X Convegno su Problemi di Fisica Nucleare Teorica

Fisica teorica del nucleo e dei sistemi a molticorpi

Cortona 6-9 Ottobre 2004

Nuclear Physics with Electroweak Probes

Giampaolo Co'

Dipartimento di Fisica Università di Lecce

INFN sez. di Lecce

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Fisica Nucleare con Sonde Elettrodeboli

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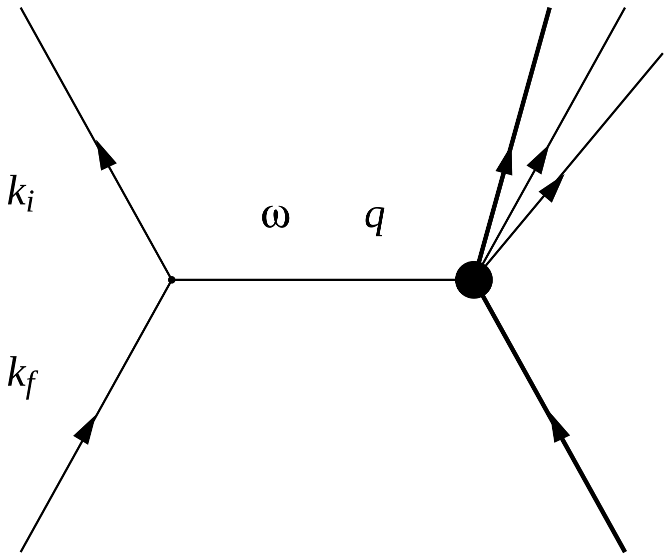
Nuclei con $A > 4$

Pubblicazioni 2002-2004

Sede	Pubblicazioni	Totale autori	Autori PRIN
To	11	45	21
Pv	15	47	32
Tn	4	15	10
Rm-I	3	4	4
Le	6	19	6
Totali	39	130	73

simboli comunemente adottati

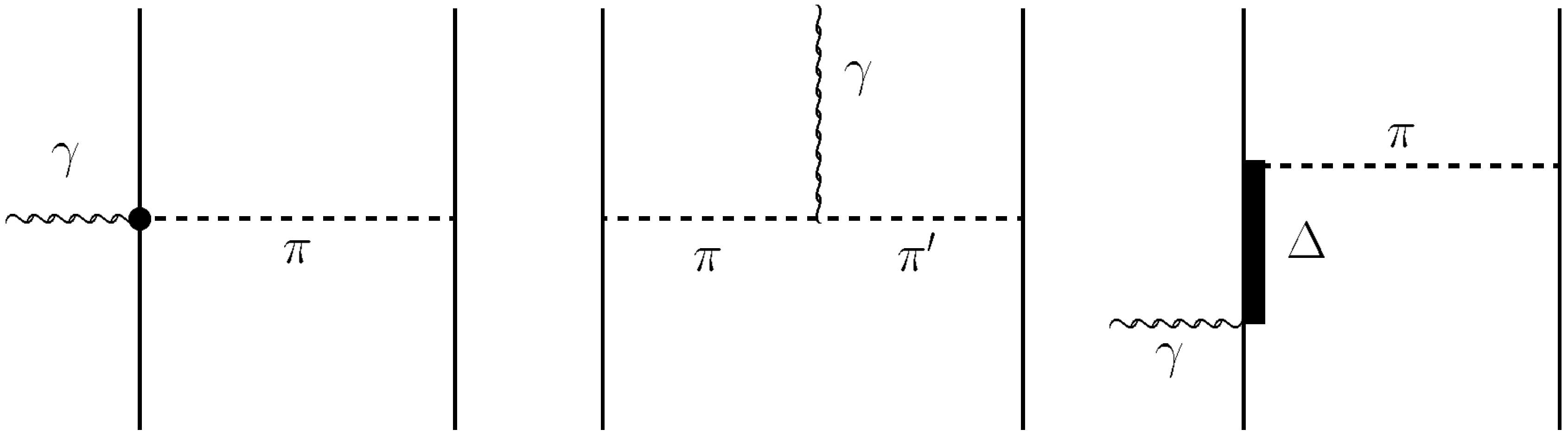
$(\epsilon_{i,f}, \vec{k}_{i,f})$	- quadrimomenti dei leptoni
ω	- energia trasferita
$\vec{q}$	- trimomento trasferito
$(E_{i,f}, \vec{p}_{i,f})$	- quadrimomenti del singolo nucleone
m	- massa del nucleone
M	- massa del nucleo



Correnti

- correnti ad un corpo (carica, convezione, magnetizzazione)

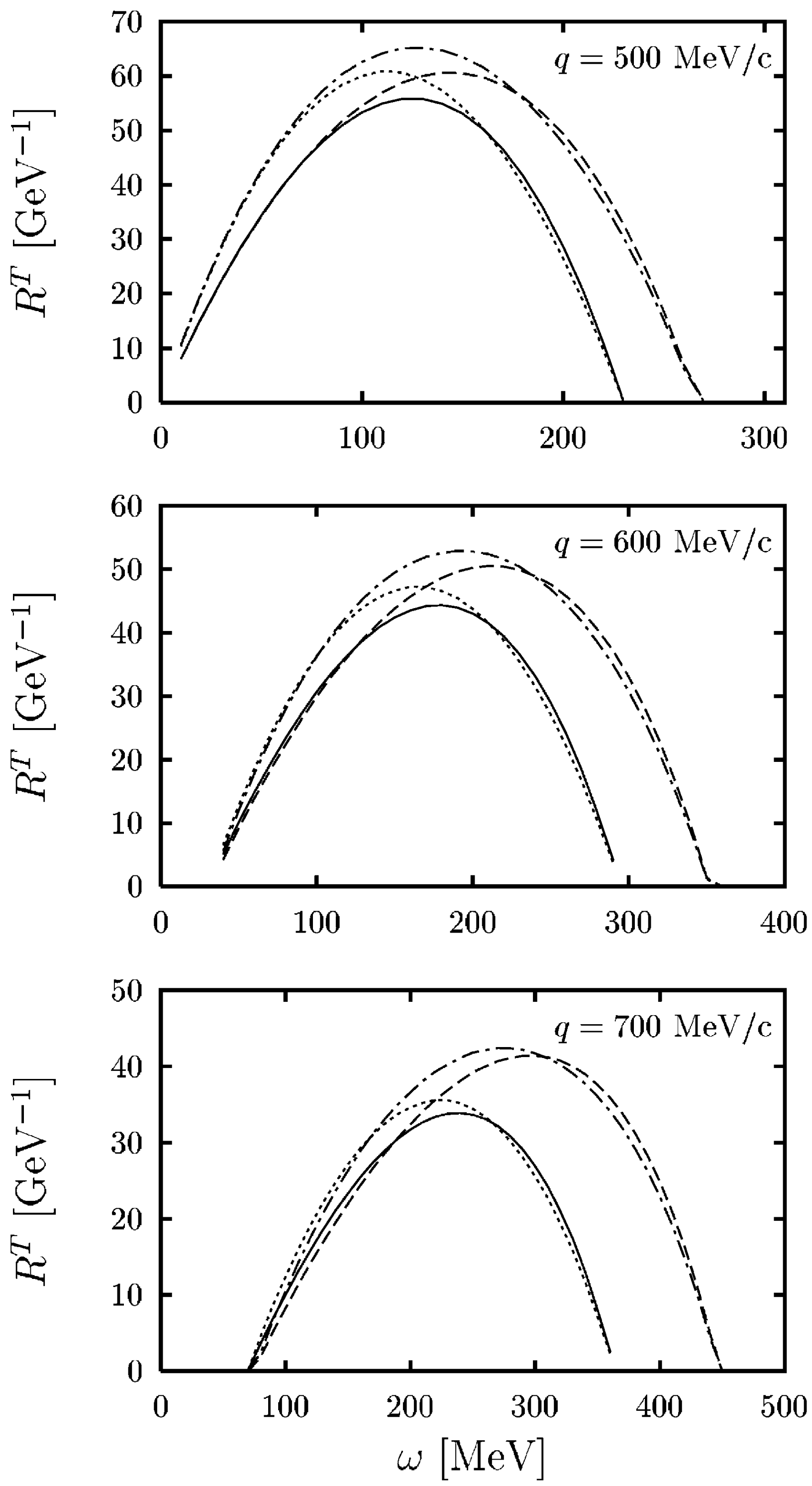
- MEC



(a) (b) (c)

RFG

linee	FG (OB)
continuo	RFG (OB)
linee punti	FG (OB+MEC)
punti	RFG (OB+MEC)



J.E. Amaro, M. Barbaro, J.A. Caballero, T.W. Donnelly, A. Molinari, Phys. Rep. 368 (2002) 317

Relativistic Fermi Gas

Correzioni semi-relativistiche

Cinematica

$$\omega \longrightarrow \omega \left(1 + \frac{\omega}{2m}\right)$$

Correnti

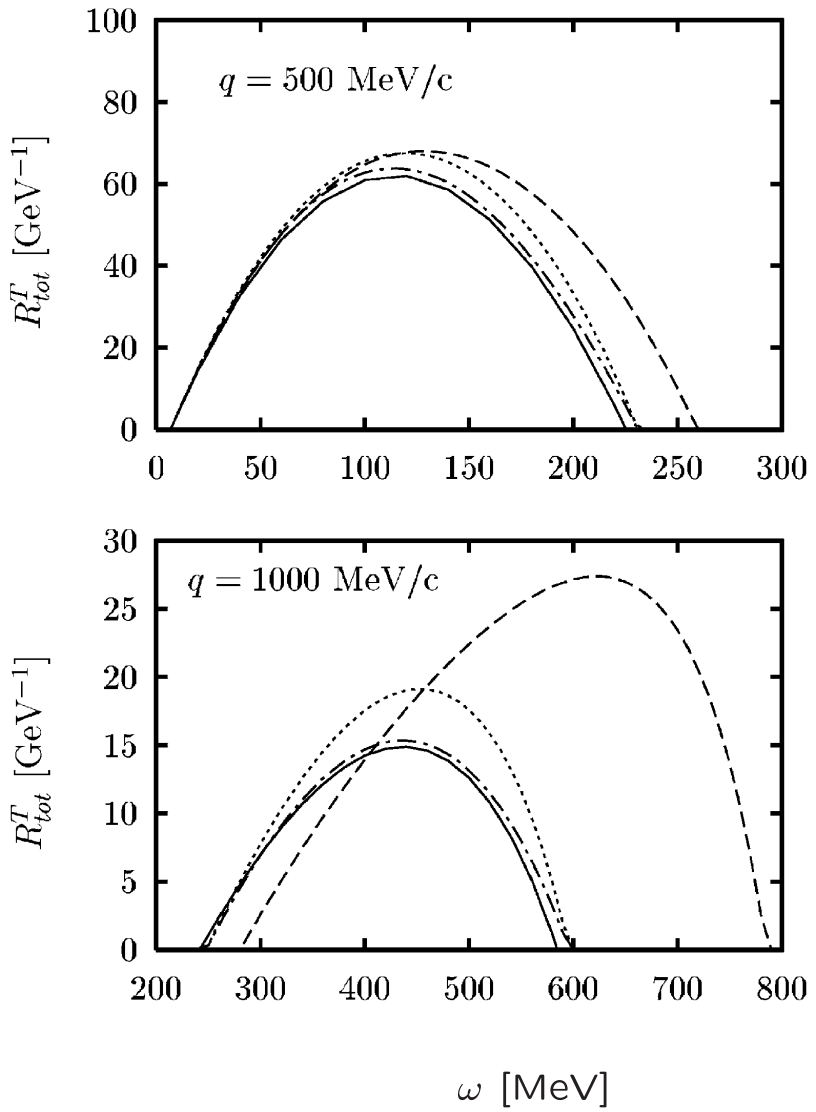
$$R_L(q,\omega) \longrightarrow \frac{q^2}{q^2-\omega^2} R_L(q,\omega)$$

$$R_T(q,\omega) \longrightarrow \frac{q^2-\omega^2}{q^2} R_T(q,\omega)$$

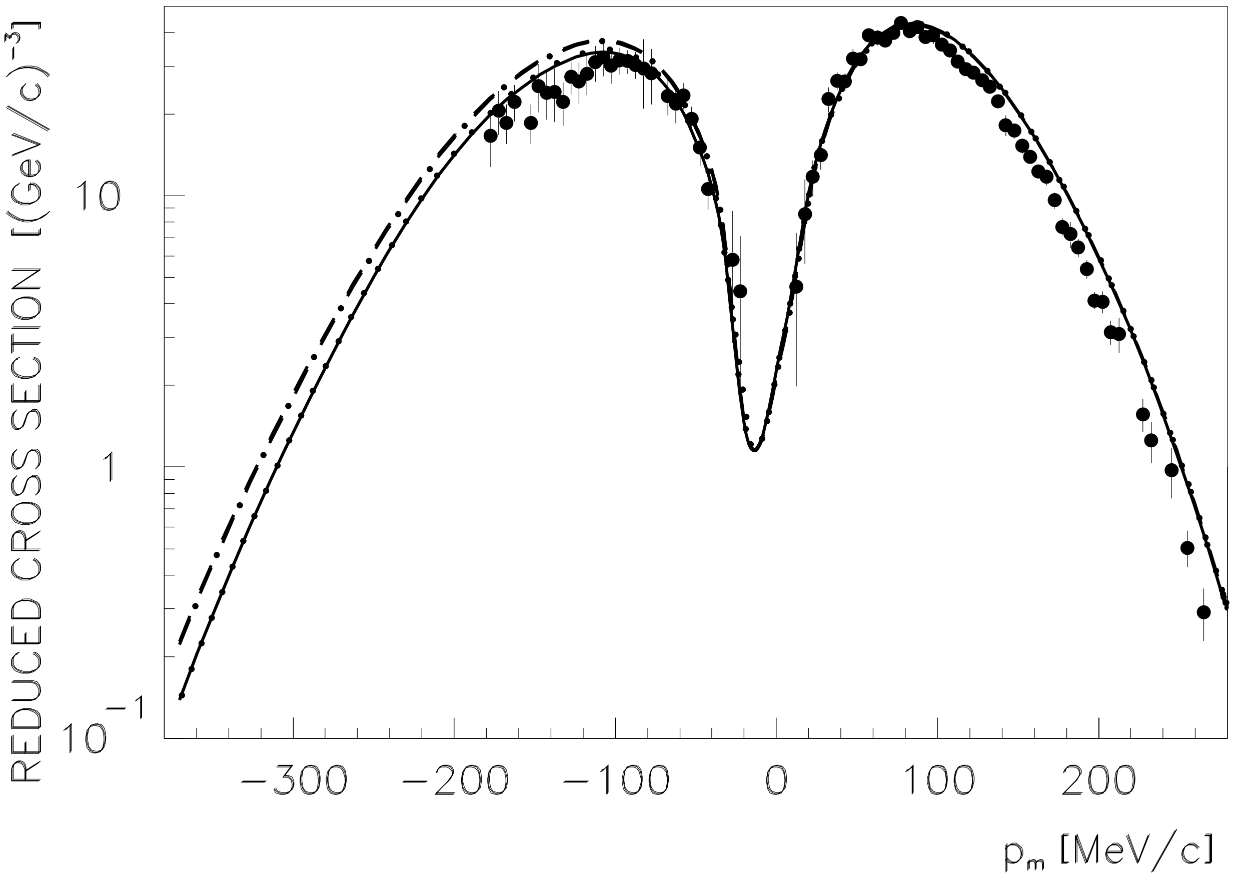
$$J_{MEC}(q) \longrightarrow \frac{2m}{\sqrt{4m^2+q^2-\omega^2}} J_{MEC}(q)$$

RFG

continuo	RFG
linee	FG (OB)
punti	FG + cin
linee punti	FG + cin. + corr.

