Future directions for probing two and three nucleon short-range correlations at high energies

Mark Strikman, Penn State

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Outline

Summary of what was learned about short-range correlations in the last few years.

Directions for study of two nucleon short-range correlations in nuclei

Directions for study of three nucleon short-range correlations in nuclei

How to discover the structure of nonnucleonic baryonic degrees of freedom in nuclei.

Fundamental questions of microscopic quark-gluon structure of nuclei and nuclear forces

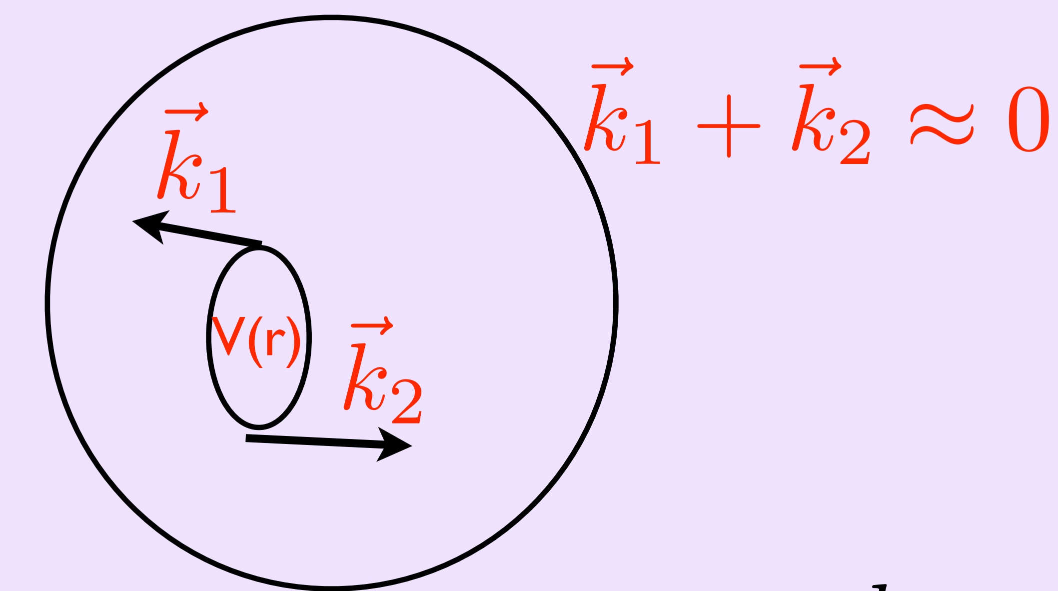
- Microscopic origin of intermediate and short-range nuclear forces
- Are nucleons good nuclear quasiparticles?
- Probability and structure of the short-range correlations in nuclei
- What are most important non-nucleonic degrees of freedom in nuclei?

Probability and structure of the short-range correlations (SRC) in nuclei

SRC for many years considered to be important though elusive feature of nuclear structure - ≥ 60% kinetic energy of nuclei are due to SRC

Questions:

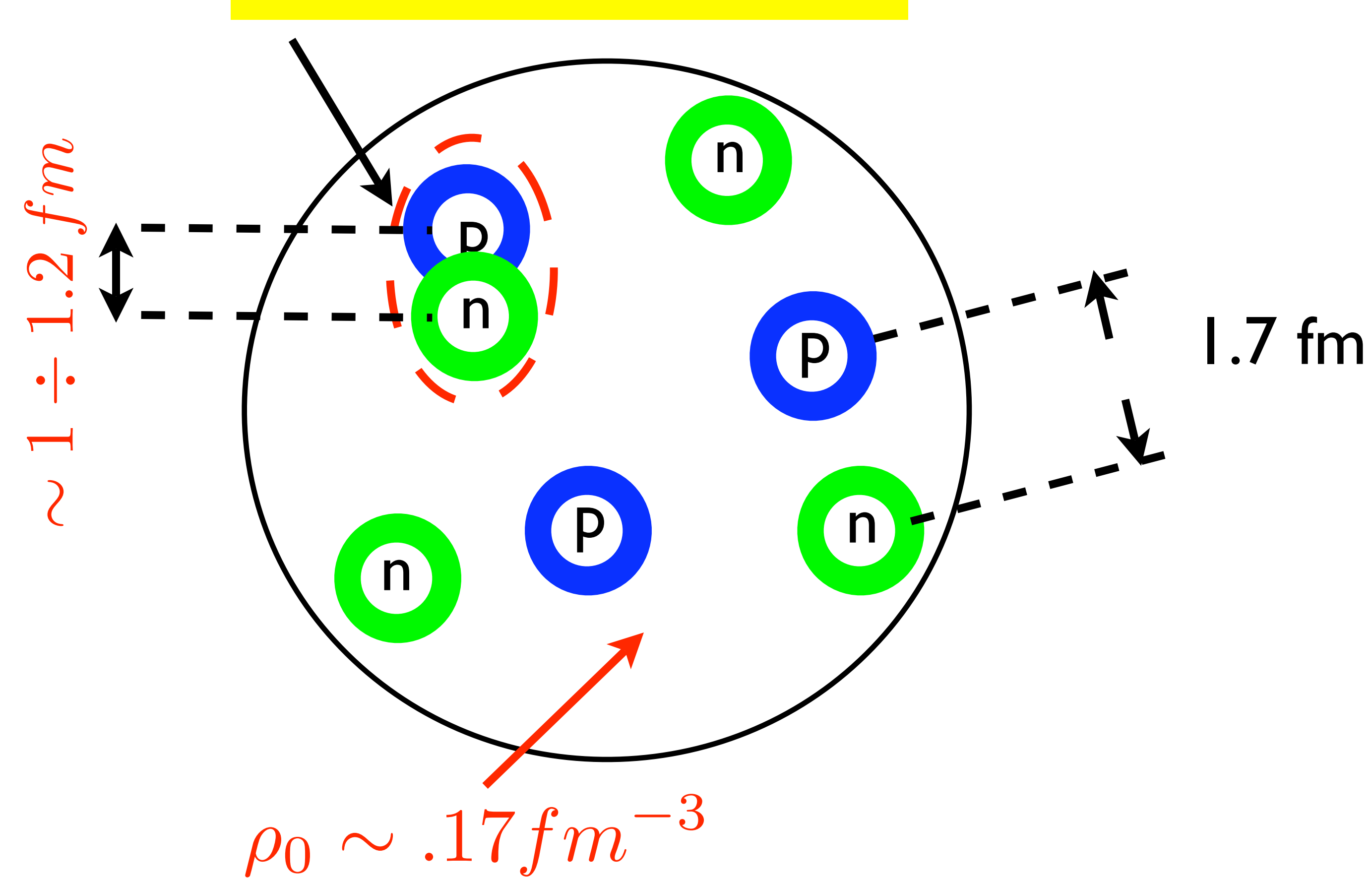
- How large is probability of SRC ?
- Isotopic structure
- Non-nucleonic degrees of freedom



Two nucleon SRC

Dominant contribution for large k; universal (A-independent up to isospin effects) momentum dependence

Short-range NN correlations (SRC) have densities comparable to the density in the center of a nucleon - *drops of cold dense nuclear matter*



Connections to neutron stars:
a) I=1 nn correlations,
b) admixture of protons in neutron stars → I=0 sensitivity
c) multi-nucleon correlations

Consensus of the 70's: it is hopeless to look for SRC experimentally

Phys.Lett. rules of 1976 as stated to us by Andi Jackson - reject claims to the opposite without peer review

NO GO theorem: high momentum component of the nuclear wave function is not observable (Amado 78)

Theoretical analysis of F&S (75): results from the medium energy studies of short-range correlations are inconclusive due to insufficient energy/momentum transfer leading to complicated structure of interaction (MEC,...), enhancement of the final state contributions.

Way out - use processes with large energy and momentum transfer:

$$q_0 \geq 1GeV \gg |V_{NN}^{SR}|, \vec{q} \geq 1GeV/c \gg 2\ k_F$$

Adjusting resolution scale as a function of the probed nucleon momentum allows to avoid Amado theorem. Standard strategy in high energy QCD

Last two years a qualitative progress in the study of SRC based on the analysis of the high momentum transfer (e,e') Jlab data, (p,2pn) BNL data and preliminary (e,e'pp) & (e,e'pn) Jlab data. SRC are not anymore an elusive property of nuclei !!

Summary of the theoretical analysis of the experimental findings

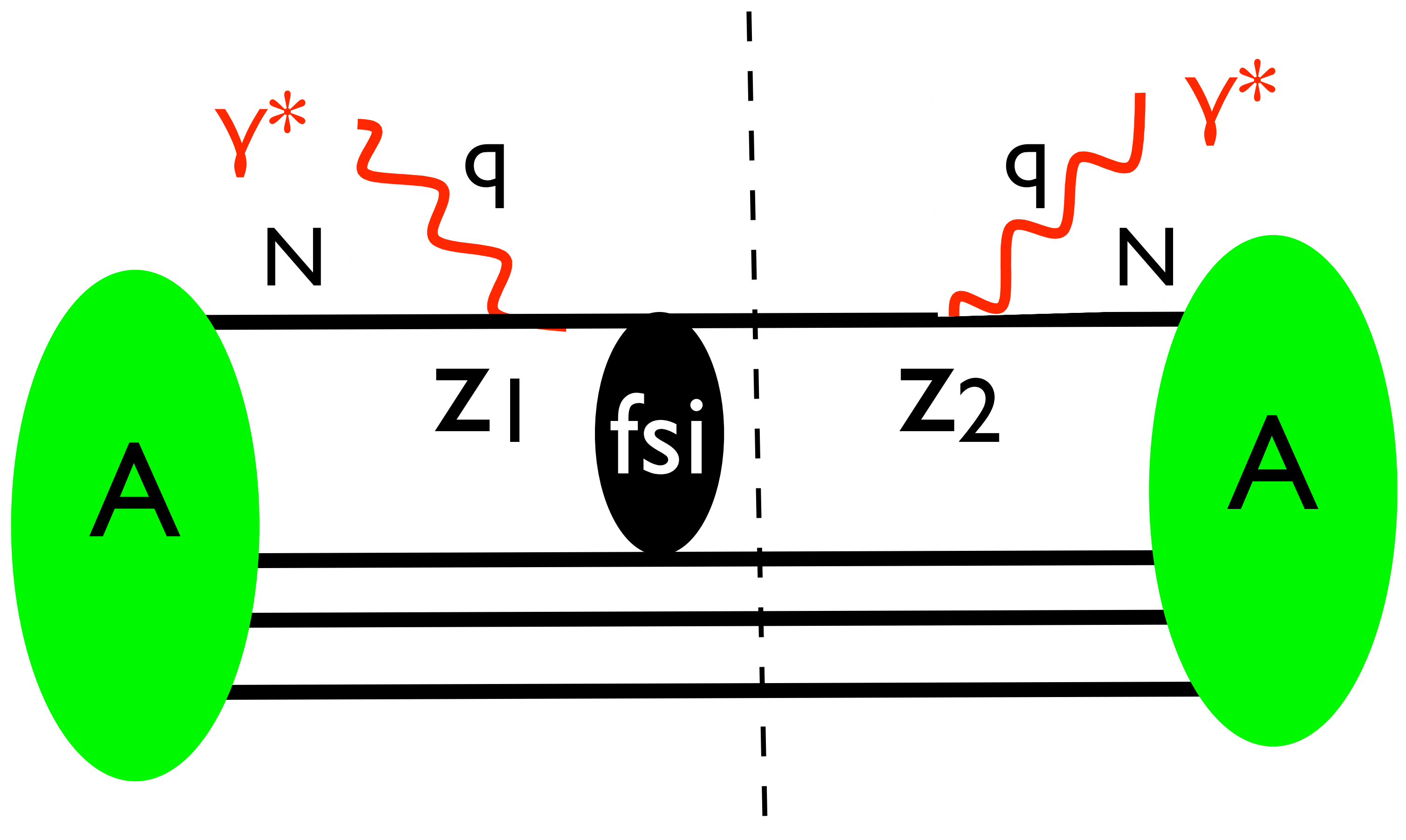
practically all of which were predicted well before the data were obtained

- More than ~90% all nucleons with momenta k≥300 MeV/c belong to two nucleon SRC correlations — BNL + Jlab +SLAC
- Probability for a given proton with momenta 600> k > 300 MeV/c to belong to **pn** correlation is ~ 18 times larger than for **pp** correlation — BNL + Jlab
- Probability for a nucleon to have momentum > 300 MeV/c in medium nuclei is ~25% — BNL + Jlab 04 +SLAC 93
- Probability of non-nucleonic components within SRC is small - < 20% - 2N SRC mostly build of two nucleons not 6q, ΔΔ,... — BNL + Jlab +SLAC
- Three nucleon SRC are present in nuclei with a significant probability — Jlab 05

The findings confirm our predictions based on the study of the structure of SRC in nuclei (77-93), add new information about isotopic structure of SRC. In particular this confirms our interpretation of the fast backward hadron emission observed in the 70's-80's as to due to SRC and allows to use information from these experiments for planning new experiments which would allow unambiguous interpretation.

