

Fisica nucleare adronica con sonde elettrodeboli (+ adroniche)

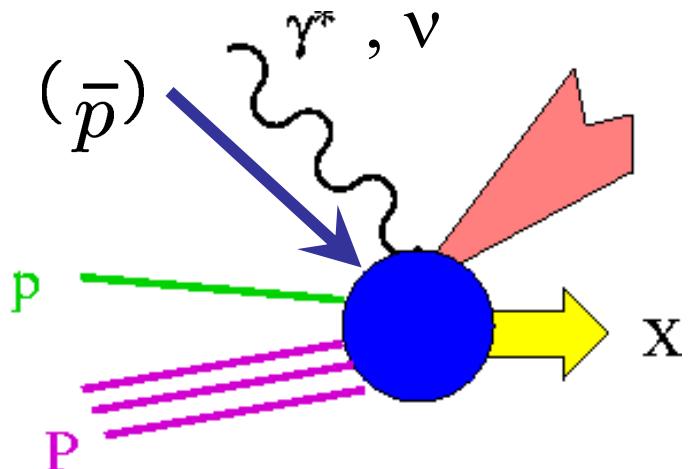
Coordinatore (locale = nazionale)

S. Boffi

INFN Ricercatore
DFNT Prof. Ordinario
Prof. Associato

Ricercatore
Ass. Ricerca
Dottorandi

M. Radici
S. Boffi, F.D. Pacati
F. Capuzzi, C. Giusti,
A. Bianconi (20% - Gr. Coll. Brescia)
B. Pasquini
A. Meucci (30/06/07)
F. Conti (XXII), M. Dorati (XXI), M. Pincetti (XXI)



Temi di ricerca 2005-2007

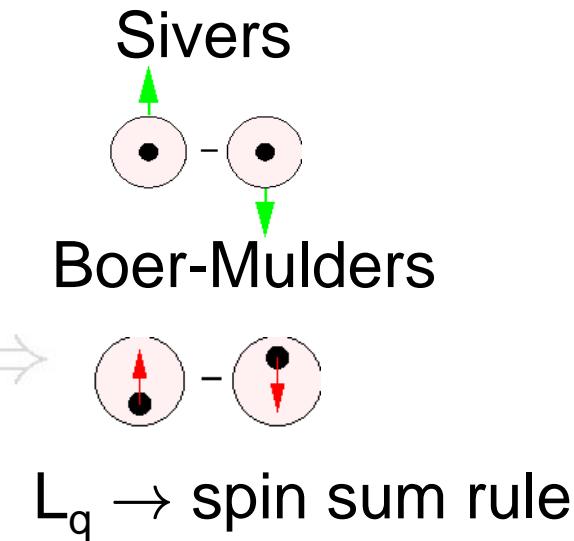
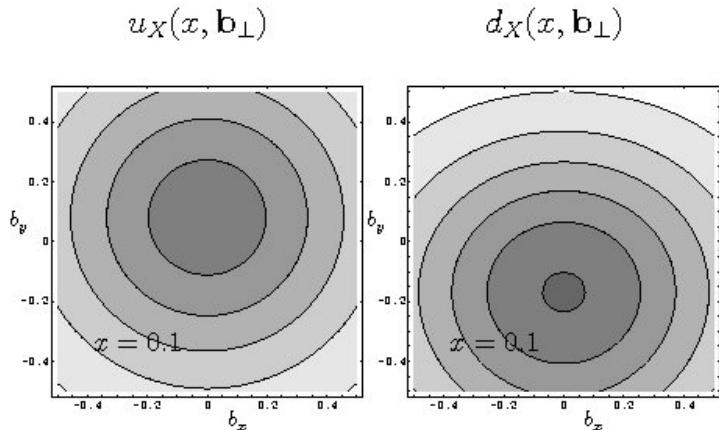
- Funzioni partoniche di distribuzione e frammentazione
 - analisi fenomenologica di Single Spin Asymmetries (SSA) [Bianconi, Radici]
 - costruzione di modelli [Conti, Radici]
 - Generalized Parton Distributions (GPD) [Boffi, Pasquini, Pincetti]
 - Momenti delle GPD in $B\chi PT$: estrapolazione di reticolo [Dorati]
 - Beam Spin Asymmetry (BSA) in e-N scattering \rightarrow GPD(N,N*) [Pasquini]
- Fattori di forma del nucleone e risonanze barioniche
 - opportunità della cinematica time-like [Bianconi, Pasquini, Radici]
- Il nucleone nel mezzo nucleare
 - correlazioni e interazioni di stato finale [Giusti, Pacati]
 - PV scattering di ν : contenuto di s nel nucleone [Meucci, Giusti, Pacati]