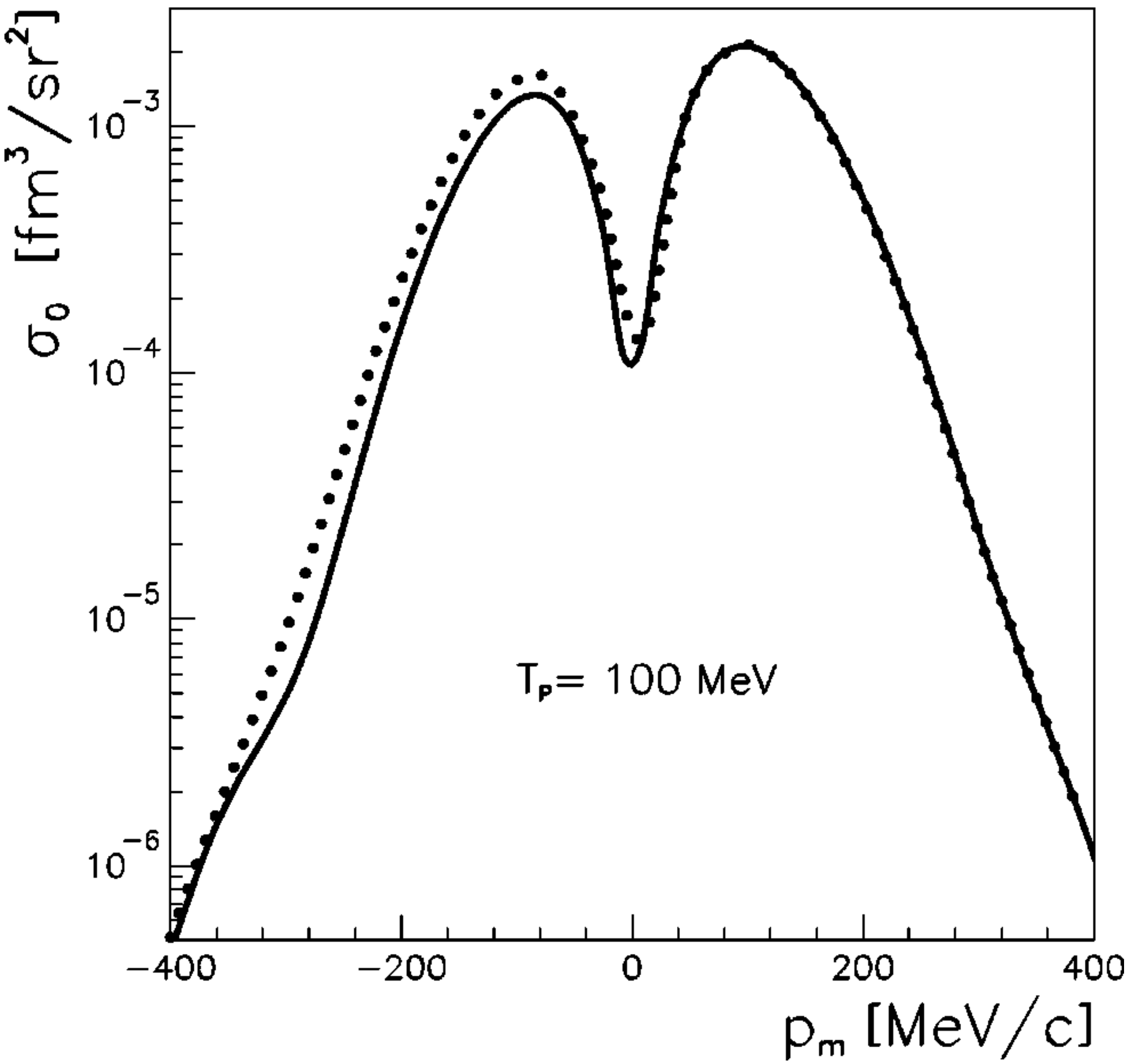


J.E. Amaro, M. Barbaro, J.A. Caballero, T.W. Donnelly, A. Molinari, Phys. Rep. 368 (2002) 317

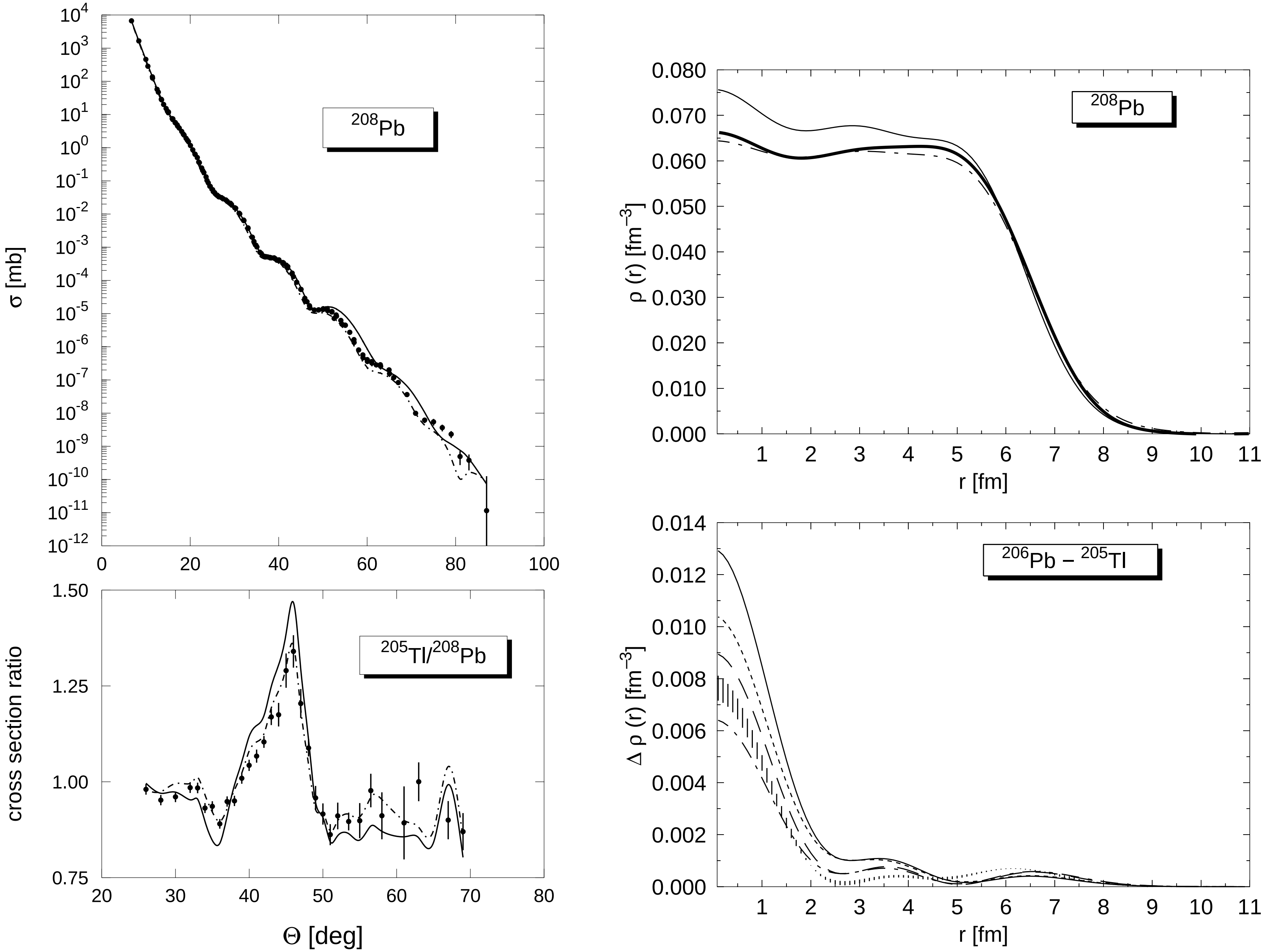


C. Giusti, F.D. Pacati, Phys. Rev. C 67 (2003) 044601

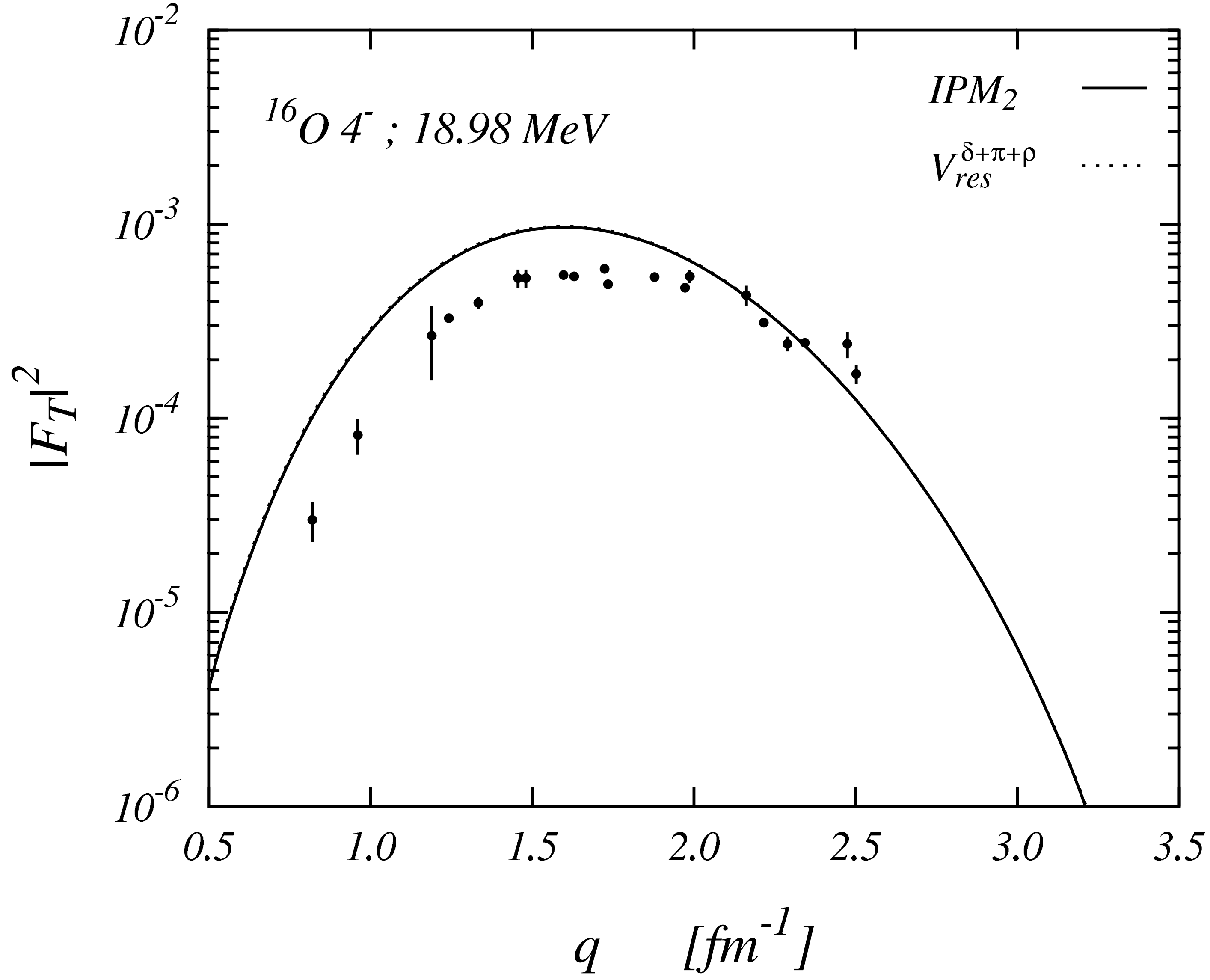
$^{16}O(e,e'p)^{15}N$



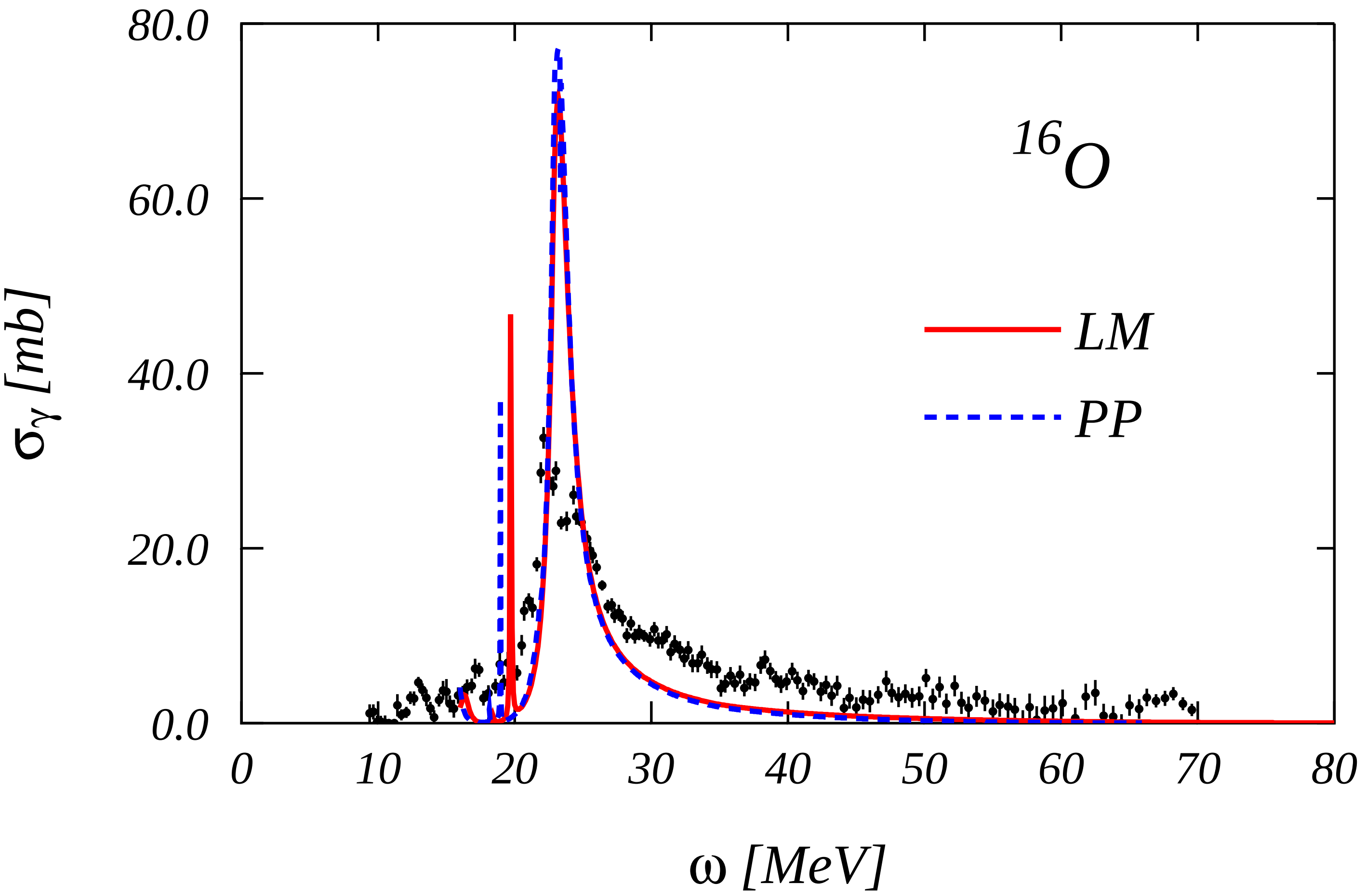
A. Meucci, C. Giusti, F.D. Pacati, Phys. Rev. C 64 (2001) 014604



M. Anguiano, G. Co', J. Phys. G 27 (2001) 2109

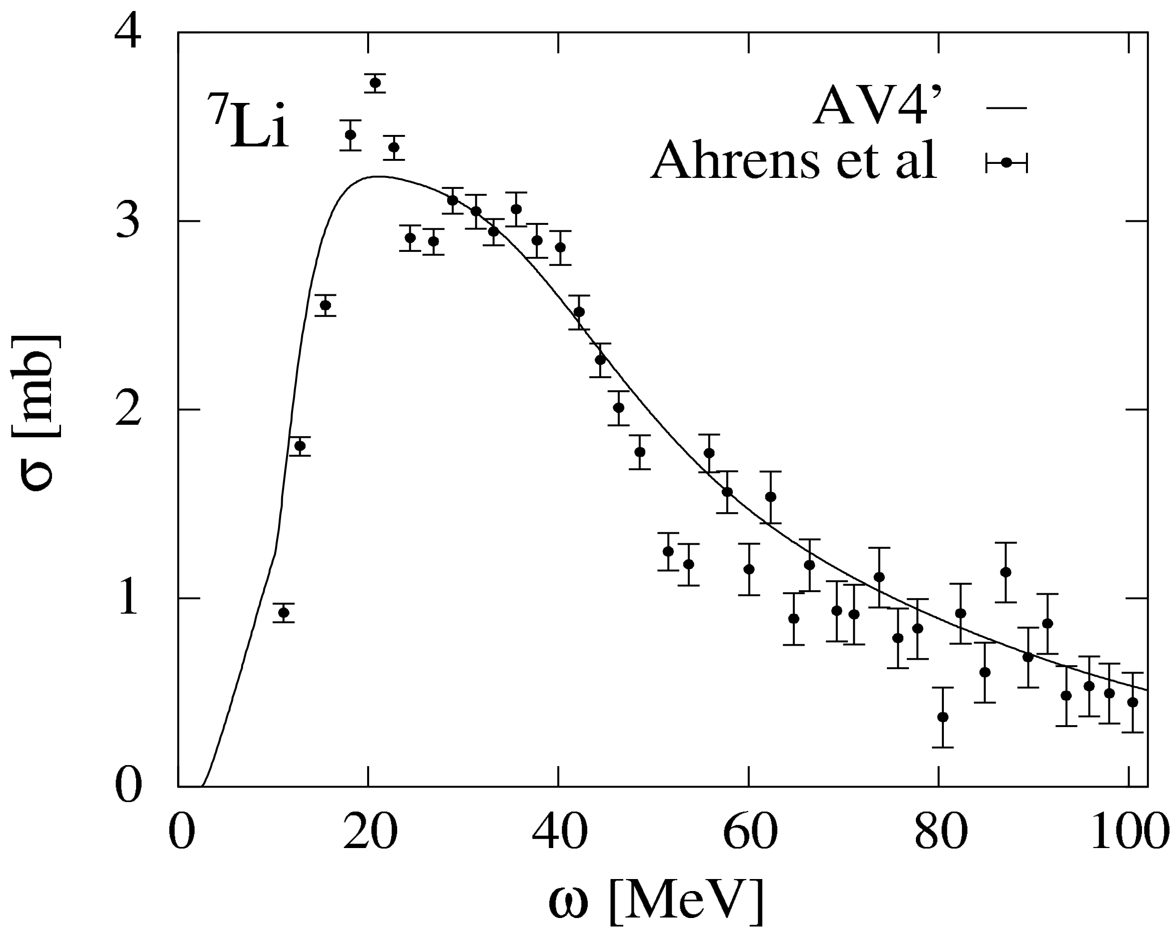


DATA: C.E. Hyde-Wright *et al.*, Phys. Rev. C 35 (1987) 880.



