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Calcoli *ab initio* in nuclei medio-pesanti

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Lecce

CBF FHNC–SOC

$$H = \sum_i \frac{-\hbar^2}{2\, m_i} \nabla_i^2 + \sum_{i<j} v_{ij} + \sum_{i<j<k} v_{ijk}$$

$$\boxed{\delta E[\Psi_0] = \delta \frac{\langle \Psi_0 | H | \Psi_0 \rangle}{\langle \Psi_0 | \Psi_0 \rangle} = 0}$$

$$\Psi_0(1, 2 ... A) = G(1, 2 ... A) \Phi_0(1, 2 ... A)$$

$$G(1, 2 ... A) = \prod_{i<j} F_{ij}$$

$$F_{ij} = \sum_{p=1,8} f^p(r_{ij}) O_{ij}^p$$

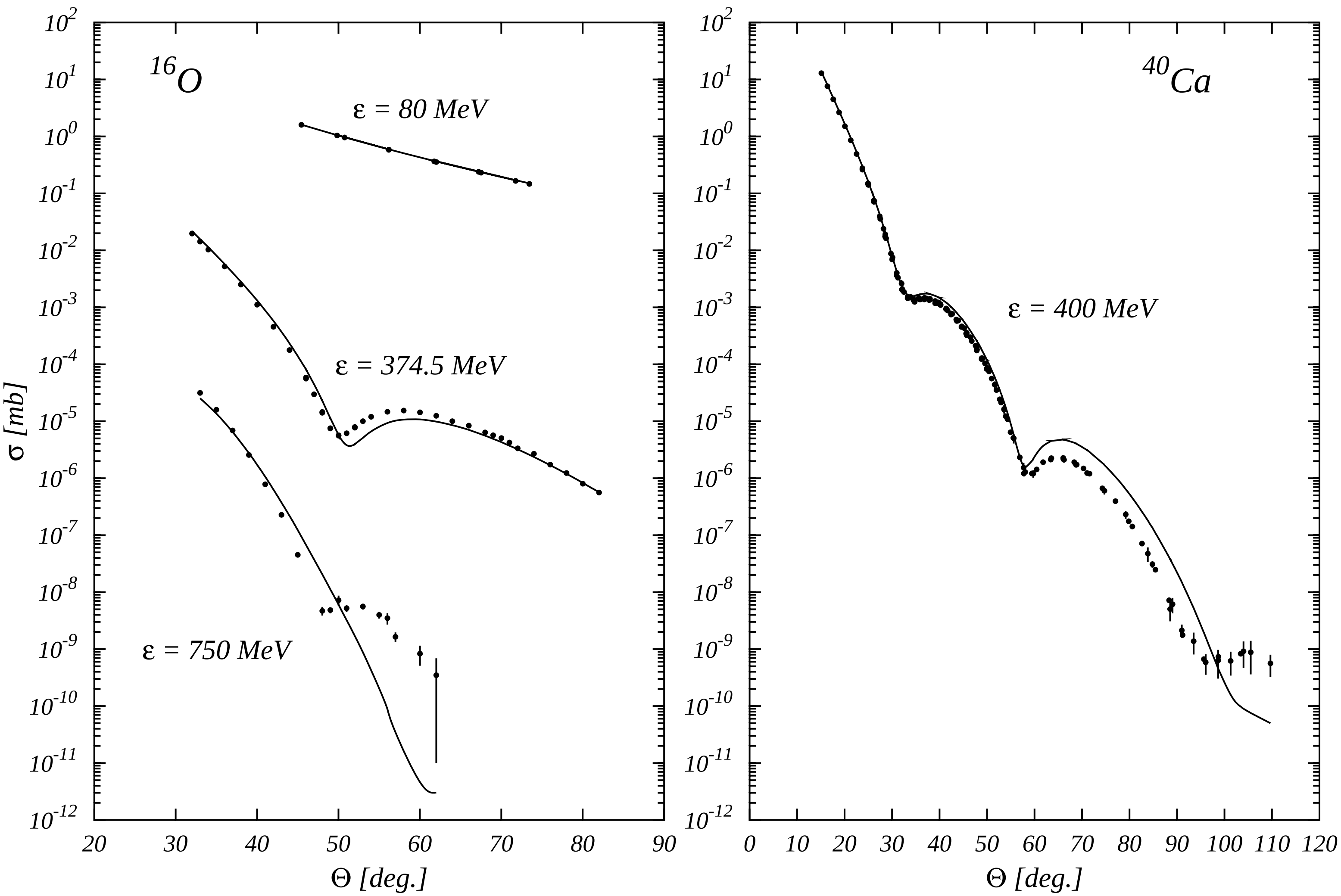
$$O_{ij}^{p=1,8} = [1, \boldsymbol{\sigma}_i \cdot \boldsymbol{\sigma}_j, S_{ij}, (\mathbf{L} \cdot \mathbf{S})_{ij}] \otimes [1, \boldsymbol{\tau}_i \cdot \boldsymbol{\tau}_j]$$

A. Fabrocini, F. Arias de Saavedra and G. C.

Phys. Rev. C **61** (2000) 044302.