$$(e, \mu) / (\pi, \bar{p}, p) + p^\uparrow \rightarrow (e', \mu') / (\pi, K) / (l^+ l^-) + X$$

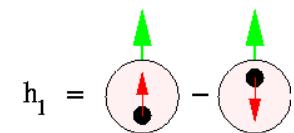
Semi-inclusive (SI) DIS, collisioni adroniche, Drell-Yan

$$SSA = \frac{d\sigma(p^\uparrow) - d\sigma(p^\downarrow)}{d\sigma(p^\uparrow) + d\sigma(p^\downarrow)} \approx \frac{q^\uparrow(x, \mathbf{k}_T) [\otimes FF^{(\uparrow)}(z, \mathbf{k}_T)] [\otimes q(x, \mathbf{k}_T)]}{q(x, \mathbf{k}_T) [\otimes FF(z, \mathbf{k}_T)] [\otimes q(x, \mathbf{k}_T)]}$$

$$q^\uparrow(x) =$$



transversity



completa
struttura di
spin del N

Simulazioni per PANDA, COMPASS, RHIC: Bianconi & Radici

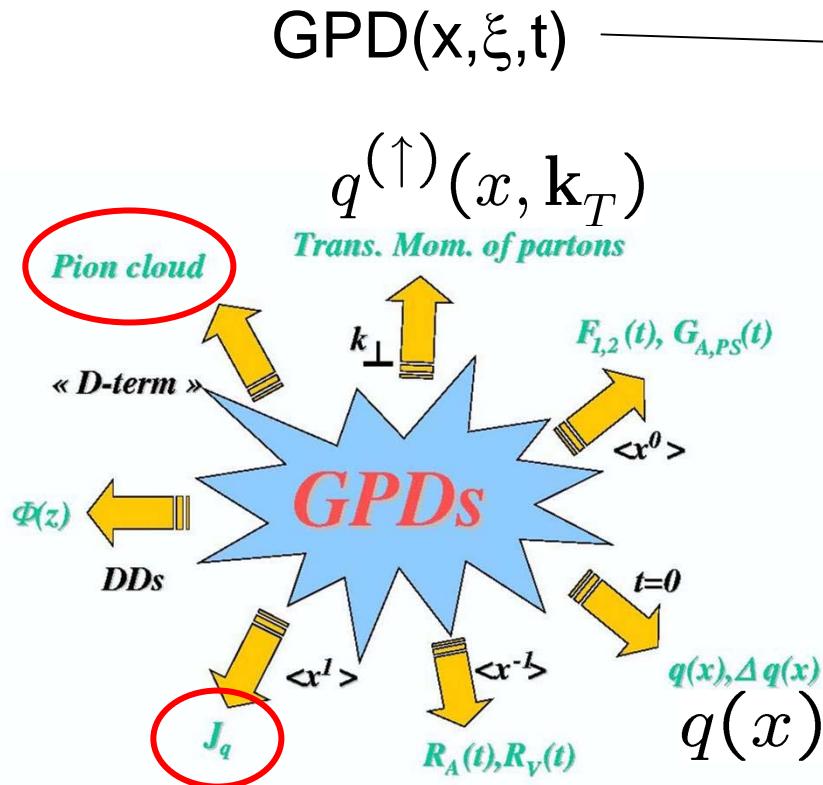
P.R.D71,074014('05); D72,074013('05); D73,114002('06); J.Ph.G31,645 ('05) +in press

