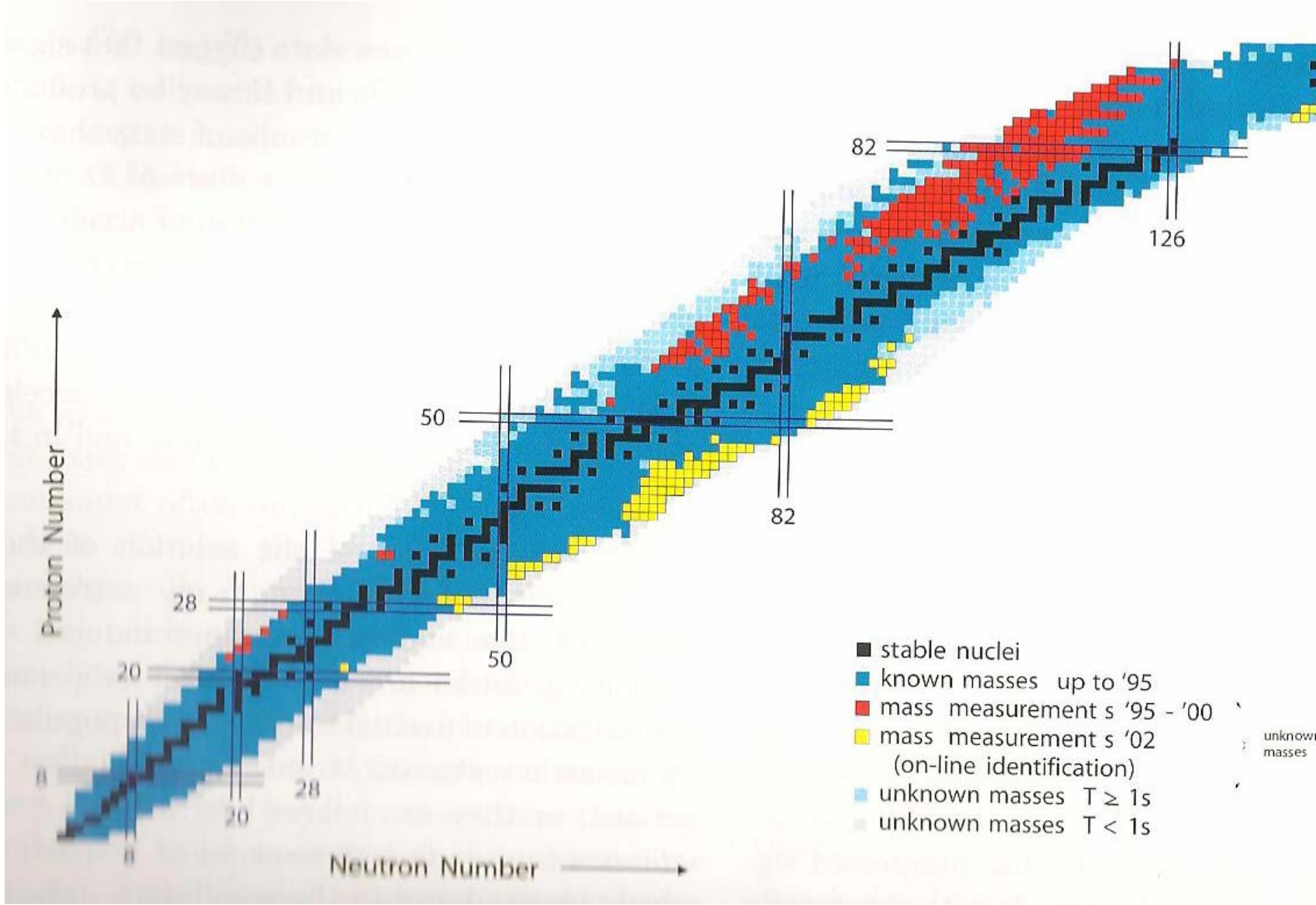


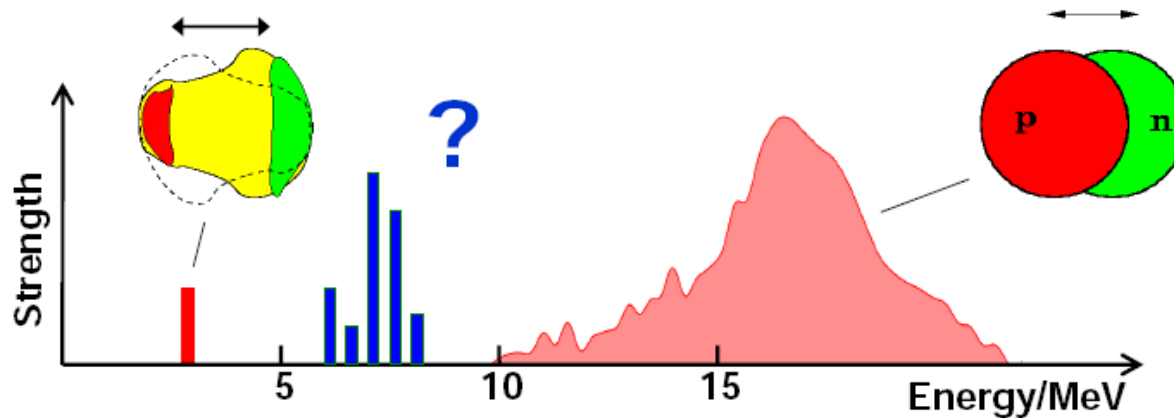
Пигми-дипольный резонанс в ядрах

С.П.Камерджиев
ФЭИ, Обнинск

ЕМАХ-09, 7-8.04.2009



Electric Dipole Strength in Nuclei



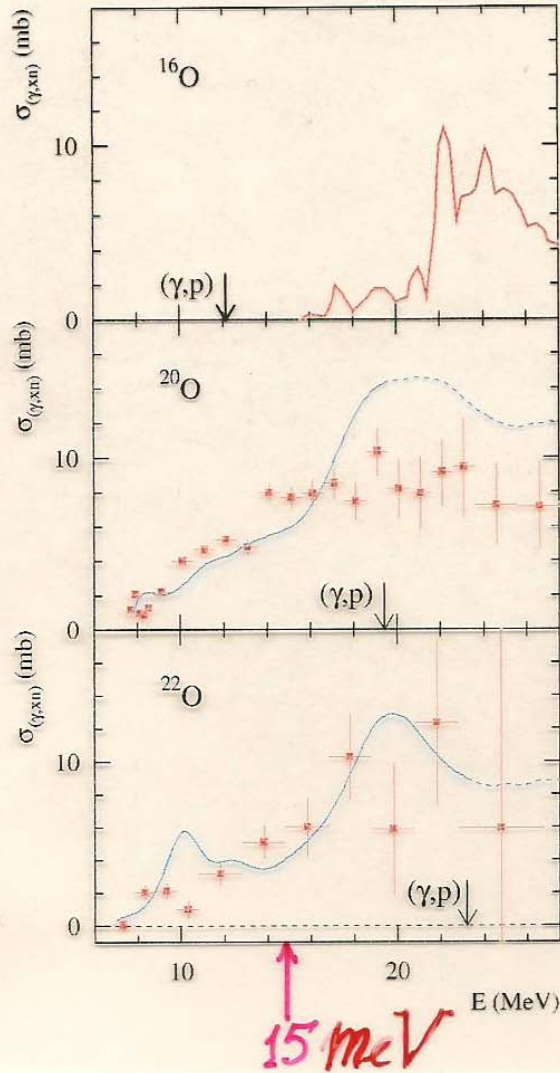
- Two Phonon Excitation: $E_x \sim 3 \text{ MeV}$, $B(E1) \sim 10^{-2} \text{ W.u.}$
- Giant Dipole Resonance: $E_x \sim 18 \text{ MeV}$, $B(E1) \sim 10 \text{ W.u.}$