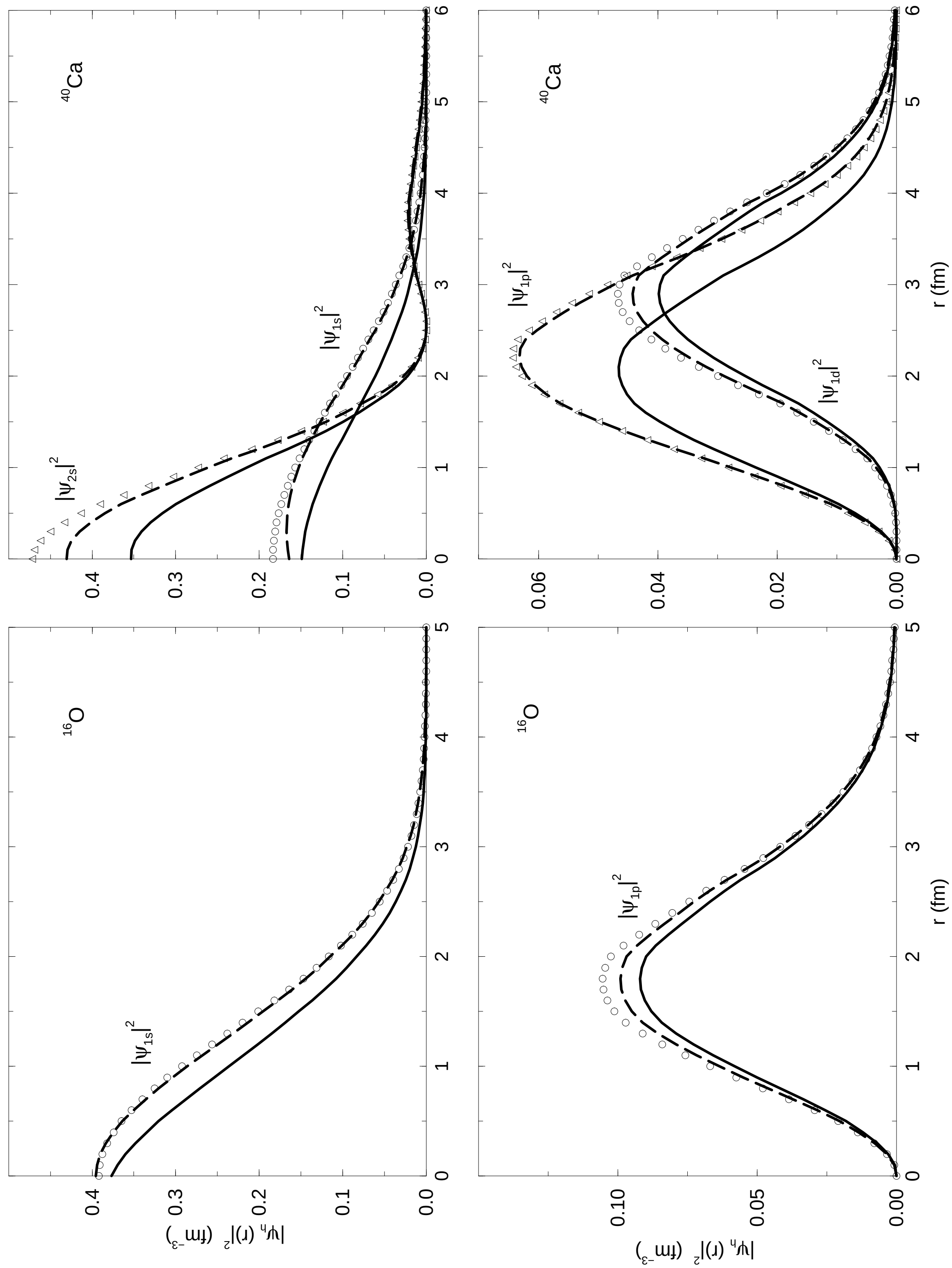
E/A (MeV)	^{16}O	^{40}Ca	n.m.
Exp	-7.97	-8.55	-16.0
A14	-5.11	-6.50	
A8’	-5.48	-6.97	-10.9
A8’*	-5.41	-6.64	

