Mysteries of pA physics at the planed GSI energies

Z. Fodor

KFKI – Research Institute for Nuclear and Particle Physics

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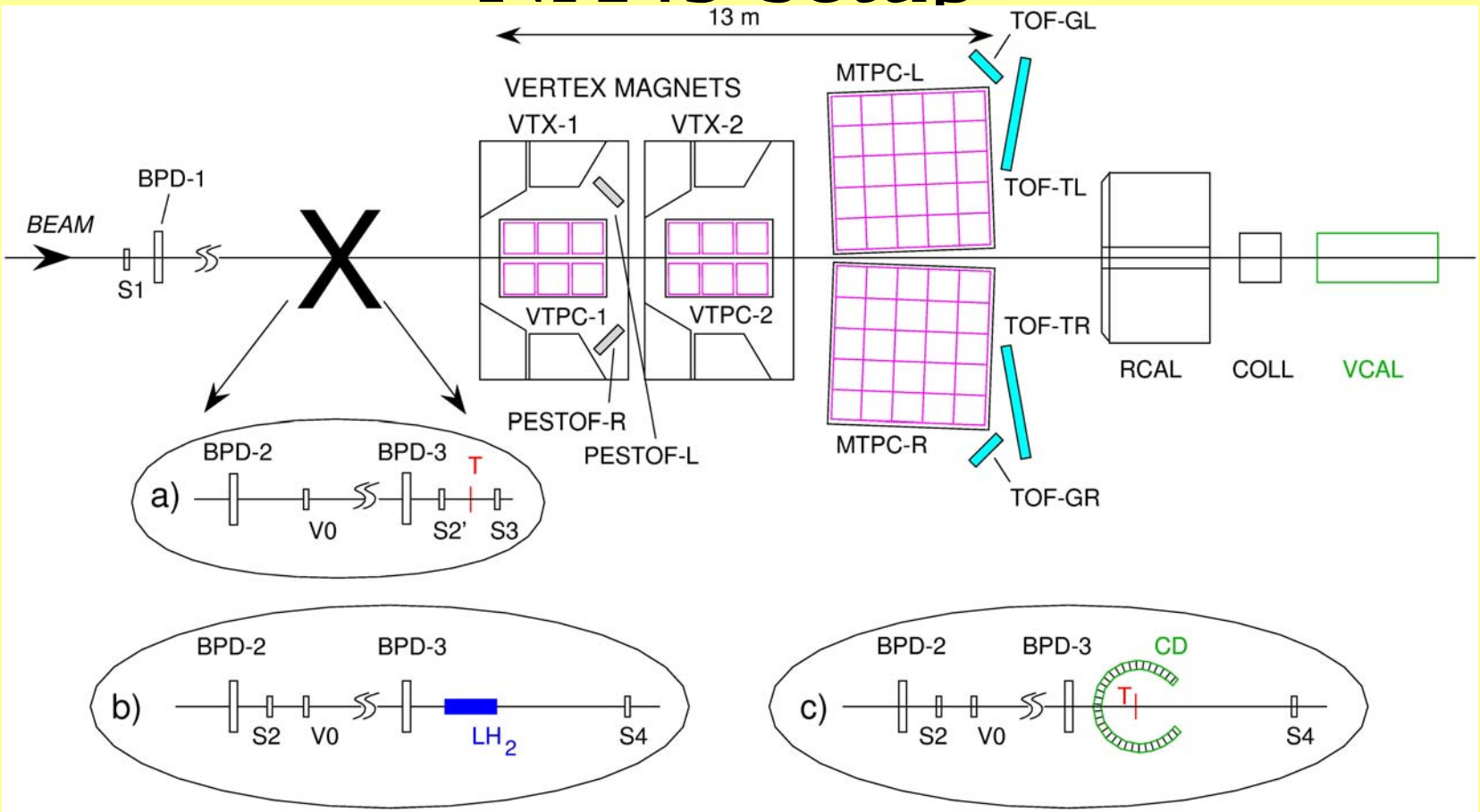
- The pA physics is a part of the Heavy ion physics at RHIC and LHC.
- We have the data at SPS and AGS.
- For the references we need the pp and np data whit the similar precision as the HI ones.
- At the pA and AA reaction we need to taken into account the isospin effects.
- For understanding the reaction dynamics, useful to measure the π, K, n, anti p, … induced reactions.