Progress in the studies of SRC at high momentum due to two concepts

Closure approximation for A(e,e') at $x > 1$, $Q^2 > 1.5$ GeV^2 up to fsi in the SRC



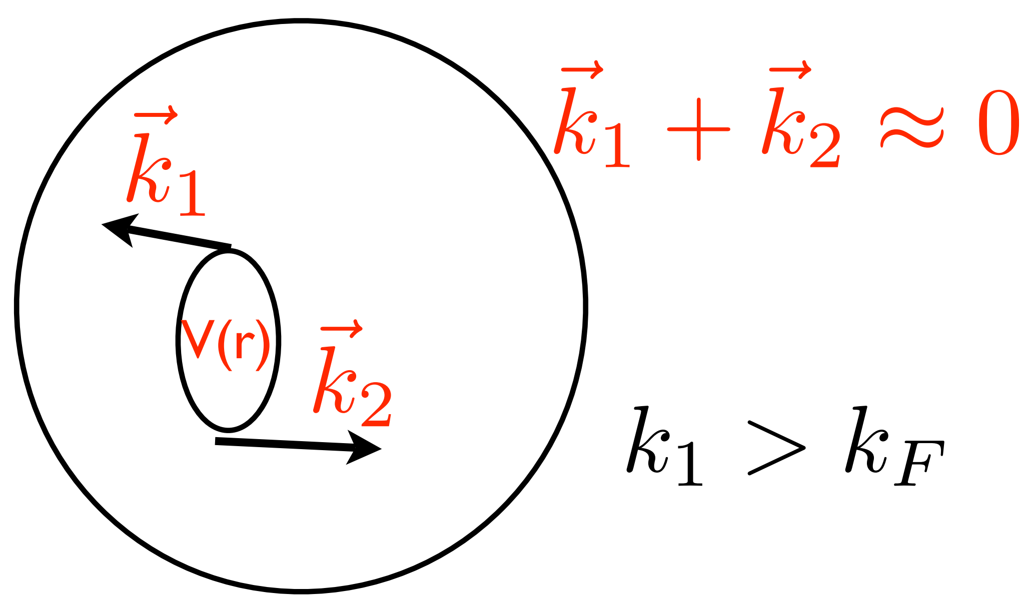
$z_1 - z_1 < 1.2$ fm ➠ only fsi within SRC

Corrections could be calculated for large Q using generalized eikonal approximation (GEA). For interactions of knocked out nucleon with slow nucleons they are less than few % - LF & Misak Sargsian & MS (08)

Hard exclusive processes where a nucleon of SRC is removed instantaneously

probe another quantity sensitive to SRC - nuclear decay function (FS 77-88) - probability to emit a nucleon with momentum k_2 after removal of a fast nucleon with momentum k_1, leading to a state with excitation energy E_r (nonrelativistic formulation)

$$D_A(k_2,k_1,E_r) = |\langle\phi_{A-1}(k_2,...)\,|\delta(H_{A-1}-E_r)a(k_1)|\,\psi_A\rangle|^2$$

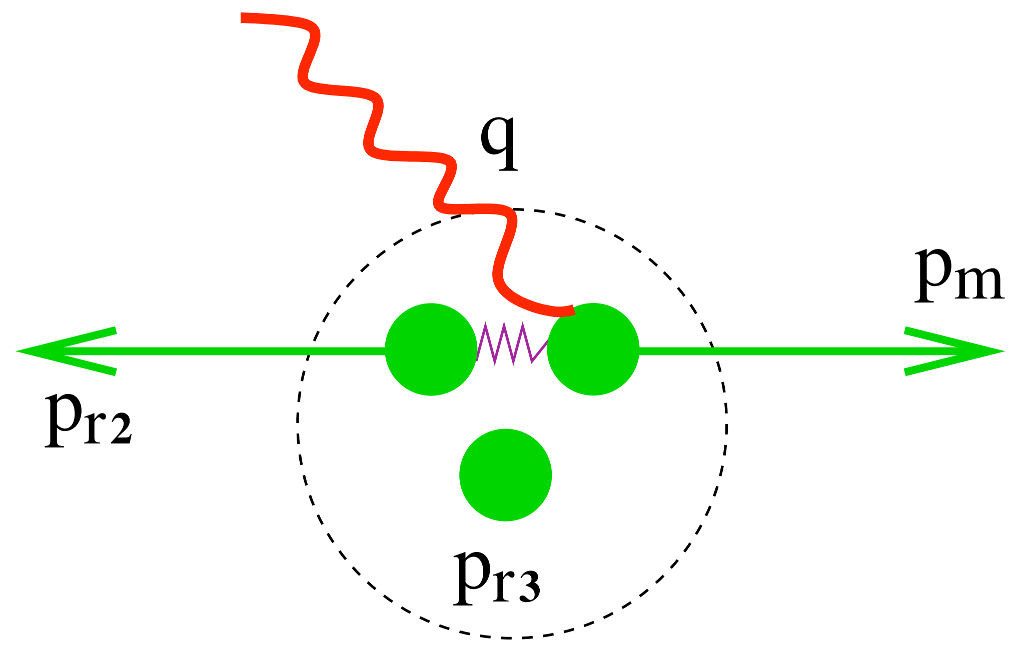


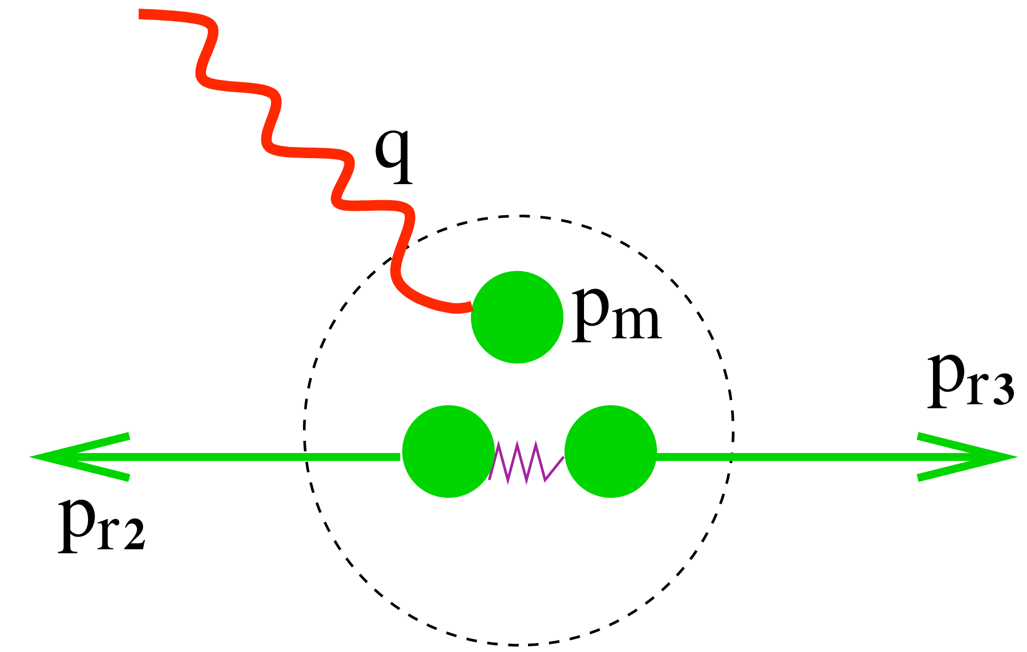
General principle (LF&MS77): to release a nucleon of a SRC - need to remove nucleons from the same correlation - perform a work against potential $V_{12}(r)$

Operational definition of the SRC: nucleon belongs to SRC if its instantaneous removal from the nucleus leads to emission of one or two nucleons which balance its momentum: includes not only repulsive core but also tensor force interactions.

For 2N SRC can model decay function as decay of a NN pair moving in mean field (like for spectral function in Ciofi & Simula, LF&MS 01) Piasetzky et al 06

Spectator is released





Emission of fast nucleons "2" and "3" is strongly suppressed due to FSI

resembles 2N momentum distribution

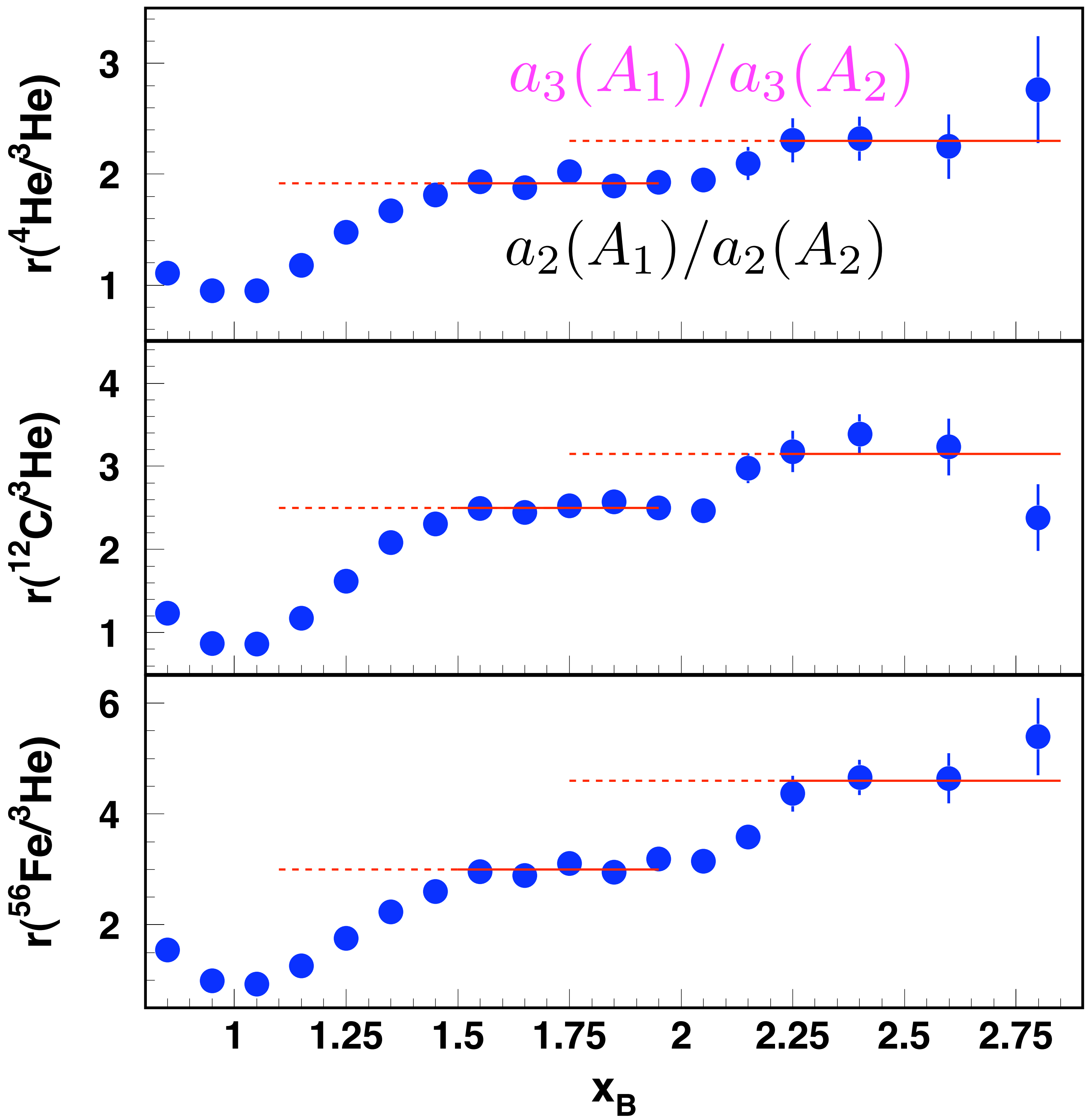
does not resemble 2N momentum distribution

Studies of the spectral and decay function of 3He reveal both 2N and 3N SRCs Sargsian et al 2004

Note that in the decay one needs to take into account recoil effects - naturally accounted for when using relativistic light-cone decay functions: conservation of LC fractions

Problem - no methods so far to calculate decay functions for A >4. However the decay function and another interesting characteristics of the nuclear structure - two nucleon momentum distributions in the nuclei (talk of Alvioli) is close to decay function for $k_1+k_2=0$, $k_1>>k_F$ *though not if* $|k_1+k_2|>$ 50 - 100 MeV/c.

Scaling of ratios - evidence for universal nucleonic SRC



Jlab data from Hall B.
$Q^2 > 1.5\ GeV^2$

confirm our 1980 prediction of scaling for the ratios due to SRC

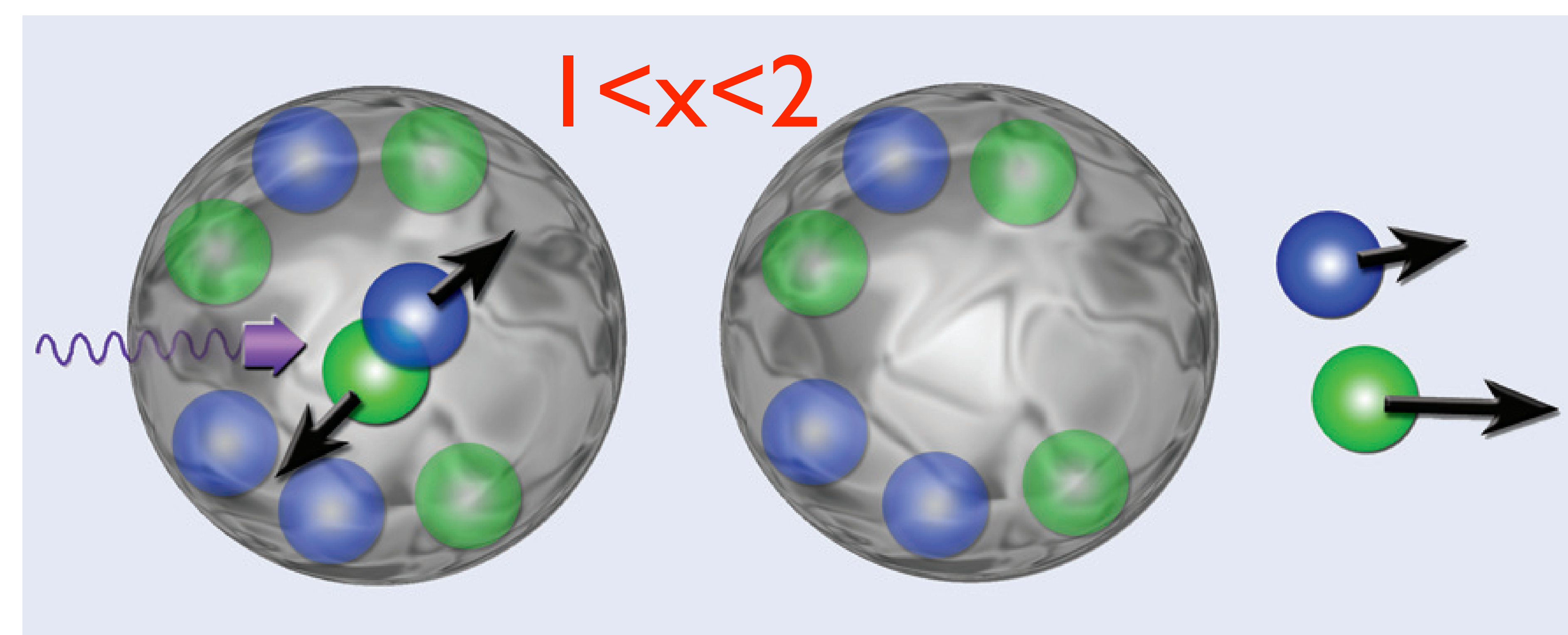
Fe/C ratios for x~1.75, x~2.5 agree within experimental errors with our prediction - density based estimate:

$$r_2 = (A_1/A_2)^{0.15}$$

$$r_3 = (A_1/A_2)^{0.22}$$

Ratio of the cross sections of (e,e')scattering off a ^{56}Fe (^{12}C,^4He) and ^3He per nucleon

The best evidence for presence of 3N SRC. One probes here interaction at internucleon distances <1.2 fm corresponding to local matter densities $\geq 5\rho_0$ which is comparable to those in the cores of neutron stars!!!



