Fine Structure of the Isoscalar Giant Quadrupole Resonance

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- Motivation
- Recent Experiment
- Wavelet Method
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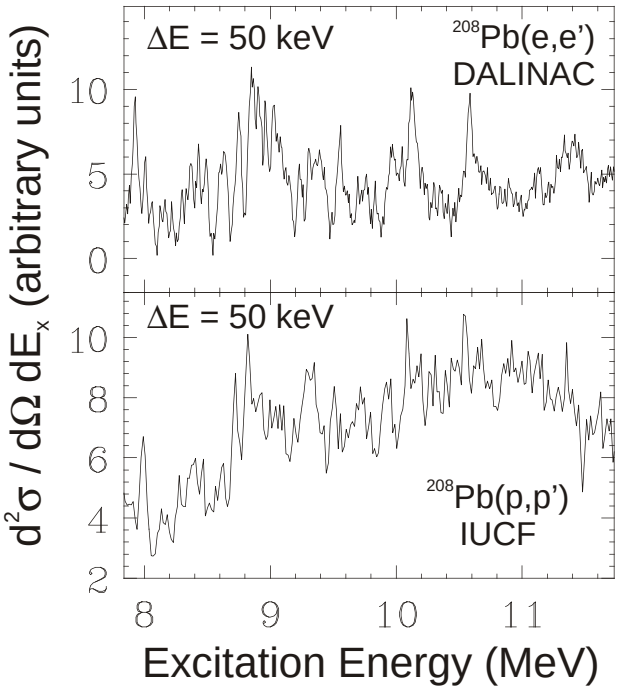
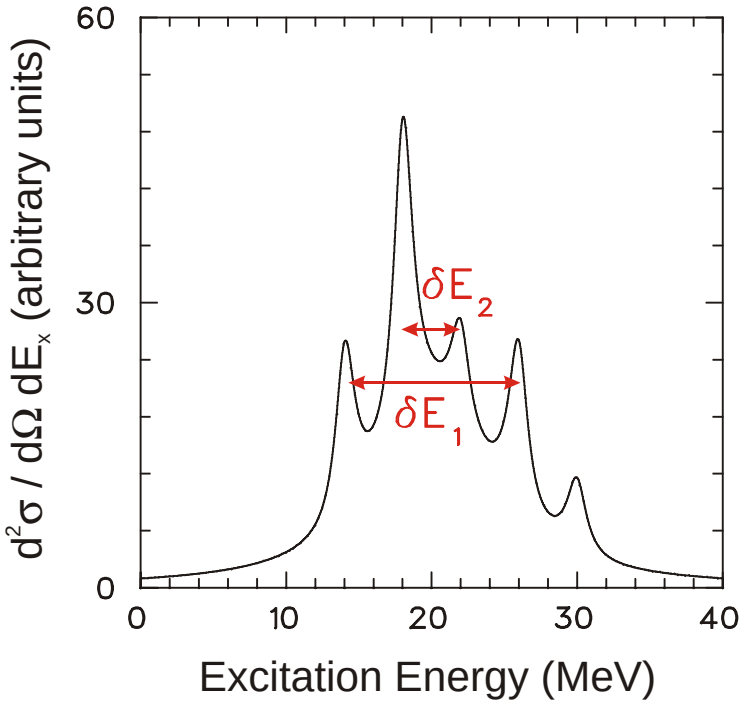
- Summary and Outlook

Motivation





- Hierarchy of "Doorway states" ⇨ Characteristic scales
- Search for scales: ⇨ **Wavelet Analysis**
- A global phenomenon?

Recent Experiment

Place: iThemba LABS in South Africa

Reaction: (p,p')

Targets: $^{208}_{82}Pb_{126}$ $^{120}_{50}Sn_{70}$ $^{90}_{40}Zr_{50}$ $^{89}_{39}Y_{50}$ $^{58}_{28}Ni_{30}$