	V [MeV]	R [fm]	a [fm]
^{16}O			
A14	-36.0	3.80	0.55
A8’	-42.0	3.60	0.55
A8’*	-53.0	3.45	0.70
^{40}Ca			
A14	-41.5	5.00	0.55
A8’	-50.0	5.30	0.53
A8’*	-50.0	4.60	0.50



^{16}O
ε = 80 MeV
ε = 374.5 MeV
ε = 750 MeV
σ [mb]
Θ [deg.]
^{40}Ca
ε = 400 MeV
Θ [deg.]

A. Fabrocini and G. C. in preparation.



^{16}O	J	f_4	f_6
$1s$	1.00	0.79	0.70
$1p$	0.98	0.96	0.90

^{40}Ca	J	f_4	f_6
$1s$	0.98	0.71	0.55
$1p$	0.99	0.76	0.58
$1d$	0.97	0.96	0.87
$2s$	0.98	0.97	0.86

Sezioni d'urto

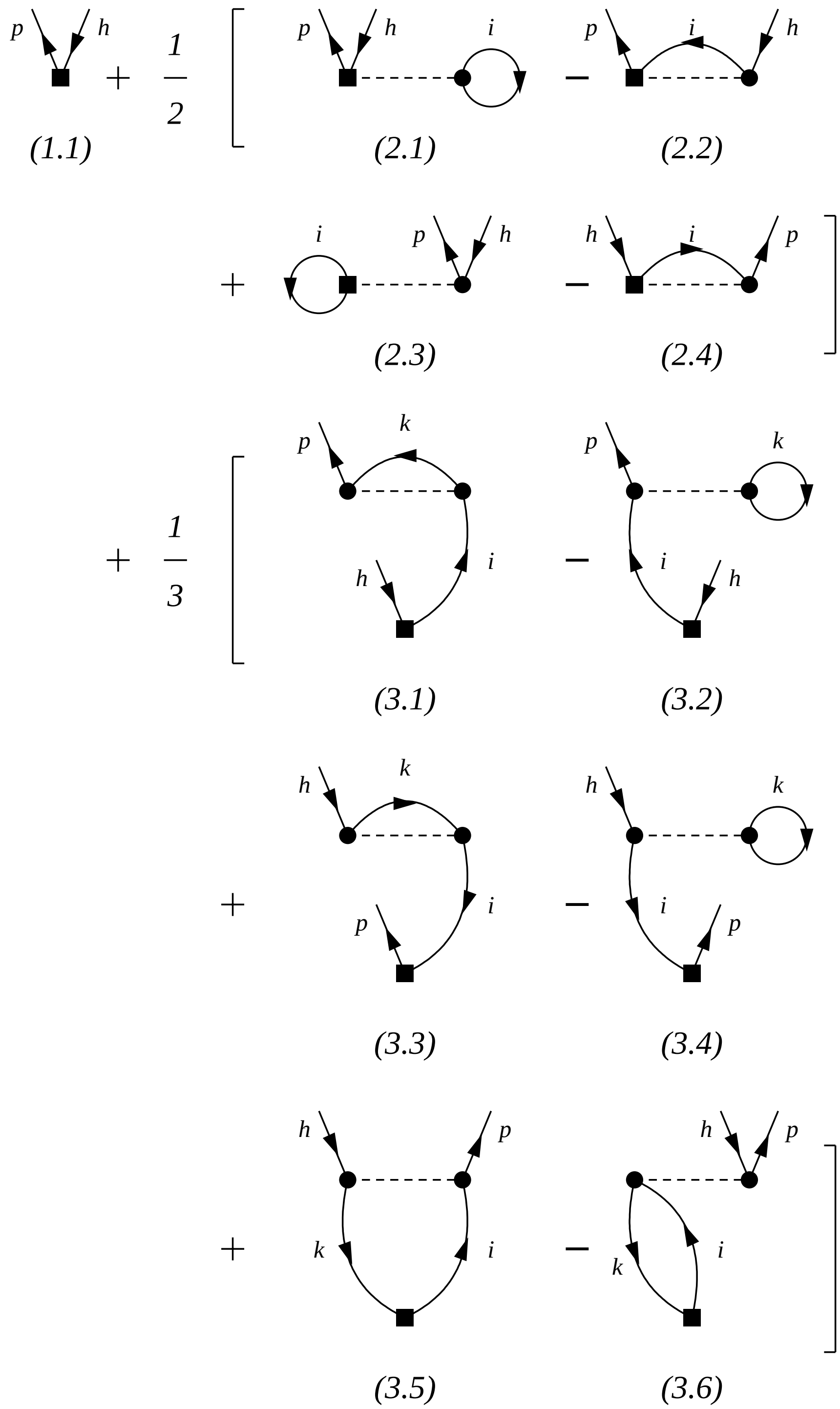
$$\sigma(\mathbf{q},\omega) \simeq |\langle \widetilde{\Psi}_n \,|\, O(\mathbf{q}) \,|\, \widetilde{\Psi}_0 \rangle|^2 \delta(E_n - E_0 - \omega)$$
$$\equiv \xi_n^\dagger(\mathbf{q}) \xi_n(\mathbf{q})\, \delta(E_n - E_0 - \omega)$$