Before absorption of the photon

After absorption

Two nucleon correlations - probability relative to "pn" in deuteron

Day, L.Frankfurt, Sargsian, MS, 93

$$a_2(^3\mathrm{He}) = 1.7(0.3)\ ,$$
$$a_2(^4\mathrm{He}) = 3.3(0.5)\ ,$$
$$a_2(^{12}\mathrm{C}) = 5.0(0.5)\ ,$$
$$a_2(^{27}\mathrm{Al}) = 5.3(0.6)\ ,$$
$$a_2(^{56}\mathrm{Fe}) = 5.2(0.9)\ ,$$
$$a_2(^{197}\mathrm{Au}) = 4.8(0.7)\ ,$$

Significant uncertainties in absolute scale

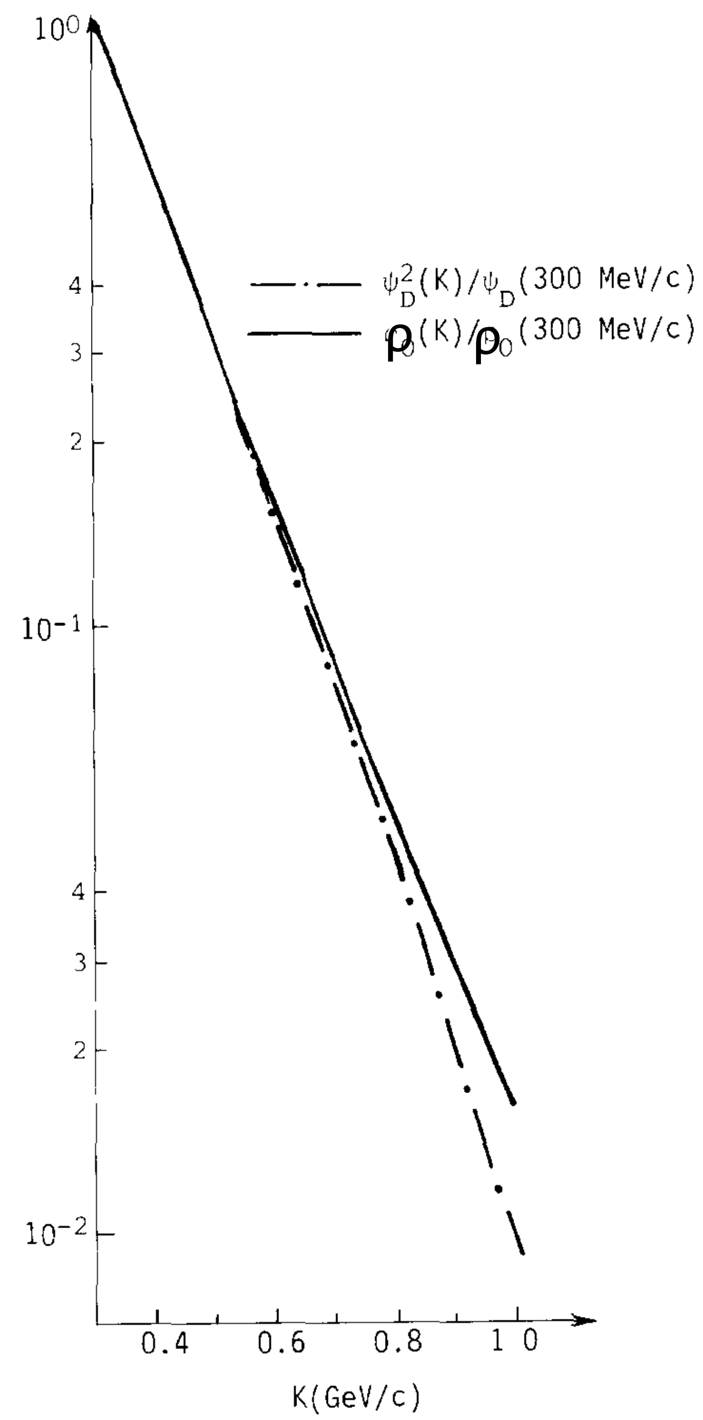
	$a_2(A/^3\mathrm{He})$	$a_{2N}(A)(\%)$	$a_3(A/^3\mathrm{He})$	$a_{3N}(A)(\%)$
$^3\mathrm{He}$	1	8.0±0.0±1.6	1	0.18±0.00±0.06
$^4\mathrm{He}$	1.96±0.01± 0.03	15.6±0.1±3.2	2.33±0.12±0.04	0.42±0.02±0.14
$^{12}\mathrm{C}$	2.51±0.01± 0.15	20.0±0.1±4.4	3.18±0.14±0.19	0.56±0.03±0.21
$^{56}\mathrm{Fe}$	3.00±0.01± 0.18	24.0±0.1±5.3	4.63±0.19±0.27	0.83±0.03±0.27

K.Egiyan, et al 2005

Amazingly good agreement between two analyses for a_2 (A)

Compare also to the analysis of EVA data on (p,2p) - $a_2(C) \sim 5$ Yaron et al 02

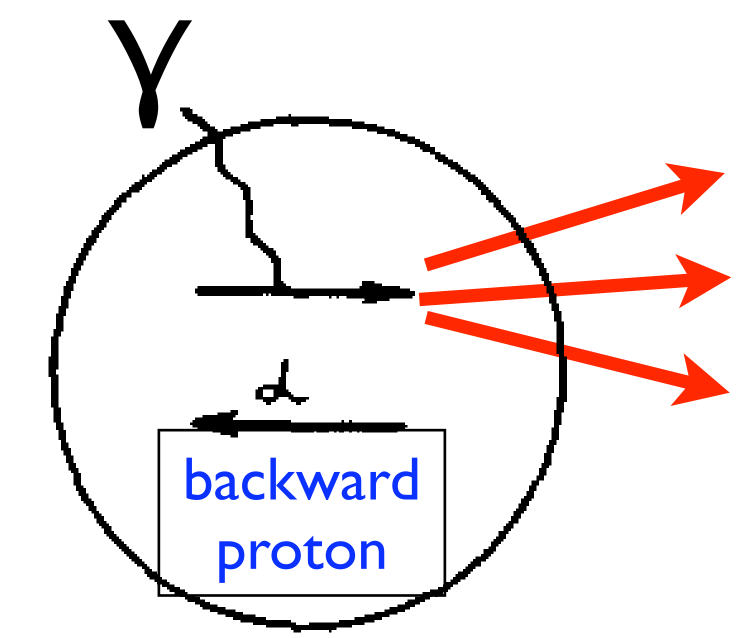
We extracted two nucleon correlation function from analysis of $\gamma(p)\ ^{12}C \rightarrow p+X$ processes



Hamada-Johnston WF

Extracted from the data assuming dominance of 2N SRC

From Phys.Lett 1977



Momentum distribution normalized to its value at 300 MeV/c.

We also estimated from these data $a_2(^{12}C) = 4 \div 5$

Backward direction is very good for looking for decay of SRCs

*) We wanted to name such particles backfires but were gave up because of censorship problems.

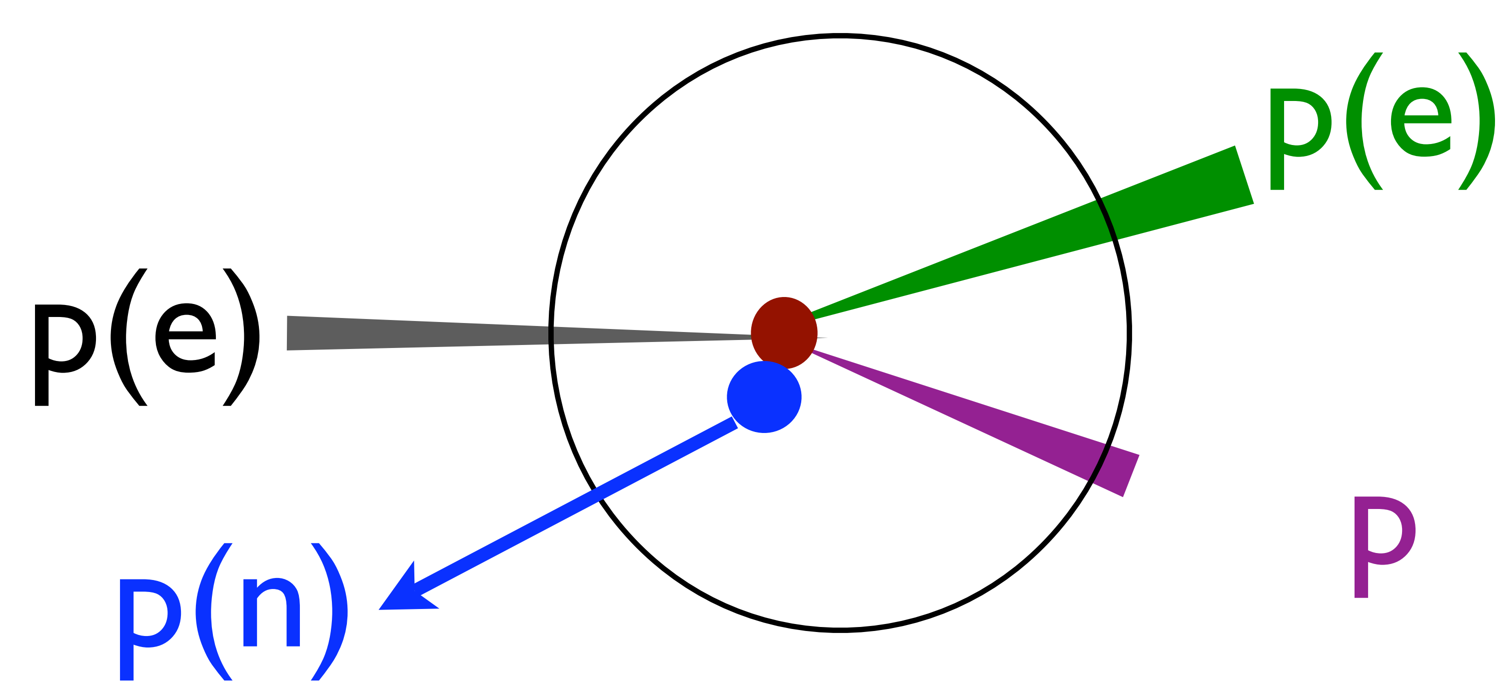
Further 2N correlation studies -- need more phase space to be able to find kinematics with minimal fsi between nucleons of the 2N SRC.

Easier to do with proton beams or higher energy electron beams - In this respect BNL (p,2pn) experiment had a better kinematics than Jlab (e,e'pp/pn) experiment.

Further studies are necessary, preferably using both leptonic and hadronic projectiles. It is crucial to establish that different probes give the same results for SRC. Set-up is the same as for CT measurements - can be done simultaneously.

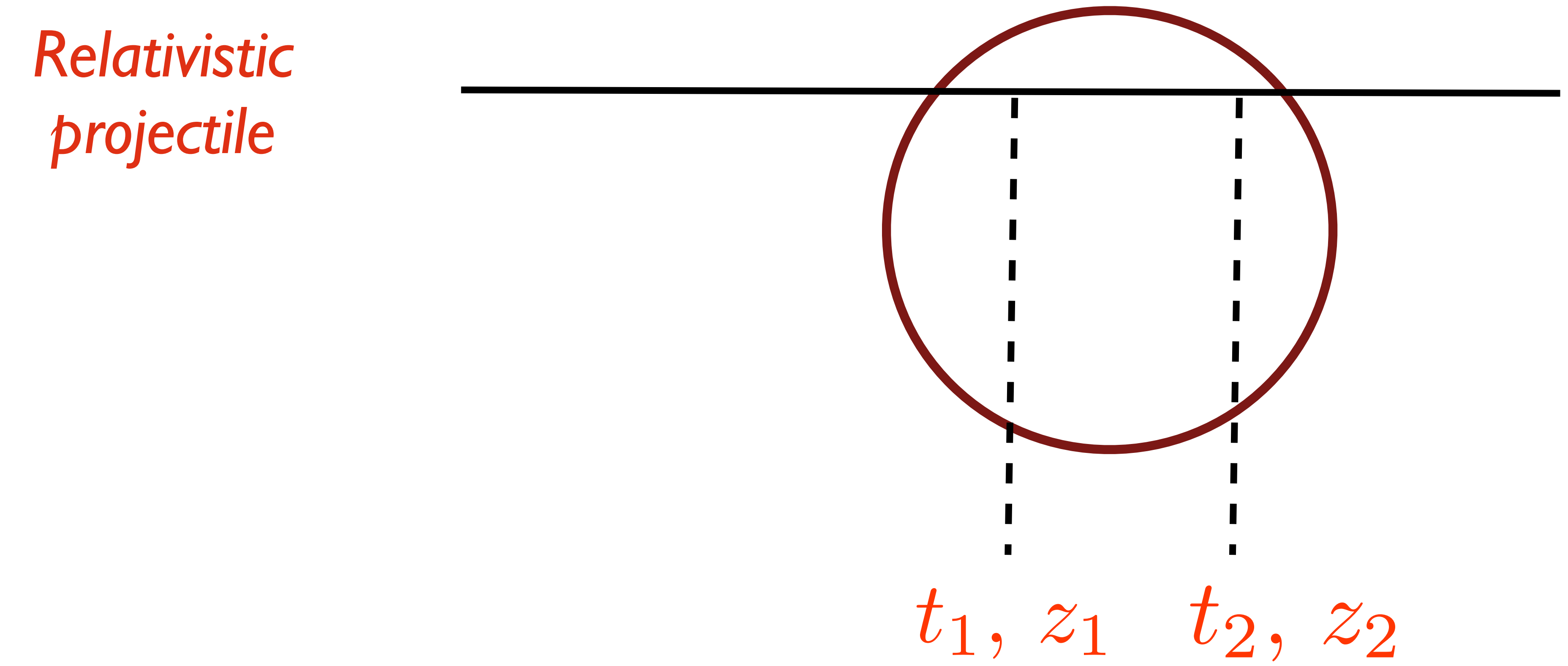
Important: *Factorization tests for 2N SRC - removal of a nucleon at different Q and by different probes - to demonstrate that decay function is universal*

Studies of forward - backward correlations for a range of light nuclei $^3He/^4He(e,e')pp/pn$ at Jlab at $Q^2=2 \div 4$ GeV^2 and at proton facilities (J-PARC, GSI) with protons of energies starting at 6 GeV. A-dependence of the pp/pn ratio, its dependence on momentum of hit nucleon. Need statistics > 100 times higher than EVA



There is a price to pay for use of high energy processes:

⇒ High energy process develops along the light cone (LC).



$$t_1 - z_1 = t_2 - z_2$$

Similar to the perturbative QCD the amplitudes of the processes are expressed through LC wave function

However for low momentum component in nuclei and for 2N SRC correspondence with nonrelativistic wave functions is unambiguous and rather simple due to angular condition FS76

Many features of NR QM hold - number of degrees of freedom, etc (but nonlinear relations with amplitudes). At the same time logic of quantum mechanics does not map easily to the language of virtual particles - transformational vacuum pairs → extra degrees of freedom.