NA49 setup



p, π^+, π^-, n(from d), C, Si, Pb + p, C, Si, Pb

E = 158, 100, 40 GeV

Full phase space coverage at forward direction at p beam with GAP TPC and VETO chambers.

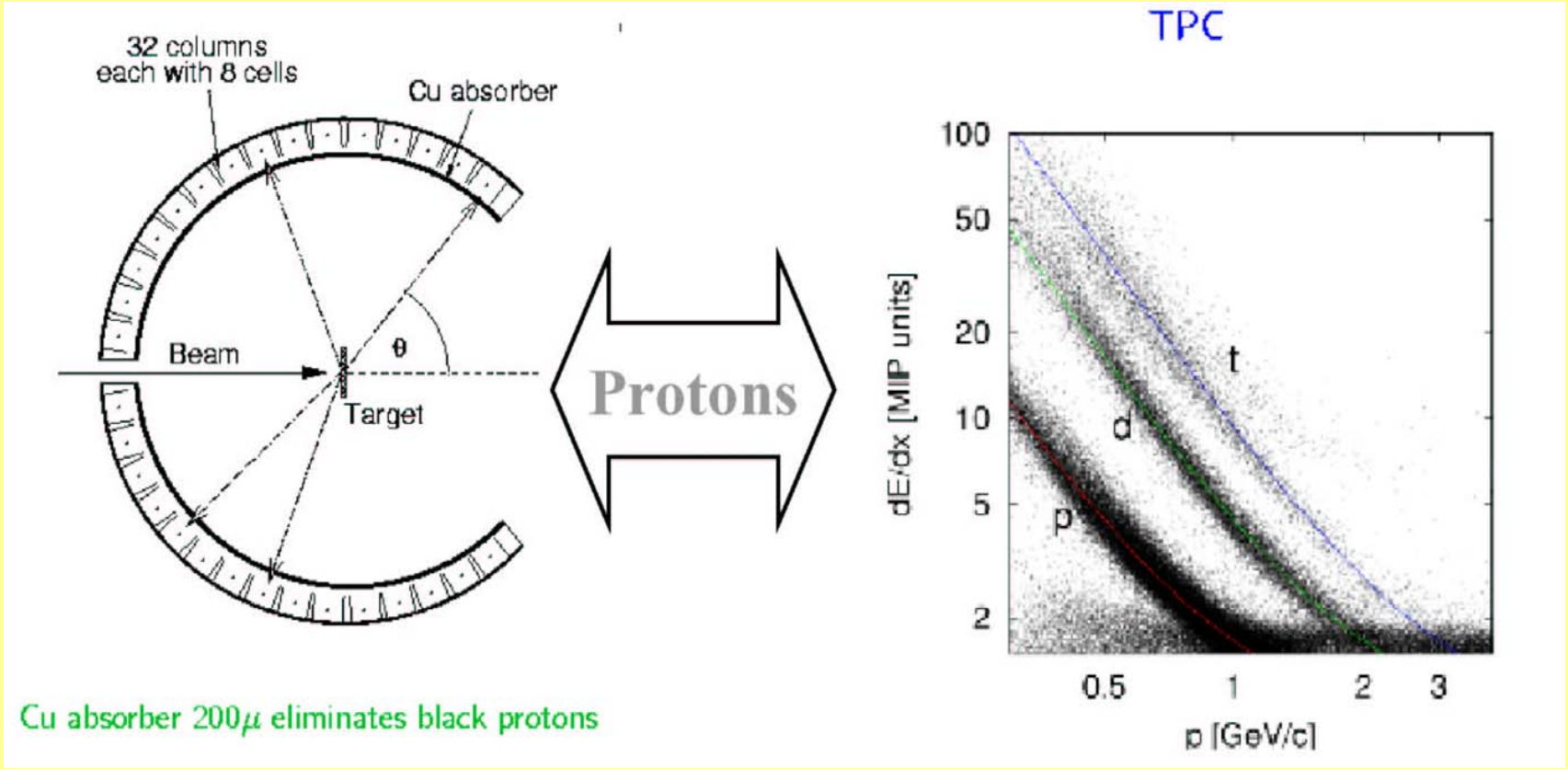
n beam

- d beam from fragmentation
- from reaction d -> n + p, with identification of p or n.
  - 42 % n interaction
  - 42 % p interaction
  - 16 % double scattering

