Retracing Edoardo's footsteps

A proud Biancavillese

From a Biancavillese family


TARTARUGA

Tesi di Laurea, 1980:

Nuclear Physics A391 (1982) 249–268

INDEPENDENT PARTICLE DESCRIPTION OF MASS AND CHARGE TRANSFER IN DEEP INELASTIC COLLISIONS

M. BALDO, F. CATARA, E. G. LANZA, U. LOMBARDO and L. LO MONACO

Istituti di Fisica dell'Università di Catania and INFN – Corso Italia, 57 95100 Catania, Italy

Nuclear Physics A451 (1986) 299–312

INTERPLAY BETWEEN PARTICLE-HOLE EXCITATION AND NUCLEON TRANSFER IN DEEP-INELASTIC COLLISIONS

F. CATARA and E.G. LANZA

Dipartimento di Fisica and INFN, Corso Italia 57, Catania, Italy

Nuclear Physics A428 (1984) 137c-144c
North-Holland, Amsterdam

A FEEDBACK PROCESS CONTROLLING ENERGY PARTITIOI
HEAVY IONS+

Luciano G. Moretto

Lawrence Berkeley Laboratory, Berkeley

Edoardo G. Lanza

Max-Planck-Institut für Kernphysik, Heidelberg

Volume 107A, number 4 PHYSICS LETTERS 28 January 1985

RANDOM WALK ANALYSIS OF QUANTUM CHAOS

E.G. LANZA [1], N.H. KWONG [2] and R.H. IBARRA [3]
Max-Planck-Institut für Kernphysik, Heidelberg, West Germany

 140–144 (1987)

On a Class of Integrals Appearing in the Theory of Statistical Nuclear Reactions

H. L. HARNEY, E. G. LANZA,* AND P. PEREYRA†

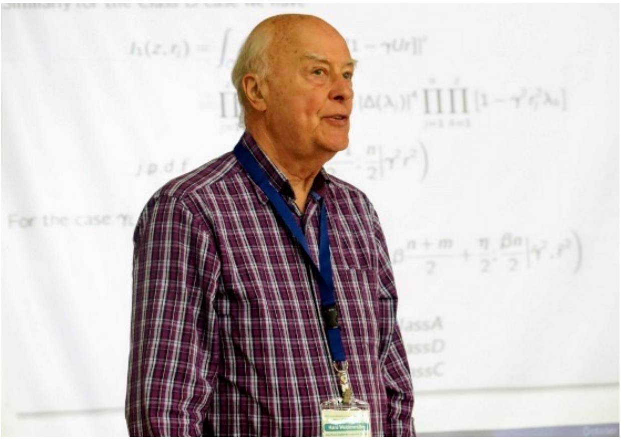
Max-Planck-Institut für Kernphysik,
Postfach 103980, 6900 *Heidelberg*, *Federal Republic of Germany*

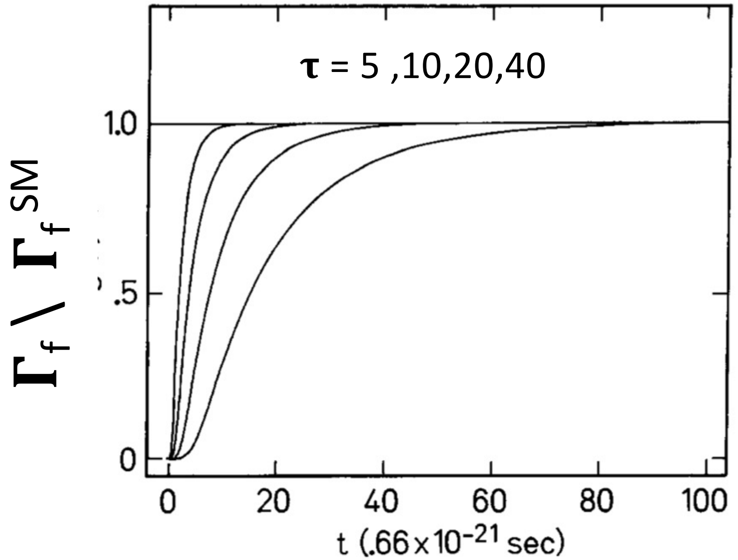
Received November 4, 1984

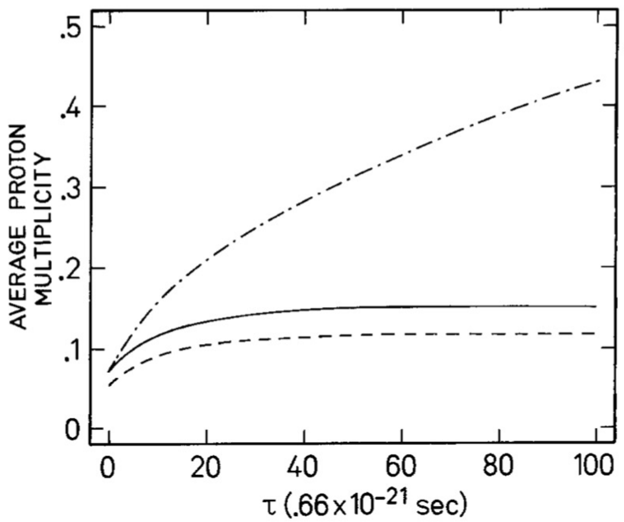
Multiplicities of Charged Particles Prior to Fission

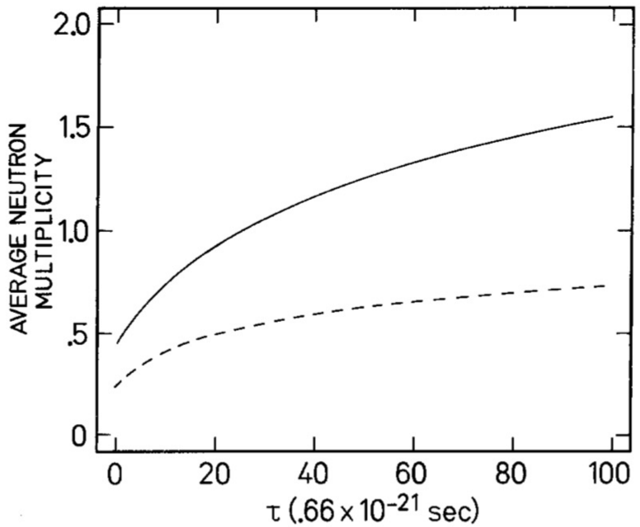
E.G. Lanza* and H.A. Weidenmüller
Max-Planck Institut für Kernphysik, Heidelberg, Federal Republic of Germany