High energy processes are dominated by interactions near light cone- hence their cross sections are simply expressed through light cone wave functions.

$$\rho_{\rm A}^{\rm p}(\alpha,k_\perp) = \int \psi^2(\alpha_1\ldots\alpha_A,k_{1\perp}\ldots k_{A\perp})\prod_{i=1}^{A}\frac{{\rm d}\alpha_i}{\alpha_i}{\rm d}^2k_{i\perp}\delta\left(1-\frac{\sum\alpha_i}{A}\right)$$
$$\times\ \delta\left(\sum_{i=1}^{A}k_{i\perp}\right)\sum_{i=1}^{Z}\alpha_i\delta(\alpha-\alpha_i)\delta(k_{i\perp}-k_\perp).$$

Single nucleon light cone density matrix

$$\int_0^A \rho_{\rm A}^{\rm N}(\alpha,k_\perp)\frac{{\rm d}\alpha}{\alpha}{\rm d}^2k_\perp = A$$

Light-cone fraction α is scaled so that 0<α<A.

$$\int_0^A \alpha\rho_{\rm A}^{\rm N}(\alpha,k_\perp)\frac{{\rm d}\alpha}{\alpha}{\rm d}^2k_\perp = \int_0^A \rho_{\rm A}^{\rm N}(\alpha,k_\perp)\frac{{\rm d}\alpha}{\alpha}{\rm d}^2k_\perp\frac{\sum\alpha_i}{A} = A.$$

Example

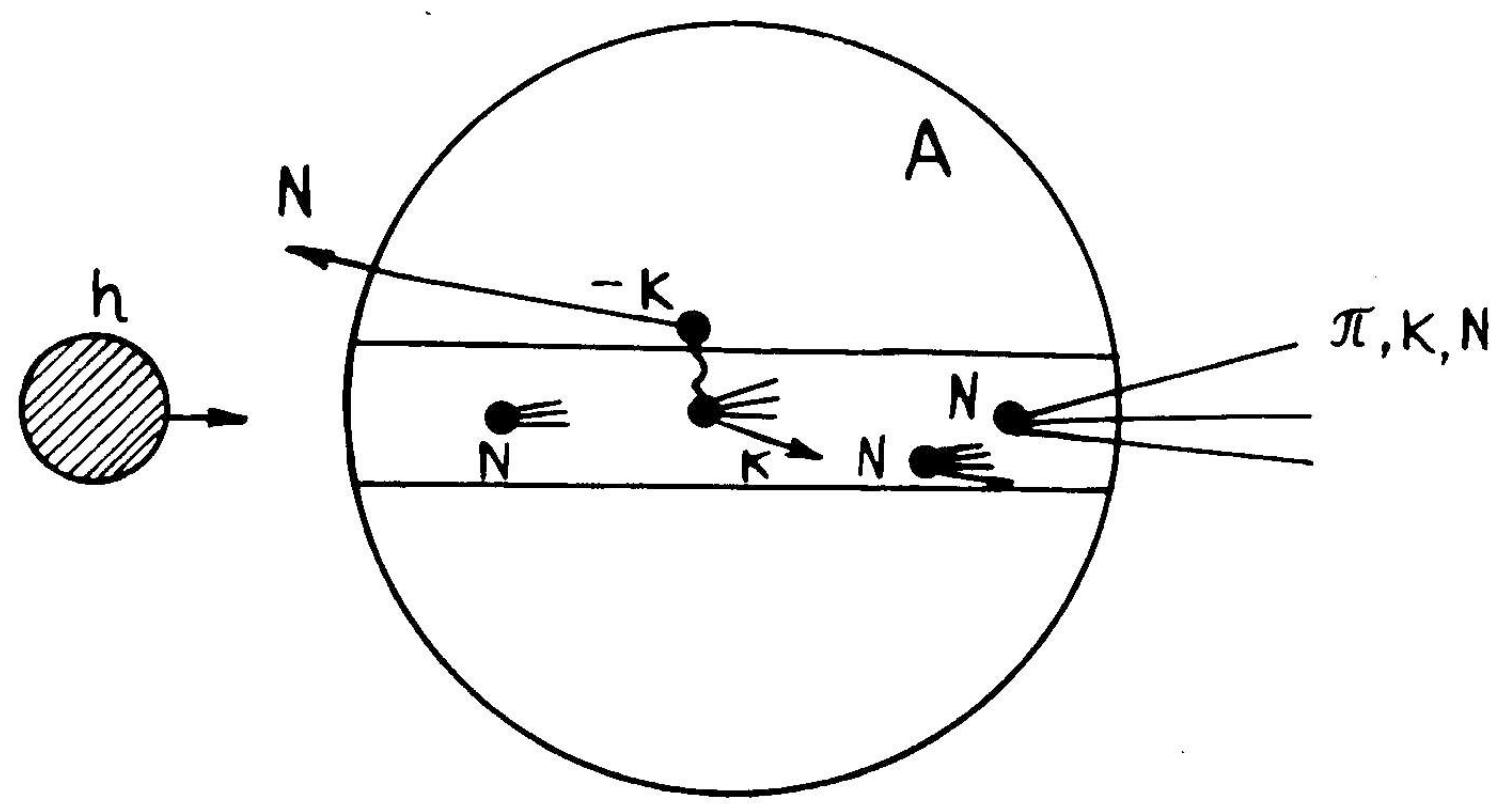
$$F_{2A}(x,Q^2) = \sum_{\rm N=p,n}\int F_{2\rm N}(x/\alpha,Q^2)\rho_A^{\rm N}(\alpha,k_{\rm t})\frac{{\rm d}\alpha}{\alpha}{\rm d}^2k_{\rm t}.$$

One can also define LC spectral function, $\rho_A^N(\alpha, p_t, M_{rec}^2)$

which due to the angular condition is a function of two variables like NR spectral function

$\rho_A^N(\alpha, p_t, M_{rec}^2)$ enters into description of (e,e') at large Q and x> 1.

Early validity of closure ⇒ can use $\int d^2 M_{rec}^2 \rho_A^N(\alpha, p_t, M_{rec}^2) = \rho_A^N(\alpha, p_t)$



Production of a fast backward nucleon in the hadron - nucleus scattering

$$G_h^{A/N}(\alpha, p_t) \equiv \frac{d\sigma^{h+A\to N+X}}{\frac{d\alpha d^2 p_t}{\alpha}} = \kappa_h A \sigma_{in}^{hN} \rho_A^N(\alpha, p_t)$$

where factor κ_h accounts for local screening effects

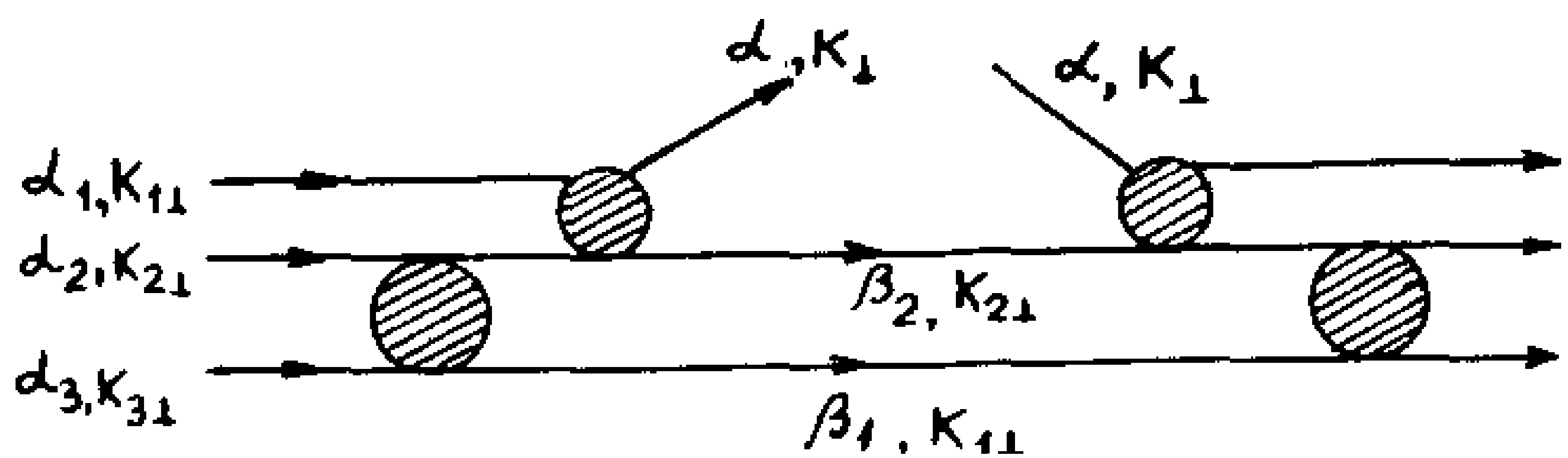
Since NN interaction is sufficiently singular for large momenta

$\rho_A^N(\alpha, p_t)$ can be expanded over contributions of j-nucleon correlations $\rho_j(\alpha, p_t)$

$$\rho_A^N(\alpha.1.3, p_t) = \sum_{j=2}^{A} \rho_j(\alpha, p_t)$$

FS 79

Three nucleon SRCs = three nearby nucleons with large relative momenta



$$\rho_j(\alpha, p_t)(j-\alpha)^{n(j-1)+j-2}, \, where \, \rho_j(\alpha, 0) \propto (2-\alpha)^n$$

Evidence from NR calculations? *3N SRC can be seen in the structure of decay of ^{3}He* (Sarsgian et al).

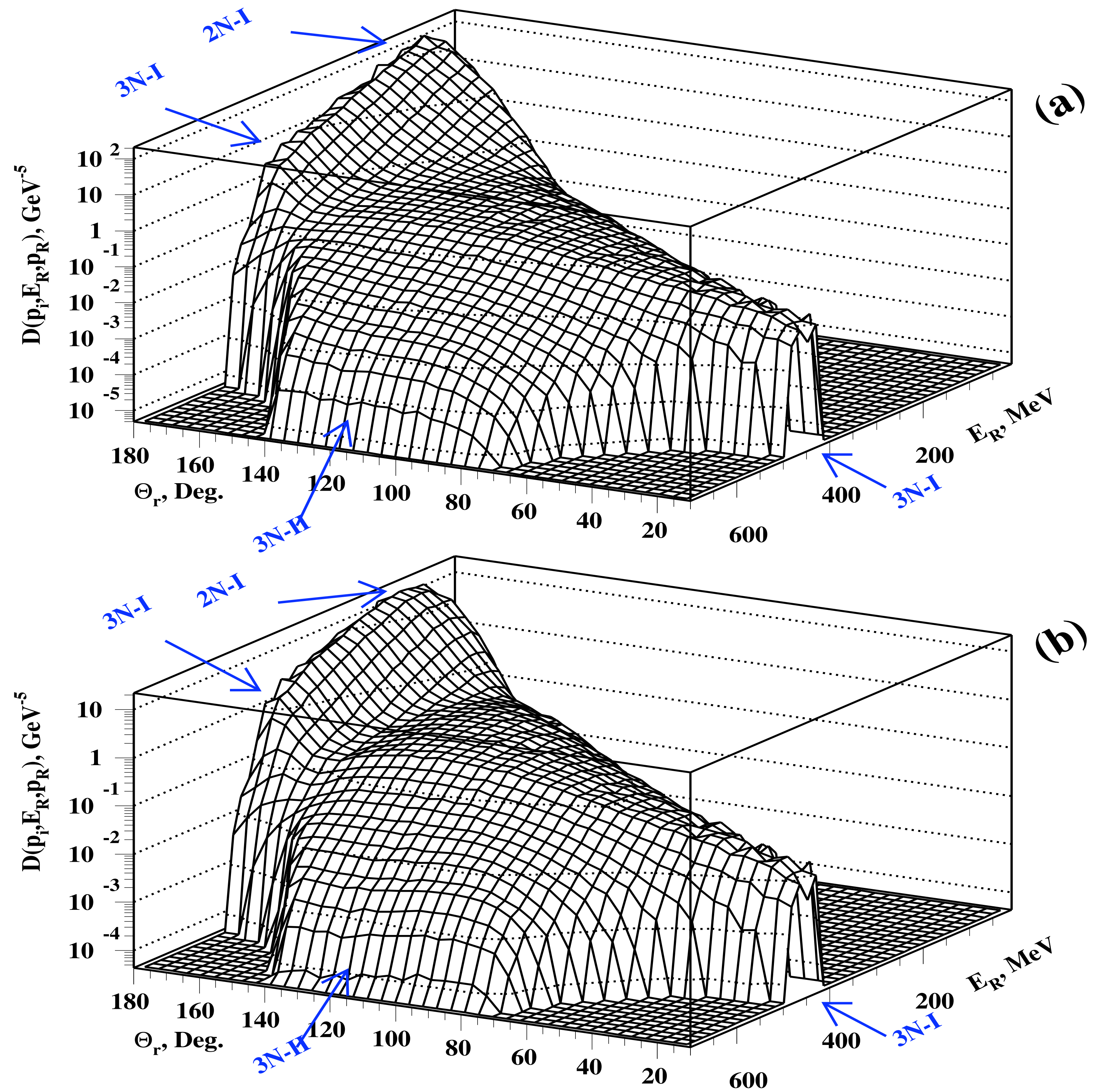
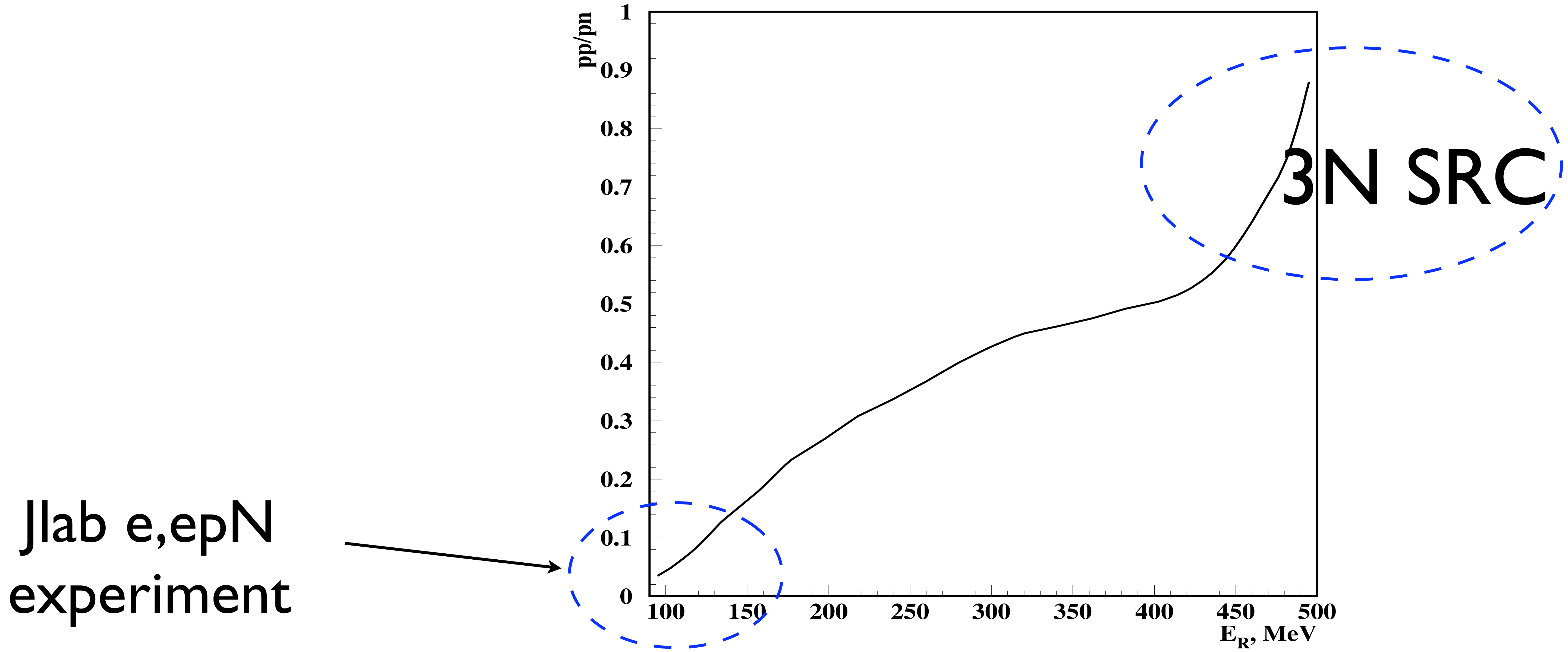