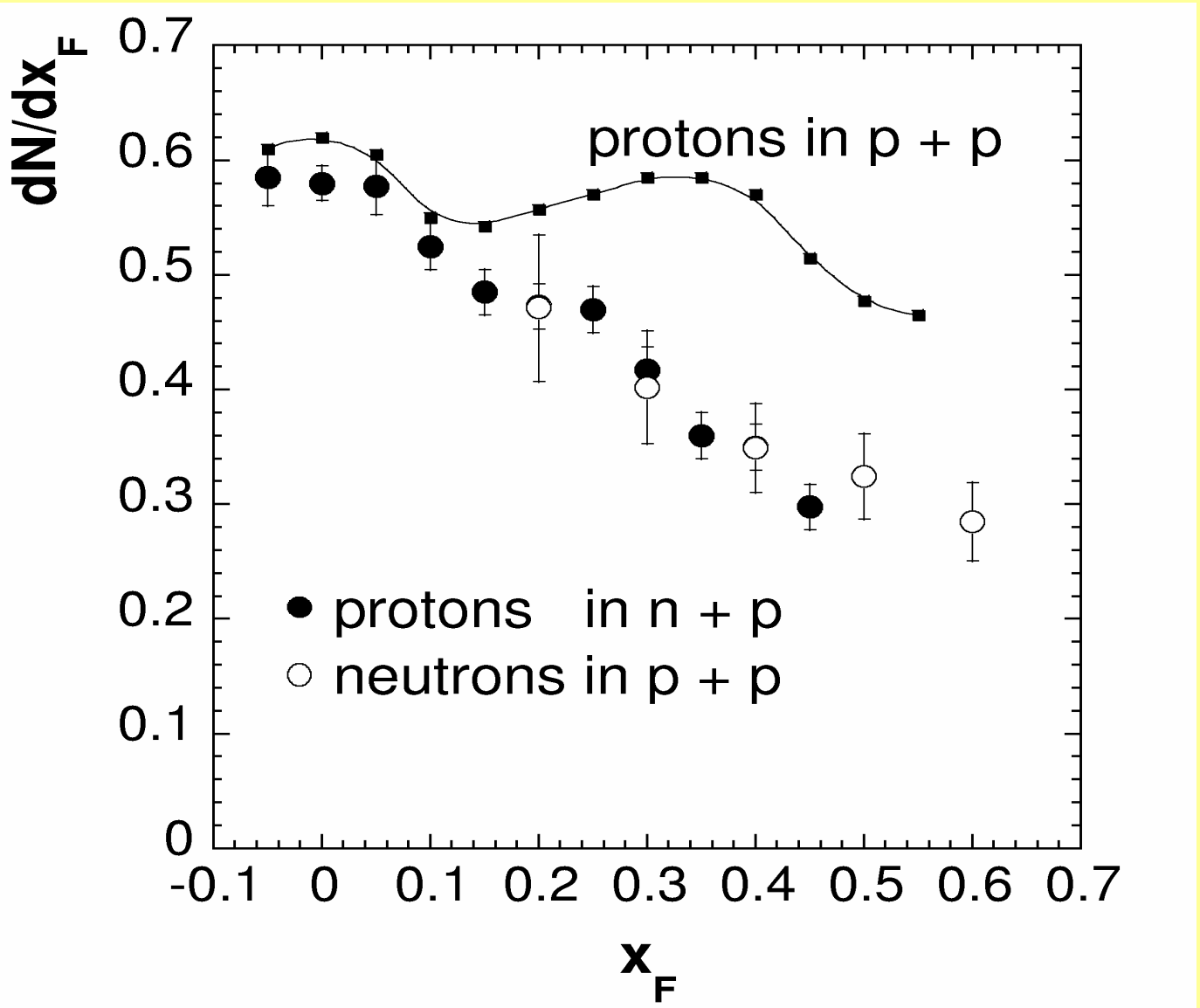
n detection

used the old calorimeter with the new calibration

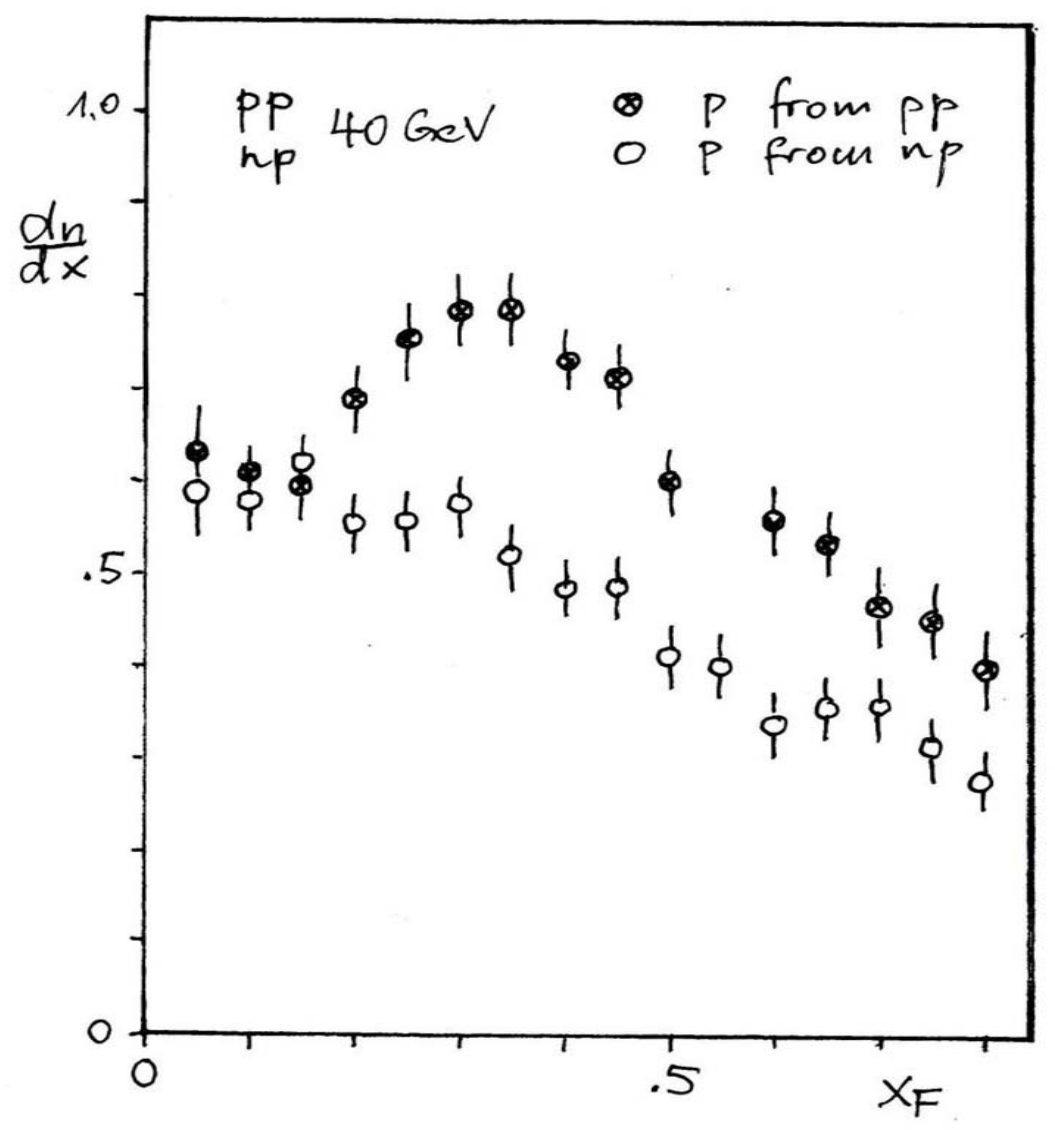