- **Pygmy Dipole Resonance ?**

МГР:

- Определение: исчерпывание EWSR на (50-) 100% . (E1- до 1972г.)
- Ренессанс 1972-1991 (M.Harakeh, Van der Woude “Giant Resonances”, 2001)
- E2, E3, E4, M1, M2 ($T=0,1$); E0
- Г Т

Section 2

T. Aumann et al.
 Nucl. Phys. A687(2001)
 103c



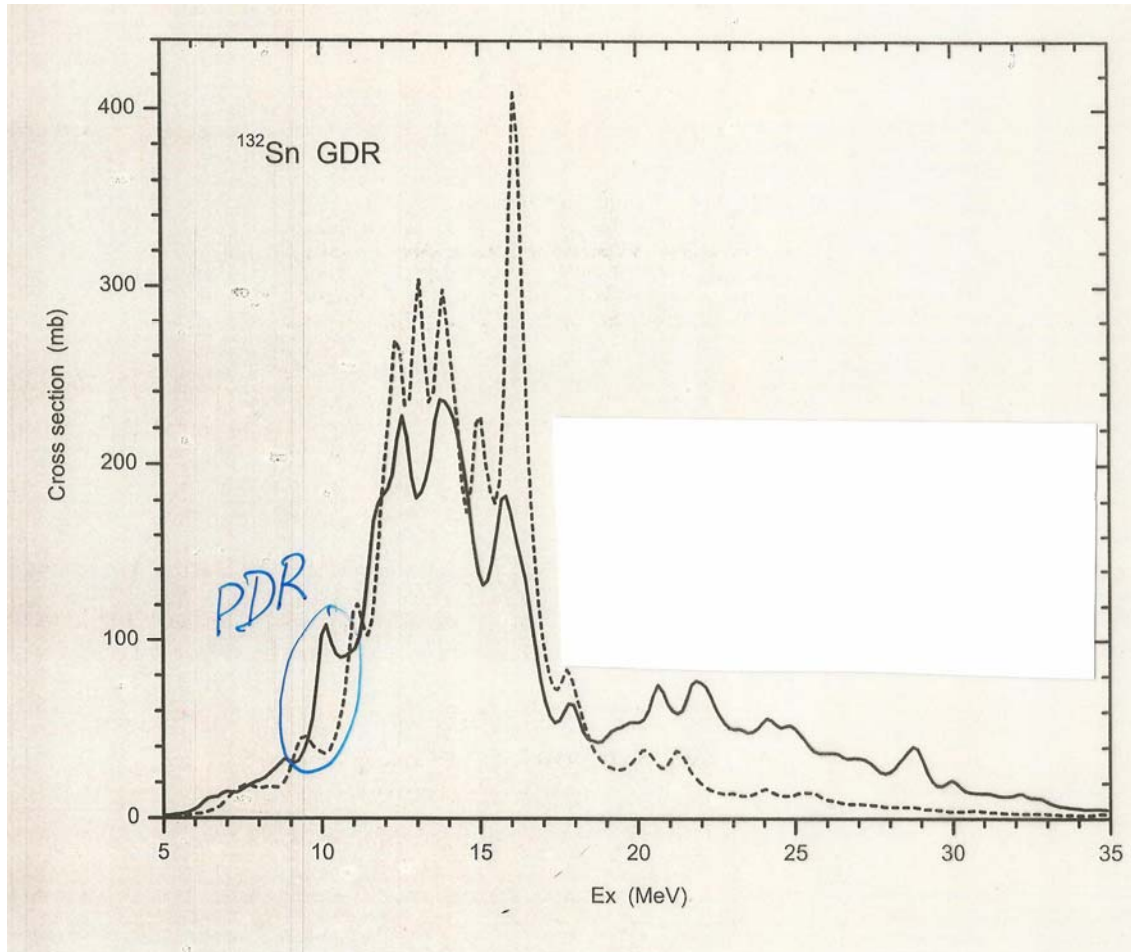
E1 Pygmy Resonance:

$\sim 10\%$ of EWSR

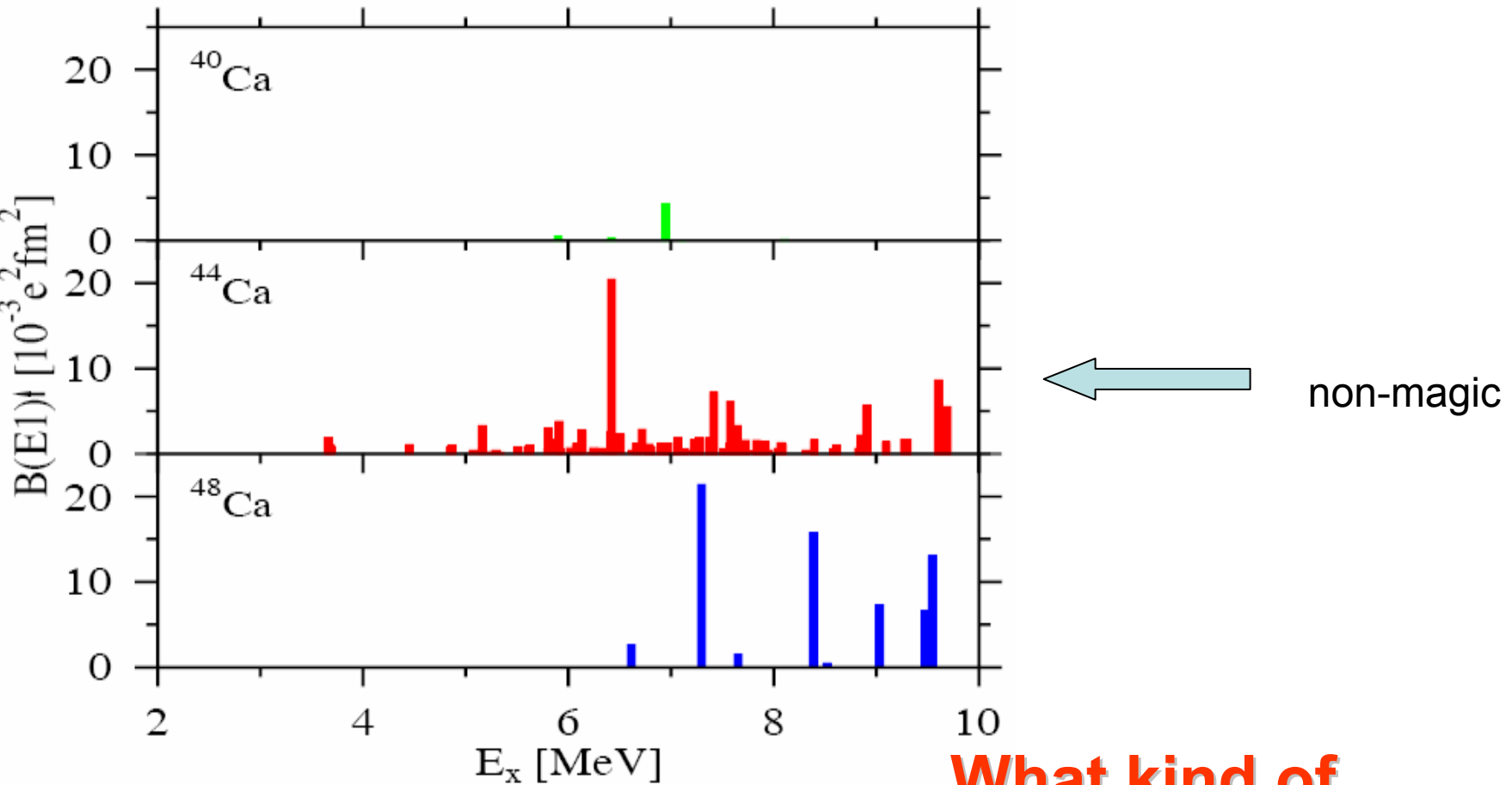
up to $E=15$ MeV

Figure 1.7: Photo-neutron cross sections measured for the unstable oxygen isotopes $^{20,22}\text{O}$ in comparison to that of the stable isotope ^{16}O . The blue curves show the result of a large-scale shell-model calculation [30]. The (γ,p) thresholds are indicated by arrows. Adapted from [29].