Modello a diquark: Bacchetta & Conti & Radici in preparation

Studio di DiFF [q^\uparrow \rightarrow (h_1 h_2) X]: Bacchetta & Radici (& Ceccopieri)

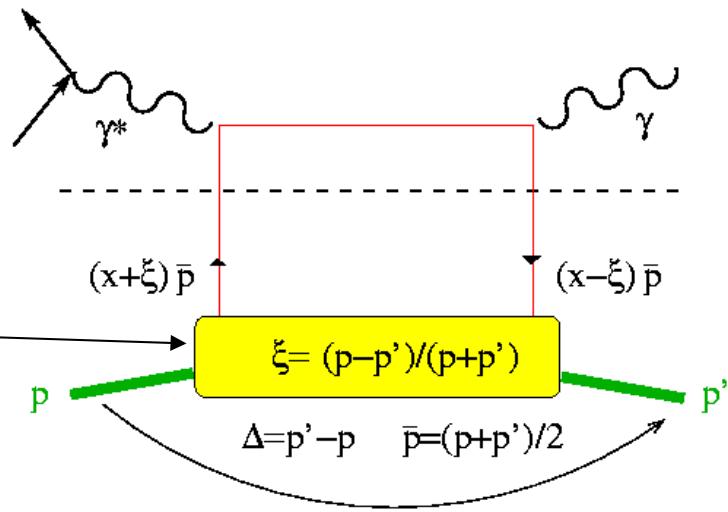
P.R.D69,074026('04); D70,094032('04); D74,114007('06); P.L.B in press

Regime DVCS:
 $Q^2 \rightarrow \infty$; $t = \Delta^2$ piccolo



$$\sum_q J_z^q(\mu^2) = \frac{1}{2} \int_{-1}^1 dx x \left[f_1^q(x, \mu^2) + E^q(x, 0, 0, \mu^2) \right]$$

$$\sum_q L_z^q(\mu^2) = \sum_q J_z^q(\mu^2) - \int_{-1}^1 dx g_1(x, \mu^2)$$



overlap representation +
 π cloud model :

Boffi & Pasquini (& Pincetti)
 P.R.D71,034022 ('05)
 D72,094029 ('05)
 D73,094001 ('06)

generalized form factor

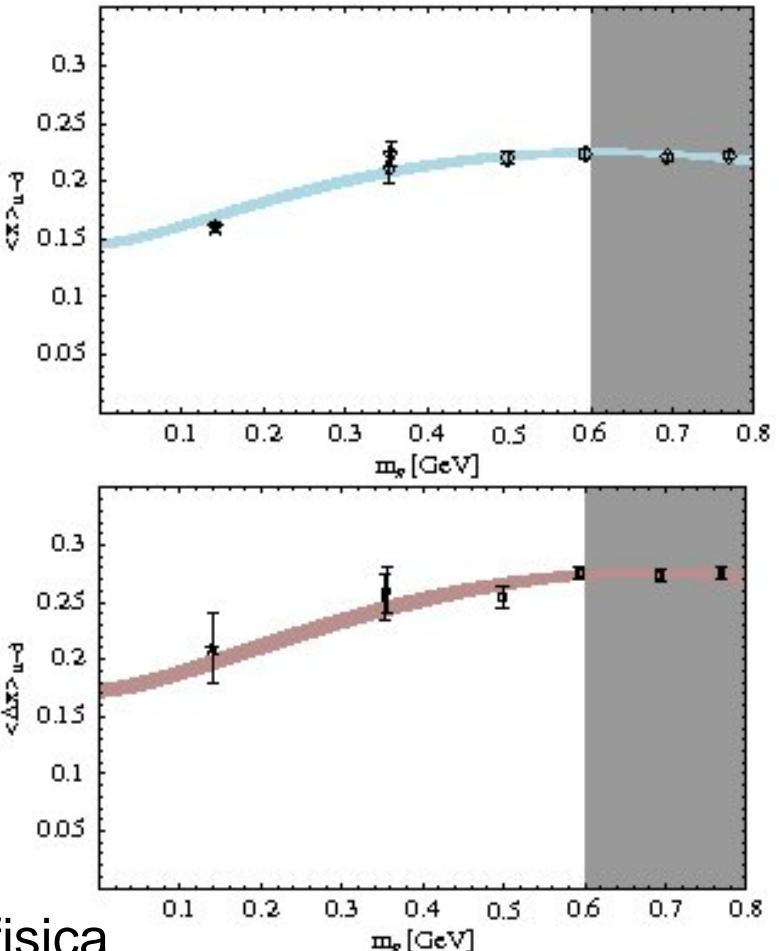
$$\text{GF}^n(t) = \int dx x^{n-1} \text{GPD}(x, \xi, t)$$