Received October 21, 1985



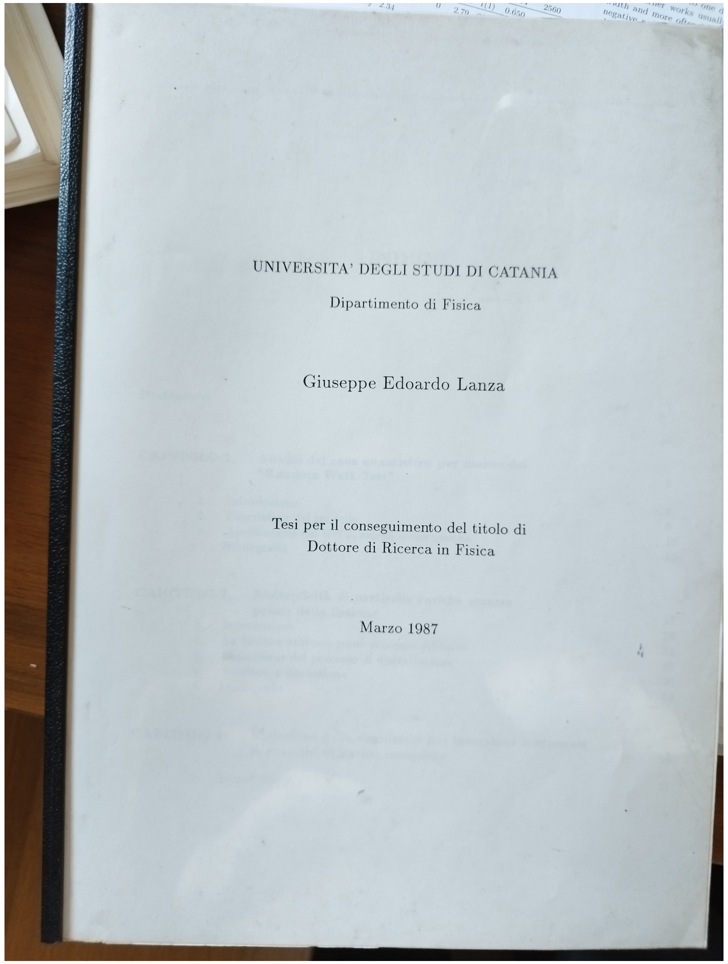






If the fission lifetime of the compound nucleus exhibits a transient time before reaching the statistical model value, the neutron and proton multiplicities are affected.
This can give information on the nuclear friction constant .

Edoardo, a physicist with two Ph.D.s?



UNIVERSITA' DEGLI STUDI DI CATANIA

Dipartimento di Fisica

Giuseppe Edoardo Lanza

Tesi per il conseguimento del titolo di
Dottore di Ricerca in Fisica

Marzo 1987

INAUGURAL–DISSERTATION
zur
Erlangung der Doktorwürde
der
Naturwissenschaftlich–Mathematischen
Gesamtfakultät
der
Ruprecht – Karls – Universität
Heidelberg

vorgelegt von
Diplom–Phisiker Edoardo Giuseppe Lanza
aus Biancavilla (CT), Italien
– 1989 –

Nel novembre del 1983 gli è stata assegnata una borsa di studio della durata di 3 anni per il conseguimento del Dottorato di Ricerca in Fisica presso l'Università degli Studi di Catania, quale vincitore del concorso bandito dal Ministero P. I. Nell'ambito degli studi per il conseguimento di detto titolo ha proseguito la sua collaborazione con il gruppo teorico del Max-Planck Institut di Heidelberg.

Nel novembre del 1985 ha vinto il concorso per un posto di ricercatore all'Istituto Nazionale di Fisica Nucleare - Sezione di Catania; assunto il 2 maggio 1986 è stato escluso d'ufficio dal Dottorato di Ricerca.

Nel giugno 1989 ha conseguito il titolo di *Dr. Rerum Naturae* (Dottorato di Ricerca) presso la Ruprecht-Karls-Universität di Heidelberg (Germania Federale) discutendo la tesi *Violation of Time Reversal Symmetry in Compound Nucleus Reaction.*

Motivation: a high precision experimental study of the validity of detailed balance in the reaction was performed by the Darmstadt-Bochum group [E. Blanke et al. PRL 51 (1983) 355]

$$^{27}\mathrm{Al} + p \rightleftarrows {}^{24}\mathrm{Mg} + \alpha.$$

Investigate the consequences of time-reversal symmetry breaking in compound nucleus reactions, assuming that the compound nucleus can be represented as a member of a GOE ensemble plus an admixture of time-reversal symmetry breaking GUE

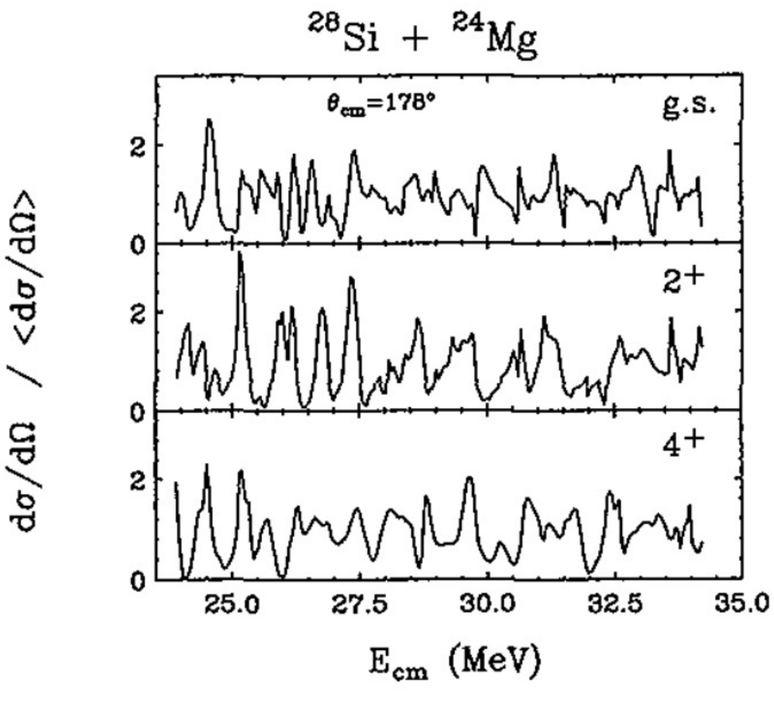

Two of Edoardo's favourite places

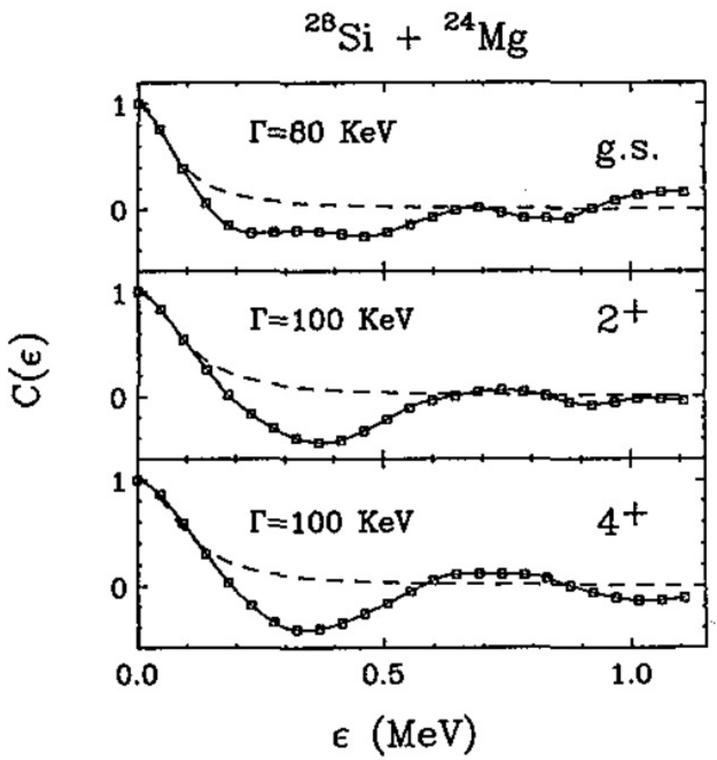
Erice School 1986

Chaotic scattering in heavy-ion reactions *Chaos 3, 691 (1993)*

M. Baldo, E. G. Lanza, and A. Rapisarda
Istituto Nazionale di Fisica Nucleare, Sezione di Catania, Dipartimento di Fisica, Universitá di Catania, Corso Italia 57, I-95129 Catania, Italy

Calculation of excitation functions in the quantum scattering of a rotor at bombarding energies slightly above the barrier in weakly absorbing systems shows fluctuations that can be related to the chaotic feature observed
In the analogous classical system