Figure 8: Dependence of the decay function on the residual nuclei energy and relative angle of struck proton and recoil nucleon. Figure (a) neutron is recoiling against proton, (b) proton is recoiling against proton. Inital momentum of the struck nucleon as well as recoil nucleom momenta is restricted to $p_{in}, p_r \geq 400$ MeV/c.

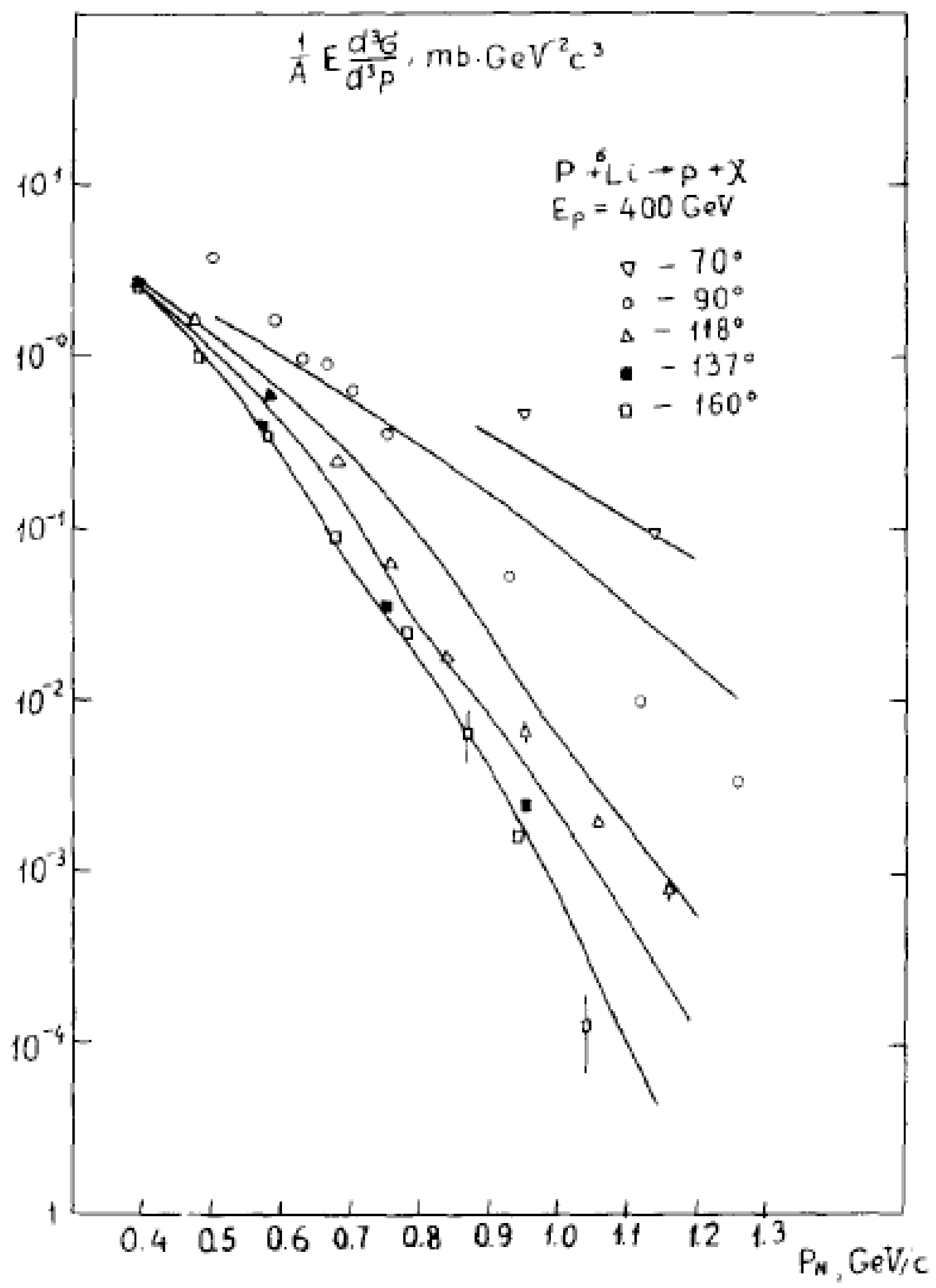


Recoil energy dependence of the ratio of decay function calculated for the case of struck and recoil nucleons - p_s & p_r for struck proton and recoil proton and neutron for p_s & $p_r >$ 400MeV/c & $180^\circ > \theta(\widehat{p_s\ p_r}) > 170^\circ$

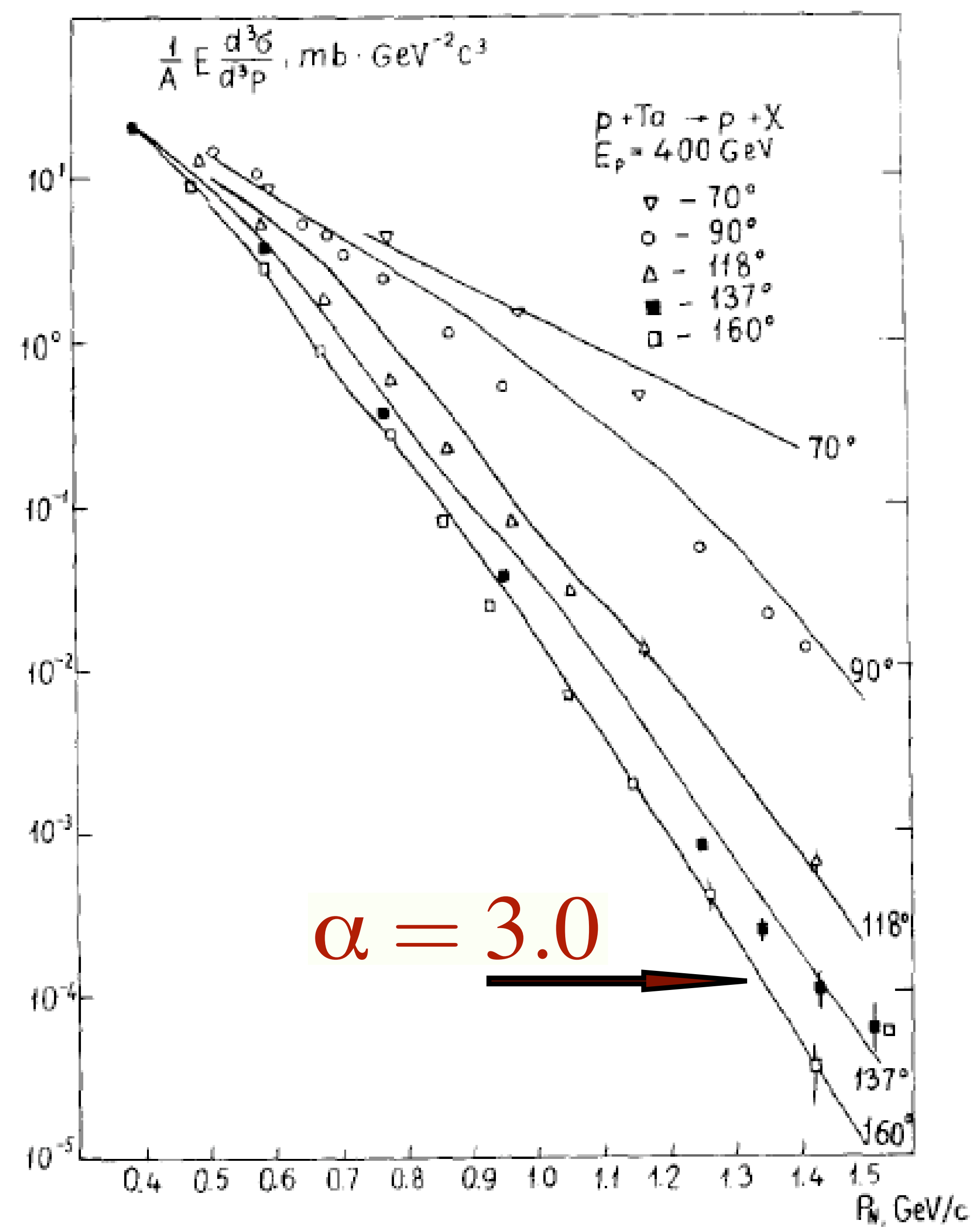
Experimental evidence in historic order

Plenty of data were described using few nucleon SRC approximation with 3N, 4N correlations dominating in certain kinematic ranges. Strength of 2N correlations is similar to the one found in (e,e'),(p,2p)

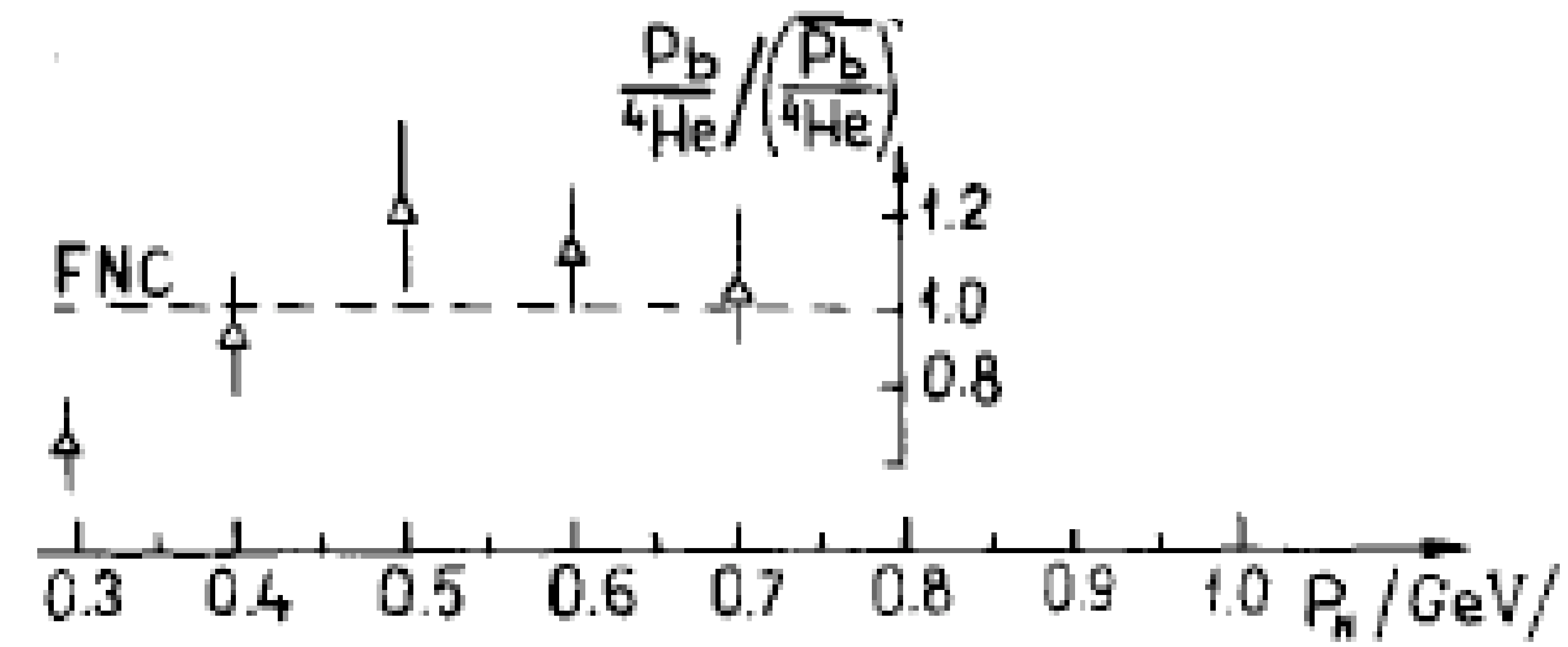
$p^6Li \to$ backward p+X



pTa$\to$backward p+X



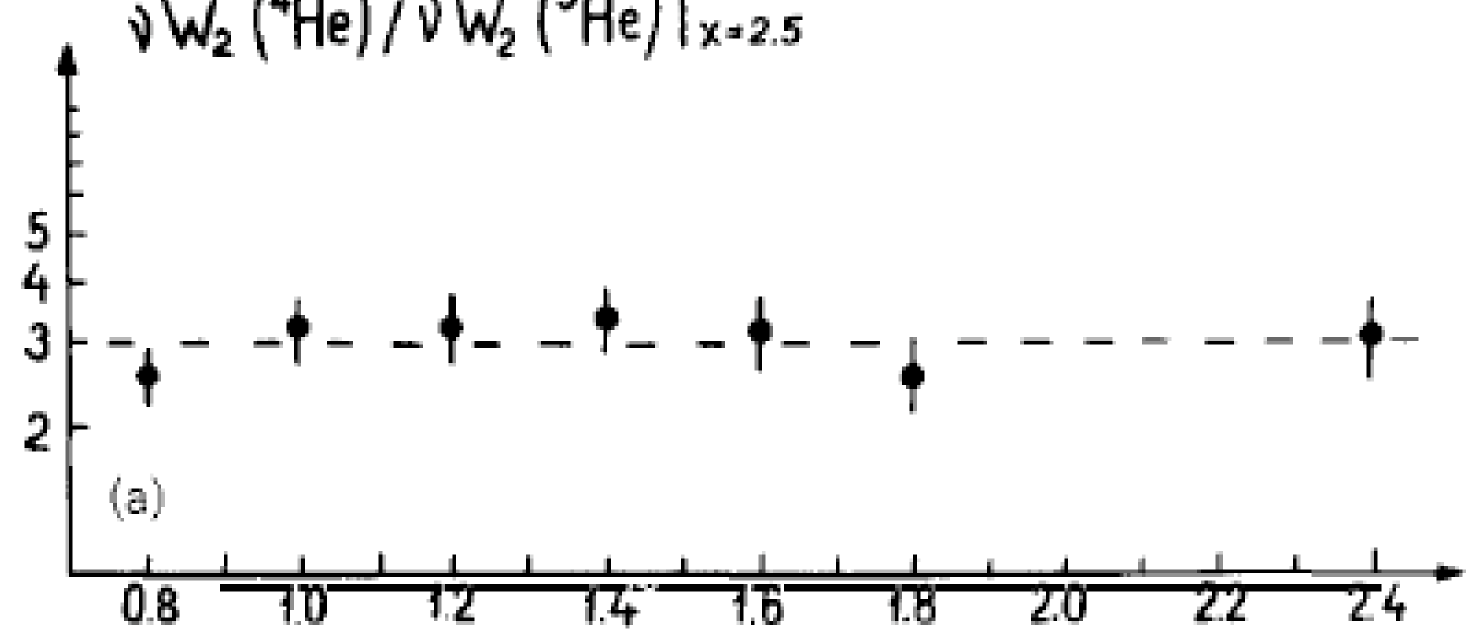
Comparison of few nucleon SRC approximation with pA data at E_p^{inc}=400 GeV