Generalized form factors

Covariant Baryon chiral (χ) Perturbation Th
 $B\chi\text{PT}$ a $O(p^2) \rightarrow 3$ parametri

$$\begin{aligned} \text{GF}^2(t; q) &\equiv A^q(t) = \int dx x \text{GPD}(x, \xi, t; q) \\ &A^q(t \rightarrow 0) = \langle x \rangle_q \end{aligned}$$

$$\begin{aligned} \text{GF}^2(t; \vec{q}) &\equiv B^q(t) = \int dx x \text{GPD}(x, \xi, t; \vec{q}) \\ &B^q(t \rightarrow 0) = \langle \Delta x \rangle_q \end{aligned}$$



Fit a dati di reticolo \rightarrow estrapolazione a m_π fisica
curvatura da effetti non lineari non ovvii

Dorati & Hemmert in preparation

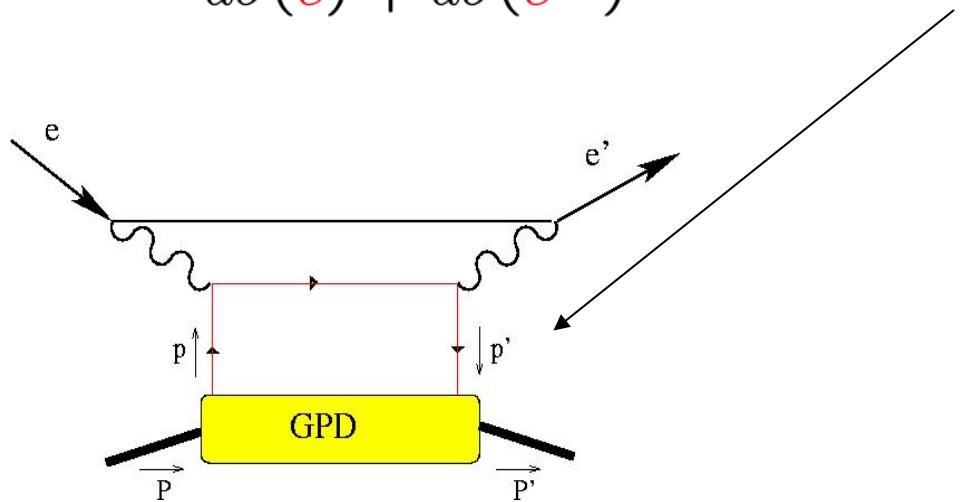
polarizzabilità generalizzate del N in $B\chi\text{PT}$: Pasquini

con JLAB Hall A P.R.L. **93**, 122001 ('04); con Drechsel & Tiator E.P.J. **A27**, 231 ('06)

$$\vec{e} \vec{p} \rightarrow e' p$$

Beam (/ target) Spin Asymmetry (BSA)

$$SSA = \frac{d\sigma(\vec{e}) - d\sigma(\vec{e}^\leftarrow)}{d\sigma(\vec{e}) + d\sigma(\vec{e}^\leftarrow)} \approx \text{Im [box]} \sim \text{DVCS tensor} \sim \text{GPD}$$