ELSEVIER
Nuclear Physics A 589 (1995) 521–534
NUCLEAR PHYSICS A

Anharmonicities and non-linearities in the excitation of double giant resonances

C. Volpe [a], F. Catara [a,1], Ph. Chomaz [a], M.V. Andrés [b], E.G. Lanza [c]

ELSEVIER
Nuclear Physics A 613 (1997) 445–471
NUCLEAR PHYSICS A

Role of anharmonicities and nonlinearities in heavy ion collisions A microscopic approach

E.G. Lanza [a], M.V. Andrés [b], F. Catara [a], Ph. Chomaz [c], C. Volpe [c]

ELSEVIER
Nuclear Physics A 647 (1999) 246–256
NUCLEAR PHYSICS A

Boson expansion methods applied to a two-level model in the study of multiple giant resonances

C. Volpe [a], Ph. Chomaz [b], M.V. Andrés [c], F. Catara [d], E.G. Lanza [c,d]

ELSEVIER
Nuclear Physics A 636 (1998) 452–466
NUCLEAR PHYSICS A

Microscopic description of Coulomb and nuclear excitation of multiphonon states in heavy ion collisions

E.G. Lanza [a,b], M.V. Andrés [b], F. Catara [a], Ph. Chomaz [c], C. Volpe [d]

1.D.2

Nuclear Physics **39** (1962) 582—604;

ANHARMONIC EFFECTS OF QUADRUPOLE OSCILLATIONS OF SPHERICAL NUCLEI

S. T. BELIAEV and V. G. ZELEVINSKY
I. V. Kurchatov Atomic Energy Institute, Academy of Sciences, Moscow, USSR †

RPA approximation: $H_{\mathrm{RPA}}=\sum_{\nu} E_{\nu} Q_{\nu}^{\dagger} Q_{\nu}\,,\qquad Q_{\nu}^{\dagger}=\sum_{p,h}\left(X_{ph}^{\nu} B_{ph}^{\dagger}-Y_{ph}^{\nu} B_{ph}\right).$

Boson mapping: $a_{p}^{\dagger} a_{h} \rightarrow B_{ph}^{\dagger}+(1-\sqrt{2}) \sum_{p' h'} B_{p' h'}^{\dagger} B_{p' h}^{\dagger} B_{p h'}+\cdots.$

Including all terms of the residual interaction (not only ph terms) and expanding up to two-boson states,

$$H=\sum_{\nu} E_{\nu} Q_{\nu}^{\dagger} Q_{\nu}+\Bigg[\sum_{\nu_1 \nu_2 \nu_3} V_{\nu_1 \nu_2 \nu_3}^{21} Q_{\nu_1}^{\dagger} Q_{\nu_2}^{\dagger} Q_{\nu_3}^{\dagger} + \sum_{\nu_1 \nu_2 \nu_3 \nu_4} V_{\nu_1 \nu_2 \nu_3 \nu_4}^{22} Q_{\nu_1}^{\dagger} Q_{\nu_2}^{\dagger} Q_{\nu_3} Q_{\nu_4}\Bigg]+\text{H.c.},$$

Eigenstates are a superposition of one- and two-phonon states:

$$|\Phi_{\alpha}\rangle = \sum_{\nu} c_{\nu}^{\alpha} |\nu\rangle + \sum_{\nu_1 \nu_2} d_{\nu_1 \nu_2}^{\alpha} |\nu_1 \nu_2\rangle\,.$$

Extended RPA: each state of nucleus A is a superposition of 1- and 2- RPA phonons

$$|\Phi_\alpha\rangle = \sum_{\nu} c_\nu^\alpha |\nu\rangle + \sum_{\nu_1\nu_2} d_{\nu_1\nu_2}^\alpha |\nu_1\nu_2\rangle .$$

Collision of heavy ions A,B at relativistic energies on semiclassical trajectories (Alder–Winther) R(t)

$$H = H_A + H_B ,$$

$$H_A = H_A^0 + \sum_{\alpha\alpha'} \langle\alpha|U_B(\boldsymbol{R}(t))|\alpha'\rangle a_\alpha^\dagger a_{\alpha'} = H_A^0 + W_A(t) ,$$

External field:

$$W = W^{00} + \sum_\nu W_\nu^{10} Q_\nu^\dagger + \text{h.c.} + \sum_{\nu\nu'} W_{\nu\nu'}^{11} Q_\nu^\dagger Q_{\nu'} + \sum_{\nu\nu'} W_{\nu\nu'}^{20} Q_\nu^\dagger Q_{\nu'}^\dagger + \text{h.c.} ,$$

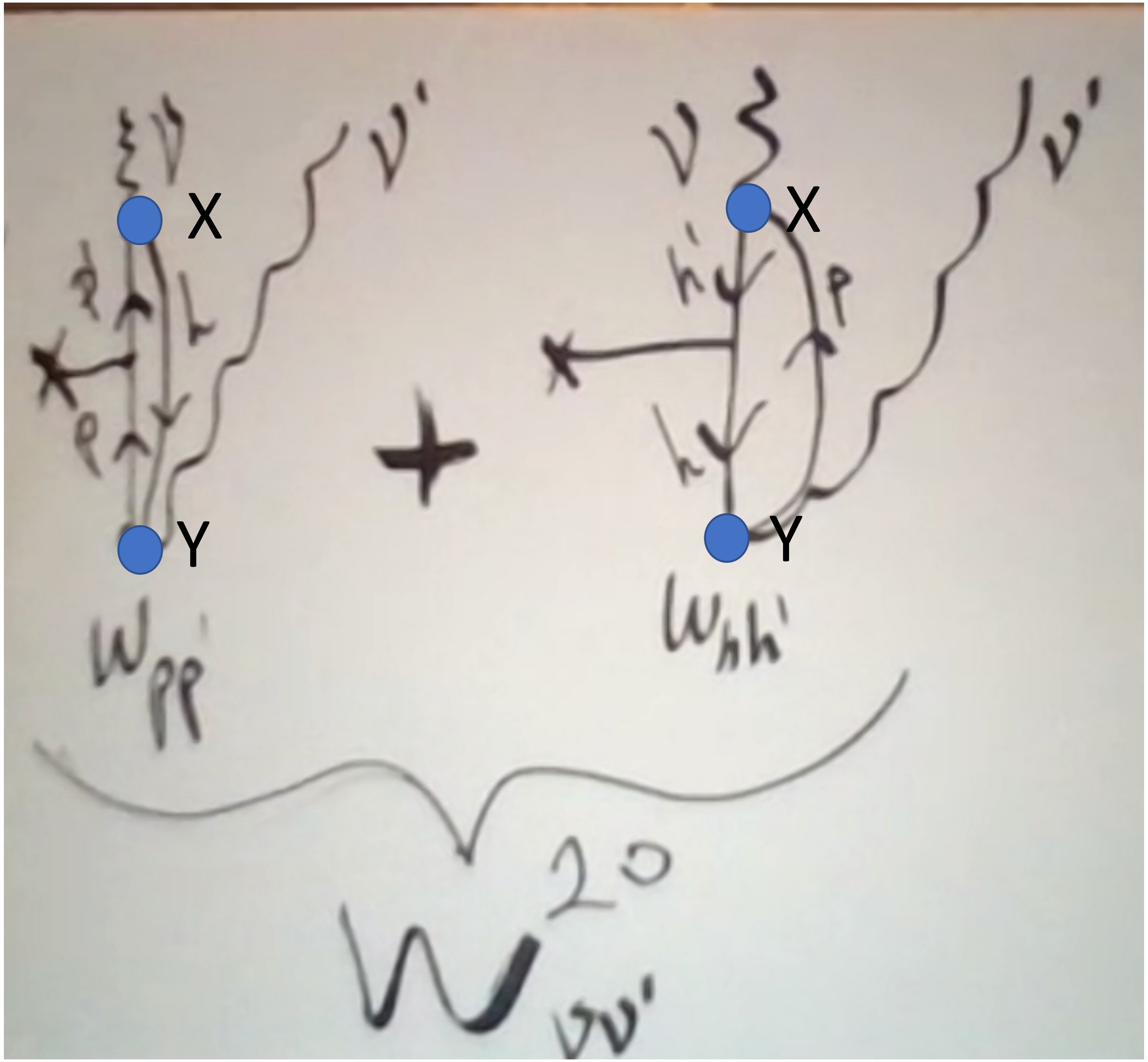
Standard excitation of one-phonon component