DATA: J. Ahrens *et al.*, Nucl. Phys. A 251 (1975) 479.

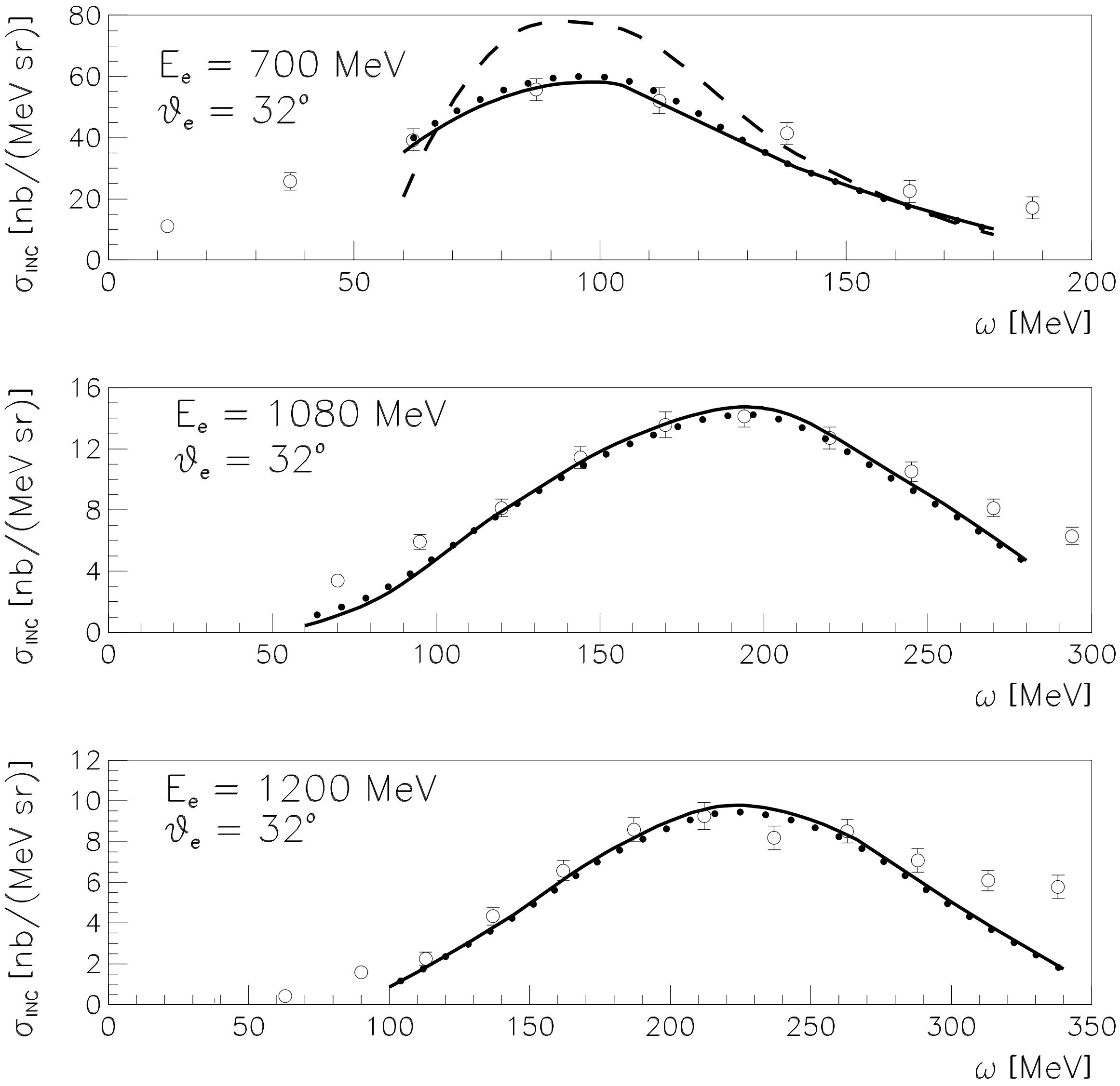
LIT



S. Bacca, N. Barnea, W. Leidemann, G. Orlandini, Phys. Rev. C 69 (2004) 057001

S. Bacca, H. Arenhövel, N. Barnea, W. Leidemann, G. Orlandini, arXiv-nucl-th/0406080

$^{16}O(e,e')^{16}O$

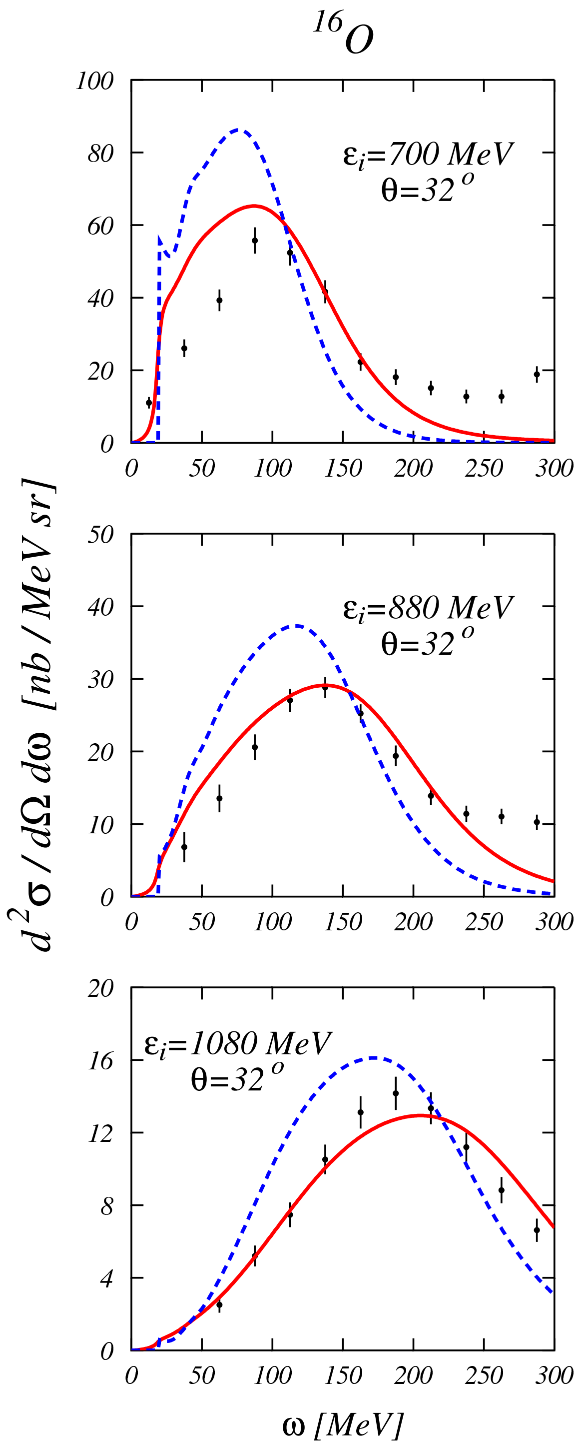


A. Meucci, F. Capuzzi, C. Giusti, F.D. Pacati, Phys. Rev. C 67 (2003) 054601

DATA: M. Anghinolfi *et al.*, Nucl. Phys. A 602 (1996) 405

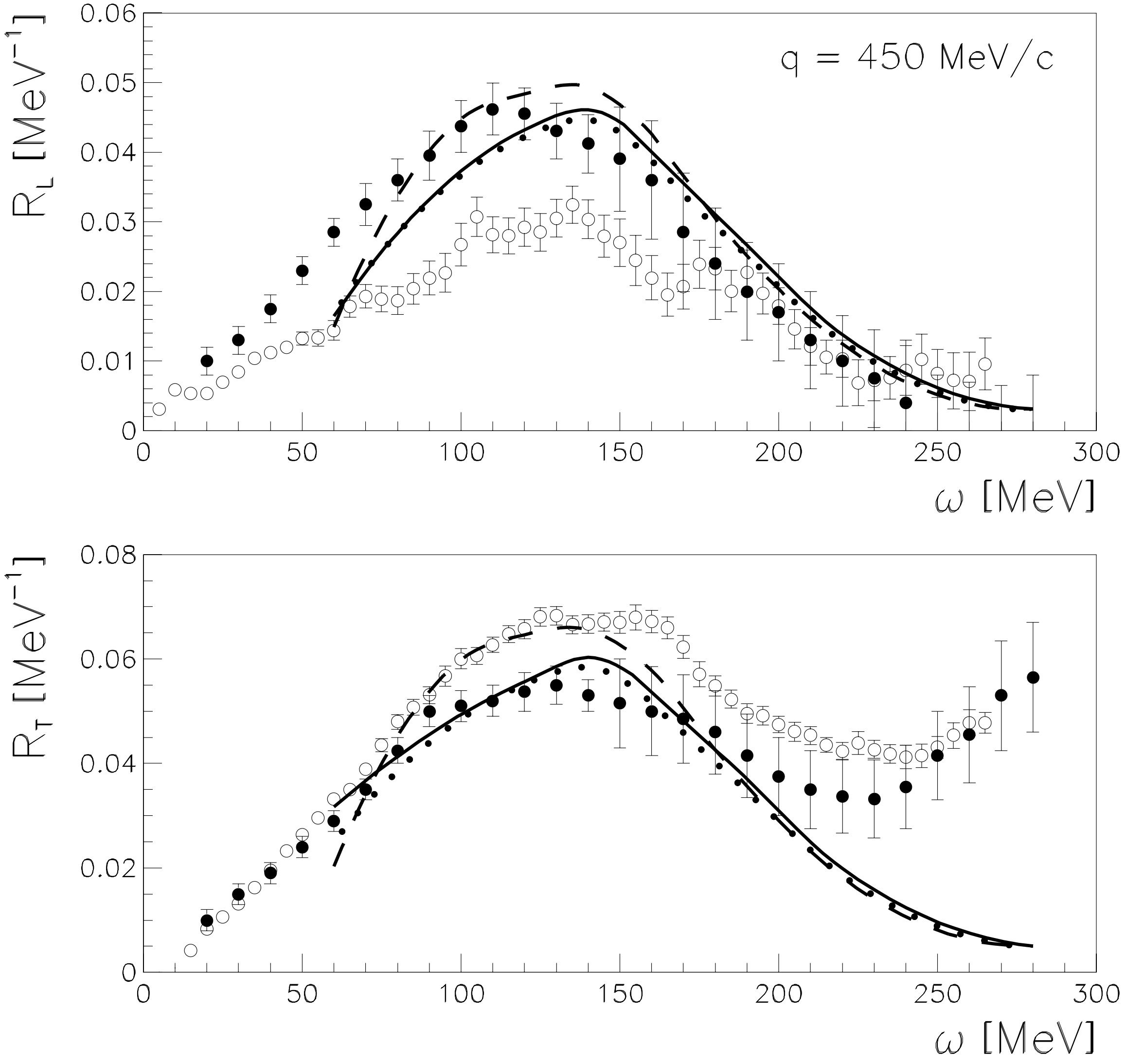
^{16}O (e,e') ^{16}O

G. Co', C. Bleve, C. Bleve, I. De Mitri, D. Martello, Nucl. Phys. B (Proc. Supp.) 112 (2002) 210



A. Meucci, F. Capuzzi, C. Giusti, F.D. Pacati, Phys. Rev. C 67 (2003) 054601

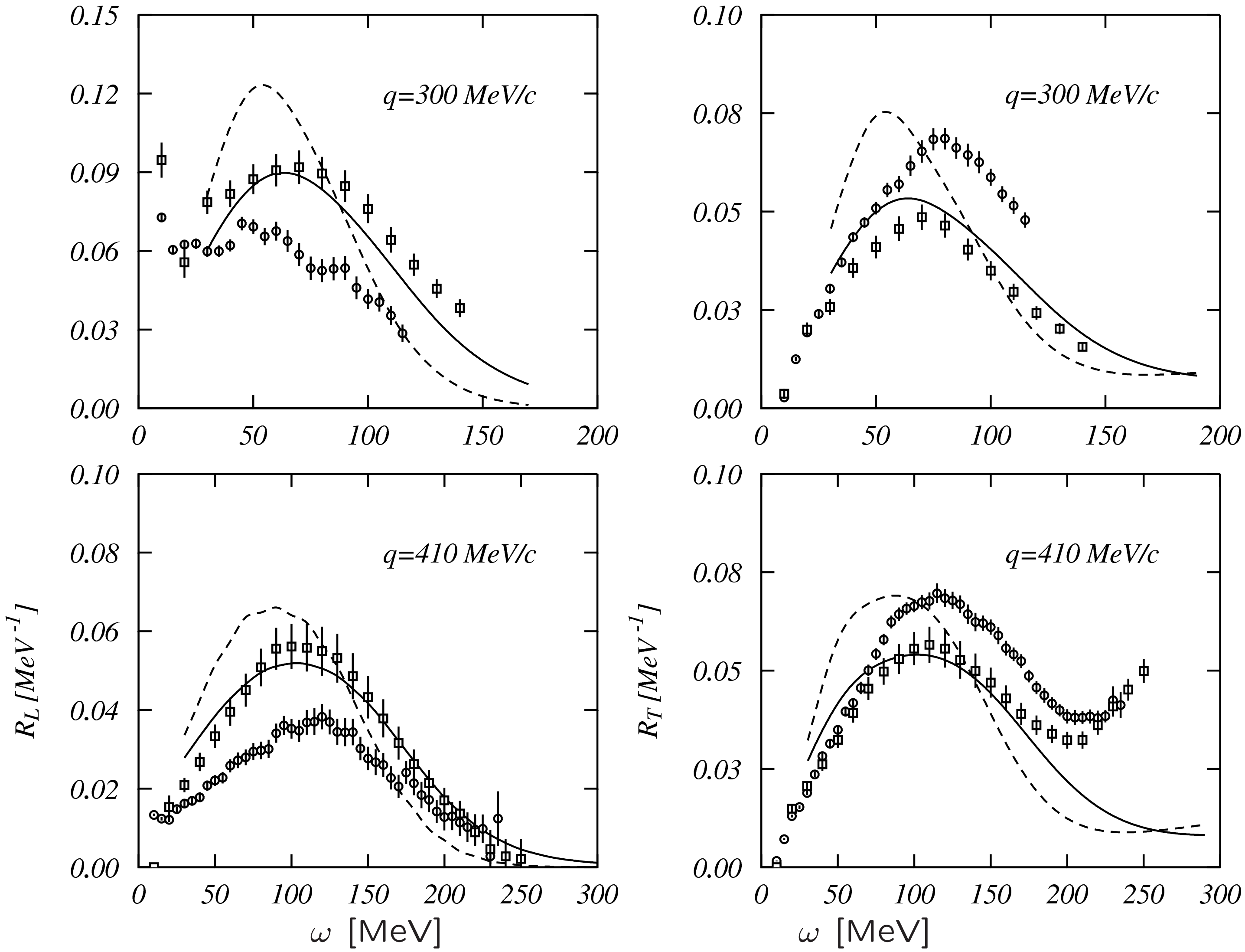
$^{40}Ca(e,e')^{40}Ca$



DATA: Z. Meziani *et al.*, Phys. Rev. Lett. 52 (1984) 2130, 54 (1985) 1233

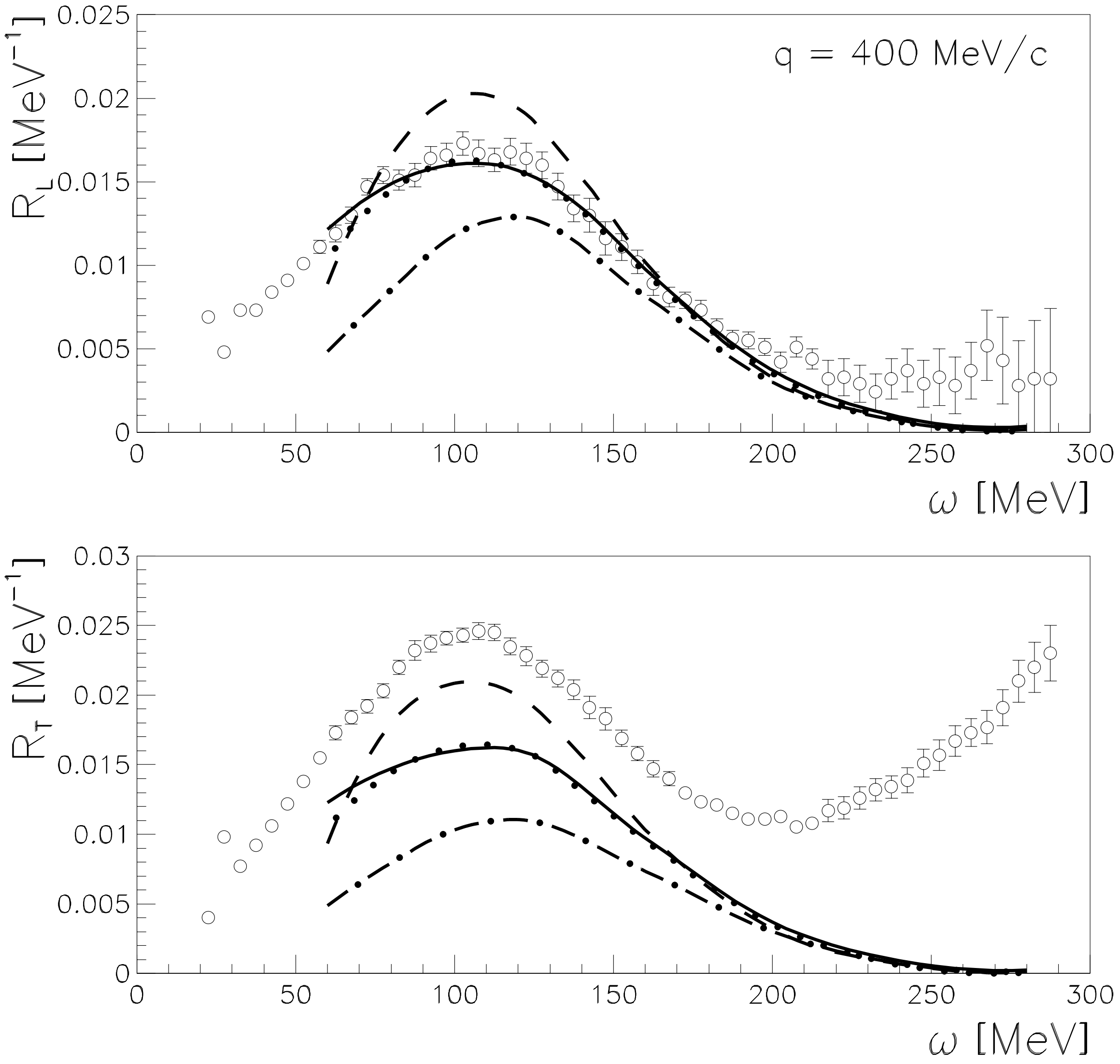
DATA: C.F. Williamson *et al.*, Phys. Rev. C 56 (1997) 3152