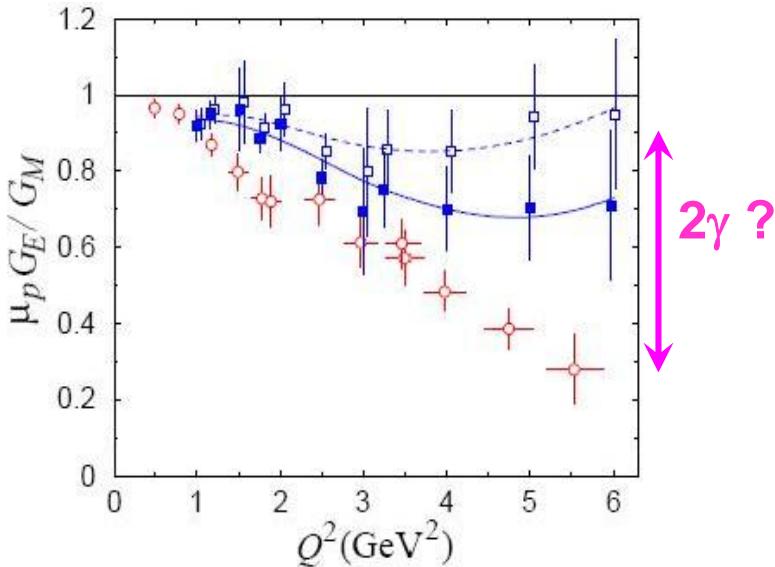


Pasquini & Vanderhaeghen
P.R. C70, 045206 ('04)
E.P.J. A24 S2:29 ('05)

MAMI A1 collaboration + Pasquini
hep-ph/0612248 spedito a E.P.J. A

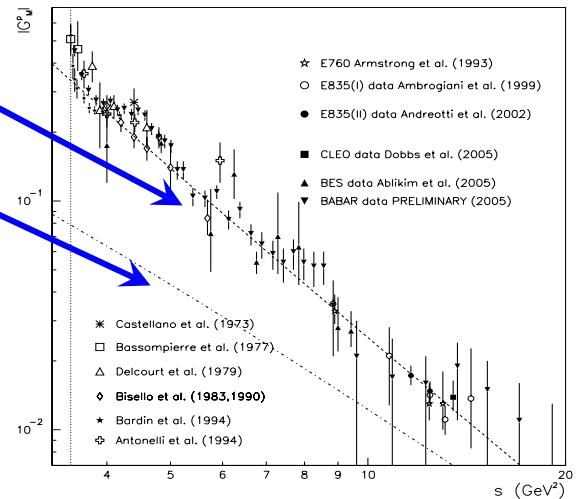
Fattori di forma del nucleone

space-like



$$G_M^p(-q^2) \approx \frac{1}{2} |G_M^p(q^2)|$$

time-like

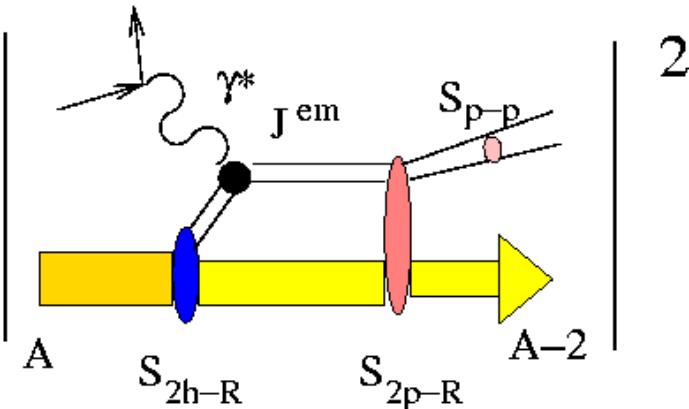


- poor angular coverage; data mainly from σ_{tot} with $|G_E^p| = |G_M^p|$ true only at threshold $q_0^2 = 4M^2 \rightarrow |G_E|$ is unknown!
- only 1 measurement for neutron (ADONE-1998) $|G_M^p| \leq |G_M^n|$
- no polarization data \rightarrow phases of $G_{E/M}$ unknown !