Transition from one-phonon or two-phonon component to another one of the same type

Transition from g.s. to two-phonon component

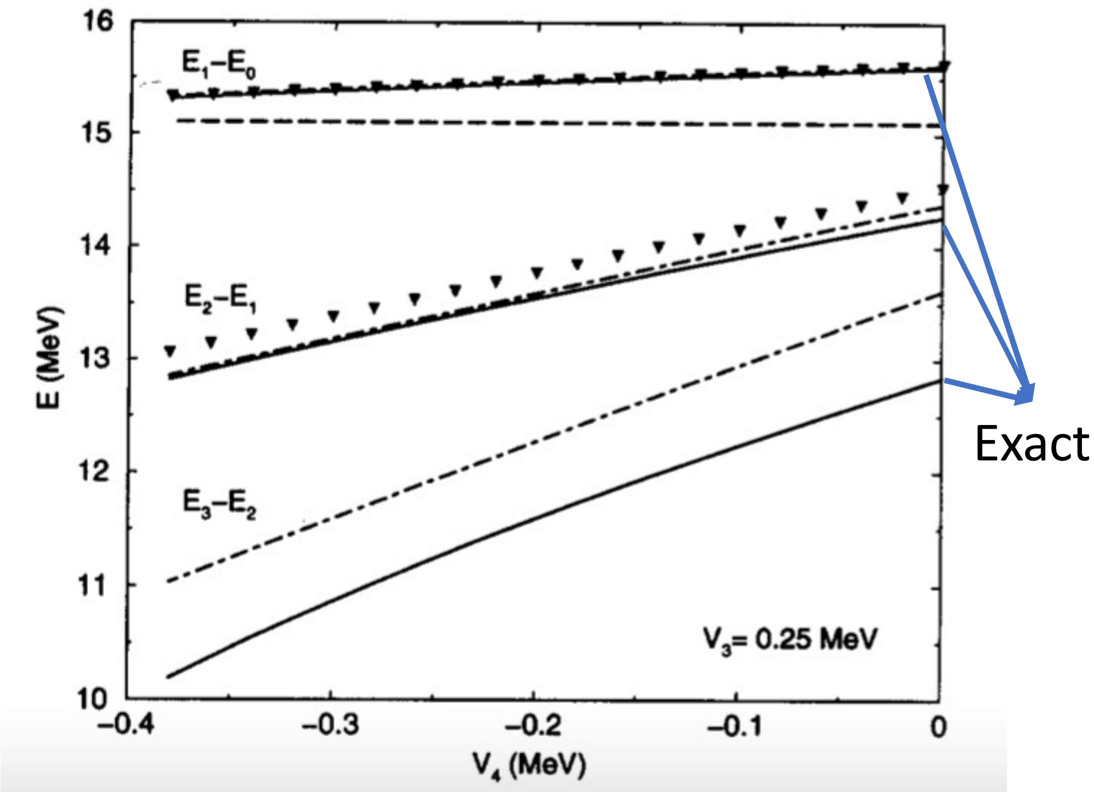
$$W_{\nu\nu'}^{11} = \sum_{php'h'} \left(W_{pp'}\delta_{hh'} - W_{hh'}\delta_{pp'}\right)\left(X_{ph}^{\nu^*} X_{p'h'}^{\nu'} + Y_{ph}^{\nu^*} Y_{p'h'}^{\nu'}\right) ,$$

$$W_{\nu\nu'}^{20} = \sum_{php'h'} \left(W_{pp'}\delta_{hh'} - W_{h'h}\delta_{pp'}\right) X_{ph}^{\nu^*} Y_{p'h'}^{\nu'^*}$$

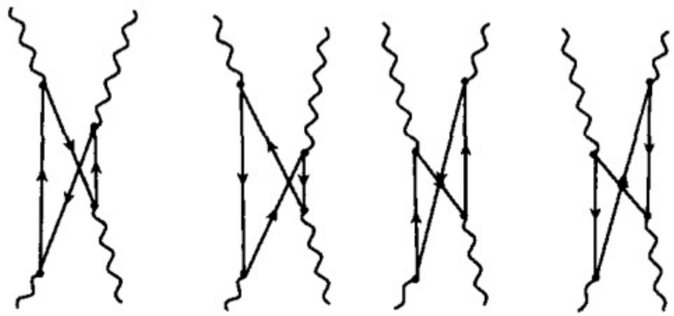


X
Y
X
Y

Check boson expansion in the two-level model



Nuclear Field Theory, butterfly diagrams: same results for two-phonon states



G.F. Bertsch, P.F. Bortignon and K. Hagino, NPA657 (1999) 59

$$H_{\mathrm{A}} = H_{\mathrm{A}}^{0} + \sum_{\alpha\alpha'} \langle \alpha | U_{\mathrm{B}}(\boldsymbol{R}(t)) | \alpha' \rangle a_{\alpha}^{\dagger} a_{\alpha'} = H_{\mathrm{A}}^{0} + W_{\mathrm{A}}(t) ,$$

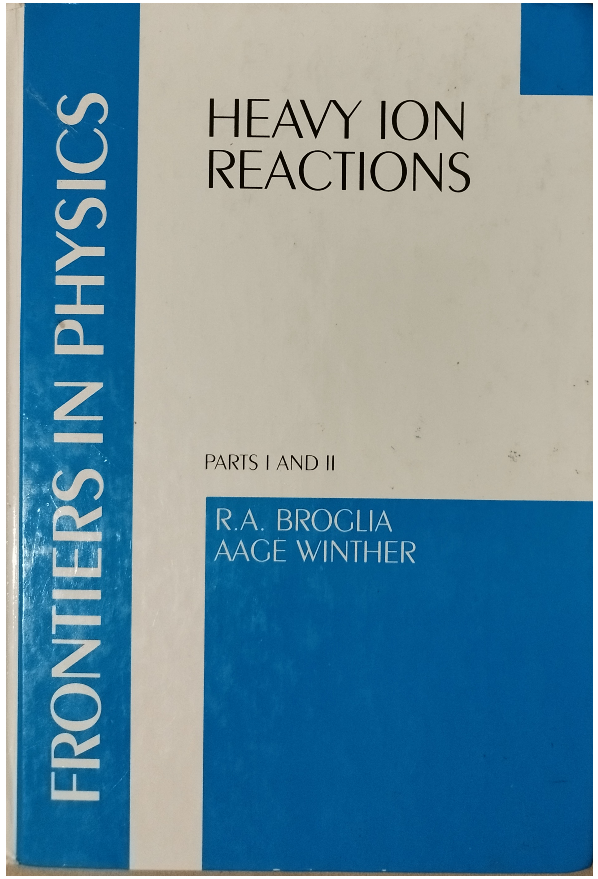
$$|\Phi_{\alpha}\rangle = \sum_{\nu} c_{\nu}^{\alpha} |\nu\rangle + \sum_{\nu_1\nu_2} d_{\nu_1\nu_2}^{\alpha} |\nu_1\nu_2\rangle .$$