^{40}Ca(e,e')^{40}Ca



J.E. Amaro, G. Co', A.M. Lallena, Nucl. Phys. A 578 (1994) 365

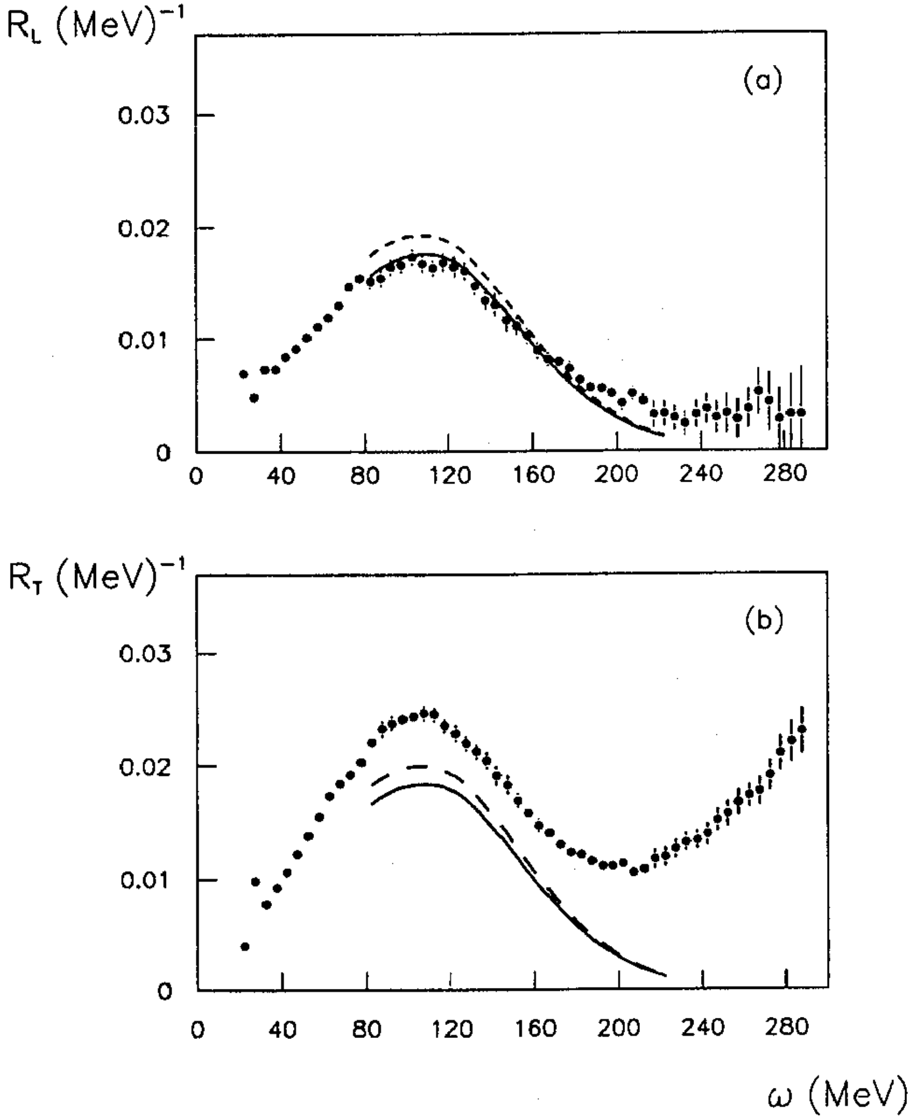
$^{12}C(e,e')^{12}C$



A. Meucci, F. Capuzzi, C. Giusti, F.D. Pacati, Phys. Rev. C 67 (2003) 054601

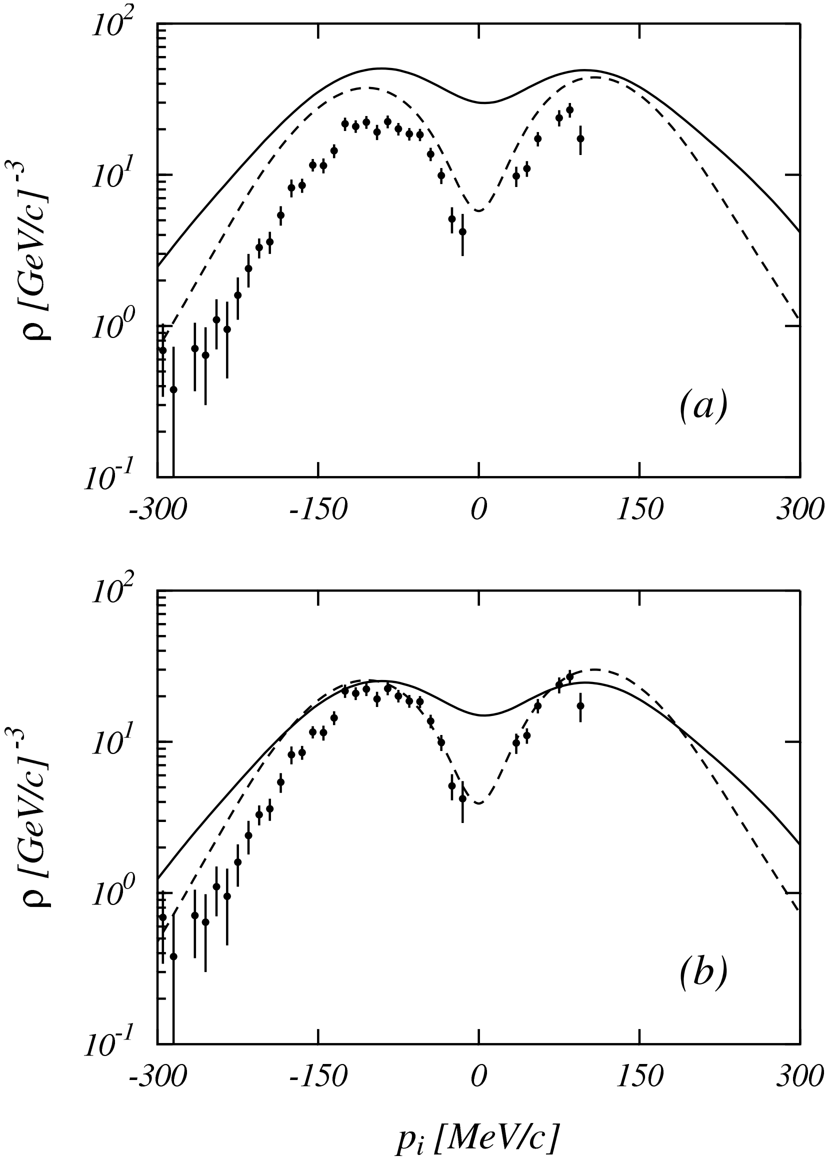
DATA: P. Barreau *et al.*, Nucl. Phys. A 402 (1983) 515

$^{12}C(e,e')^{12}C$



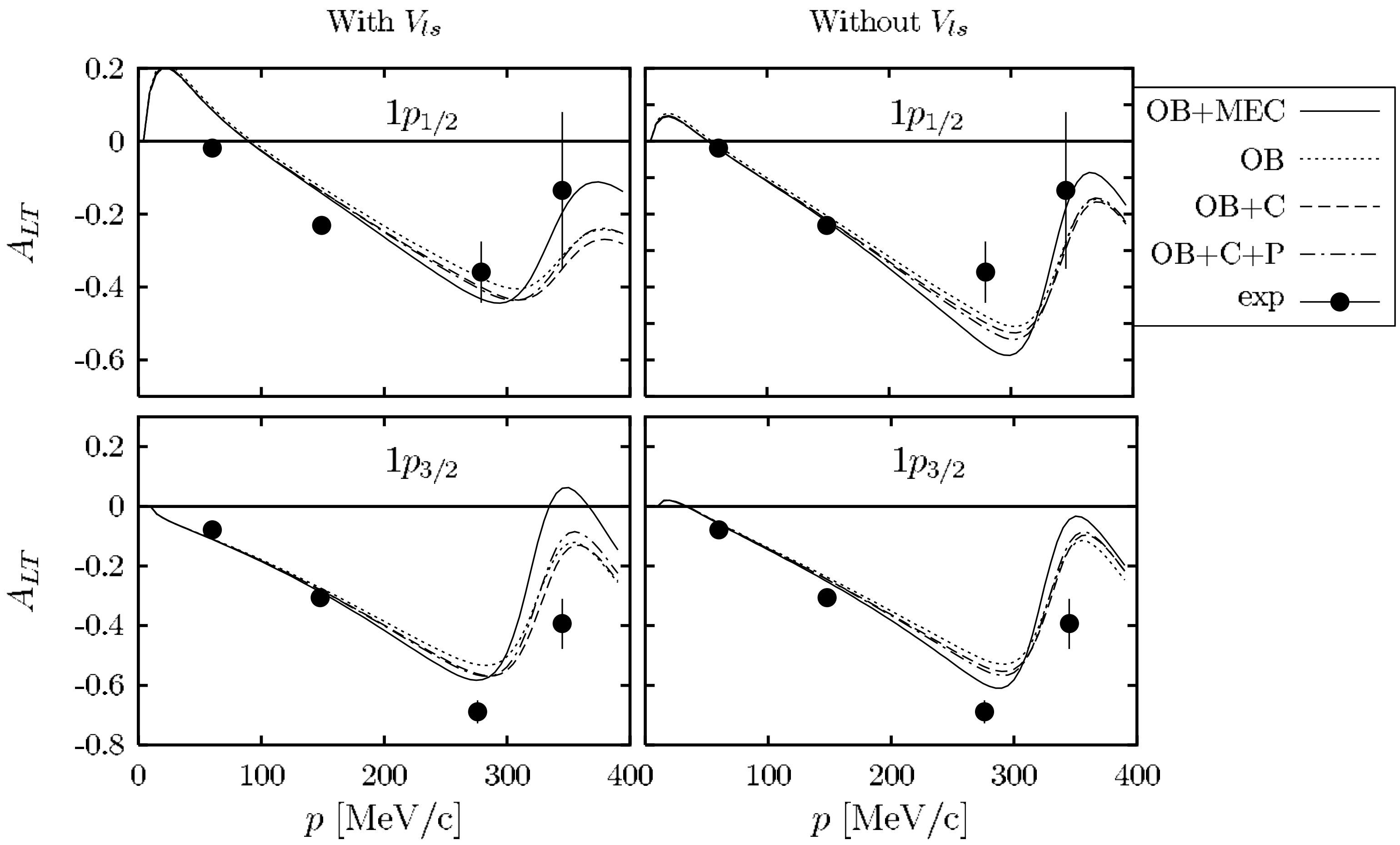
F. Capuzzi, C. Giusti, F.D. Pacati, Nucl. Phys. A 524 (1991) 681

$^{16}O(e,e'p)^{15}N$



S.R. Mokhtar, M. Anguiano, G. Co', A.M. Lallena, Ann. Phys. 292 (2001) 67.

$^{16}O(e,e'p)^{15}N$



$$\mathcal{A}_{LT} = (\sigma(\phi = 0^o) - \sigma(\phi = 180^o))/(\sigma(\phi = 0^o) + \sigma(\phi = 180^o))$$

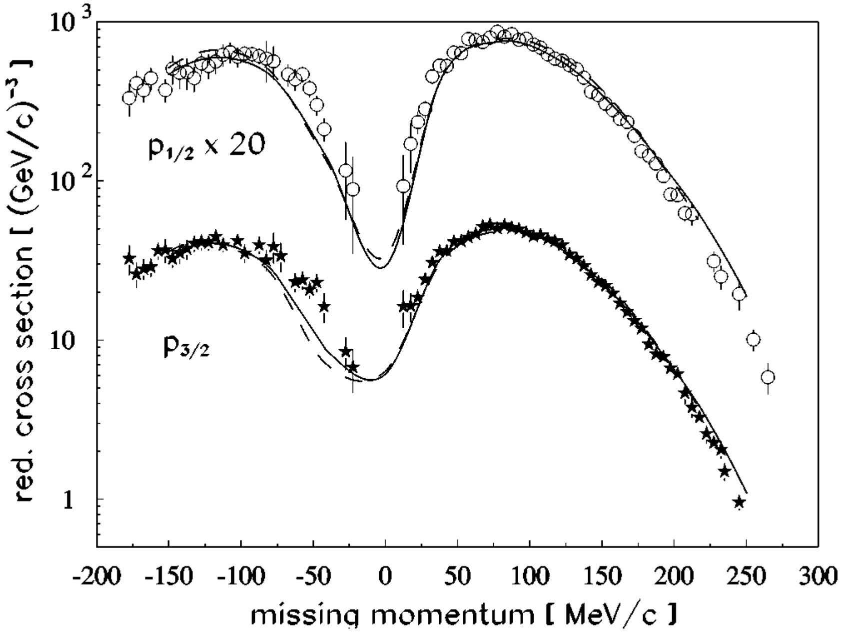
J.E. Amaro, M. Barbaro, J.A. Caballero, F. Kazemi Tabatabaei, Phys. Rev. C 68 (2003) 014604

