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

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
  \[ E_{GMR} = \frac{b_0 K_c}{3} \]
- Compressibility of nucleus: \( K_c \)
- From the compressibility of nuclei we can calculate the compressibility of nuclear matter
- Leptodermous Expansion:
  \[ K_A = K_{NM} + K_{Sff} A^{1/3} + K_{Sff}(N - Z)^2/4 + K_{Com} Z^2/4 \]
- Calculations with effective interactions more accurate
- Period: \( \sim 10^{-27} s \)
- Oscillation Amplitude: \( \sim 10^{-11} \)
- Velocity of Sound in Nuclear Matter: \( \sim 0.15 c \)

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

Experimental Data with Multipole Calculation

- 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