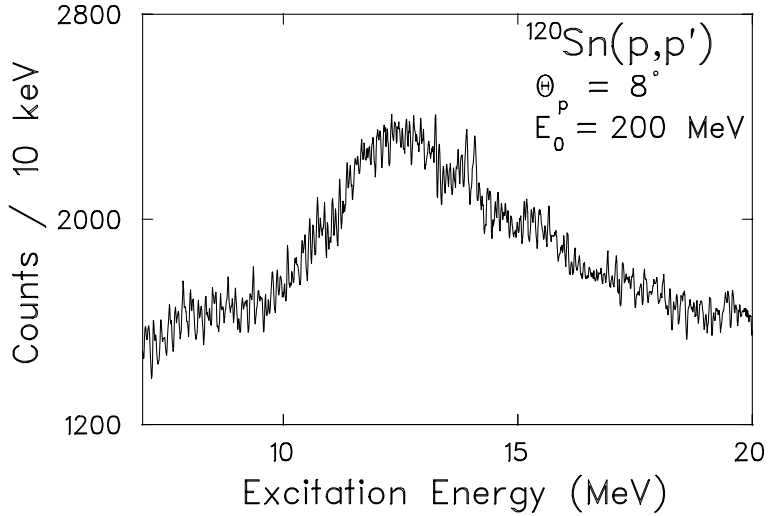
Beam Energy: E_p = 200 MeV

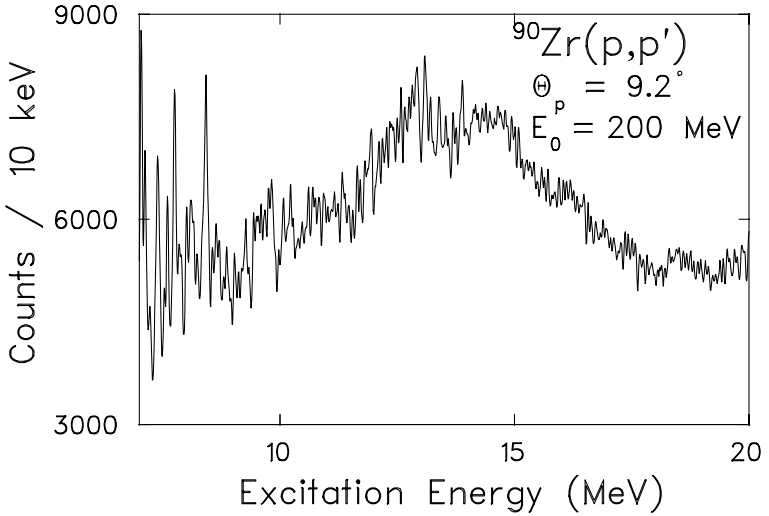
Excitation Energy Range: E_x = 0 - 23 MeV

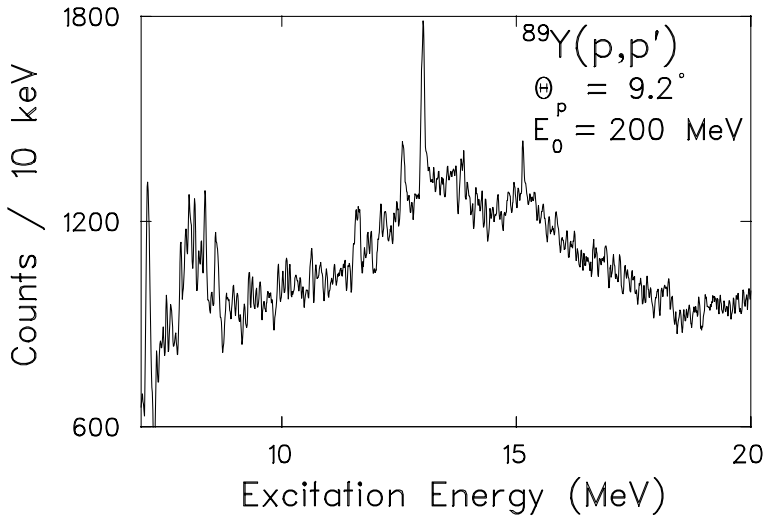
Energy Resolution (FWHM): ΔE = 35 - 50 keV

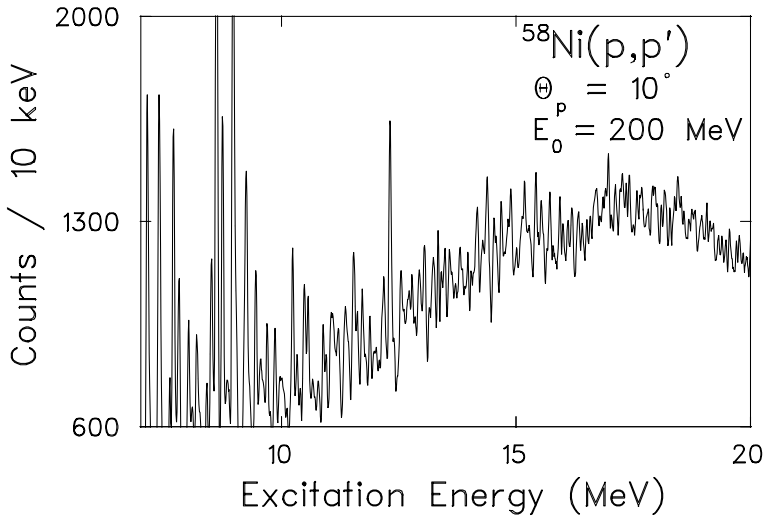
Scattering Angles: 8^{O} - 10^{O}
(close to maximum of $\Delta L=2$ transitions)
6^{O} - 14^{O}
(check contributions of different multipoles)

Fine Structure of the ISGQR: A Global Phenomenon?