$$| \widetilde{\Psi}_n \rangle = \frac{|\Psi_n\rangle}{\langle \Psi_n | \Psi_n \rangle^{\frac{1}{2}}}$$

$$\xi_n(\mathbf{q}) = \frac{\langle \Psi_n |\, O(\mathbf{q}) \,| \Psi_0 \rangle}{\langle \Psi_n | \Psi_n \rangle^{\frac{1}{2}} \, \langle \Psi_0 | \Psi_0 \rangle^{\frac{1}{2}}}$$

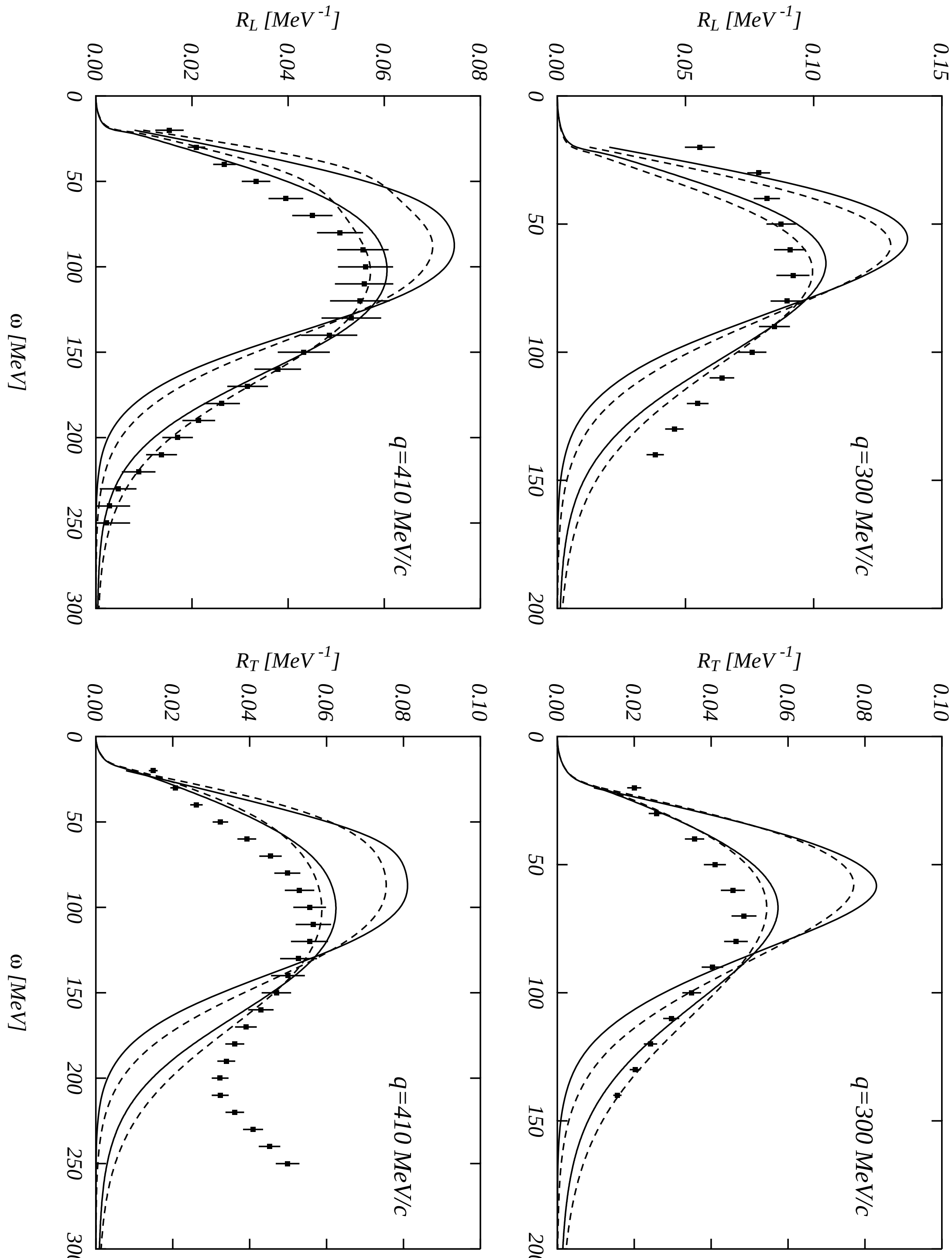
$$|\Psi_0\rangle = G\,|\Phi_0\rangle \; ; \; |\Psi_n\rangle = G\,|\Phi_n\rangle$$