GDR and PDR in ^{150}Sn ("primitive" ETFFS)



PDR in Ca isotopes (exp)



*T. Hartmann et al., Phys. Rev. Lett. **93** (2004) 192501,
Phys. Rev. C **65** (2002) 034301,
Phys. Rev. Lett. **85** (2000) 274*

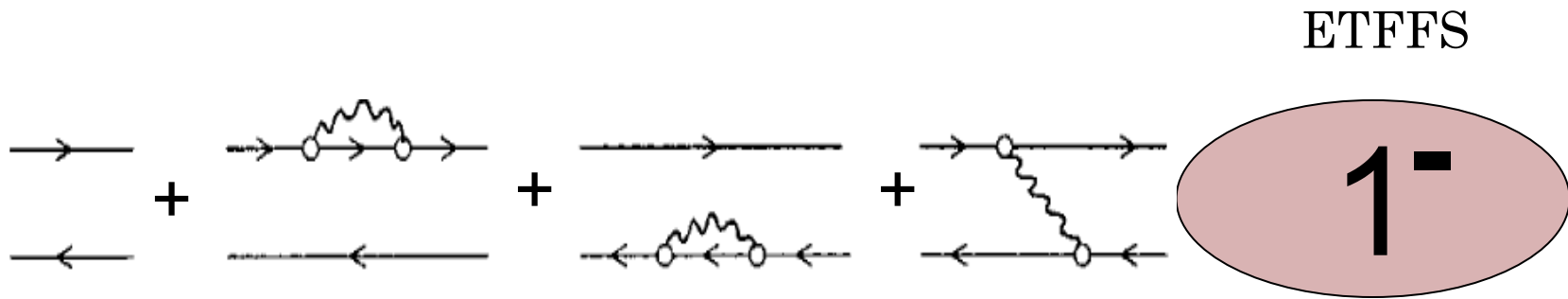
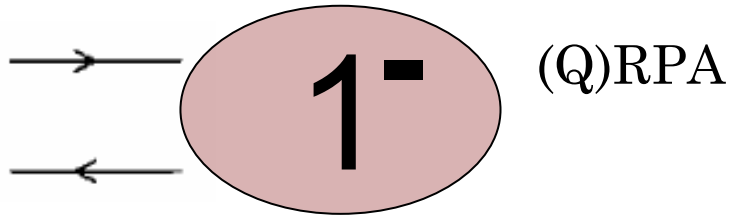
**What kind of
theory do we
need?**

- At present we were able to understand, in fact, only one important question in the PDR (microscopic) theory, namely
it is necessary to go beyond the standard RPA or QRPA approaches and take into account :
 1. the phonon coupling
 2. and single-particle continuum

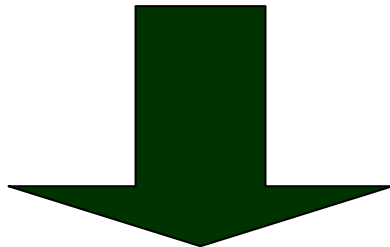
The wave function must contain simple (1p1h) and complex 1p1h \otimes phonon configurations :

$$\Psi_i = \sum_{1,2} c_{12}^i \varphi_1^* \varphi_2 + \sum_{1,2,s} c_{12s}^i \varphi_1^* \varphi_2 \Phi_s$$