Search for Scales

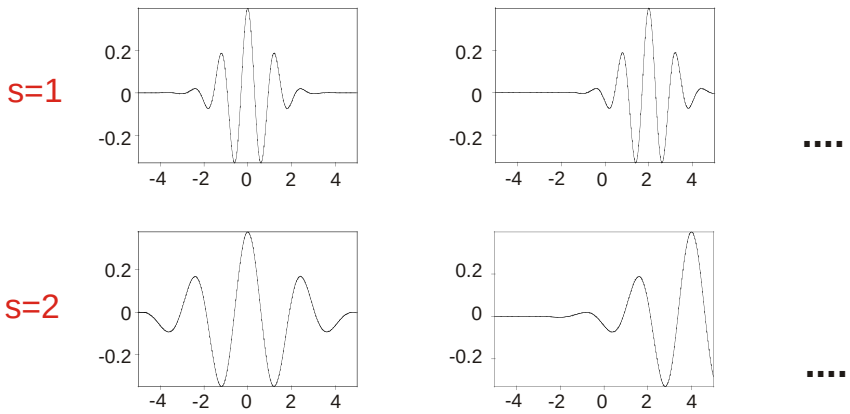
Wavelet Transform

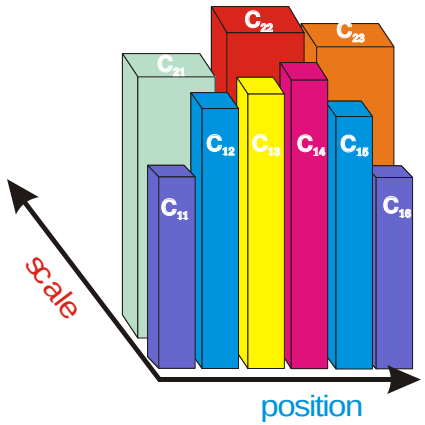
$$C(s, E_x) = \frac{1}{\sqrt{s}} \int f(E)\, \Psi^* \left(\frac{E_x - E}{s \cdot \Delta E} \right) dE$$