$$|\Psi(t)\rangle = \sum_{\alpha} A_{\alpha}(t)\, e^{-iE_{\alpha}t}\, |\Phi_{\alpha}\rangle ,$$

$$\dot{A}_{\alpha}(t) = -i \sum_{\alpha'} e^{i(E_{\alpha}-E_{\alpha'})t} \langle \Phi_{\alpha} | W(t) | \Phi_{\alpha'} \rangle A_{\alpha'}(t)$$

$$P_{\alpha} = |A_{\alpha}(t = +\infty)|^{2}$$

$$\sigma_{\alpha} = 2\pi \int_{0}^{+\infty} P_{\alpha}(b) T(b)\, b\, db ,$$

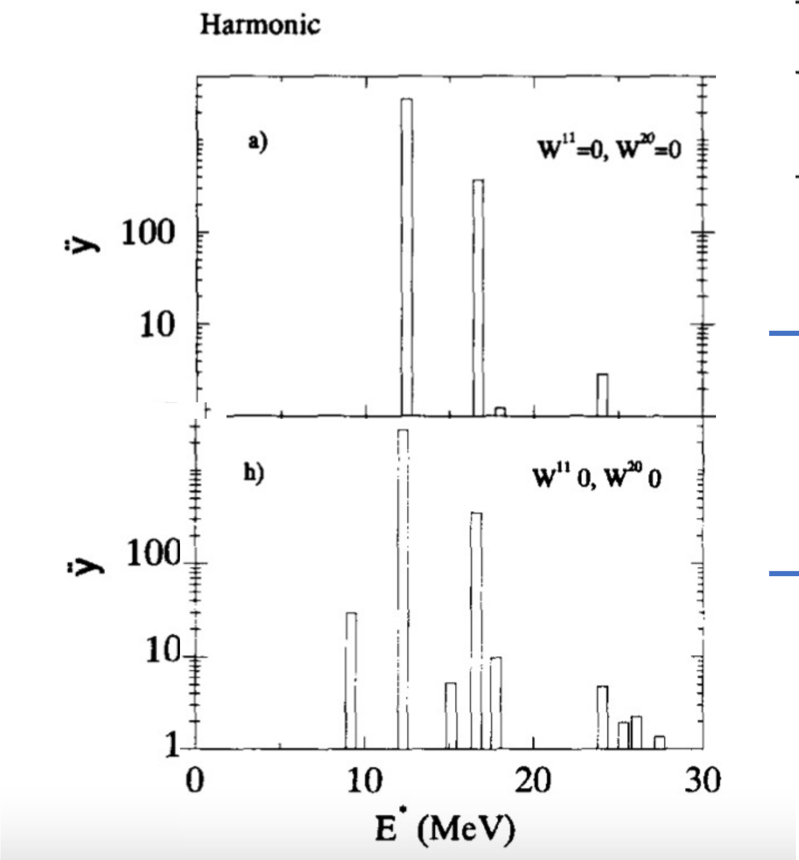


$^{208}Pb + ^{208}Pb$ L=1

Elab= 641MeV/A

States	J^π	harm. & lin.	W^{11}	W^{20}	anharm.	anharm. & nonlin.
$2^+ \otimes 3^-$	1^-	0.03	0.04	6.21	2.60	29.53
ISGQR $\otimes 3^-$	1^-	0.05	0.07	7.22	3.63	5.18
$22 < E < 28$ (MeV)	1^-	3.55	5.95	5.07	6.42	12.18
$2^+ \otimes$ GDR$_1$	1^-	1.24	2.07	0.99	7.64	9.83
ISGQR	2^+	298.91	332.56	300.09	278.35	314.18

	GDR	DGDR	DGDR energy region
σ_{th}	3.13 (3.14)	0.21 (0.22)	0.31 (0.28)
σ_{exp}	3.28 ± 0.05	0.38 ± 0.04	0.38 ± 0.04