Simulazioni Monte Carlo per DAFNE2 e PANDA: Bianconi & Pasquini & Radici
RoadMap Gr.1 E.P.J.C50,729('07); P.R. D74 034009 ('06); D74 074012 ('06)

2-N emission

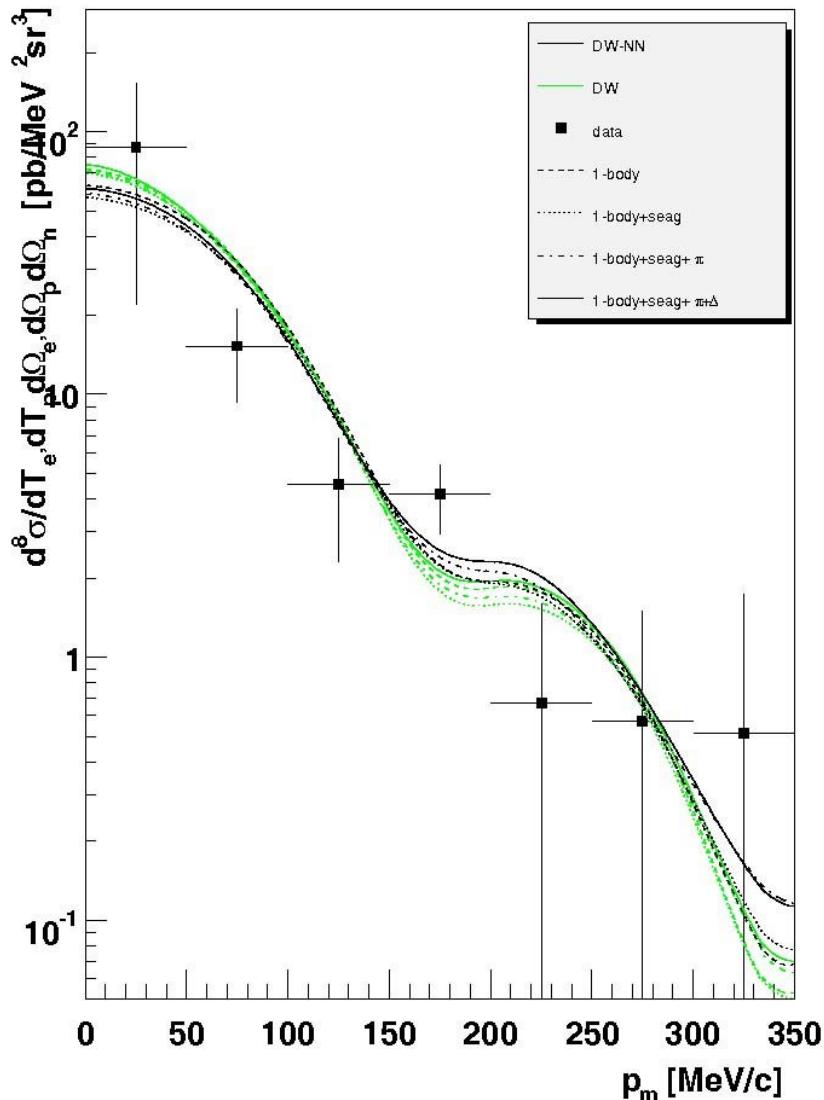
→ correlazioni “gratis”



- correlazioni a corto raggio
- vertice e.m. a 1 e 2 corpi (gauge inv.)
- interazioni stato finale