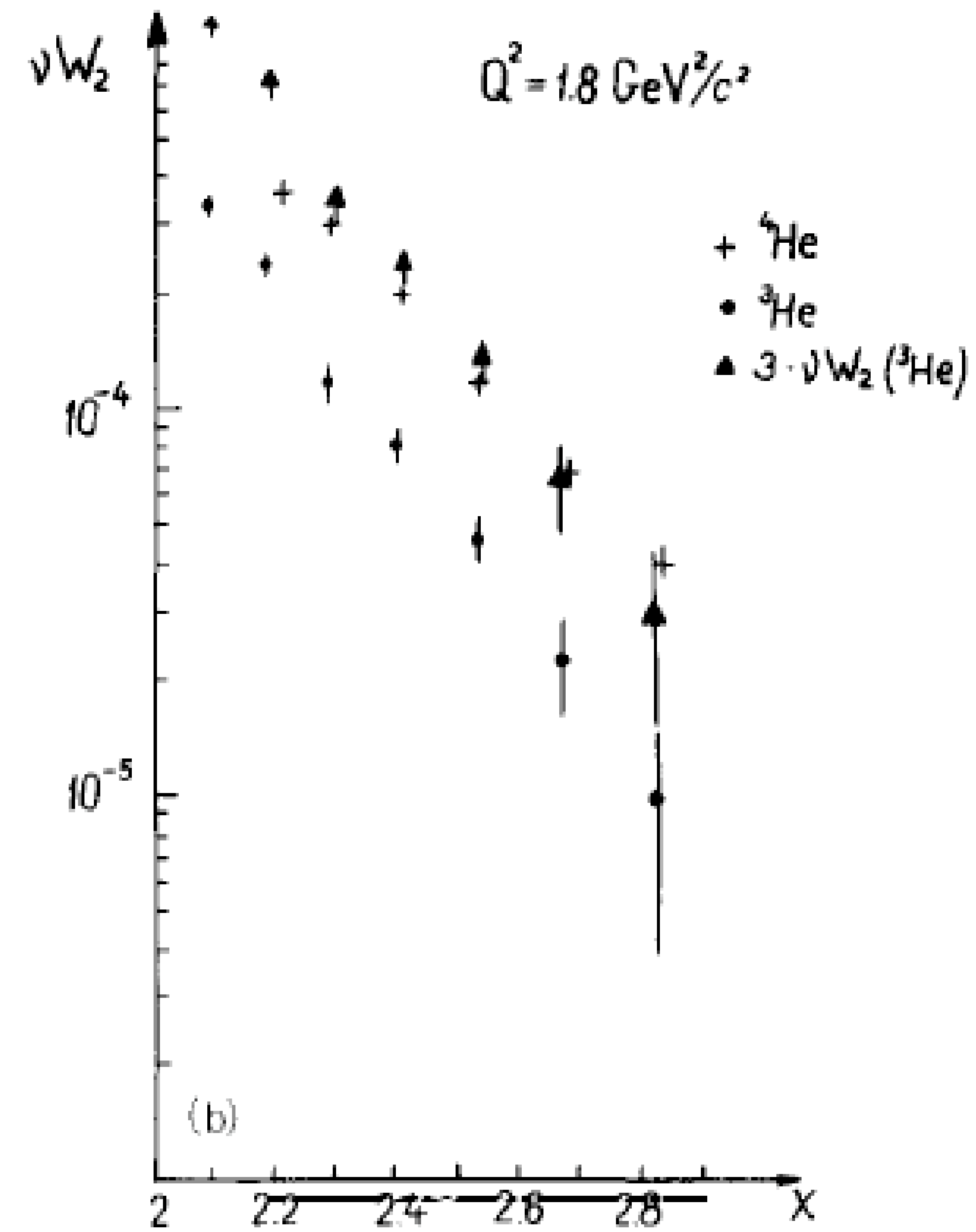


Test of universality for pA$\to$p+X spectra for backward emission at Ep= 9 GeV

Observations of (p,2pn) &(e,e') at x>1 confirm the origin of SRC as the dominant source of the fast backward nucleons

(e,e') x> 2





Steps observed by Hall B - Egiyan

New experiment approved

Further studies are necessary of LC scaling of the ratios, etc. Recoil structure more complicated than in 2N case

Correlations in p A→ p (backward) + p (backward) +X

measurements of Bayukov et al 86

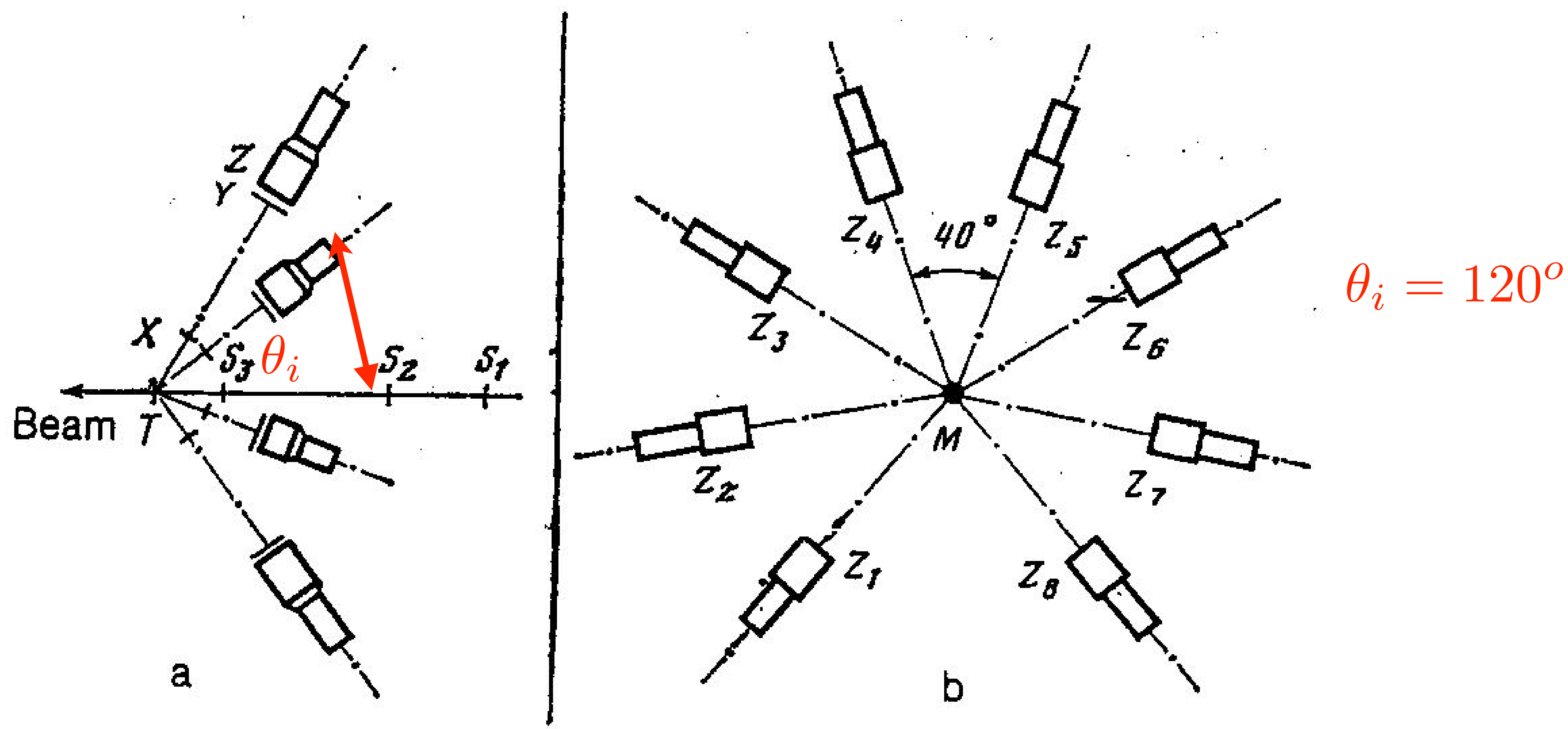
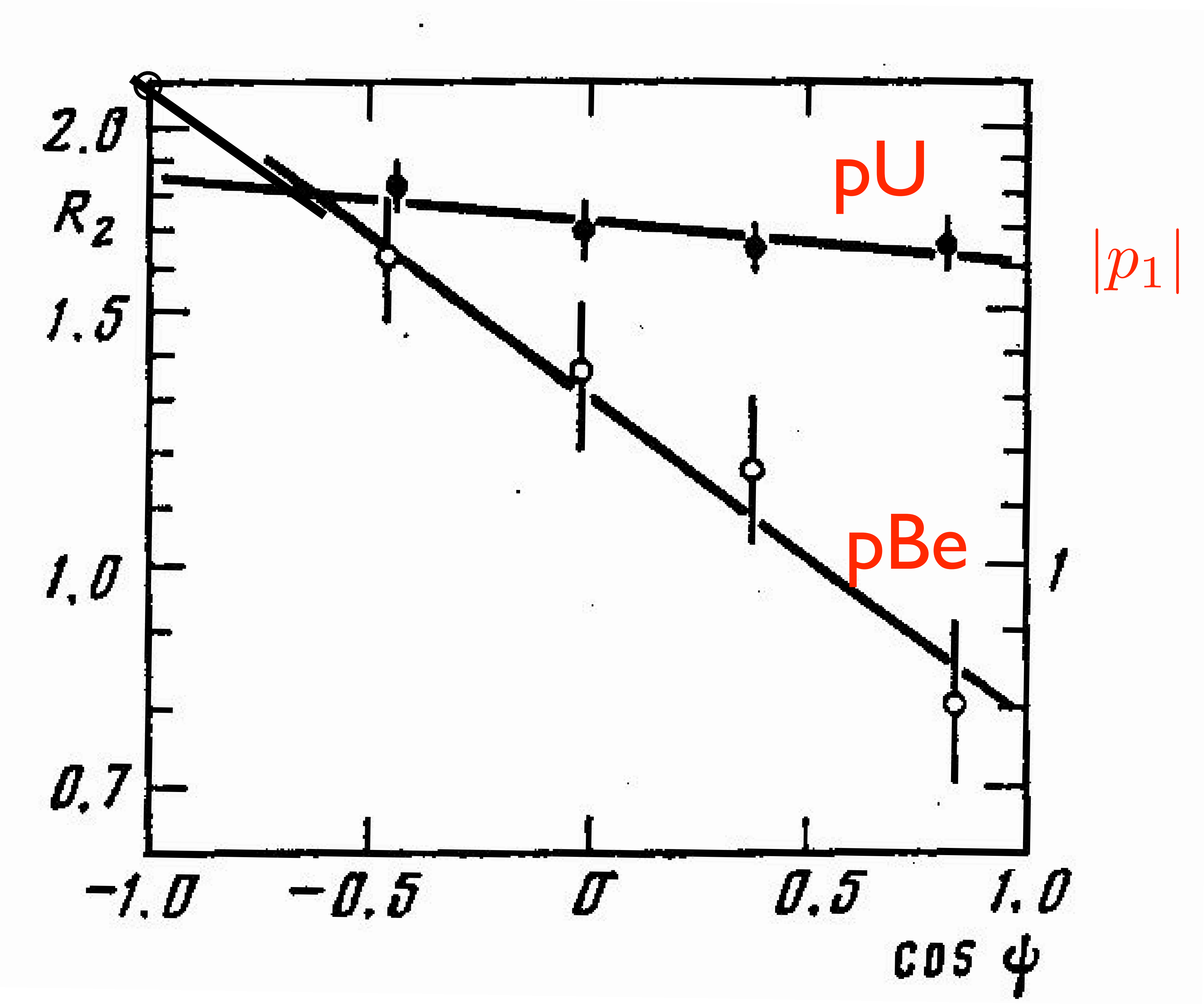
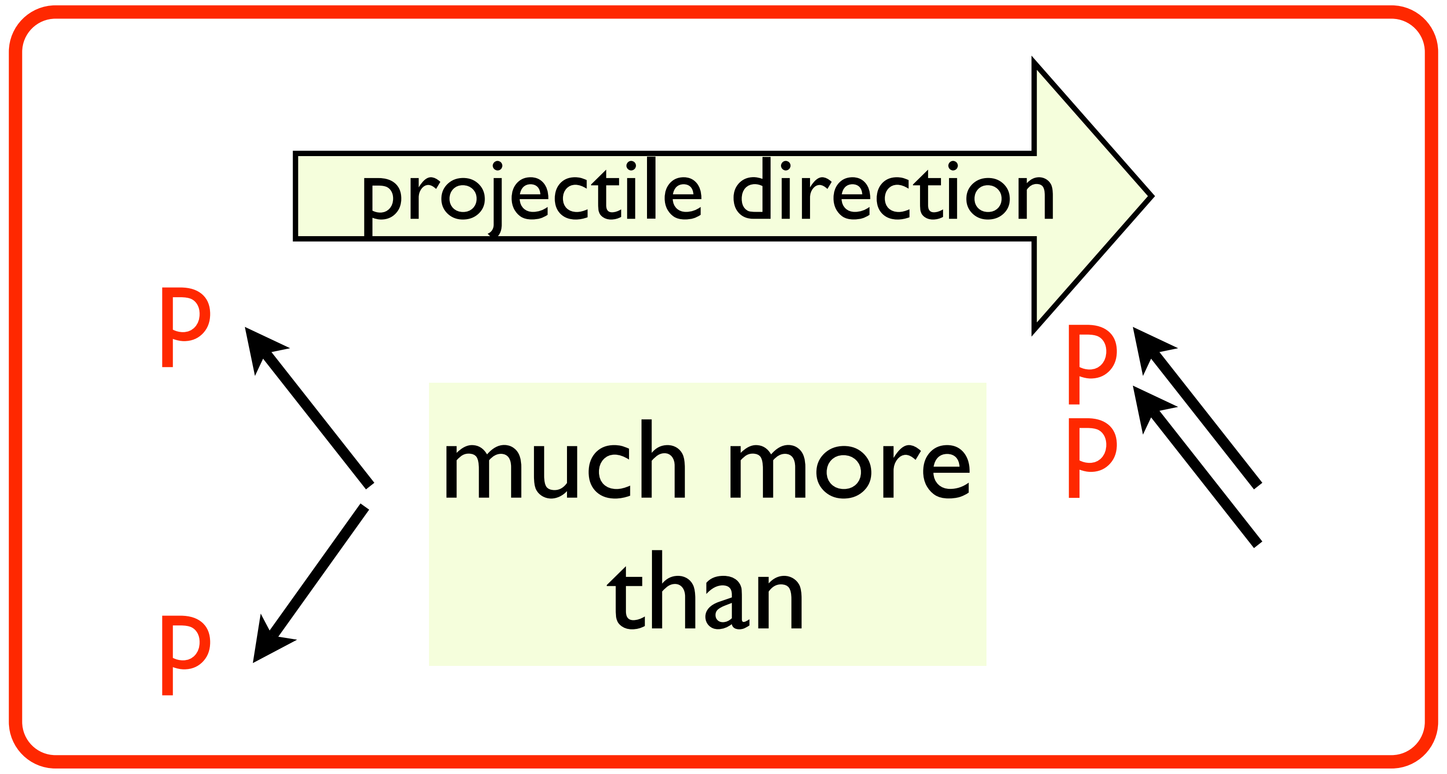