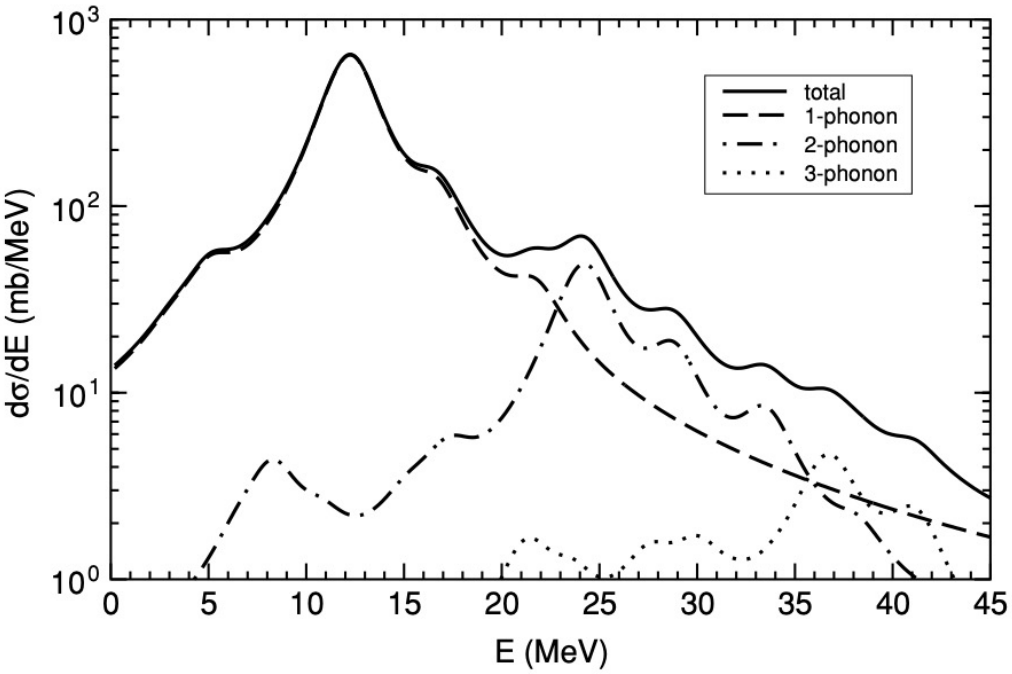
Harmonic

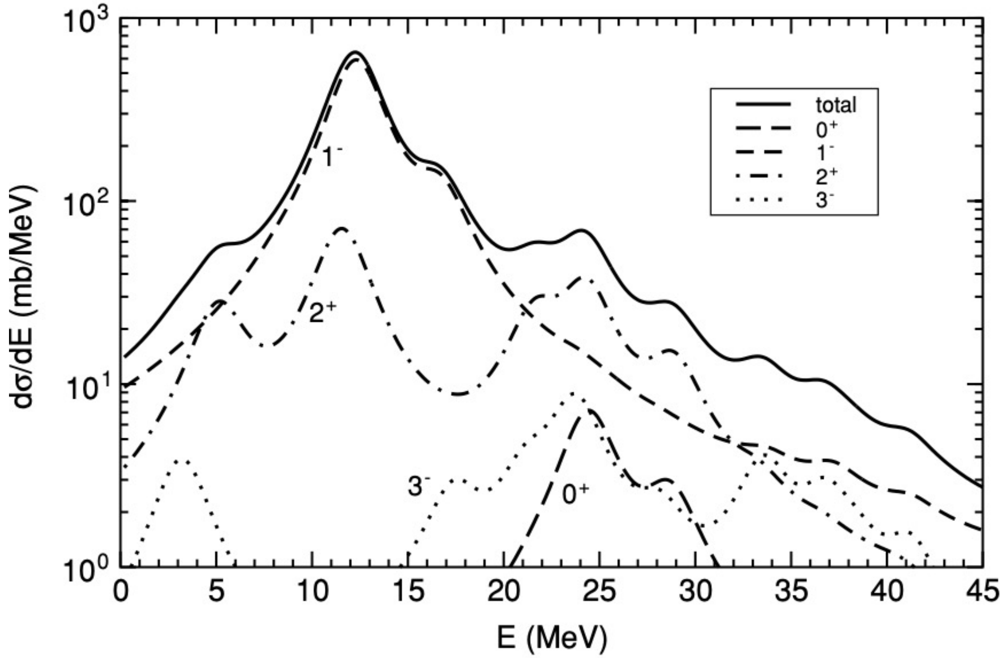
Anharmonic + Nonlinear

$^{208}Pb+^{208}Pb$ L=1

Elab= 641MeV/A

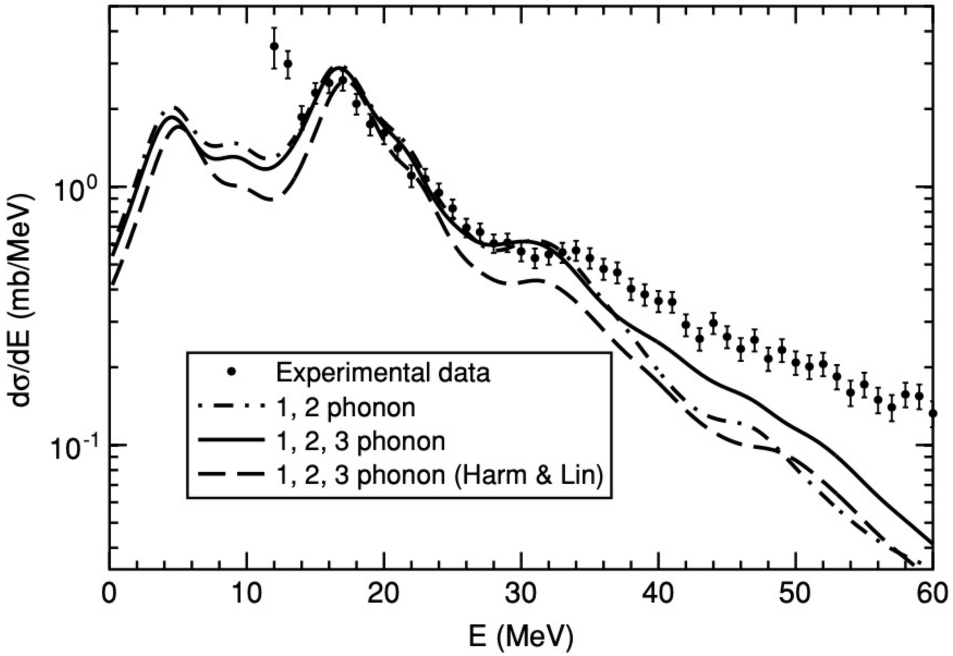
Calculation extended to three phonon states