Centrality measurement of pA



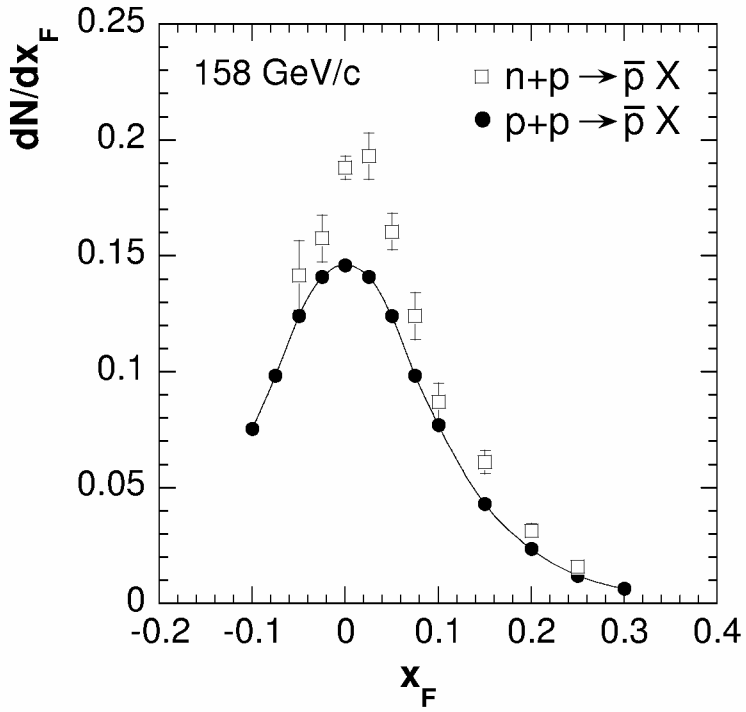
number of gray proton connected to the number of collision (ν)