FIG. 1. Diagram of apparatus. (a)—Side view, (b)—view along the beam direction. Only the Z counters are shown.

$$R_2 = \frac{1}{\sigma^{in}_{pA}} \frac{d\sigma(p+A \to pp+X)/d^3p_1 d^3p_2}{d\sigma(p+A \to p+X)/d^3p_1 d\sigma(p+A \to p+X)/d^3p_2}$$



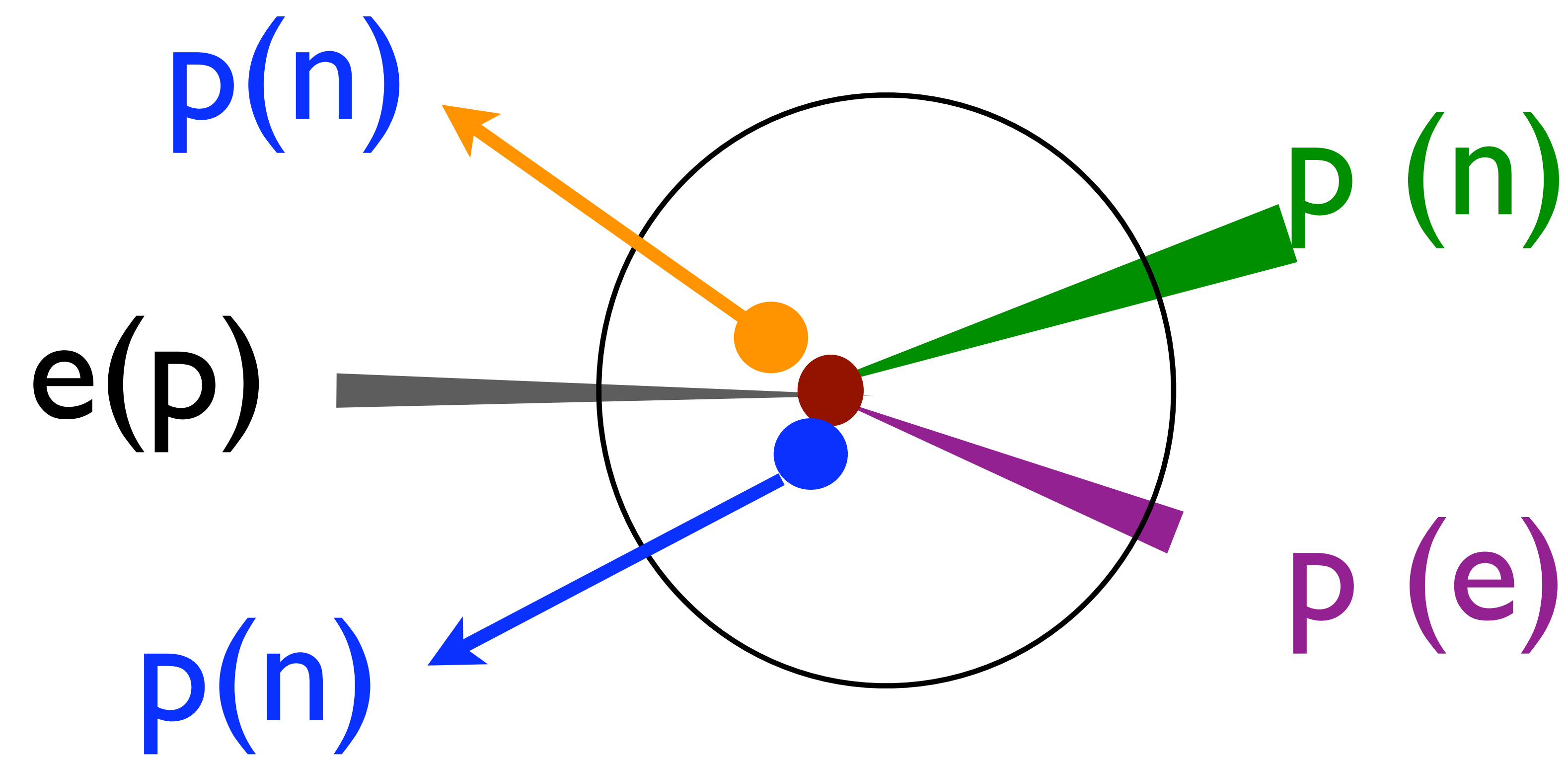
$|p_1| = |p_2| \approx 500 MeV/c$



Curves are experimental fit.

We can reasonably reproduce the pattern of ψ dependence of R_2 as due to correlated contributions of scattering off 3N SRC and uncorrelated term due to scattering of spacially separated 2N SRC

Study 3N correlations in A(e,e' p +2 backward nucleons) &A(p,p' p +2 backward nucleons).
Reminder: for the neutron star dynamics mostly isotriplet nn, nnn,.. SRC are relevant.



Start with ^{3}He, followed by ^{4}He, C. Expectations:

(a) $\alpha_{1\,Back.Nucl} + \alpha_{2\,Back.Nucl}\alpha_{1\,Forw.Nucl} \approx 3$

(b) ppn ~ nnp >> nnn, ppp

(c) e+A → e+ 2N +X stronger angular dependence and larger $R_2(\psi=-180°)$ than in pA.

Up to what momenta description of NN correlations in terms of nucleonic degrees of freedom maybe justified?

Decomposition over hadronic states could be useless if too many states are involved in the Fock representation

$$|D\rangle = |NN\rangle + |NN\pi\rangle + |\Delta\Delta\rangle + |NN\pi\pi\rangle + \ldots$$

We can use the information on NN interactions at energies below few GeV and the chiral dynamics combined with the following general quantum mechanical principle - *relative magnitude of different components in the wave function should be similar to that in the NN scattering at the energy corresponding to off-shellness of the component.*

Important simplification is due to the structure of the final states in NN interactions: direct pion production is suppressed for a wide range of energies due to chiral properties of the NN interactions:

$$\frac{\sigma(\mathrm{NN} \to \mathrm{NN}\pi)}{\sigma(\mathrm{NN} \to \mathrm{NN})} \simeq \frac{k_\pi^2}{16\pi^2 F_\pi^2}, \quad F_\pi = 94 \text{ MeV}$$

⇒ Main inelasticity for NN scattering for $T_p \leq 1$ GeV is single Δ-isobar production which is forbidden for I=0

|Δ Δ> threshold is $k_N = \sqrt{m_\Delta^2 - m_N^2} \approx 800\, MeV$!!!

Small parameter for inelastic effects in the deuteron WF, while relativistic effects are already significant as v/c ~1

For the nuclei where single Δ can be produced $k_N \approx 550\, MeV$

☝ *- Correspondence argument (WF ↔ continuum) is not applicable for the cases when the probe interacts with rare configurations in the bound nucleons due to the presence of an additional scale.*

⇒ Relativistic (light-cone) treatment of the nucleus (FS76) - price of switching from NR to LC quantum mechanics is not very high: in broad kinematic range a smooth connection with nonrelativistic description of nuclei (more complicated structure of the scattering amplitude).

⇒ Best to look for admixture at large momenta ($\alpha_\Delta > 1$)

To summarize: pn and pp correlations are predominantly build of nucleons 10--20 % (?) accuracy. Little room for exotic components (6q, Δ-isobars) should be corrections even in SRC where energy scale is larger and internucleon distances are < 1.2 fm.

The EMC effect for 0.3<x<0.7 unambiguously indicates presence of non-nucleonic degrees of freedom in nuclei? *Claims that opposite are due to the violation of baryon or energy-momentum conservation or both (normalization of* $\rho_A^N(\alpha)$*)*

$$F_{2A}(x,Q^2) = \sum_{p,n} \int \rho_A^N(\alpha) F_{2N}(x,Q^2) \frac{d\alpha}{\alpha}$$

Are SRC results consistent with EMC effect ? Yes - for some of the models

Evidence for change of the radius of nucleon (**S. Strauch talk)**

Evidence for suppression of pion fields -- from Drell Yan

Looking for exotic baryonic degrees of freedom most promising

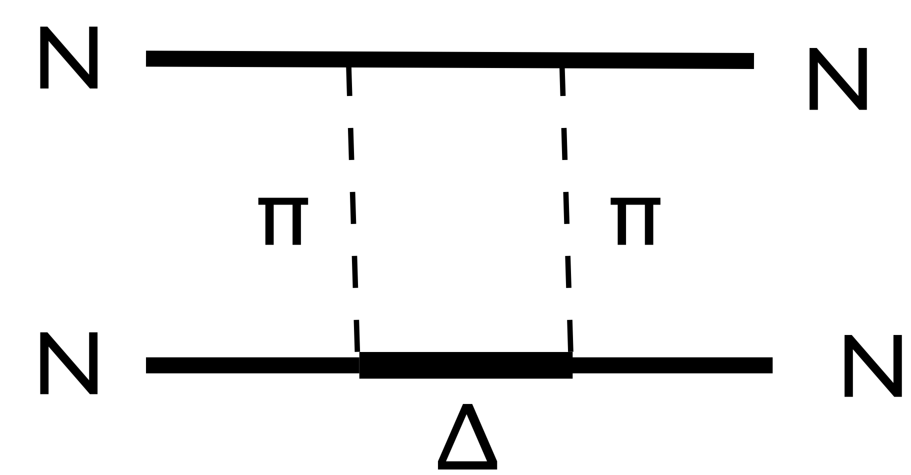
Non-nucleonic degrees of freedom

The reviewed data seem to indicate that 2N correlations dominate for

$600 > k_N > 300$ MeV/c

What about Δ's in nuclei?

Attraction in NN at medium distance (1 fm) is due to two pion exchange



Reminder - quark exchanges also should generate Δ's

Intermediate states with Δ -isobars.

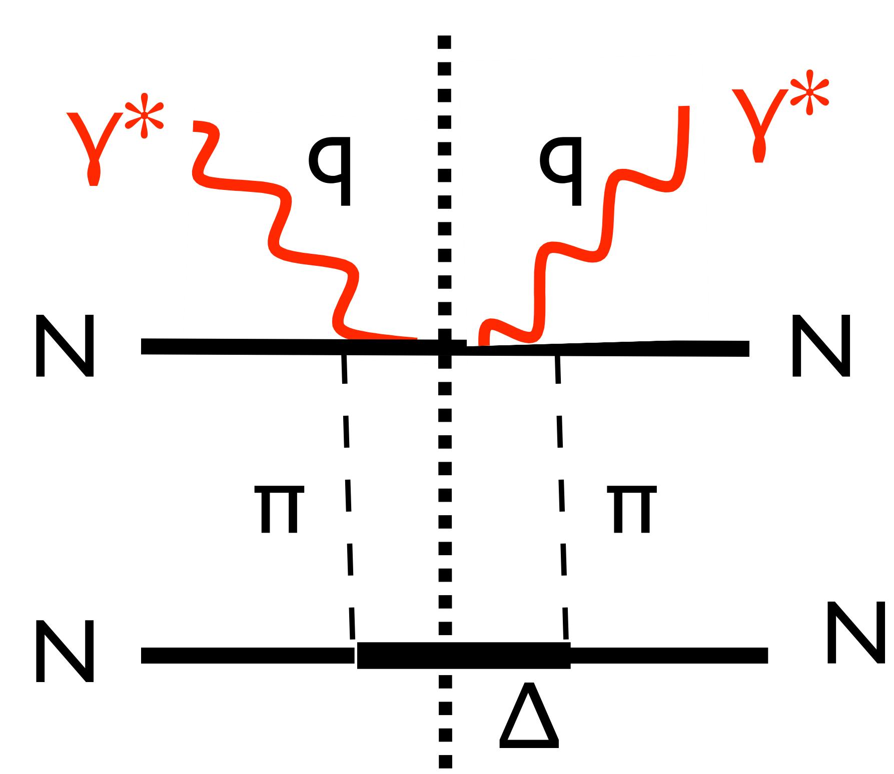
Often hidden in the potential. Probably OK for calculation of the energy binding, energy levels. However wrong for high Q^2 probes.