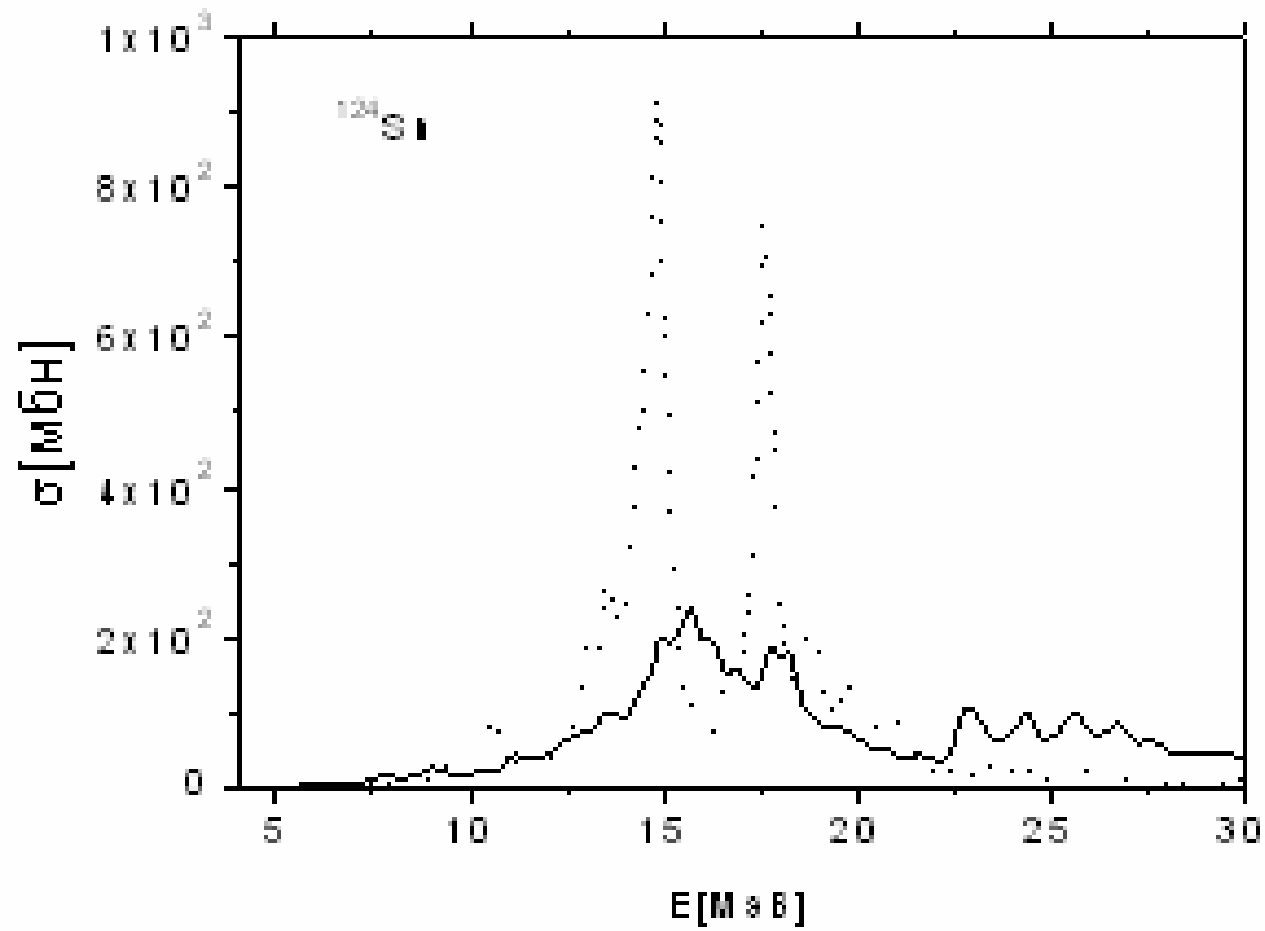
Theory: (Q)RPA versus ETFFS

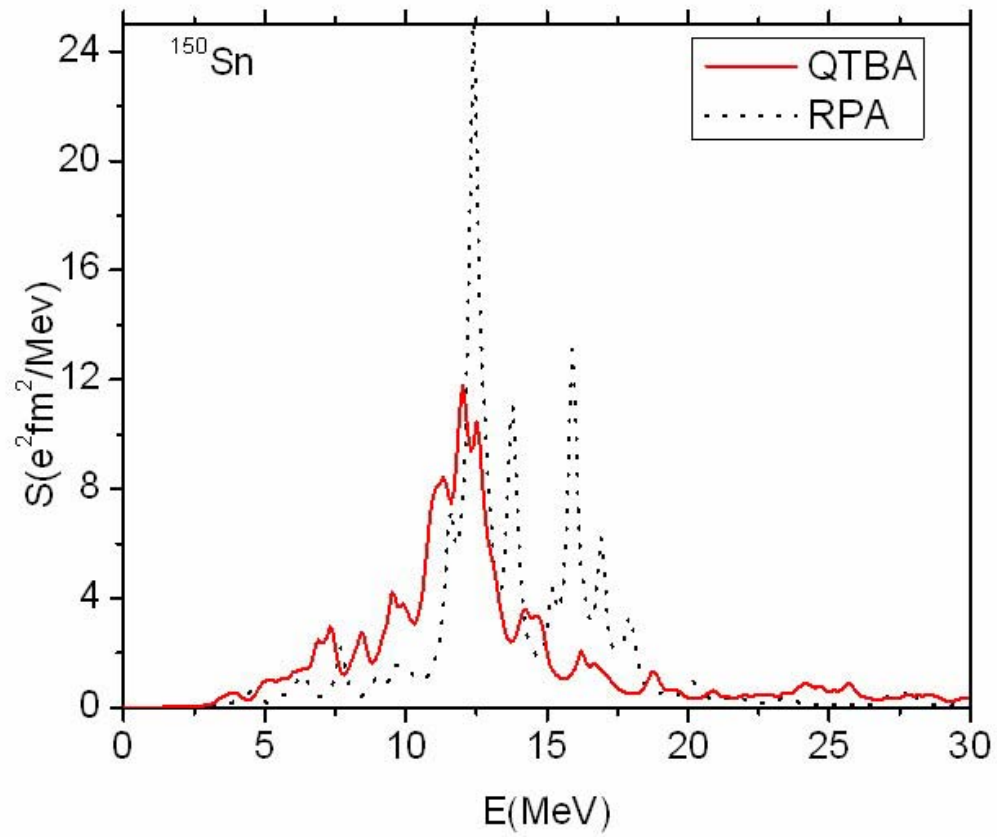


What is the role of complex configurations?