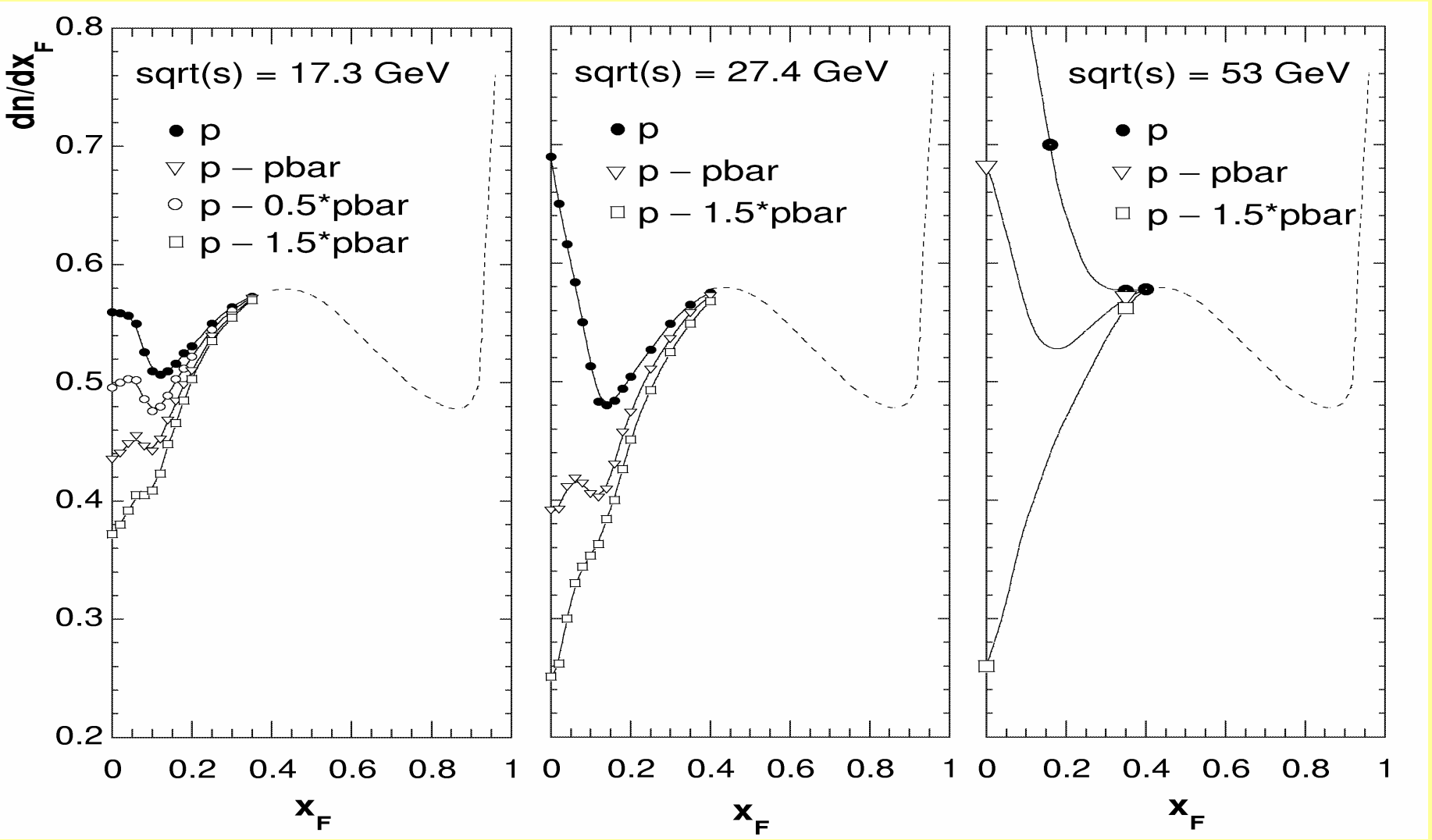
p and n spectra at E=158 GeV