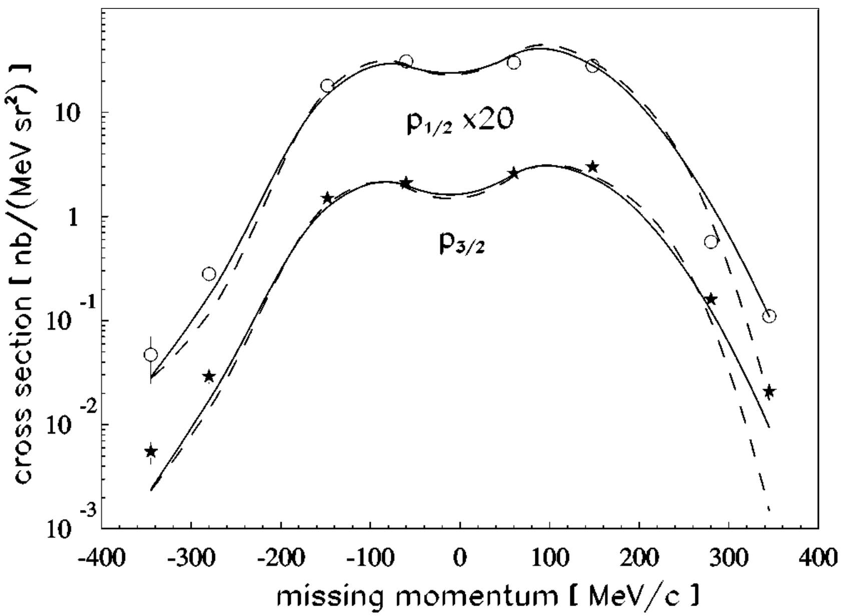
$^{16}O(e,e'p)^{15}N$

$E_p = 90$ MeV

$Q^2 = 0.8\ (GeV/c)^2$

SF(p1/2) = 0.644
SF(p3/2) = 0.537





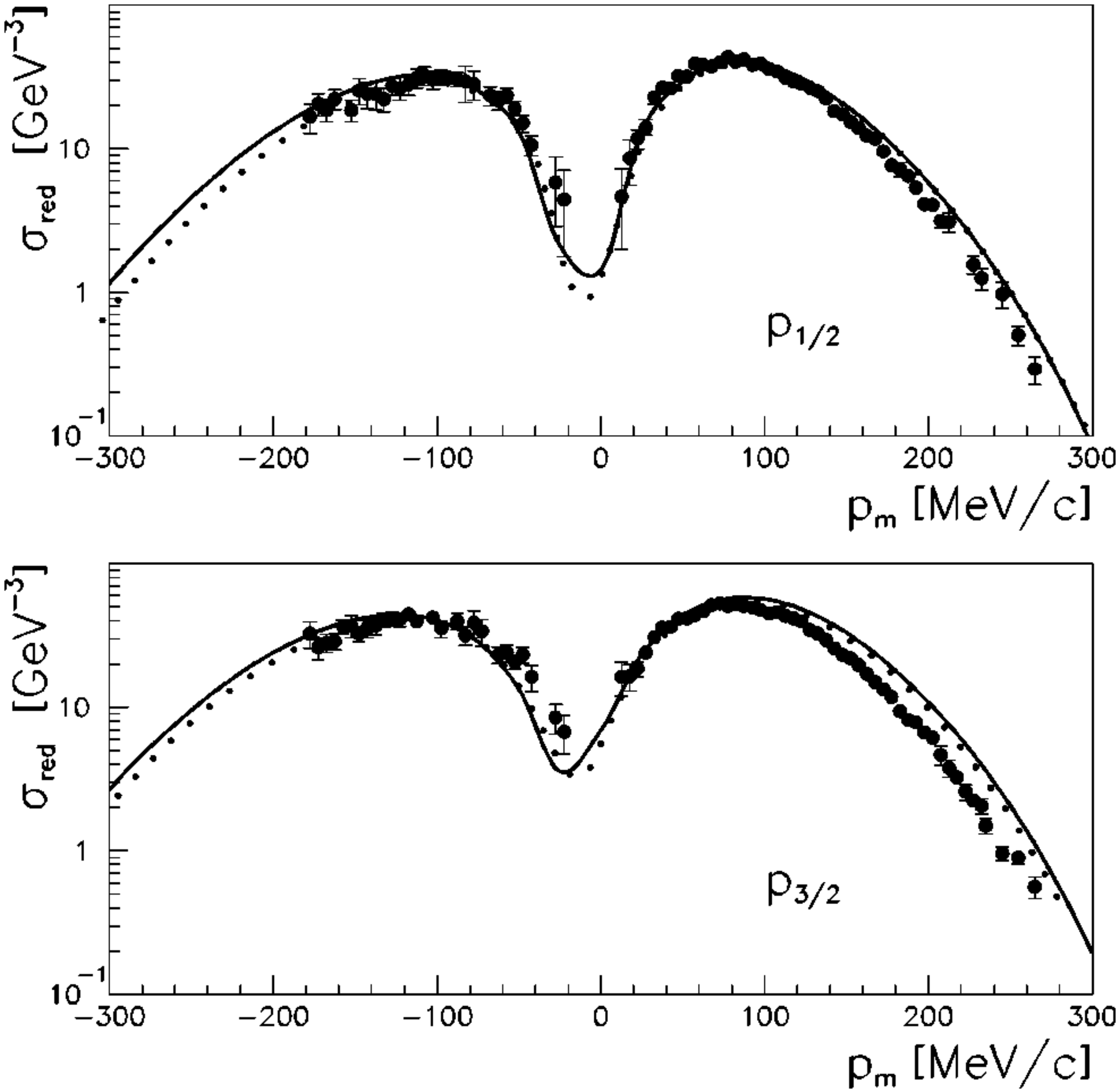
M. Radici, W.H. Dickhoff, E. Roth Stoddard Phys. Rev. C 66 (2002) 014613

$^{16}O(e,e'p)^{15}N$

S.F.

RDWIA	0.70
DWEEPY	0.65

A. Meucci, C. Giusti, F.D. Pacati, Phys. Rev. C 64 (2001) 014604



(e,e'N) (γ,N)

$$W(\vec{q}) = \int d^3r\, e^{i\vec{q}\cdot\vec{r}} \; < \Psi_f \mid J(\vec{r}) \mid \Psi_0 >$$

- Pavia

$$W(\vec{q}) = \int d^3r\, e^{i\vec{q}\cdot\vec{r}}\, \chi(\vec{r}) J(\vec{r}) \; < \Psi^{A-1}(\vec{r}) \mid \Psi_0^A >$$

- Lecce

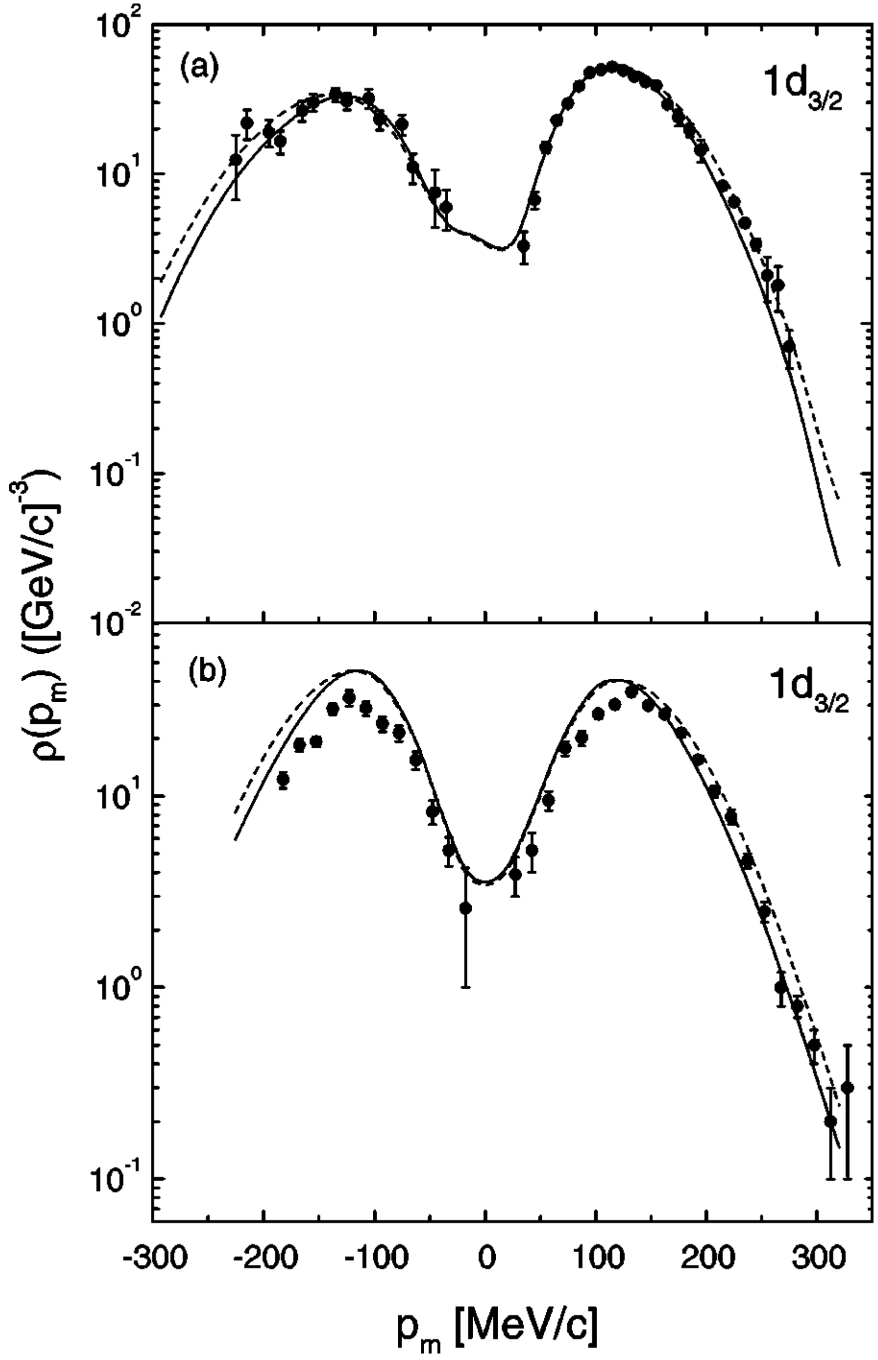
$$W(\vec{q}) = \int d^3r\, e^{i\vec{q}\cdot\vec{r}} \; < \Phi_f \mid F^\dagger J(\vec{r}) F \mid \Phi_0 >$$

$^{40}Ca(e,e'p)^{39}K$

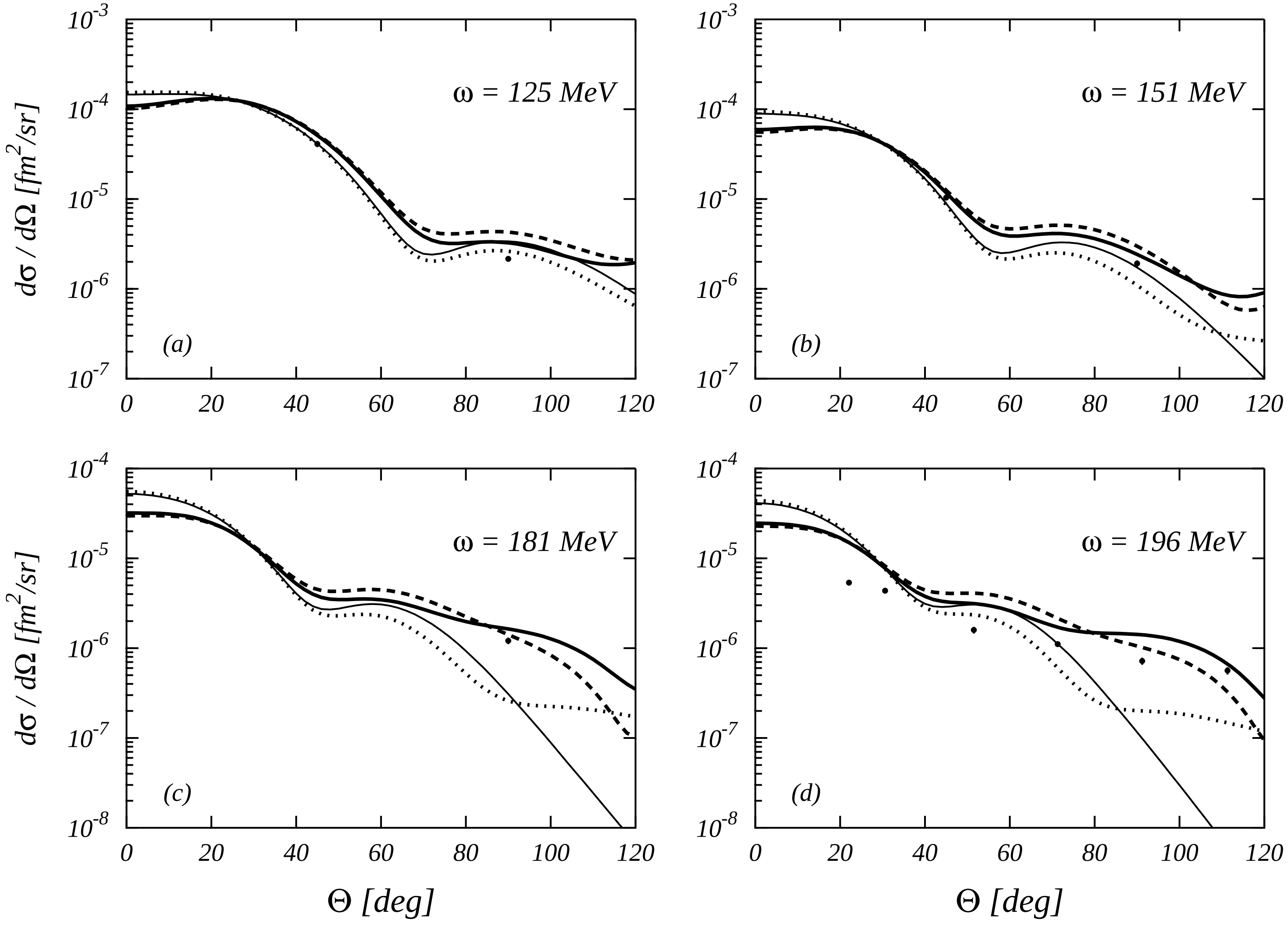
S.F.

GCM	0.54
DWEEPY	0.66

M.V. Ivanov, M.K. Gaidarov, A.N. Antonov, C. Giusti, Nucl. Phys. A 699 (2002) 336c, Phys. Rev. C 64 (2001) 014605

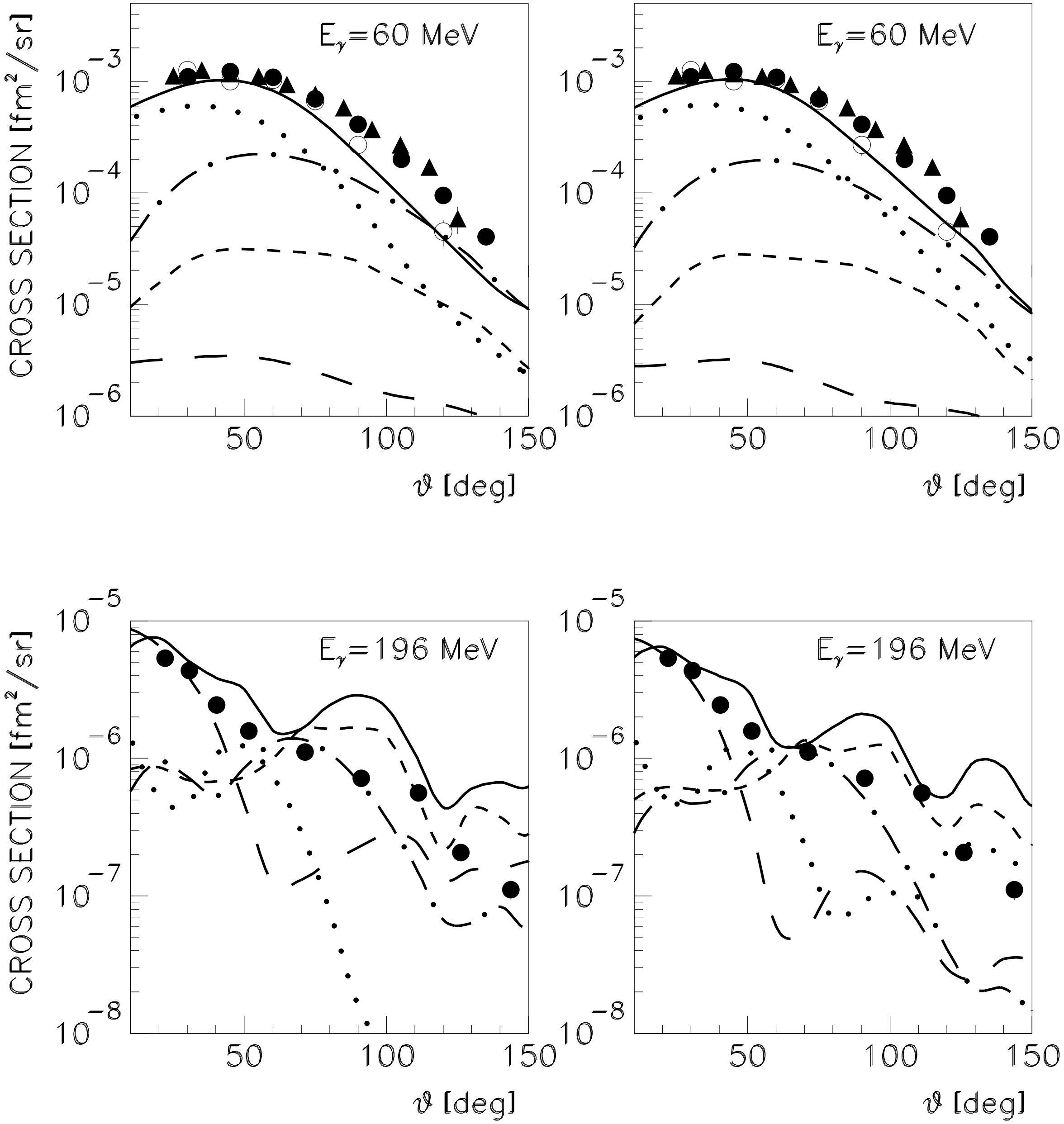


$^{16}O(\gamma,p)^{16}N$



M. Anguiano G. Co', A.M. Lallena, S.R. Mokhtar, Ann. Phys. 296 (2002) 235

$^{16}O(\gamma,p)^{16}N$



C. Giusti, F.D. Pacati, Phys. Rev. C 67 (2003) 044601

(e,e'NN) $(\gamma$,NN)

$$W(\vec{q}) = \int d^3r\, e^{i\vec{q}\cdot\vec{r}_{12}} \; < \Psi_f \mid J(\vec{r}_{12}) \mid \Psi_0 >$$