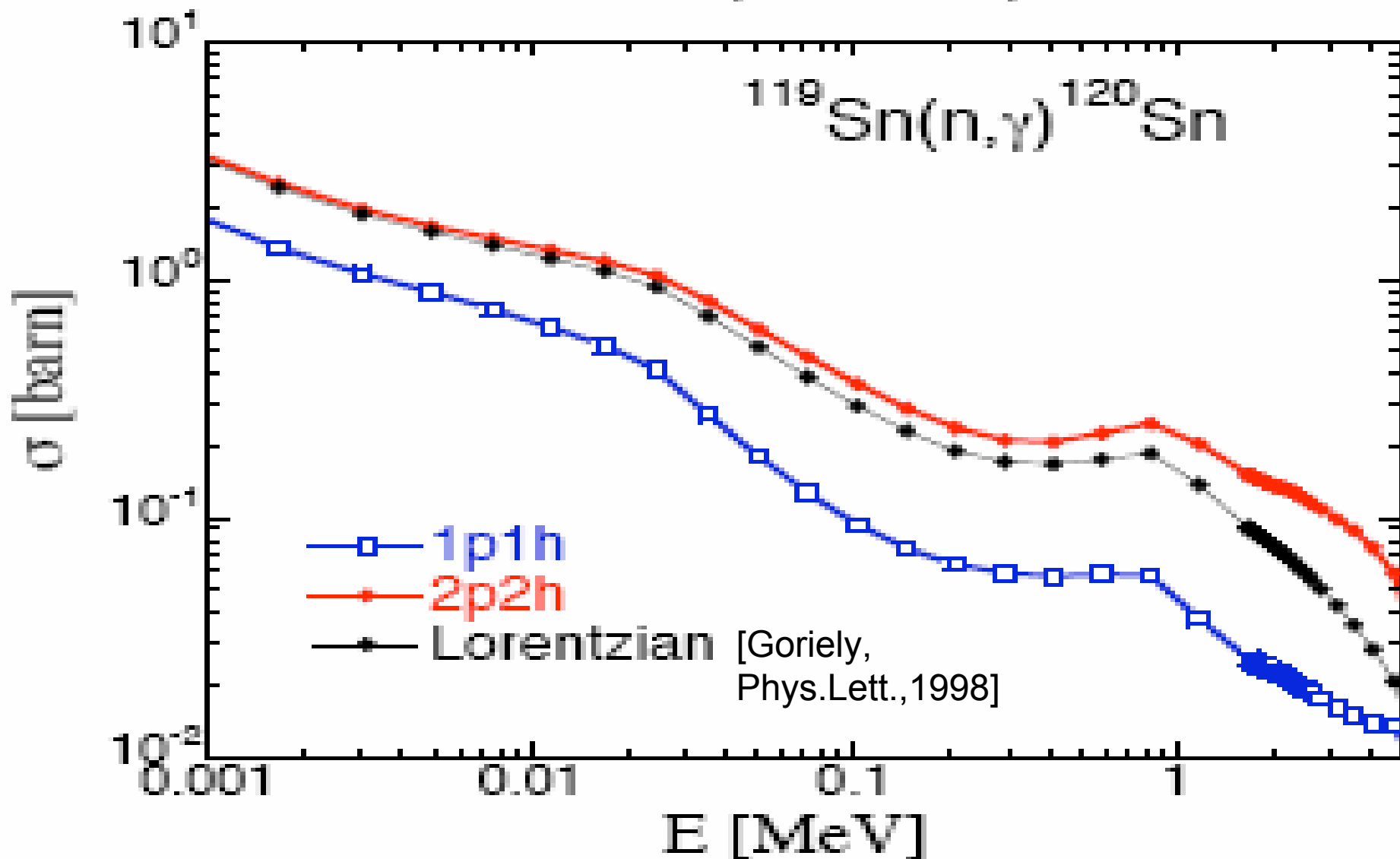


- Для астрофизики нужна теория с максимальной предсказательной силой.
- В настоящее время – это
- микроскопическая
- самосогласованная теория
- “QRPA+phonon coupling+continuum”
- (Skyrme forces)



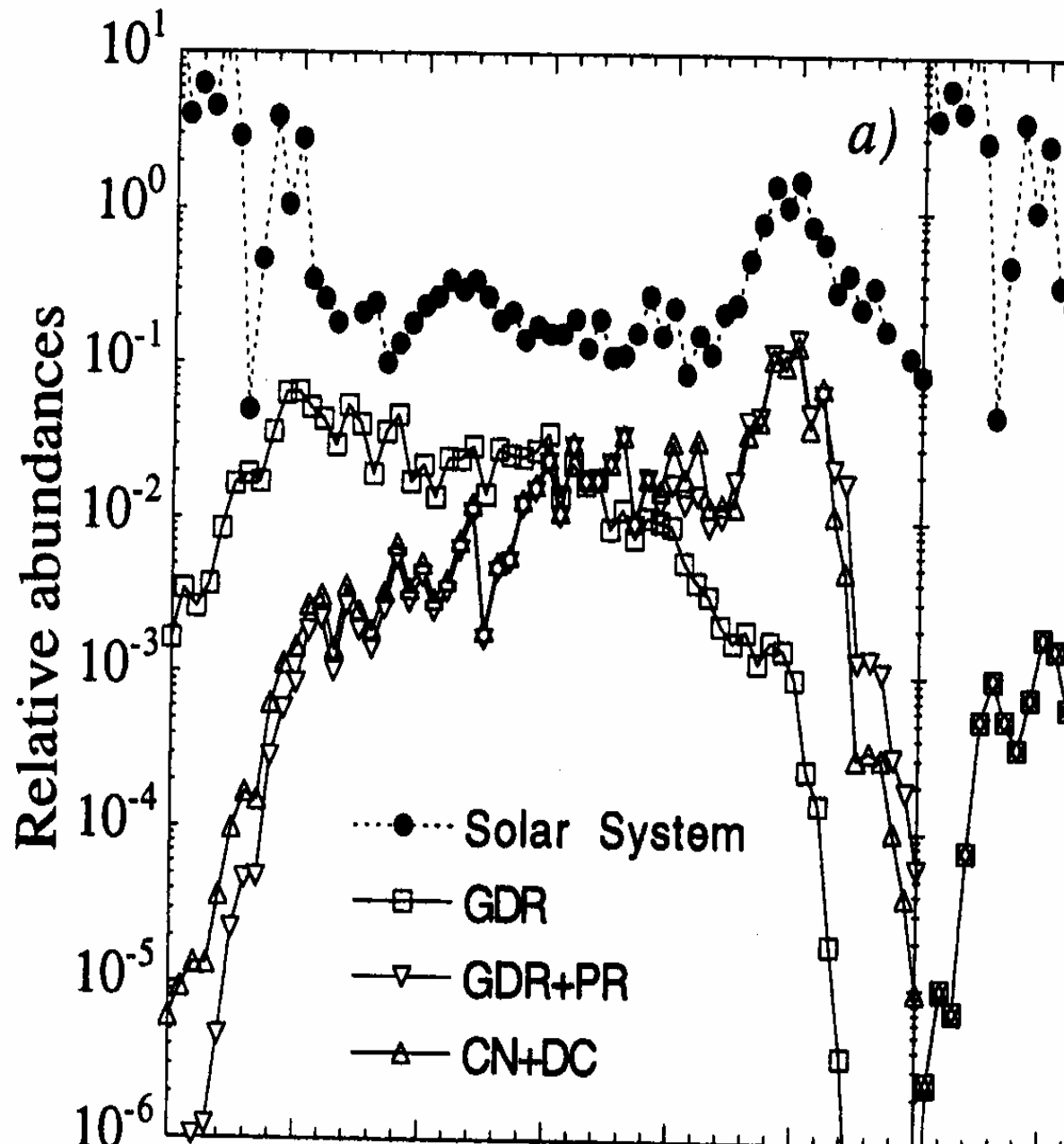


Original E1 strength without any folding and normalization on photoabsorption data

