = K_{NM} + K_{Surf}A^{-1/3} + K_{VS}\left(\frac{N-Z}{A}\right)^2 + K_{Coul}\frac{Z^2}{A^{4/3}}$$

- Calculations with effective interactions more accurate
- Period: $\tau \approx 6 * 10^{-22}s$
- Oscillation Amplitude: $\frac{\delta\rho}{\rho} \approx 0.05$
- Velocity of Sound in Nuclear Matter: .15c

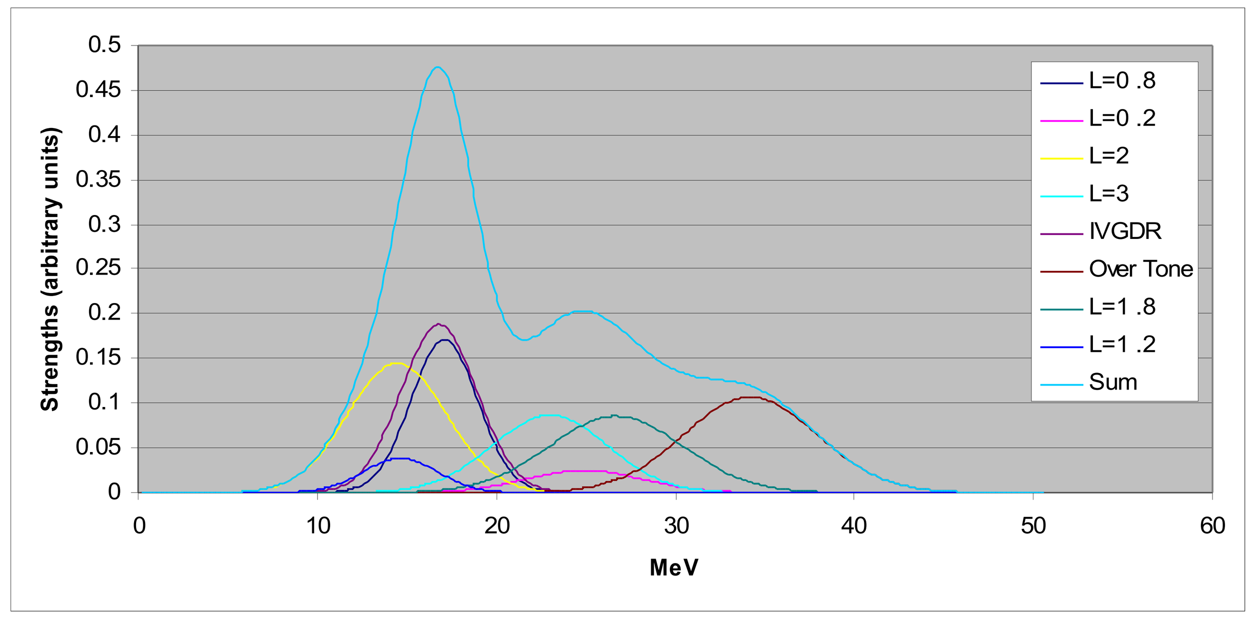
Current Method of Estimating the Continuum

- We assume a fermi shape at low excitation energy and a line at high excitation energy
- Assume continuum changes smoothly with angle
- Must be within "reason"

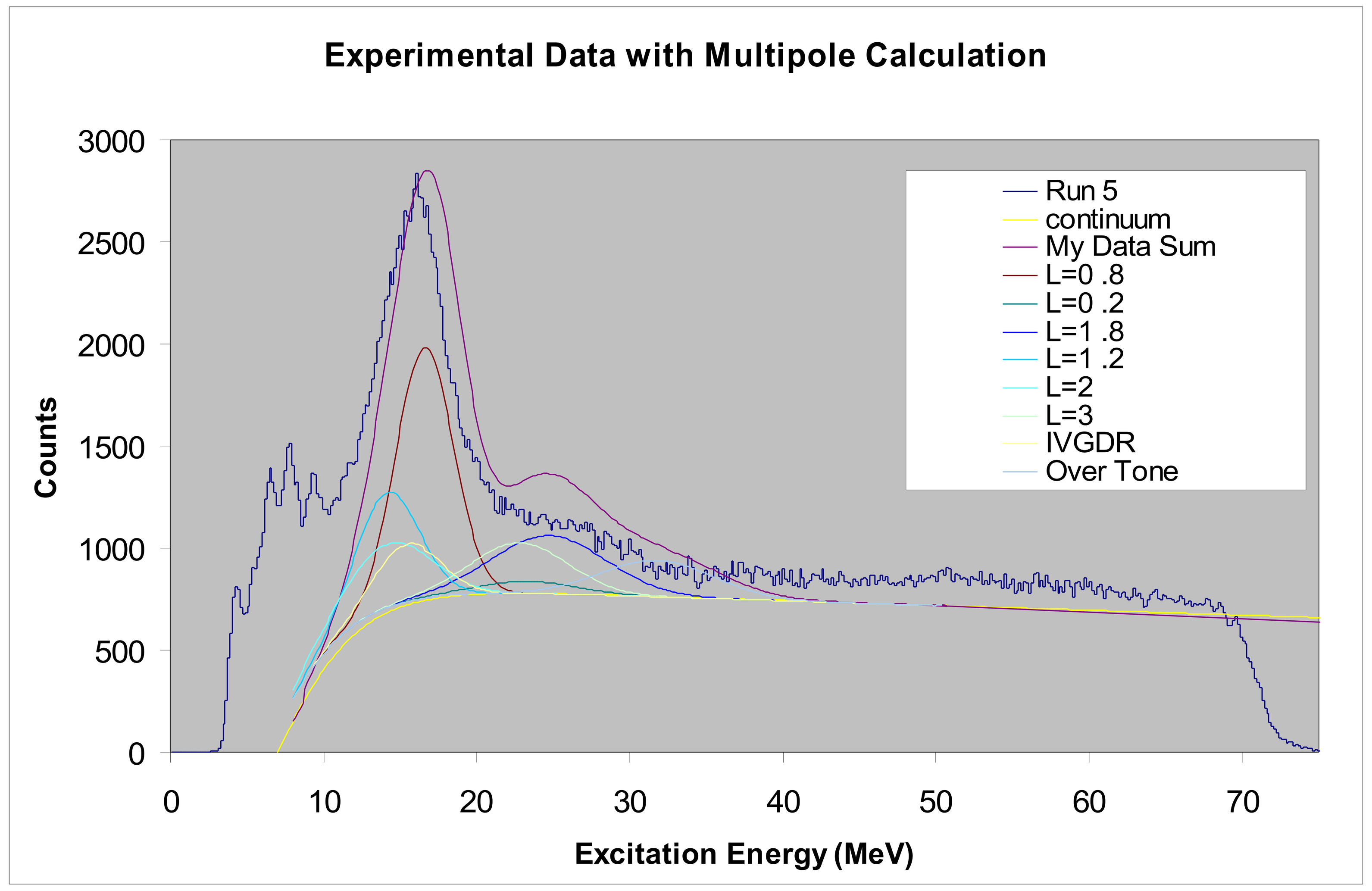


Working Backwards: Calculating Cross-Section

- From experimental results we know approximate distributions of strengths of each multipole
- Assume 100% of the energy weighted sum rule to calculate how much each multipole contributes to the data



- Use DWBA calculations for cross section as a function of angle then calculate the angular distributions from multipole distributions
- Convert the angular distribution into counts and plot this data
- This is the inverse of what we do with experimental data



- Now we can see how each resonance contributes to the experimental data
- We can also "play" with the continuum to see where the continuum should be