$$\xi_n(\mathbf{q}) = \frac{\langle \Phi_n |\, G^+ \, O(\mathbf{q}) \, G | \Phi_0 \rangle}{\langle \Phi_0 |\, G^+ \, G \,| \Phi_0 \rangle} \left[\frac{\langle \Phi_0 |\, G^+ \, G \,| \Phi_0 \rangle}{\langle \Phi_n |\, G^+ \, G \,| \Phi_n \rangle} \right]^{\frac{1}{2}}$$

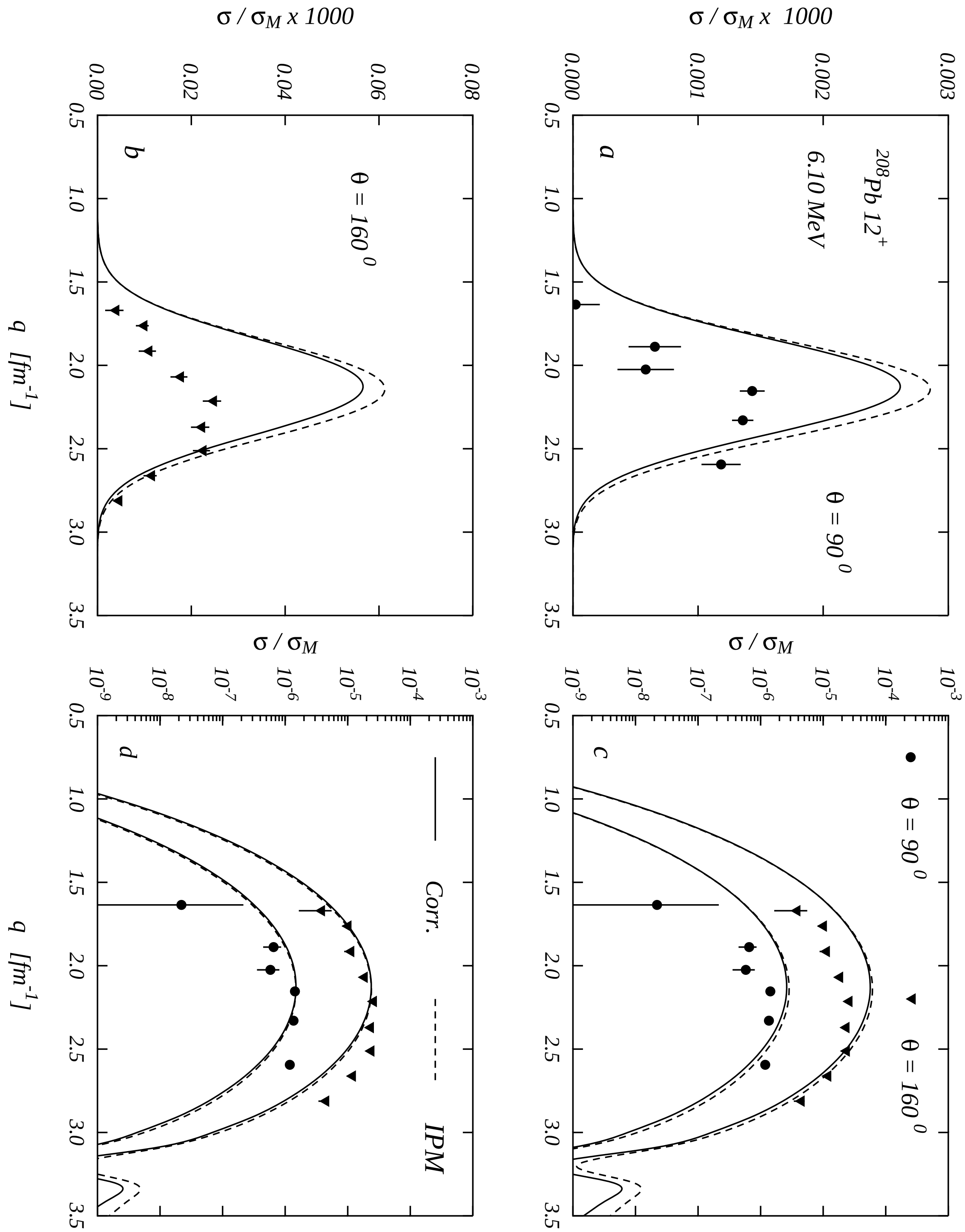


(1.1)
(2.1)
(2.2)
(2.3)
(2.4)
(3.1)
(3.2)
(3.3)
(3.4)
(3.5)
(3.6)

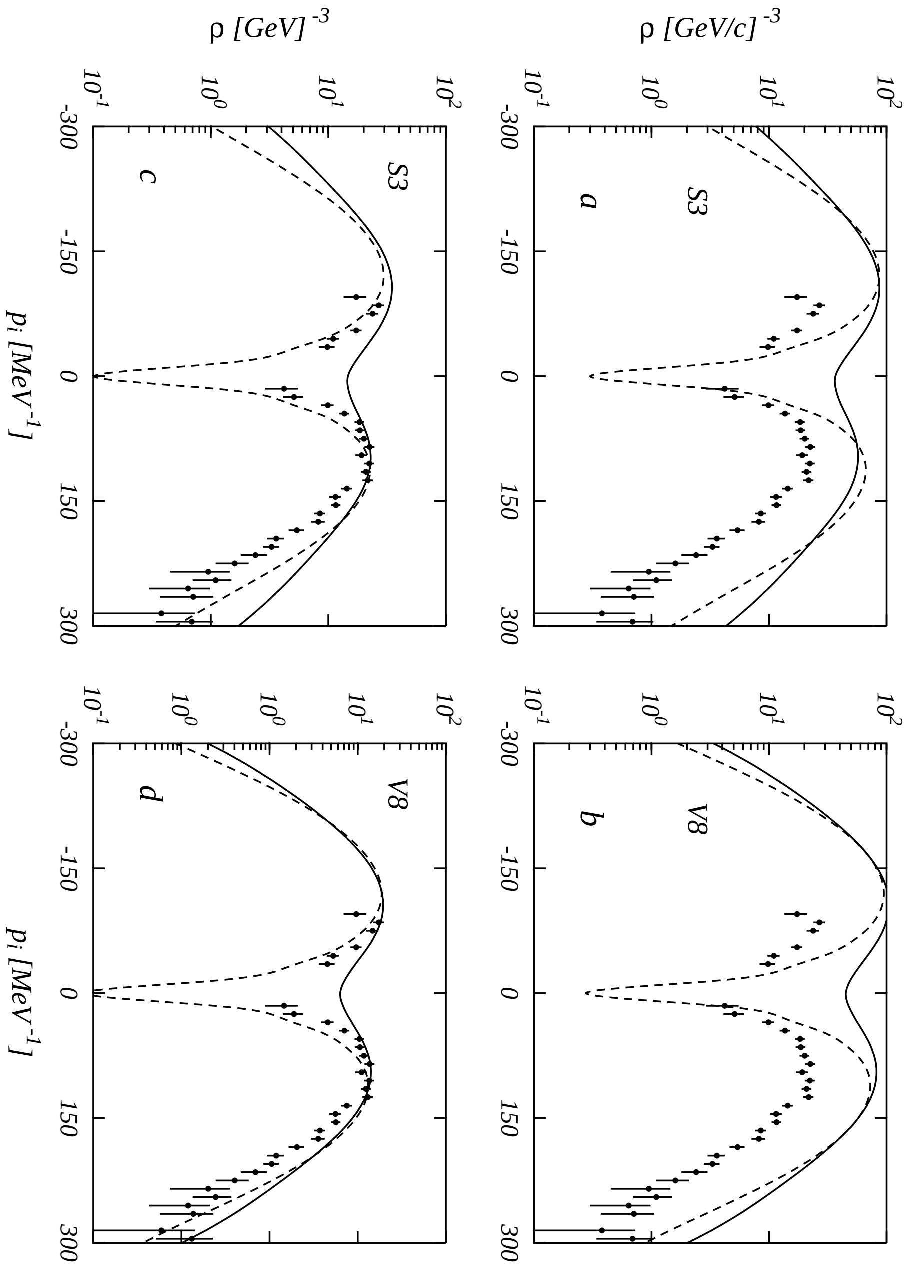
G. C. and A.M. Lallena, to be published in Ann. Phys.