Explicit calculations of B.Wiringa - ~1/2 high momentum component is due to ΔN correlations, significant also ΔΔ .Tricky part - match with observables - momentum of Δ in the wf and initial state

Large Δ admixture in high momentum component

⇓

- Suppression of NN correlations in kinematics of BNL experiment
- Presence of large E_R tail (~ 300 MeV) in the spectral function



Looking for non-nucleonic degrees of freedom (a sample of processes)

electron beams

isobars, N*'s $\alpha_\Delta > 1$

for x> 0.1 very strong suppression of two step mechanisms (FS80)

Confirmed by neutrino study of Δ-isobar production off deuteron

Best limit on probability of $\Delta^{++}\Delta^{-}$ component in the deuteron < 0.2%

⇒ a limit on 6q probability

An analysis has been made of 15 400 ν–d interactions in order to find a $\Delta^{++}(1236)$–$\Delta^{-}(1236)$ structure of the deuteron. An upper limit of 0.2% at 90% CL is set to the probability of finding the deuteron in such a state.

SEARCH FOR A Δ(1236)–Δ(1236) STRUCTURE OF THE DEUTERON

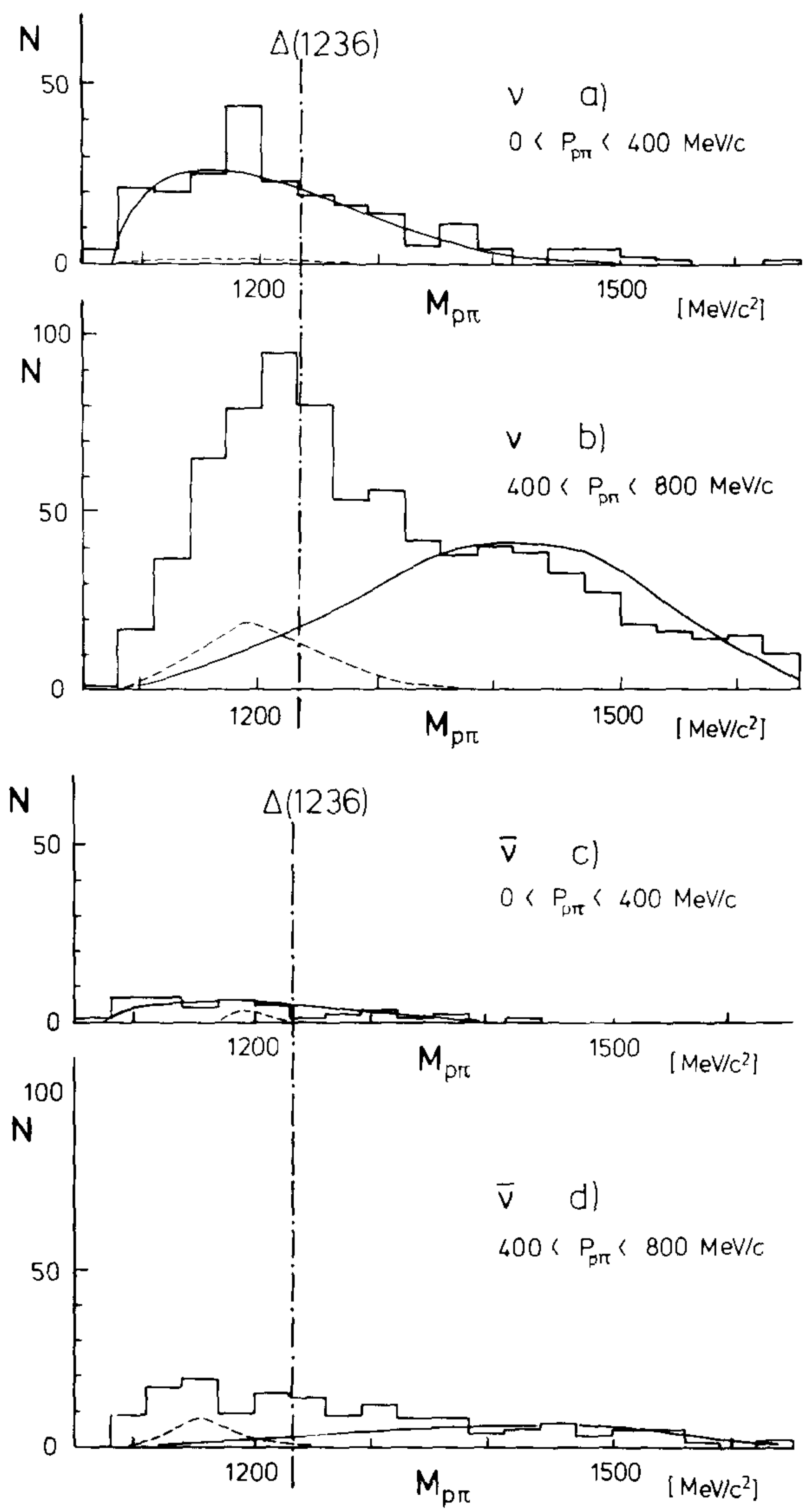


Fig. 1. Effective mass distributions of $p\pi^+$ combinations for ν (top) and $\bar{\nu}$ (bottom) interactions. The distributions are presented for two intervals of the combined $p\pi^+$ momentum: 0–400 and 400–800 MeV/c. The chosen bin size is 30 MeV/c^2 = $\Gamma(1235)/4$. The solid lines show the calculated background of combinations of a pion with a spectator proton. The dotted lines show prompt $p\pi^+$ production as obtained from $\nu/\bar{\nu}$–hydrogen data.

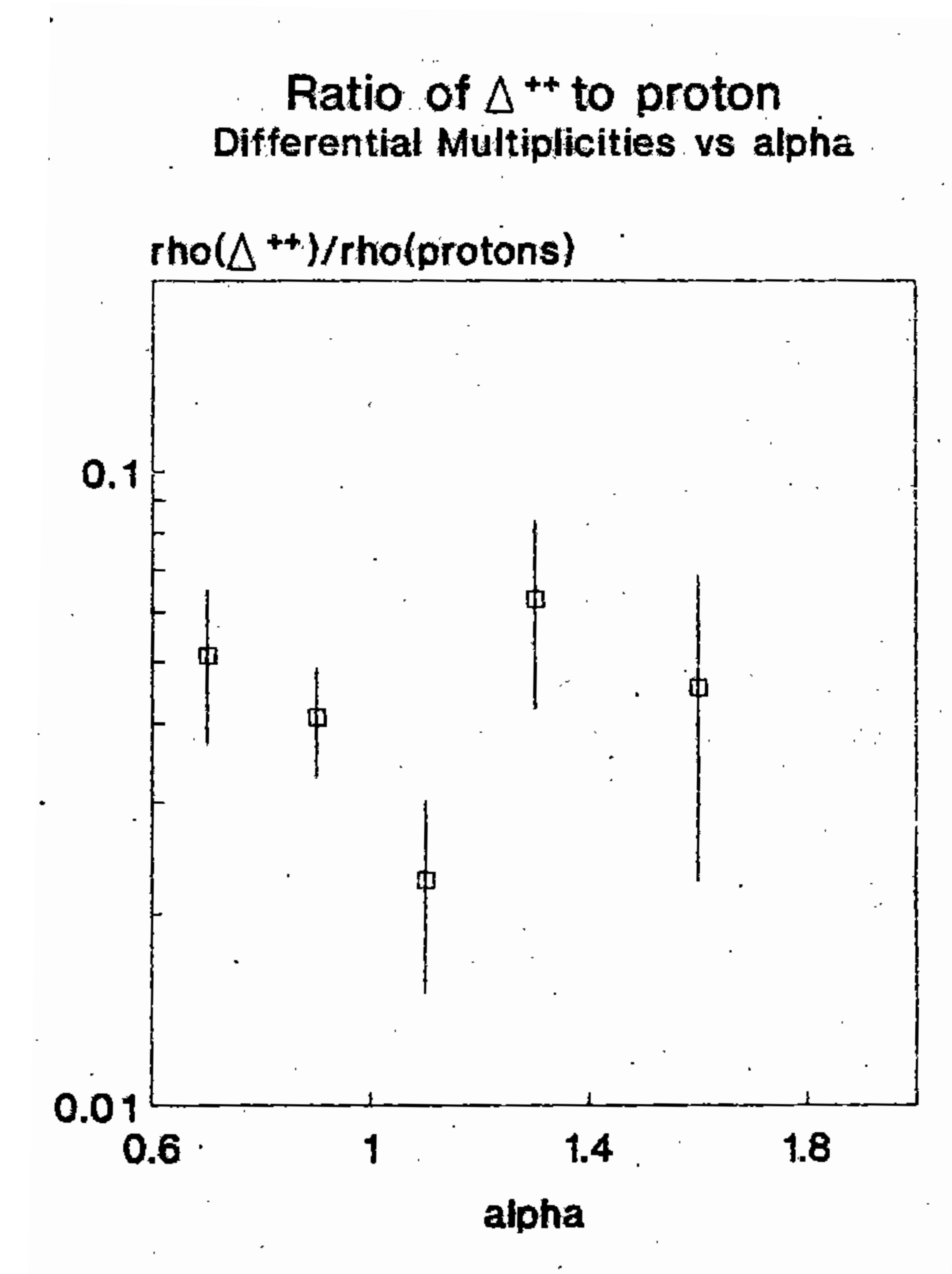
Is there a positive evidence for Δ's in nuclei?

Indications from DESY AGRUS data (1990) on electron - air scattering at E_e=5 GeV (Degtyarenko et al).

Measured Δ^{++}/p, Δ^0/p for the same light cone fraction alpha.

$$\frac{\sigma(e+A\to\Delta^0+X)}{\sigma(e+A\to\Delta^{++}+X)}=0.93\pm0.2\pm0.3$$

$$\frac{\sigma(e+A\to\Delta^{++}+X)}{\sigma(e+A\to p+X)}=\boxed{(4.5\pm0.6\pm1.5)\cdot10^{-2}}$$



It seems that data taken by CLAS may allow to do much better job

☞ *Searching/discovering baryonic nonnucleonic degrees of freedom in nuclei*

(a) Knockout of Δ^{++} isobar in

$$e + {}^2H \to e + \ forward\ \Delta^{++} + \ slow\ \Delta^{-}$$

$$e + {}^3He \to e + \ forward\ \Delta^{++} + \ slow\ nn$$

Sufficiently large Q are necessary to suppress two step processes where Δ^{++} isobar is produced via charge exchange. Can regulate by selecting different x - rescatterings are centered at x=1.

(b) Looking for slow (spectator) Δ's in exclusive processes with ^{3}He

Another possibility for 12 GeV, study of x_F ≥0.5 production of Δ− isobars in e+D(A)→e+ Δ +X. For the deuteron one can reach sensitivity better than 0.1 % for ΔΔ especially with quark tagging (FS 80-89)

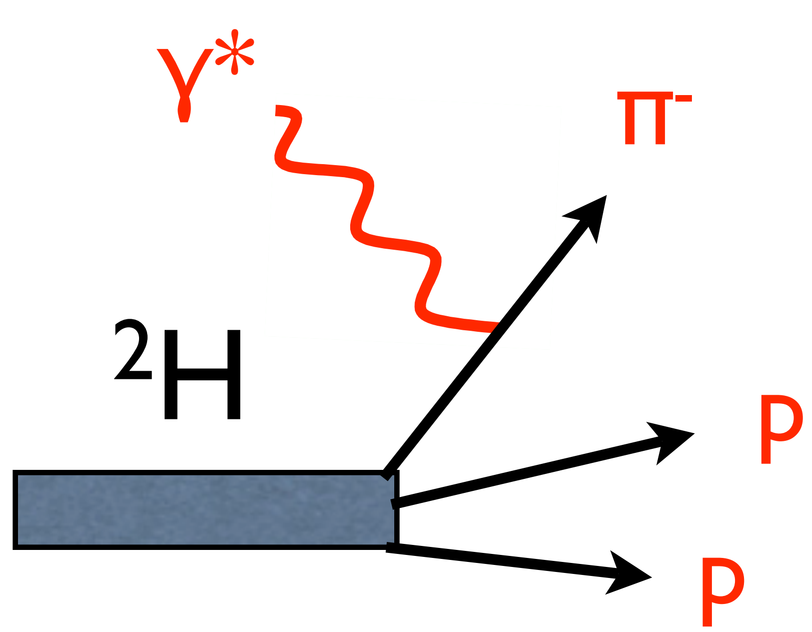
(c) $$e + {}^2H \to e + \ forward\ N + \ slow\ N^*$$

(d) Measure G_E/G_M as a function of nucleon momentum for SRC in deuteron extending current measurements (**Strauch** talk) to k > 400 MeV/c

☞ *Searching/discovering mesonic degrees of freedom in nuclei*

$$e + {}^2H \to e + \ forward\ \pi^{-}(along\ \vec{q}) + p(forward)\ +\ p(forward)$$

$$p_N \sim 0.3 - 0.4\ GeV/c$$



FS 77

SKEEP

Inclusive (e,e') at x> 1

6 GeV

- Detailed study of onset of scaling at $Q^2 \sim 1$ GeV^2 - sensitive to minimum momentum where SRC dominate.
- Observing a break down of the scaling of ratios at large $Q^2 > 5$ GeV^2 due to onset of the contribution of inelastic processes - ratios A/D should further increase !!!
- *x> 2.2 need much more data for all Q*

12 GeV

- Reaching regime of scattering of quarks - QCD scaling at x=1.5 for $Q^2 \sim 15$ GeV^2

Discovery of superfast quarks in nuclei

Current data are conflicting - FNAL neutrino data: large tail consistent with SRC predictions, muon data from CERN (BCDMS) - much smaller large x tail

Looking for non-nucleonic degrees of freedom using hadron beams.

Look for channels forbidden for scattering off single nucleons but allowed for scattering off exotics: Δ's 6q... .

$$p + A \to \Delta^{++} + p + (A-1)$$

Important tool for the analysis: $\alpha_\Delta < 1$ cut as the α_Δ distribution is broader than α_N distribution.

In the kinematics where CT sets in look for effect of the suppression of point-like configurations in bound nucleons in reaction

$p + {}^2H \to pp$ + "backward neutron"

Conclusions

Impressive experimental progress of the last three years - *discovery of strong short range 2N correlations in nuclei with strong dominance of I=0 SRC* :

- proves validity of strategy of use of high momentum transfer processes
- provides solid basis for discovery strategies & further detailed studies of SRC

A number of theoretical challenges including a) calculation of the decay functions A=4,... b) isotopic effects for SRC, c) isobars, d) relativistic effects, e) studies of FSI dynamics - optimizing for signal of SRC, understanding the role of CT effects (GEA - good starting point - need more tests of isobar FSIs)

Several experiments are under way/ been planned for 12 GeV, need more coherence in the program & complementary studies using hadron beams.