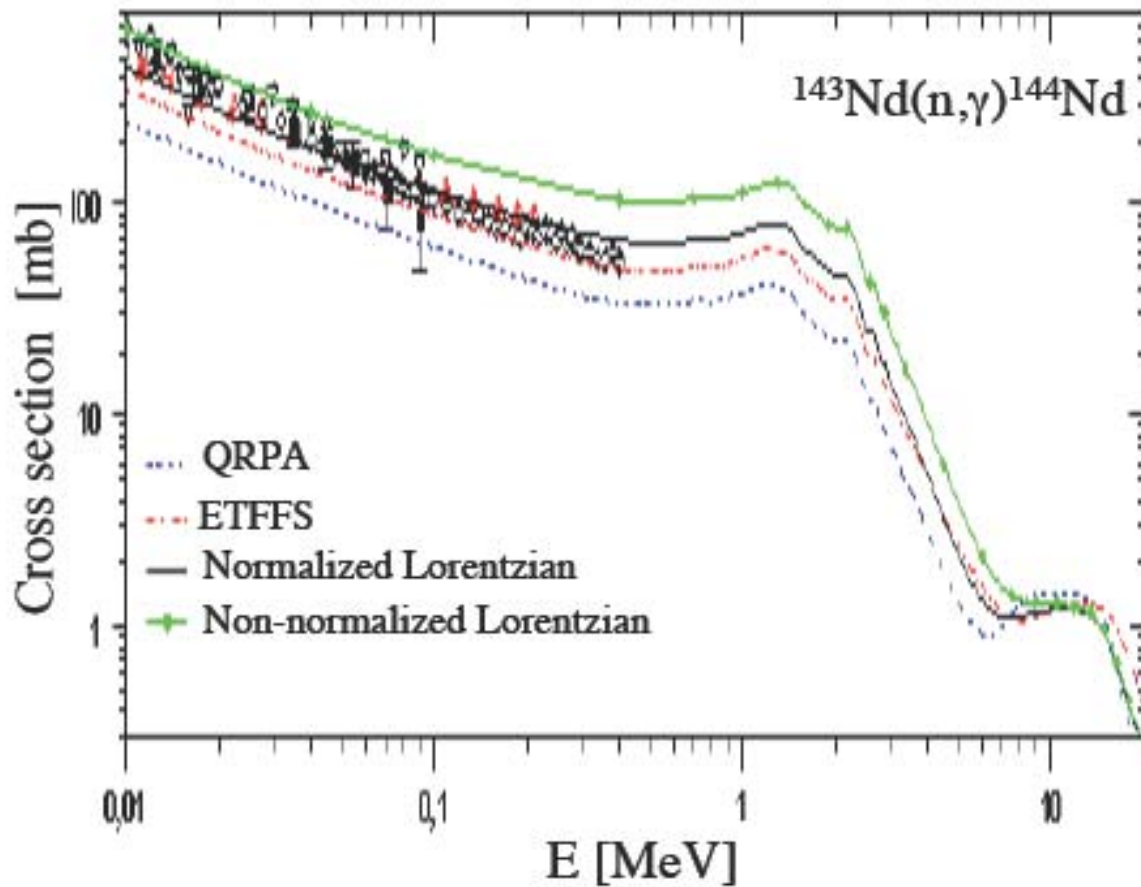


[Goriely,2004]

Goriely, 1998

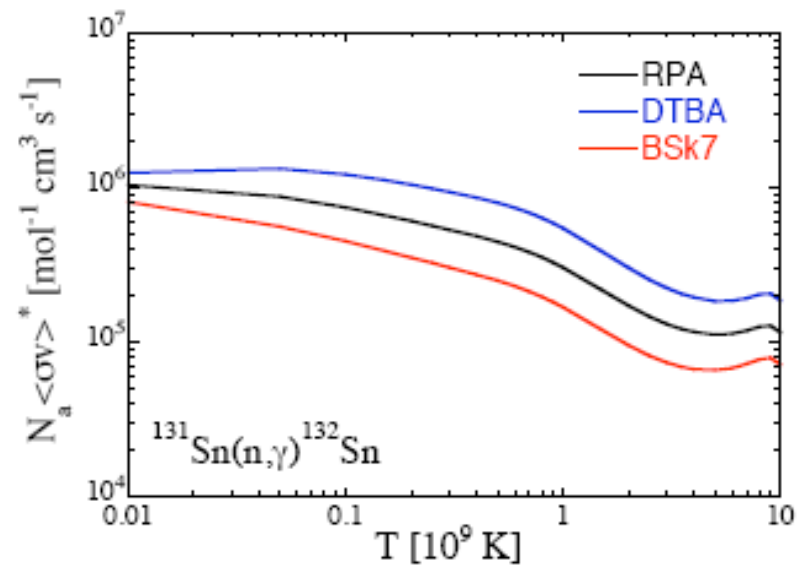
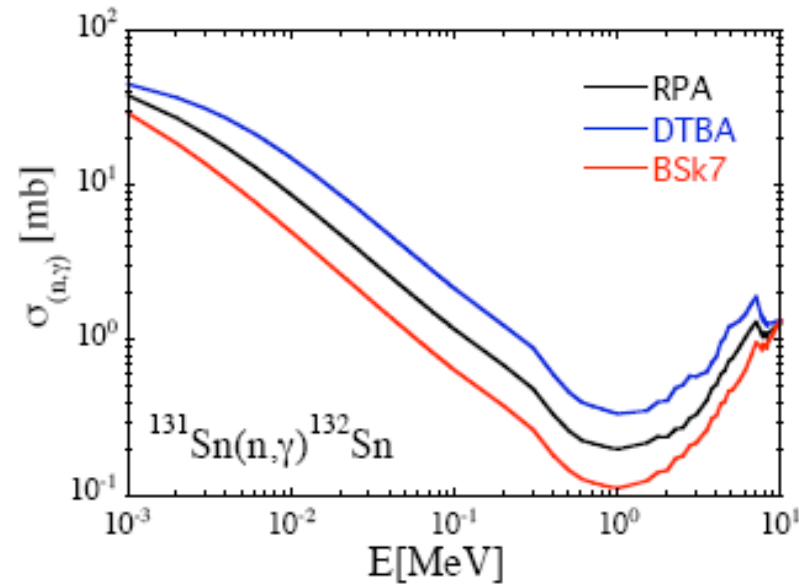