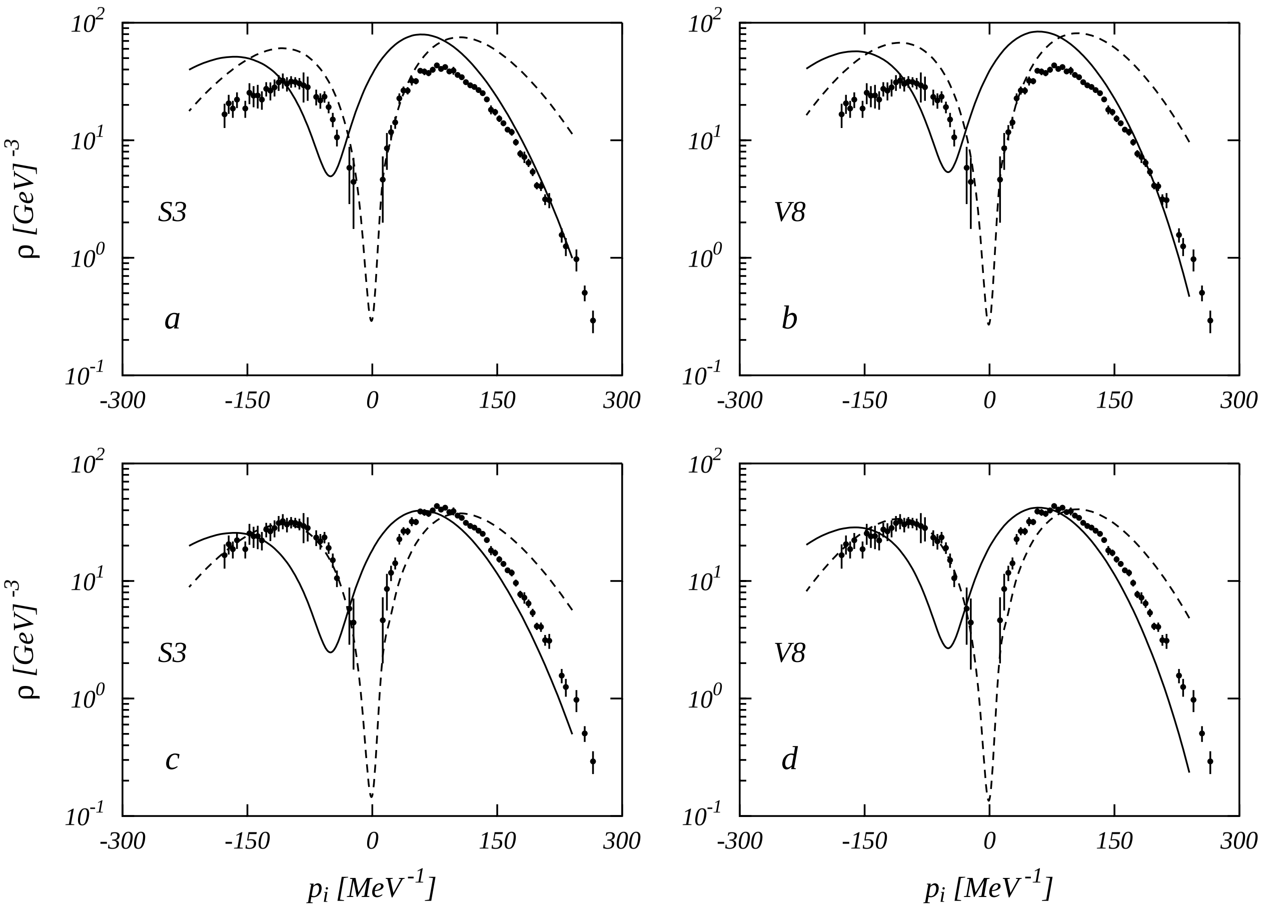


S.R. Mokhtar, G. C. and A.M. Lallena, to be published in Phys. Rev. C



S.R. Mokhtar, G. C. and A.M. Lallena, in preparation





ρ [GeV]^-3
S3
a
V8
b
S3
c
V8
d
10^2
10^1
10^0
10^-1
-300
-150
0
150
300
p_i [MeV^-1]

Conclusioni

❶ Fattibilità di calcoli *ab initio* per nuclei medio-pesanti.

❷ Minimo del funzionale $E[\Psi_0]$.

❸ Per il confronto con l'esperimento cosa manca?