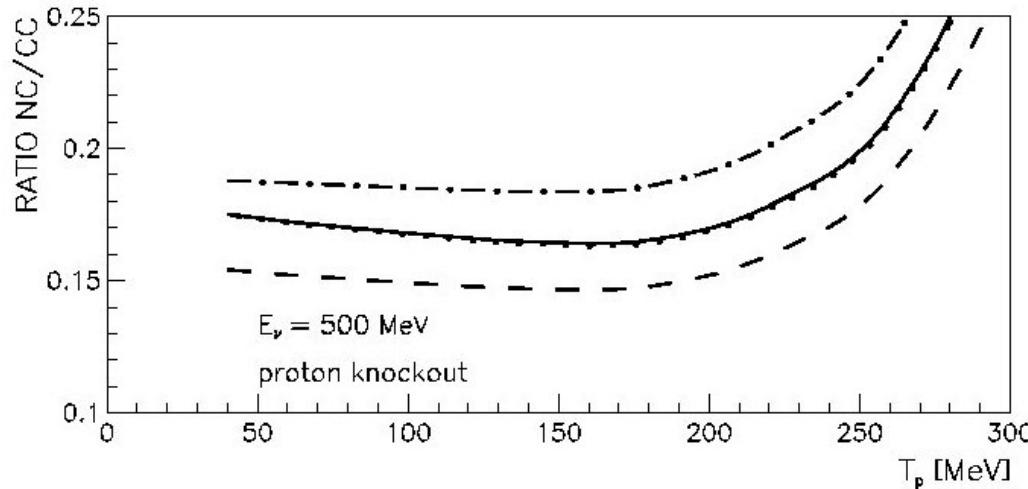
Giusti & Pacati & Schwamb & Boffi
 E. P. J. **A26**, 209 ('05)
 MAMI + Giusti & Pacati in preparation

$^{16}\text{O}(\text{e},\text{e}'\text{pn})$: $(2 < E_x < 9)/3.95\text{MeV}$



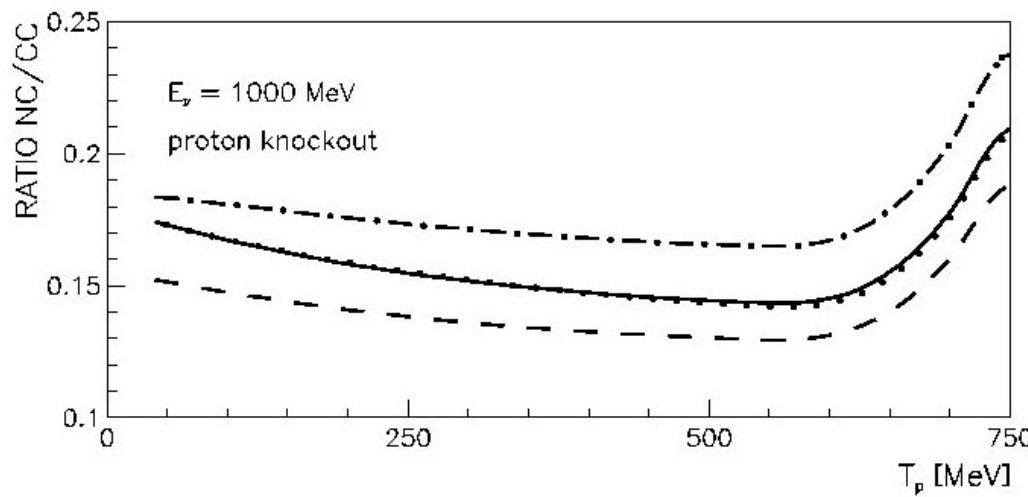
Parity Violating (PV) $e / \nu / \bar{\nu}$ scattering su nuclei

\rightarrow contenuto di s nel nucleone



$\nu_\mu(\bar{\nu}_\mu)^{12}C$

- dashed lines \rightarrow no s
- solid lines $\rightarrow g_A^S = -0.10$
- dot-dashed lines
 $\rightarrow g_A^S = -0.10$ e $\mu^S = -0.50$
- dotted lines
 $\rightarrow g_A^S = -0.10$ e $\rho^S = +2$



Meucci & Giusti & Pacati
N.P. A756, 359 ('05)

Collaborazioni con :

- Institut fuer Kernphysik – Mainz
(A1 coll.; Drechsel + Tiator)
- INRNE – Bulgarian Academy of Science – Sofia
(Antonov + Kadrev)
- DESY – Th Div. (Bacchetta)
- Inst. Theoretische Physik – Univ. Graz
(Melde + Plessas)
- Techn. Universitaet – Monaco (Hemmert)
- Univ. Williamsburg (VA-USA; Vanderhaeghen)