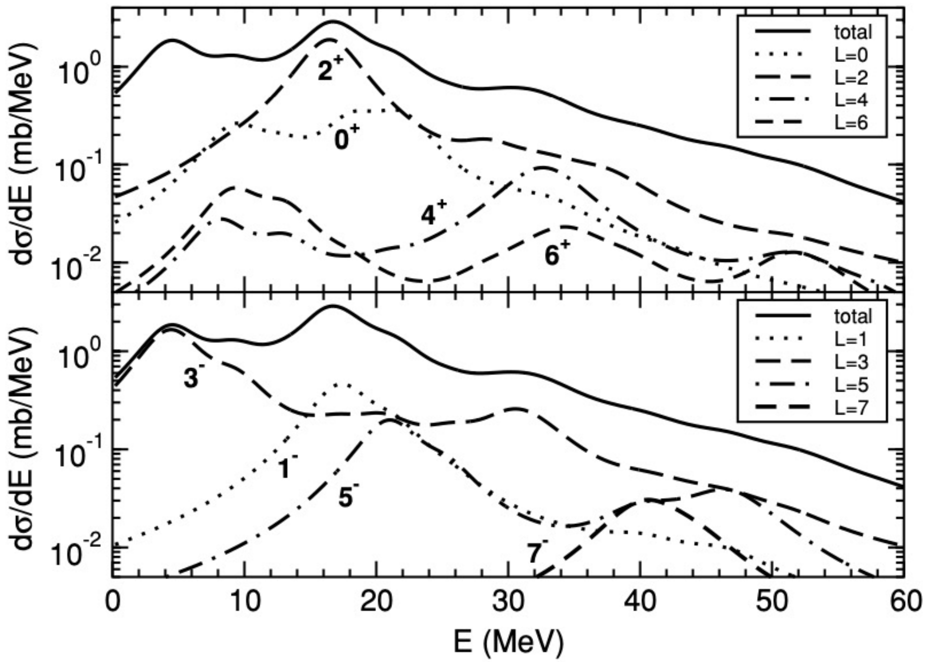


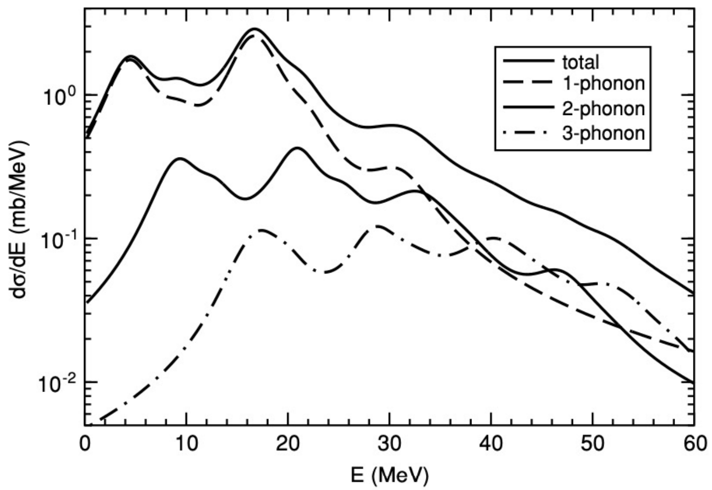


PRC 74 (2006) 064614

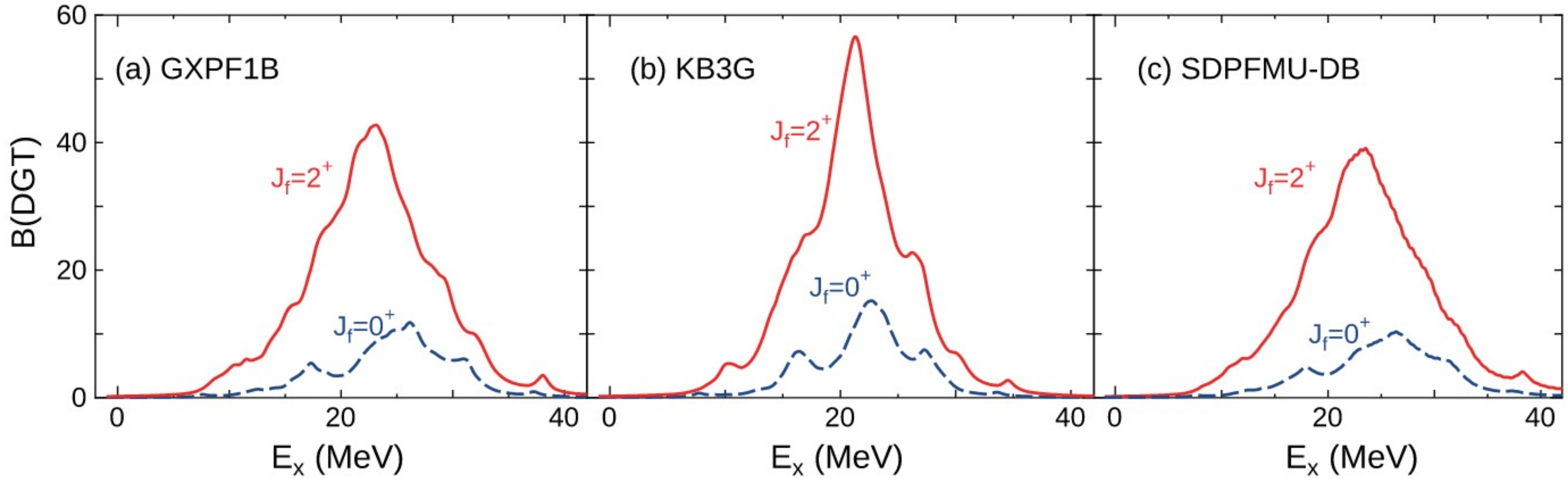
$^{40}Ca+^{40}Ca$ 50 MeV/A







The search for double giant modes is not so active anymore.
With the exception of the double Gamow-Teller resonance



N. Shimizu, J. Menendez and K. Yako, PRL 120 (2018) 142502

ELSEVIER

Nuclear Physics A 614 (1997) 86–94

NUCLEAR PHYSICS A

Collective transition densities in neutron-rich nuclei

F. Catara [a], E.G. Lanza [a], M.A. Nagarajan [b], A. Vitturi [c]

ELSEVIER

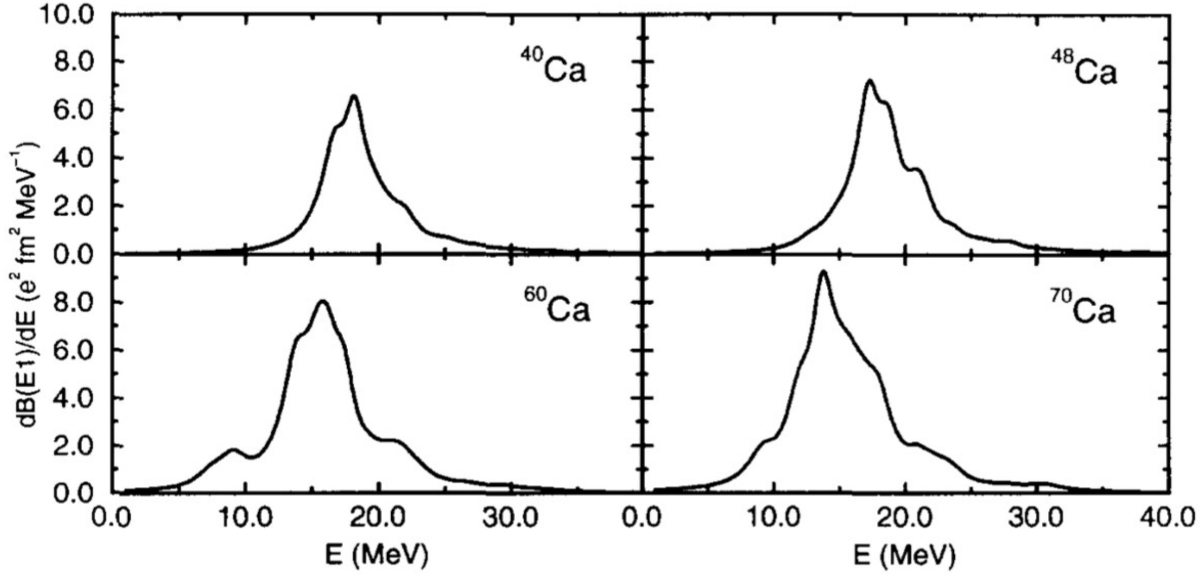
Nuclear Physics A 624 (1997) 449–458

NUCLEAR PHYSICS A

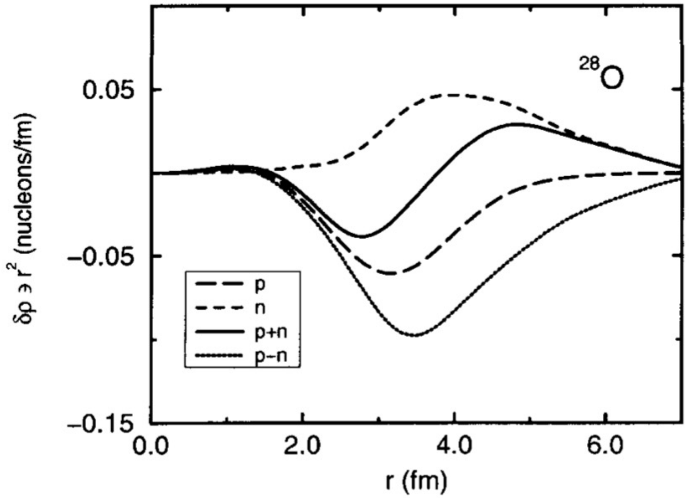
Effect of large neutron excess on the dipole response in the region of the giant dipole resonance

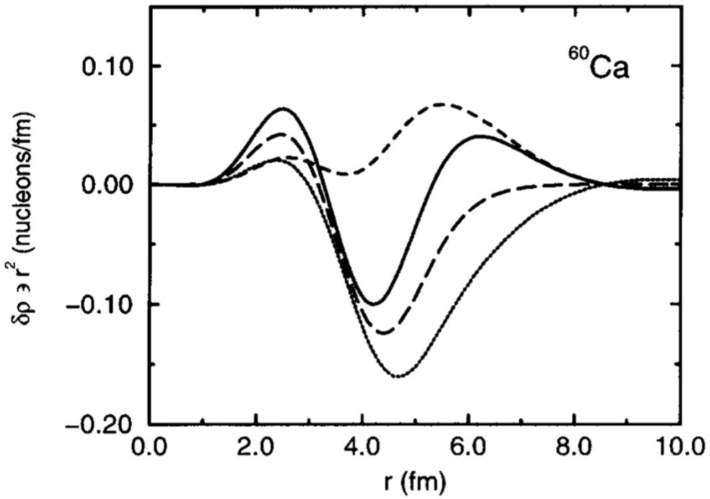
F. Catara [a,d], E.G. Lanza [a], M.A. Nagarajan [b,1], A. Vitturi [c]