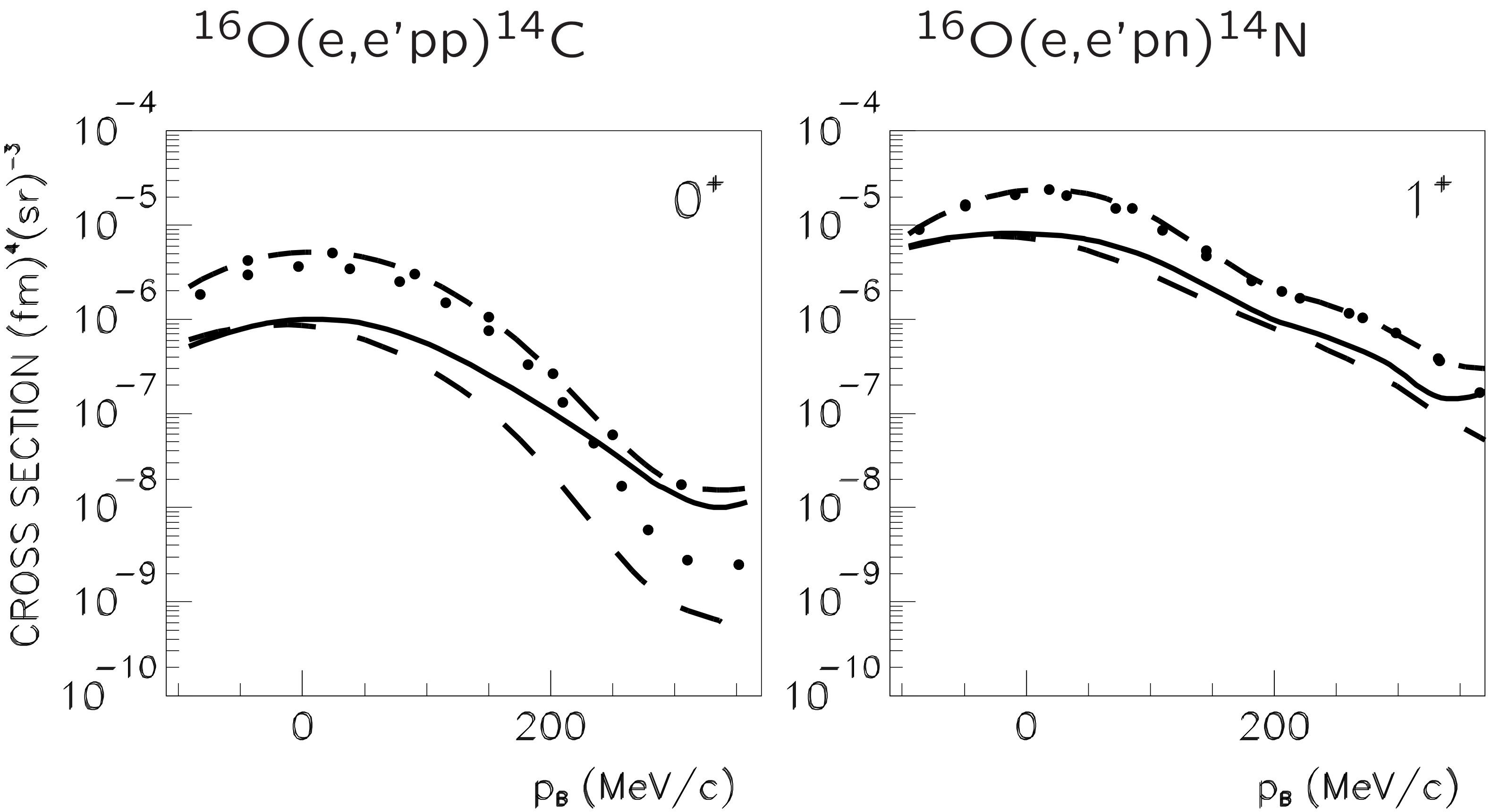
- Pavia

$$W(\vec{q}) = \int d^3r\, e^{i\vec{q}\cdot\vec{r}_{12}} \; \chi_1(\vec{r}_1)\,\chi_2(\vec{r}_2) J(\vec{r}_{1,2}) \; < \Psi^{A-2}(\vec{r}_1, \vec{r}_2) \mid \Psi_0^A >$$

- Lecce

$$W(\vec{q}) = \int d^3r\, e^{i\vec{q}\cdot\vec{r}_{12}} \; < \Phi_f \mid F^\dagger J(\vec{r}_{1,2}) F \mid \Phi_0 >$$

ω = 215 MeV, θ_e = 18^o, ϵ_i=855 MeV

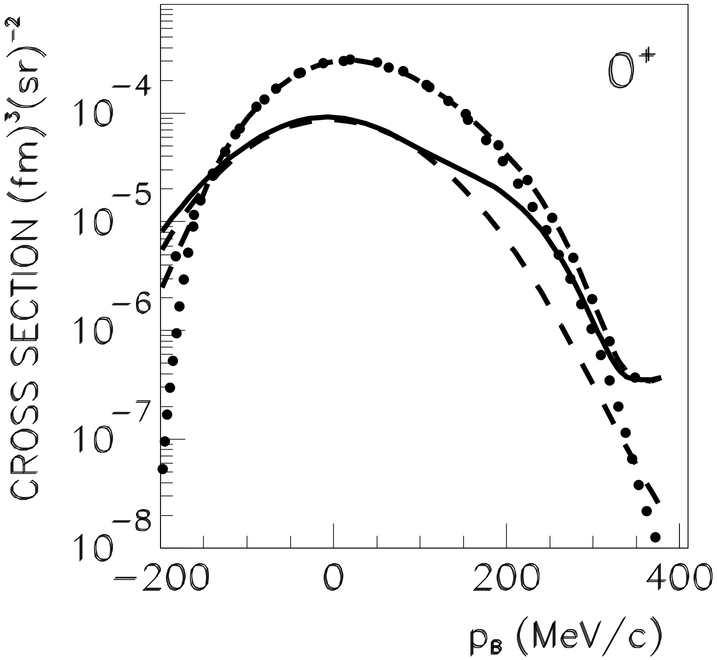


M. Schwamb, S. Boffi, C. Giusti, F.D. Pacati, Eur. Phys. J. A17 (2003) 7.

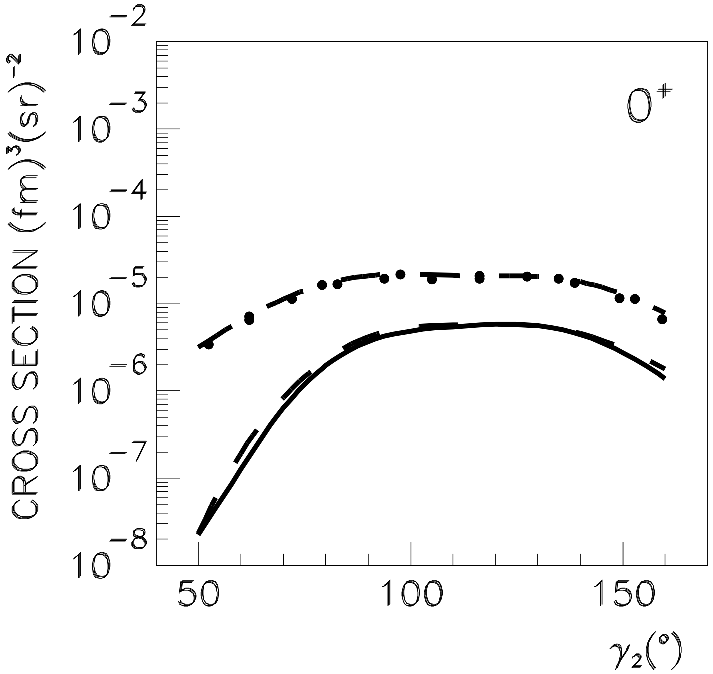
M. Schwamb, S. Boffi, C. Giusti, F.D. Pacati, Eur. Phys. J. A20 (2004) 233.