scale — position — spectrum — wavelet function

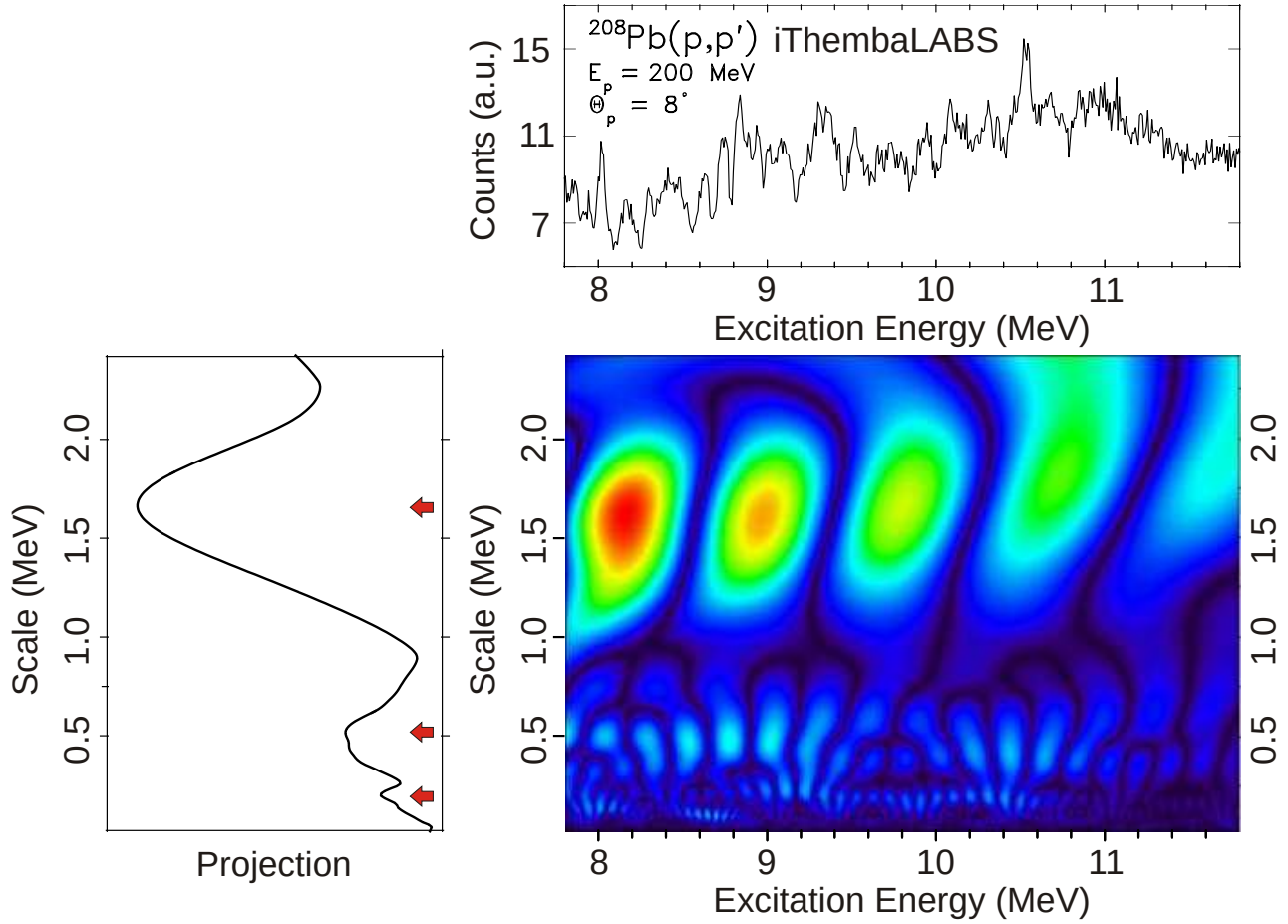
Basis Wavelet Function

Morlet $\Psi(x) = \pi^{-1/4} e^{2\pi i \omega x} e^{-x^2/2}$



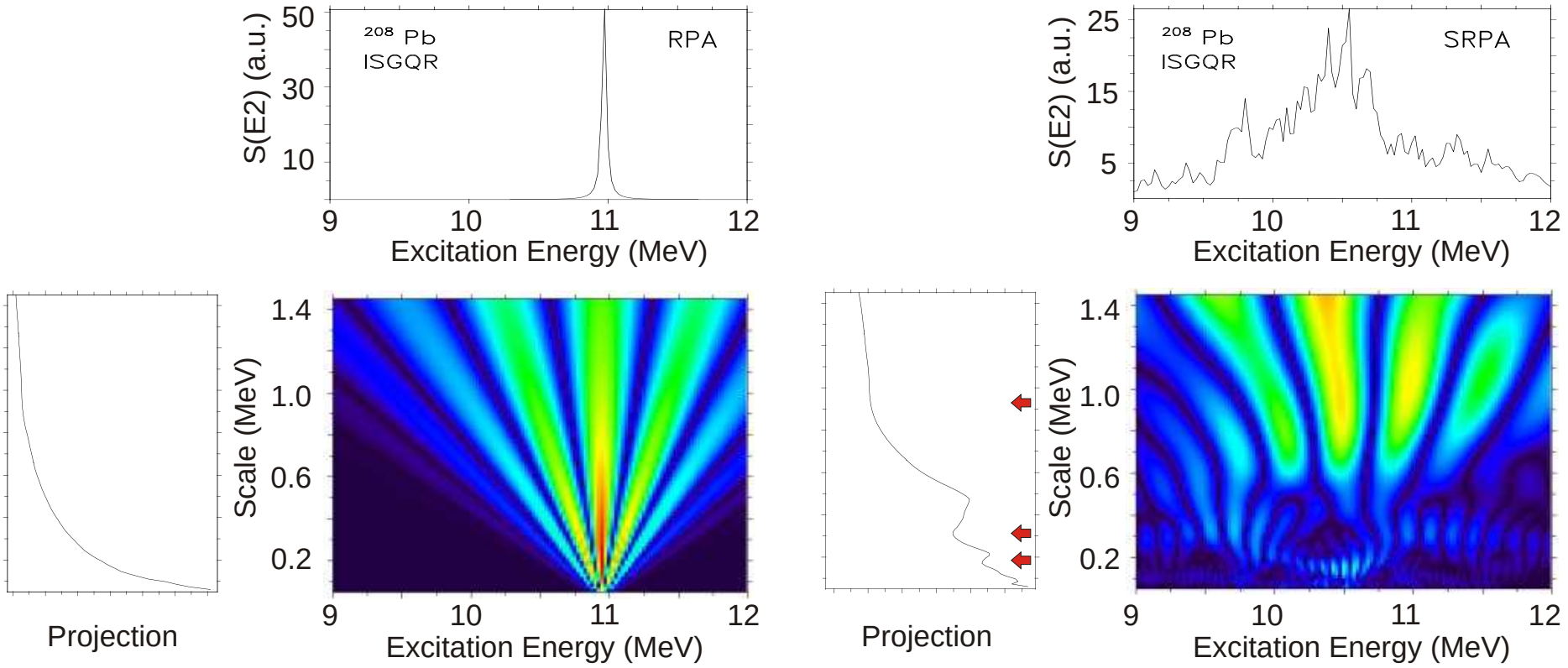


Results: ^{208}Pb(p,p')



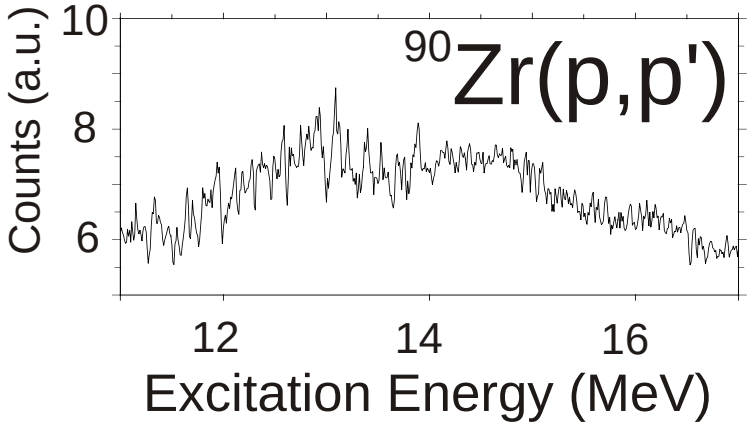
- Prominent Scales: 200 keV, 500 keV, and 1.6 MeV
- Interpretation: comparison with theory

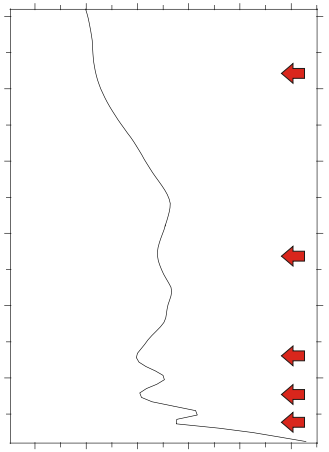
Interpretation



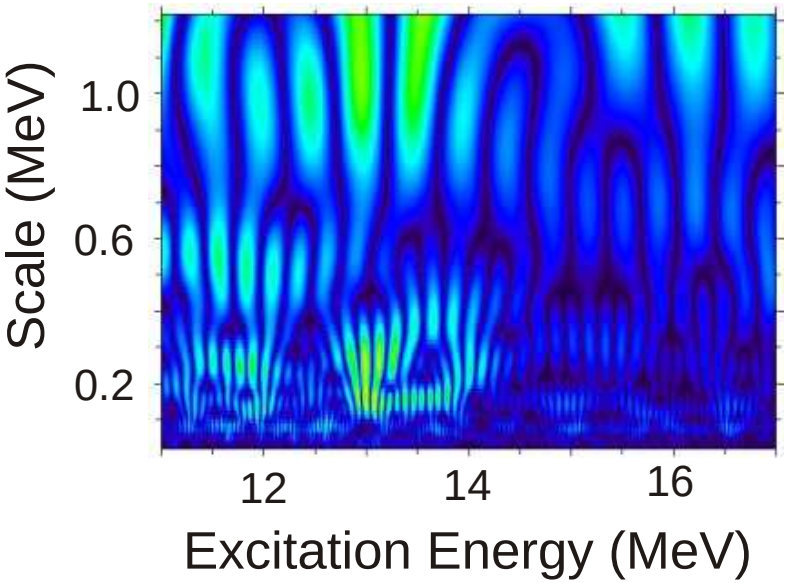
- Similar scales in SRPA as in experiment
- Signature of 2p-2h damping

Results: Other Nuclei





Projection



Summary and Outlook

- Fine structure of the ISGQR is a general phenomenon
- Wavelet analysis:
  - (i) yields scales
  - (ii) fast compared e.g. to doorway state analysis
  - (iii) unrestricted with respect to the number of scales
- Method can be extended to other GR's
- Experimental access to $\Gamma\downarrow$
- Level densities

Collaboration List

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