Width of dipole reponse increases going neutron-rich

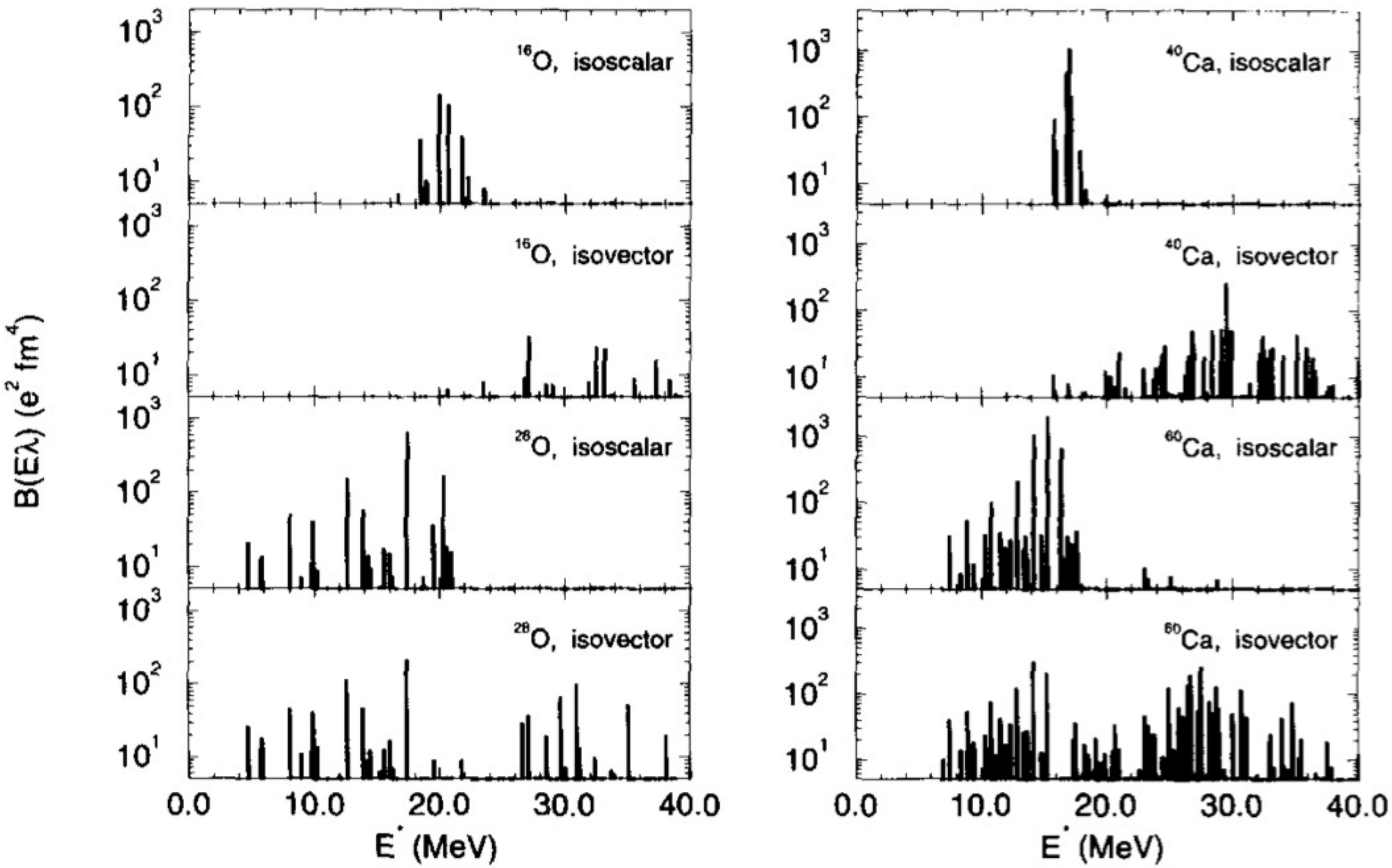


Neutron dominance at large r





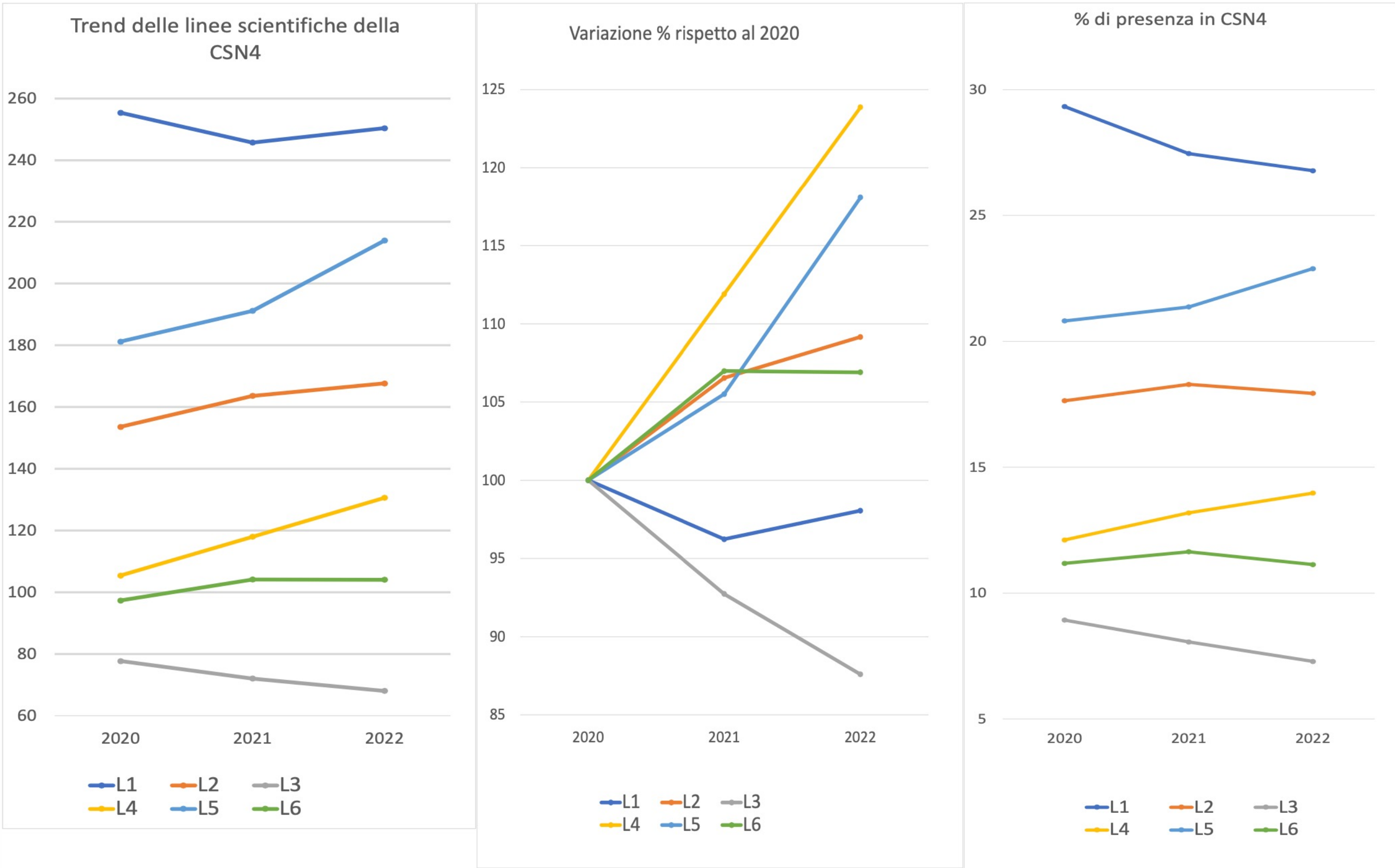
Modifications of the isoscalar and isovector quadrupole response going neutron-rich



Transition densities are very sensitive to neutron skin
They indicate collective in-phase oscillations of neutrons and protons

The effect of the neutron skin is expected to become apparent in nuclear excitation where the details of the transition densities near the nuclear surface will be effective. The detailed study of Coulomb and nuclear inelastic excitation of the neutron-rich nuclei is therefore of interest and should be pursued in the future.

Linee di tendenza delle 6 linee della CSN4



WHAT NEXT?


PROMOCIÓN 2015/2019
UNIVERSIDAD DE SEVILLA
7 de Junio de 2019


CATANIA

May you drink
Very good wine
For many many years

Thanks to:
Maria Victoria Andrés
Francesco Catara
Maria Colonna
Danilo Gambacurta
Antonio Lanza
Andrea Rapisarda
Michelangelo Sambataro
Andrea Vitturi