$^{16}O(\gamma,pp)^{14}C$

ω = 215 MeV

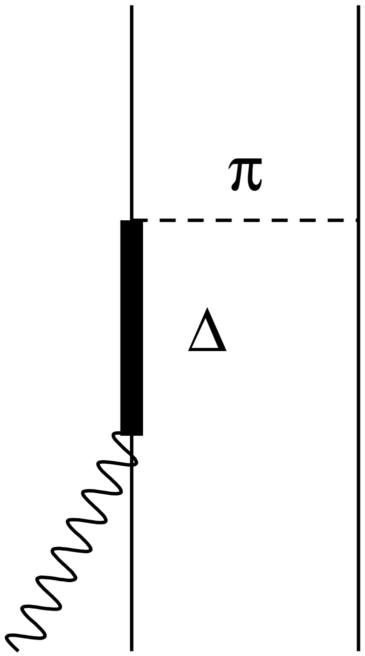


ω = 120 MeV

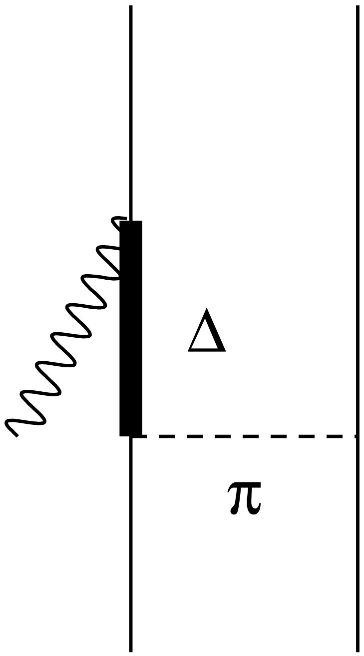


M. Schwamb, S. Boffi, C. Giusti, F.D. Pacati, Eur. Phys. J. A17 (2003) 7.

M. Schwamb, S. Boffi, C. Giusti, F.D. Pacati, Eur. Phys. J. A20 (2004) 233.

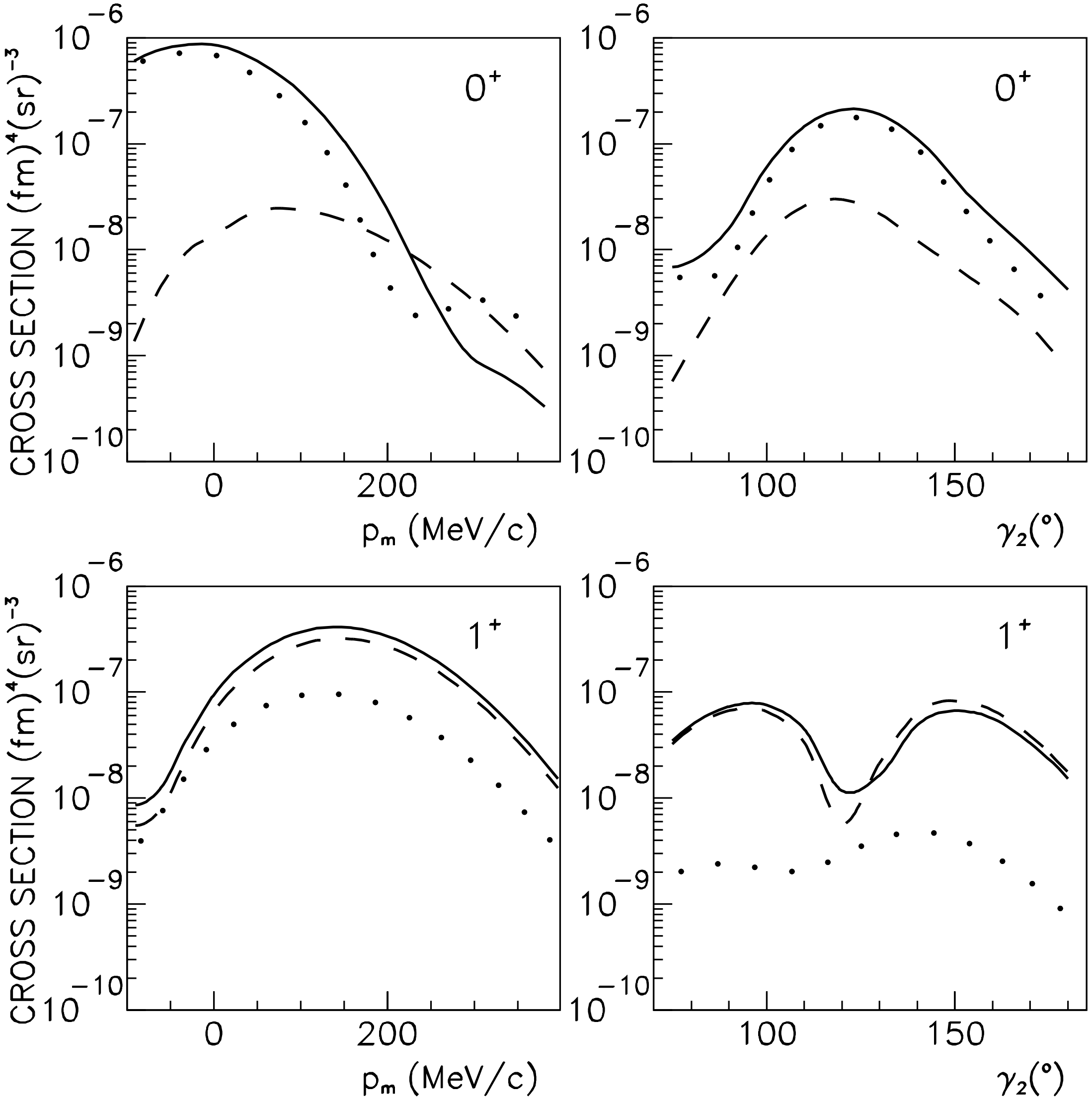


A



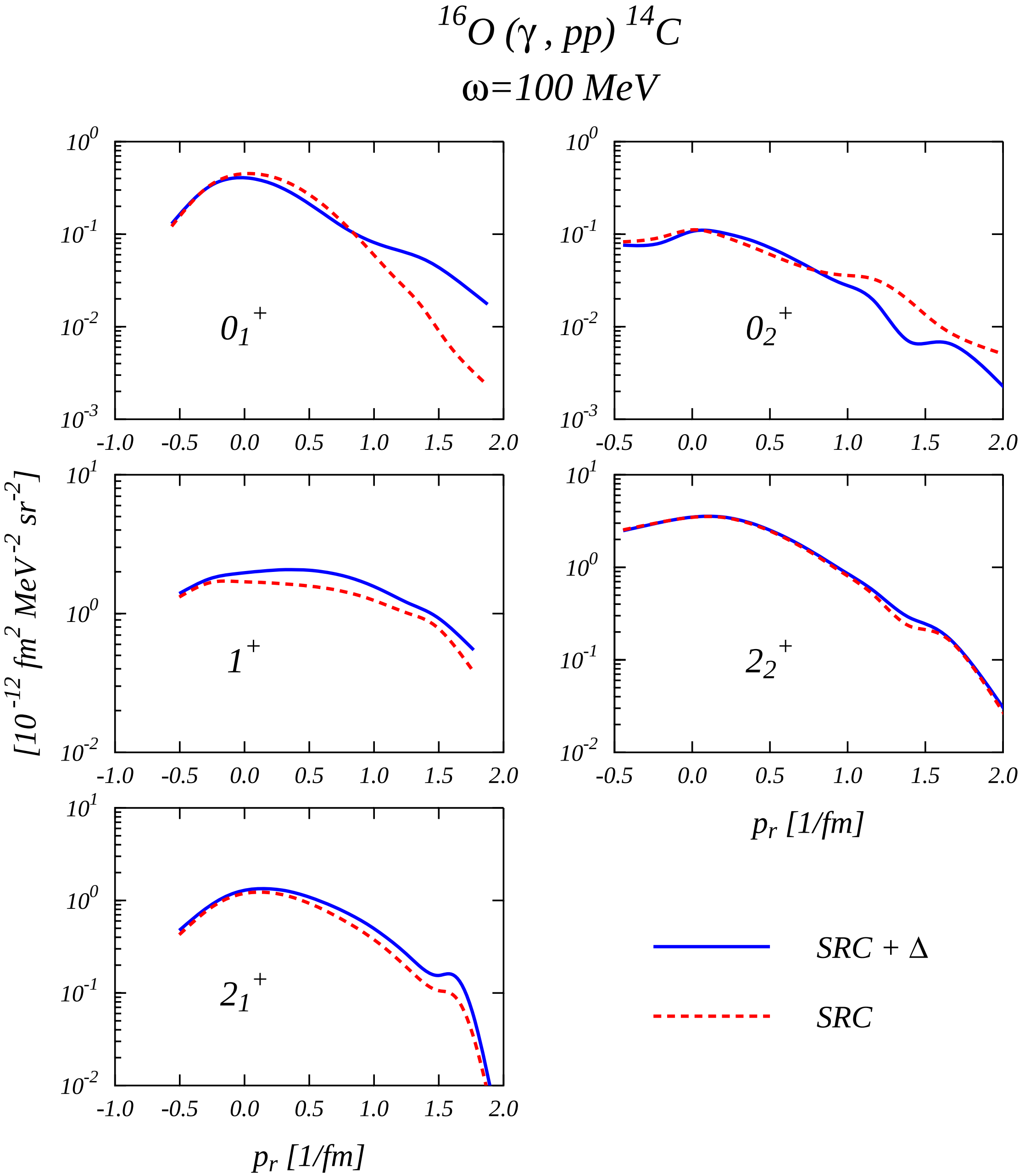
B

$^{16}O(e,e'pp)^{14}C$

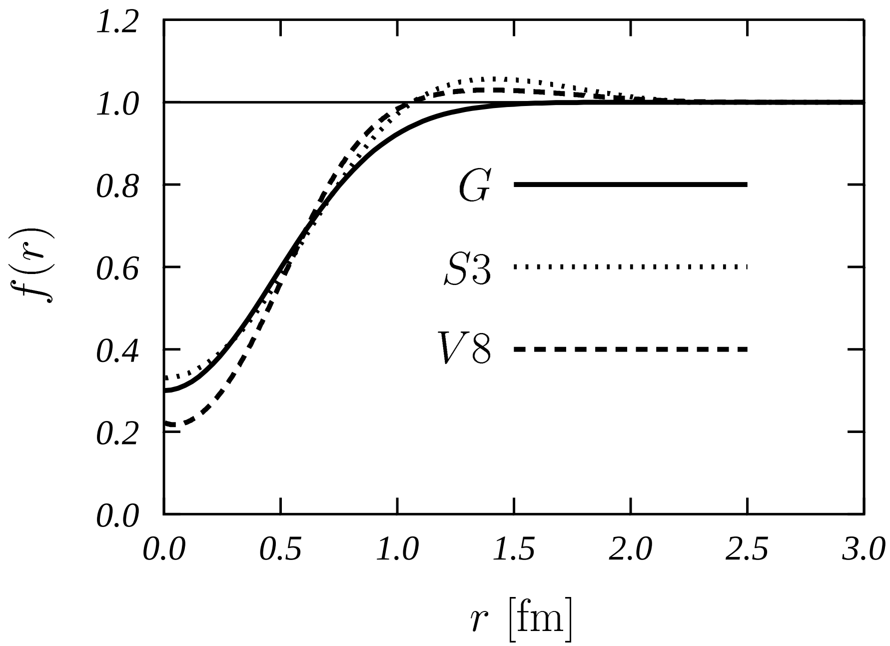


C. Giusti, Eur. Phys. J. A17 (2003) 419

C. Barbieri, C. Giusti, F.D. Pacati, W.H. Dickhoff, Phys. Rev. C 70 (2004) 014606



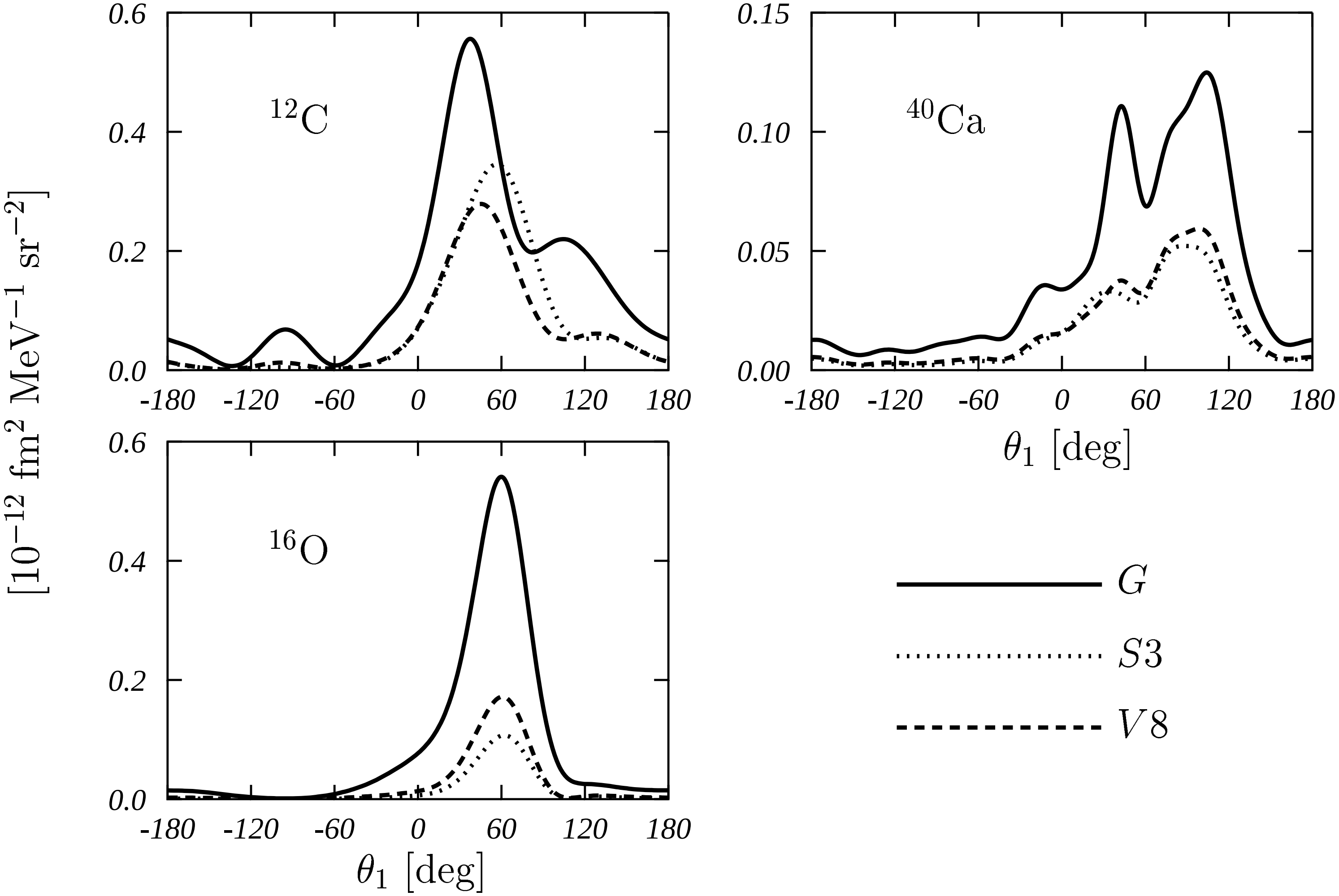
M. Anguiano, G. Co', A.M. Lallena, arXiv:nucl-th/0408041



M. Anguiano, G. Co', A.M. Lallena, arXiv:nucl-th/0408041

(γ,pp)

$\omega = 100$ MeV $\quad \theta_2 = 90^o$



M. Anguiano, G. Co', A.M. Lallena, arXiv:nucl-th/0408041

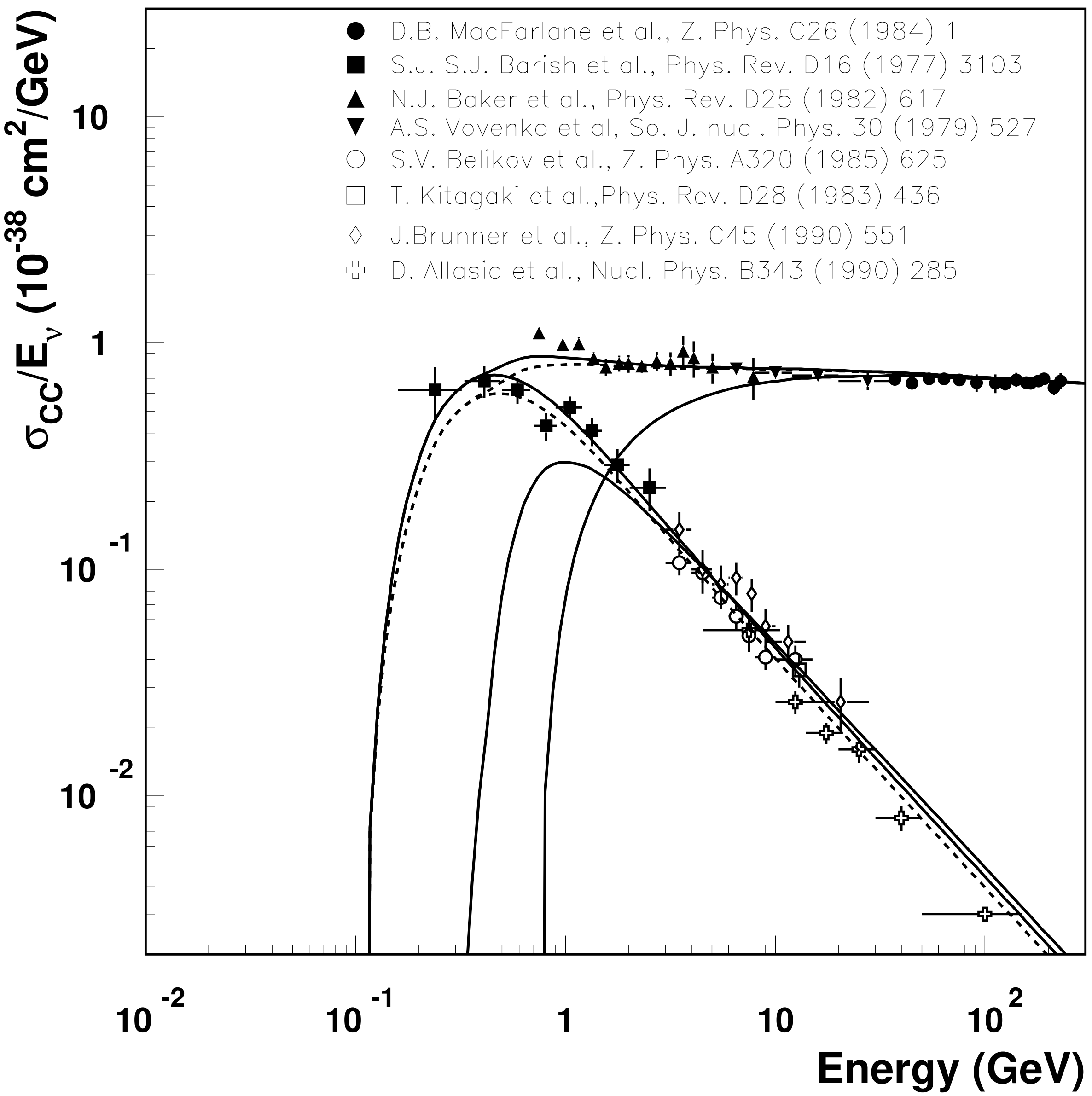
Riassumendo: sonde elettromagnetiche

- Buona descrizione del picco quasi-elastico
  - ^{12}C - Saclay data

- Fattore spettroscopico

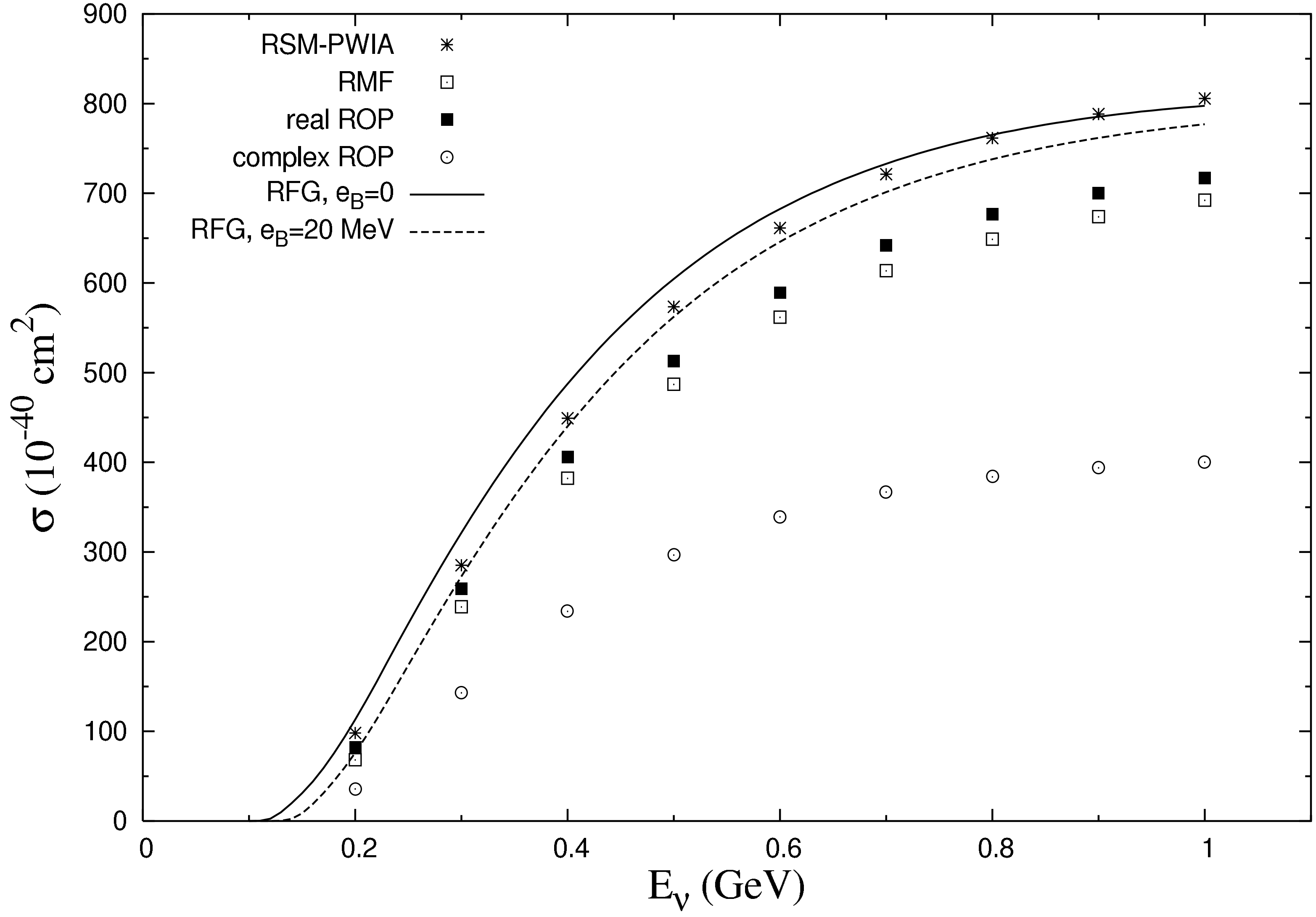
- Correlazioni a corto raggio

SONDA	INCOGNITA	SCOPO
Elettroni e Fotoni	Bersaglio	Nucleo
Neutrini	Fascio	Neutrini e loro Sorgenti



C. Bleve, G. Co', C. Bleve, I. De Mitri, P. Bernardini, G. Mancarella, D. Martello, A. Surdo, Astr. Phys. 16 (2001) 145

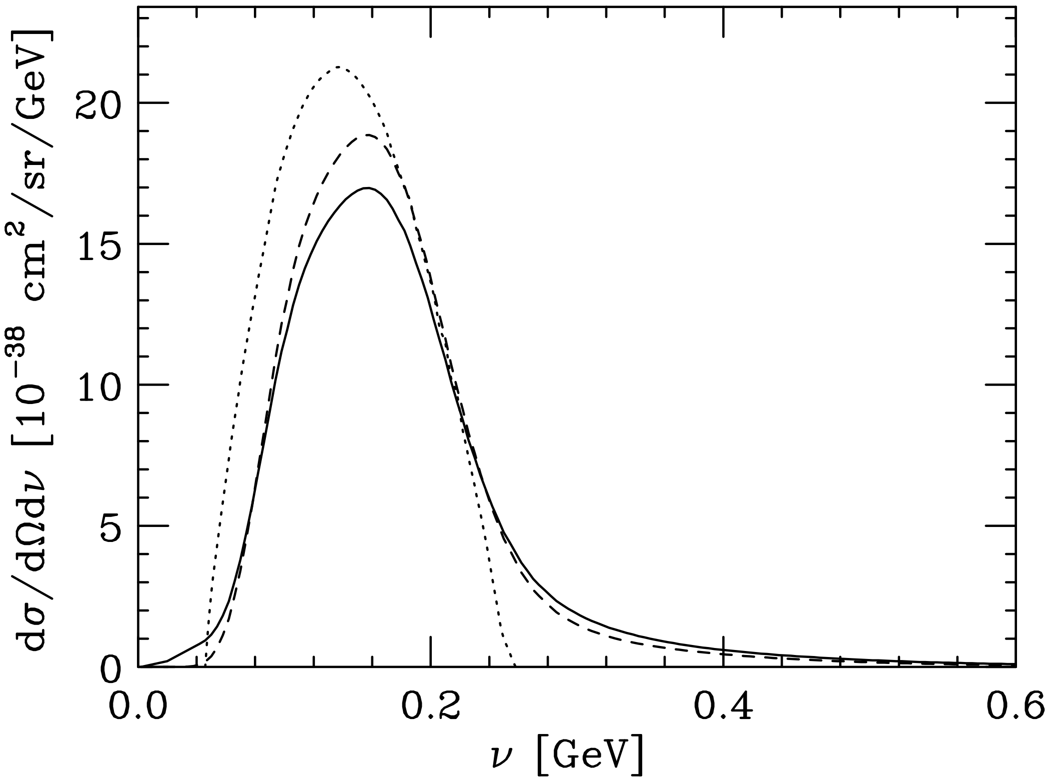
$^{16}O(\nu_\mu,\mu)^{16}F$



C. Maieron, M.C. Martínez, J.A. Caballero, J.M. Udías, Phys. Rev. C 68 (2003) 048501

(ν_e, e)