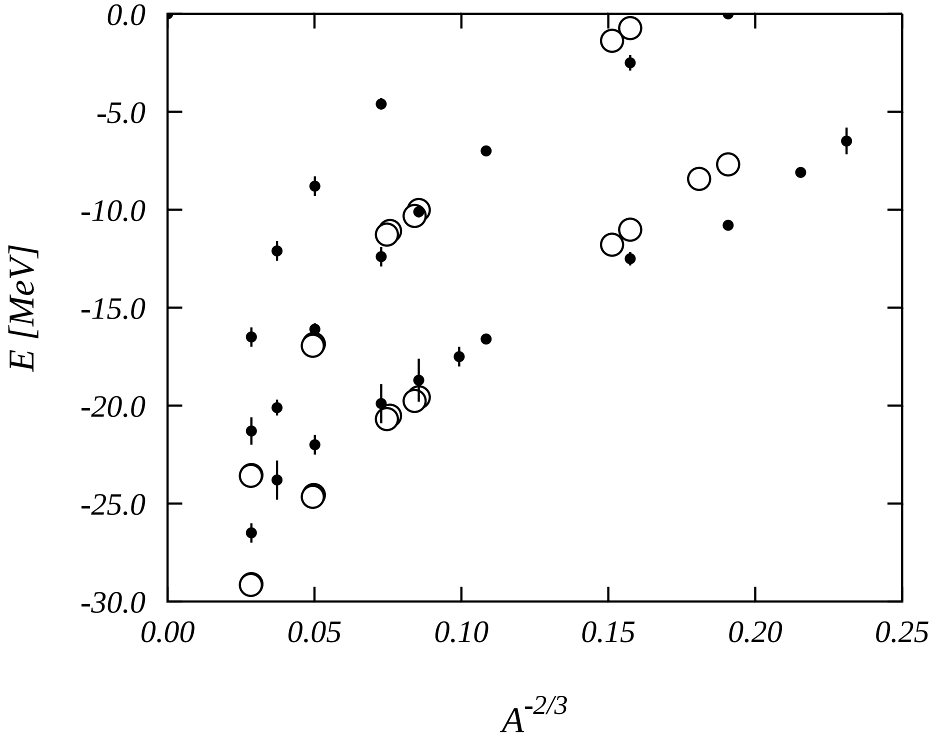
F. Arias de Saavedra, G. C., A. Fabrocini, in preparation

Hypernucleus	B^I_Λ	B^R_Λ	B_Λ
${}^{12}_{\Lambda}$C	-9.54	1.85	-7.69
${}^{13}_{\Lambda}$C	-10.16	1.74	-8.42
${}^{16}_{\Lambda}$O	-12.41	1.39	-11.02
${}^{17}_{\Lambda}$O	-12.89	1.11	-11.78
${}^{40}_{\Lambda}$Ca	-20.76	1.18	-19.58
${}^{41}_{\Lambda}$Ca	-20.84	1.08	-19.76
${}^{48}_{\Lambda}$Ca	-21.90	1.39	-20.51
${}^{49}_{\Lambda}$Ca	-22.01	1.32	-20.69
${}^{90}_{\Lambda}$Zr	-25.88	1.31	-24.57
${}^{91}_{\Lambda}$Zr	-25.93	1.27	-24.66
${}^{208}_{\Lambda}$Pb	-30.72	1.60	-29.12
${}^{209}_{\Lambda}$Pb	-30.74	1.59	-29.15
n.m.	-31.99	1.73	-30.26

Termini di interazione (I) e riarrangemento (R) per l'energia totale della Λ in nello stato S per vari ipernuclei.

Hypernucleus	B^I_Λ	B^R_Λ	B_Λ
$^{16}_{\Lambda}$O	-1.27	0.54	-0.73
$^{17}_{\Lambda}$O	-1.74	0.36	-1.38
$^{40}_{\Lambda}$Ca	-10.73	0.72	-10.01
$^{41}_{\Lambda}$Ca	-10.97	0.65	-10.32
$^{48}_{\Lambda}$Ca	-12.32	1.24	-11.08
$^{49}_{\Lambda}$Ca	-12.45	1.18	-11.27
$^{90}_{\Lambda}$Zr	-18.13	1.28	-16.85
$^{91}_{\Lambda}$Zr	-18.20	1.25	-16.95
$^{208}_{\Lambda}$Pb	-25.28	1.74	-23.54
$^{209}_{\Lambda}$Pb	-25.31	1.73	-23.58

Termini di interazione (I) e riarrangemento (R) per l'energia totale della Λ in nello stato P per vari ipernuclei.



Dati sperimentali da:

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