$^{143}\text{Nd}(n,\gamma)^{144}\text{Nd}$ **cross sections** calculated with the use of the non-selfconsistent QRPA and ETFFS (QTBA) strength



$^{131}\text{Sn}(n,\gamma)^{132}\text{Sn}$ cross sections and reaction rates

obtained with the DTBA and RPA strengths



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¹IPPE Obninsk, Russia; ²IKP TU Darmstadt, Germany; ³GSI Darmstadt, Germany

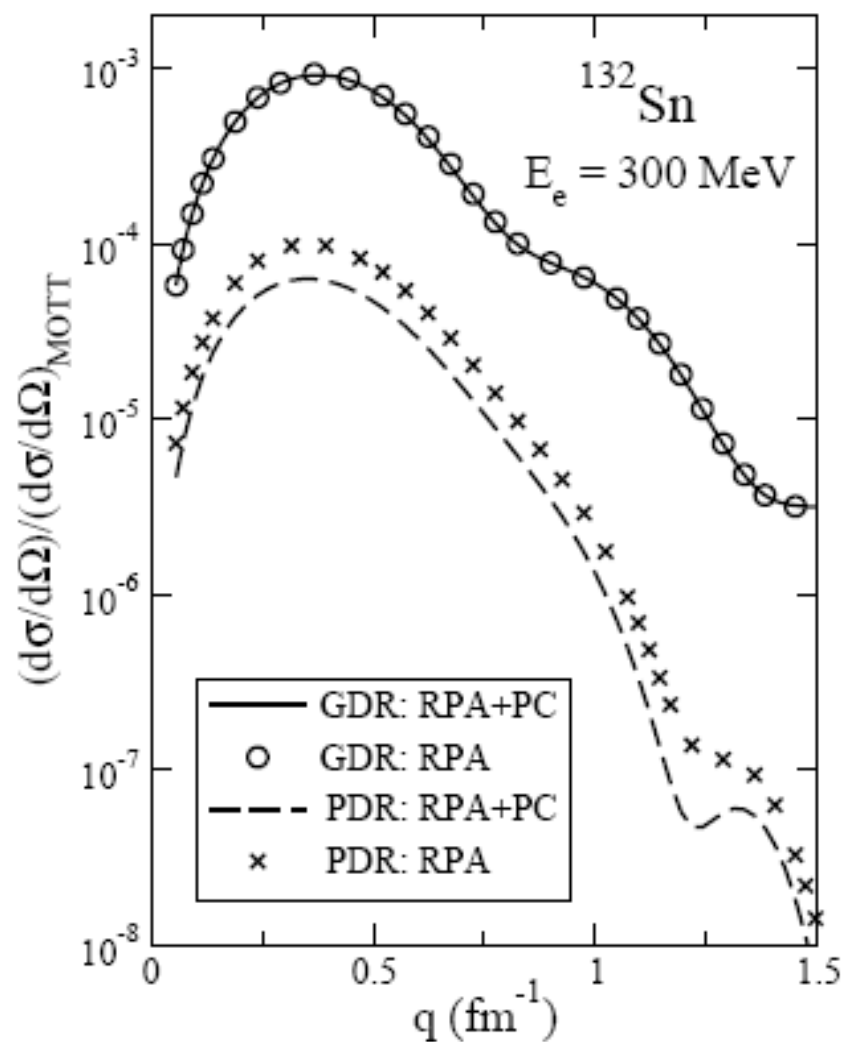


Figure 1: The $^{132}\text{Sn}(e,e')$ cross section of excitation of the

Проблемы ПДР

- 1. Коллективность
- Не определена даже область энергий
- 2. IS E1 versus IV E1
- 3. В расчетах не учитываются новые эффекты (новые корреляции в основном состоянии, tadpole's effects, зависимость от плотности част.-частичного взаимодействия и др.)
- 4. Работы чехов = проблемы фотонной силовой функции (PSF) и ПДР [M.Krticka, F.Vecvar, J.Phys. G35, vol.1 (2008)]

Заключение

- Исследования ПДР важны для астрофизики , прежде всего эксперименты для нейтронно-обогащенных ядер
- Необходимы последовательные самосогласованные расчеты в теории вне стандартных RPA и QRPA подходов

Dipole strength function and photoabsorption cross section for ^{132}Sn calculated within the DTBA and RPA with the Skyrme forces SLy4 and within the HFB+RPA model with the BSk7 forces