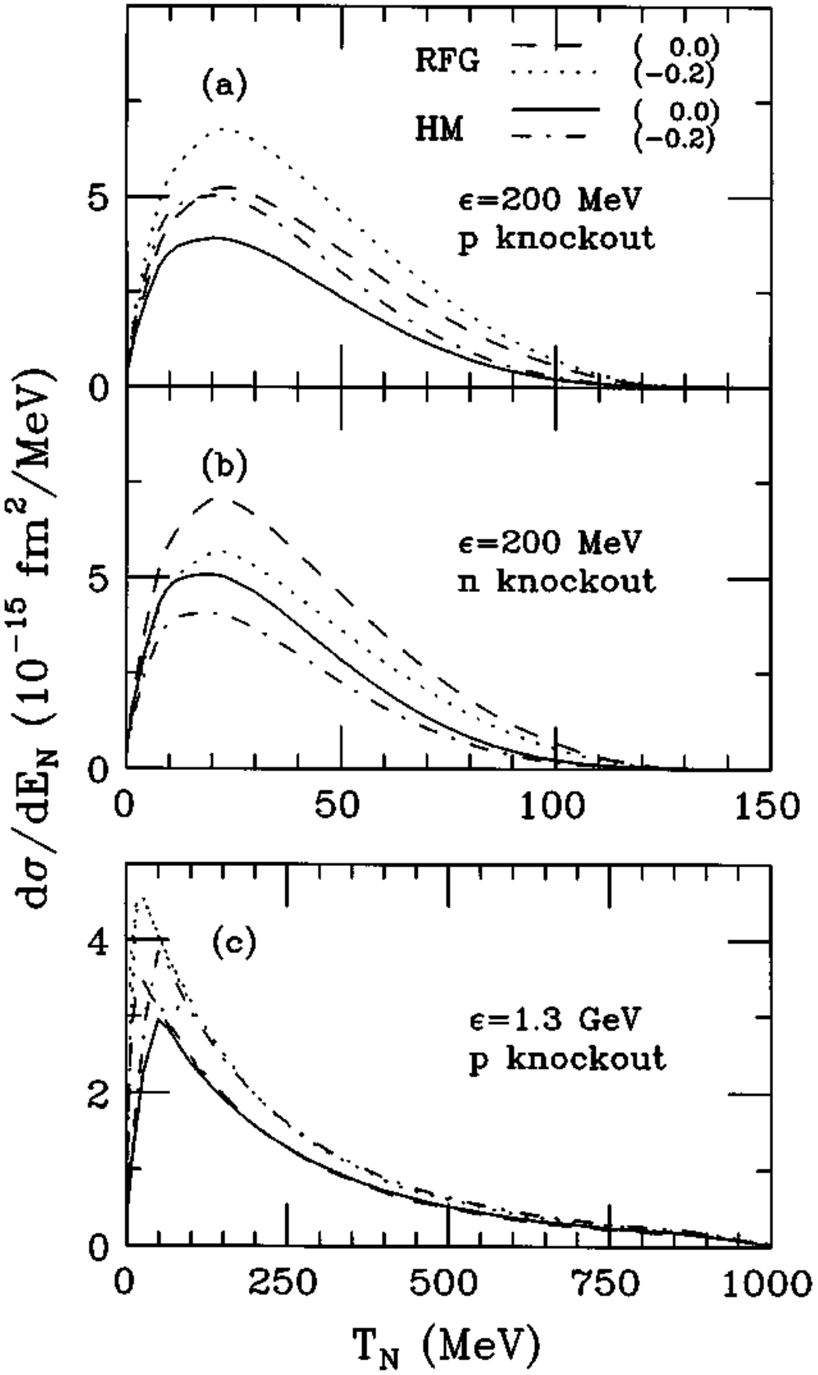
$\nu_e = 1$ GeV $\quad \theta = 30^o$

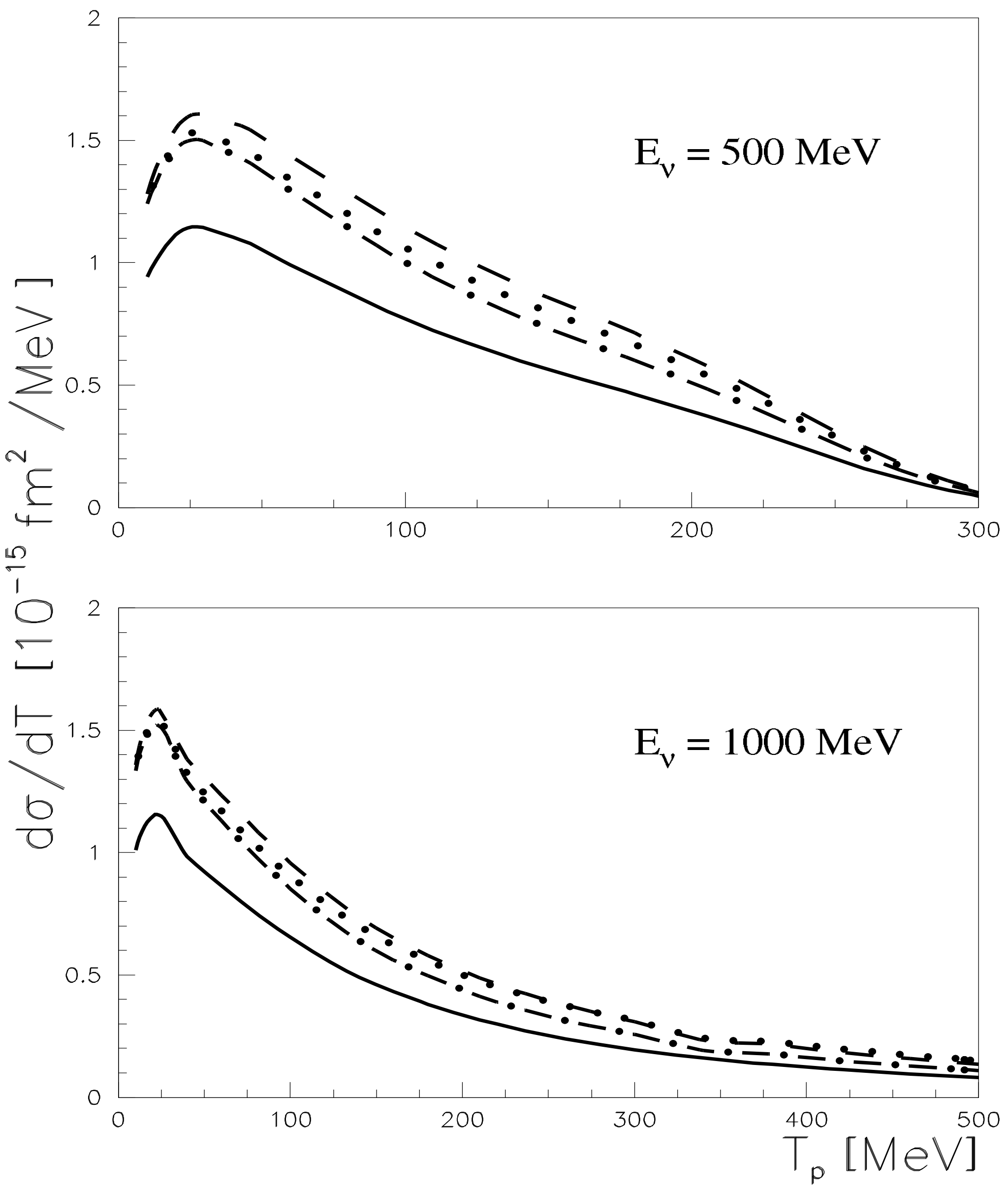


O. Benhar, N. Farina, arXiv:nucl-th/0407106

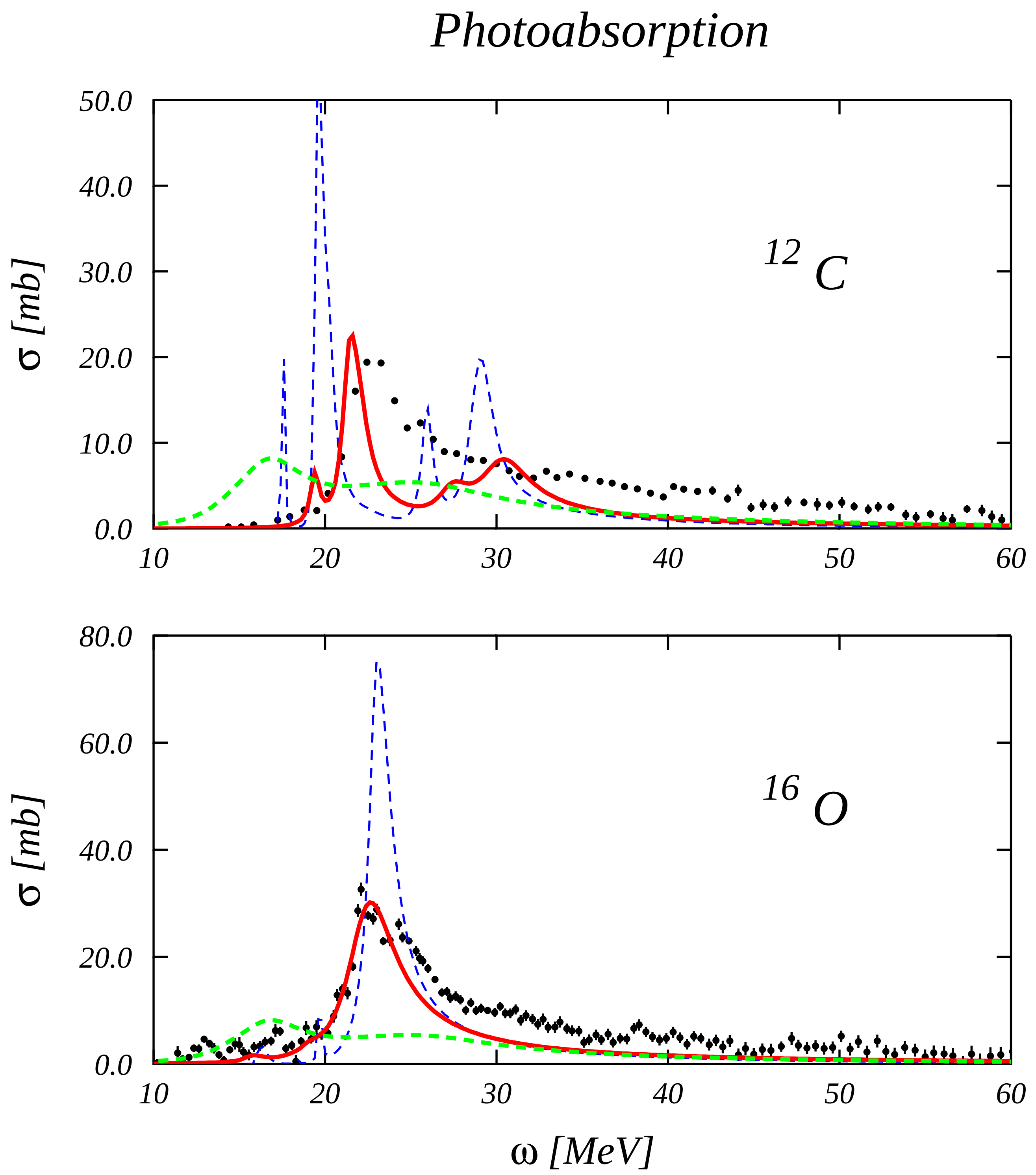
W.M. Alberico, S.M. Bilenky, C. Maieron, Phys. Rep. 358 (2002) 227

M. Barbaro, A. De Pace T.W. Donnelly, A. Molinari, M.J. Musolf, Phys. Rev. C 54 (1996) 1954

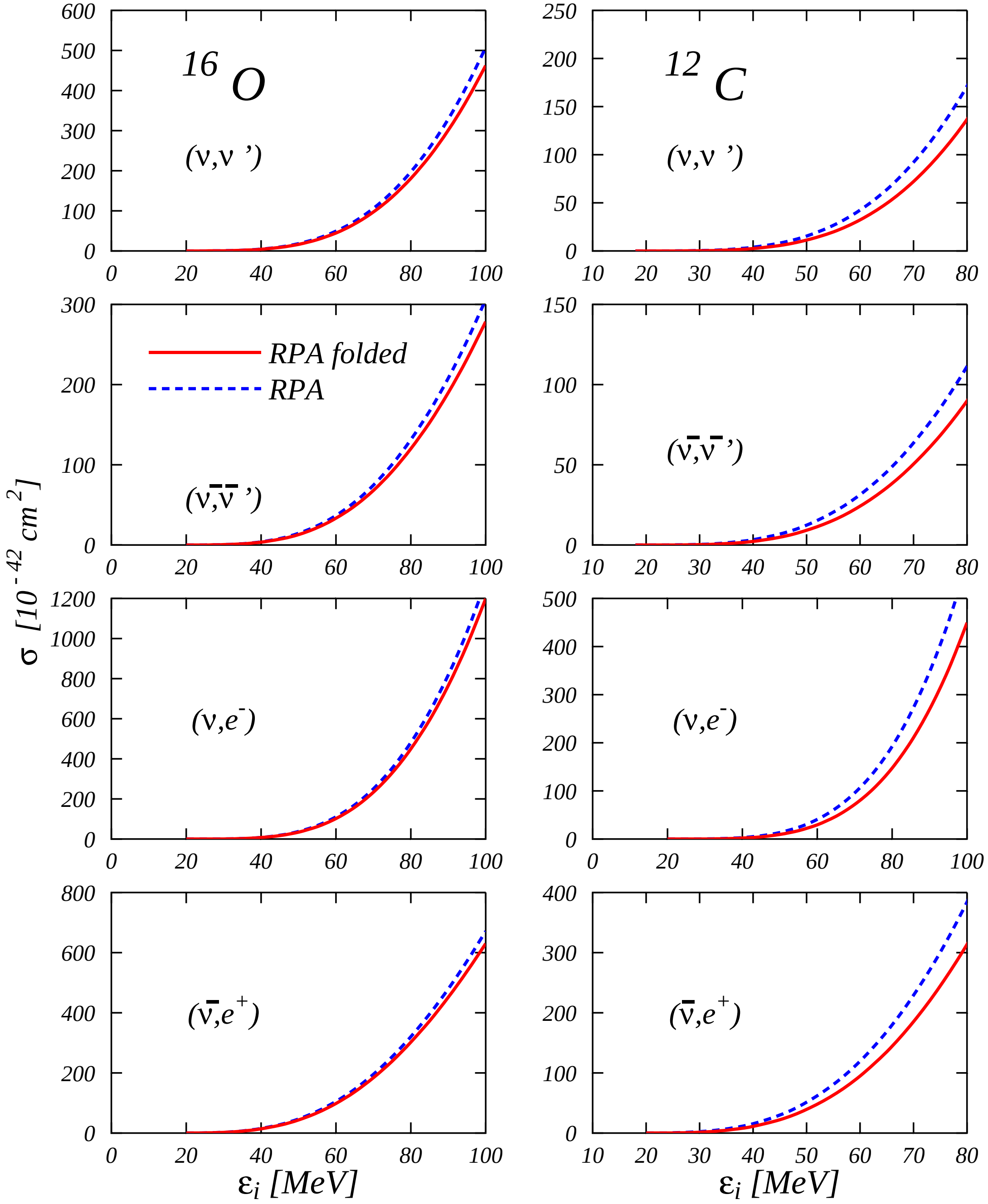




A. Meucci, C. Giusti, F.D. Pacati, arXiv:nucl-th/0405004



Photoabsorption
σ [mb]
50.0
40.0
30.0
20.0
10.0
0.0
12 C
10
20
30
40
50
60
σ [mb]
80.0
60.0
40.0
20.0
0.0
16 O
10
20
30
40
50
60
ω [MeV]



16 O
12 C
(ν,ν ')
(ν̄,ν̄ ')
(ν,e⁻)
(ν̄,e⁺)
RPA folded
RPA
σ [10⁻⁴² cm²]
εi [MeV]

Alcune considerazioni da PRIN

- Buon gruppo di lavoro

- Scarsa interazione tra le varie sedi

Possibili Sinergie

- Esperimenti nel settore

- Teoria del quasi-elastico

- Gruppo di lavoro su neutrino-nucleo

Esperimenti nel settore

- Fotoassorbimento (Orlandini)
- (e,e') nelle risonanze giganti ^{12}C ^{16}O
- Separazione di Rosenbluth in ^{16}O
- Verifica dati di Saclay
- Emissione di due nucleoni

Teoria del quasi elastico (inclusivo)

- Nuclei finiti e sistemi infiniti
- RPA vs MF
- FSI
- MEC
- SRC
- Relatività

Gruppo di lavoro sui neutrini

- Necessità di buone sezioni d'urto (miniboone)

- Produzione di un data base