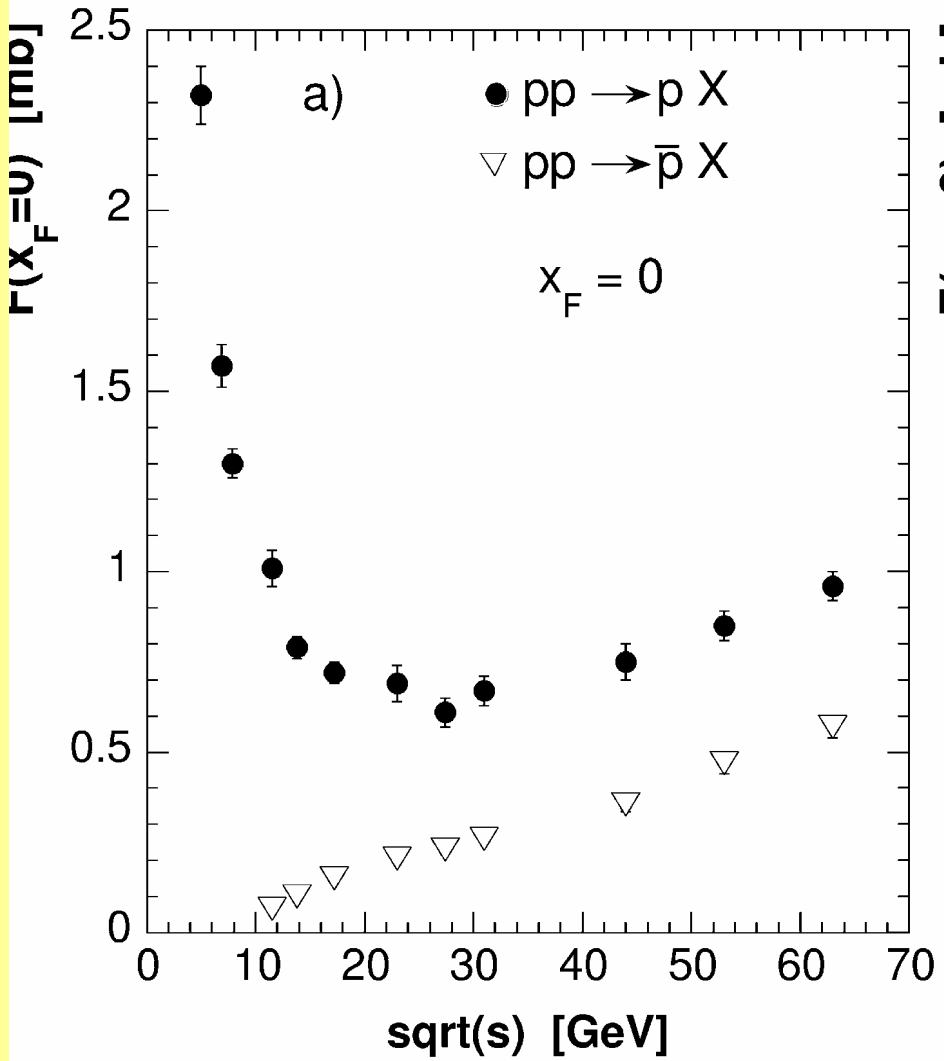
p spectra at 40 GeV

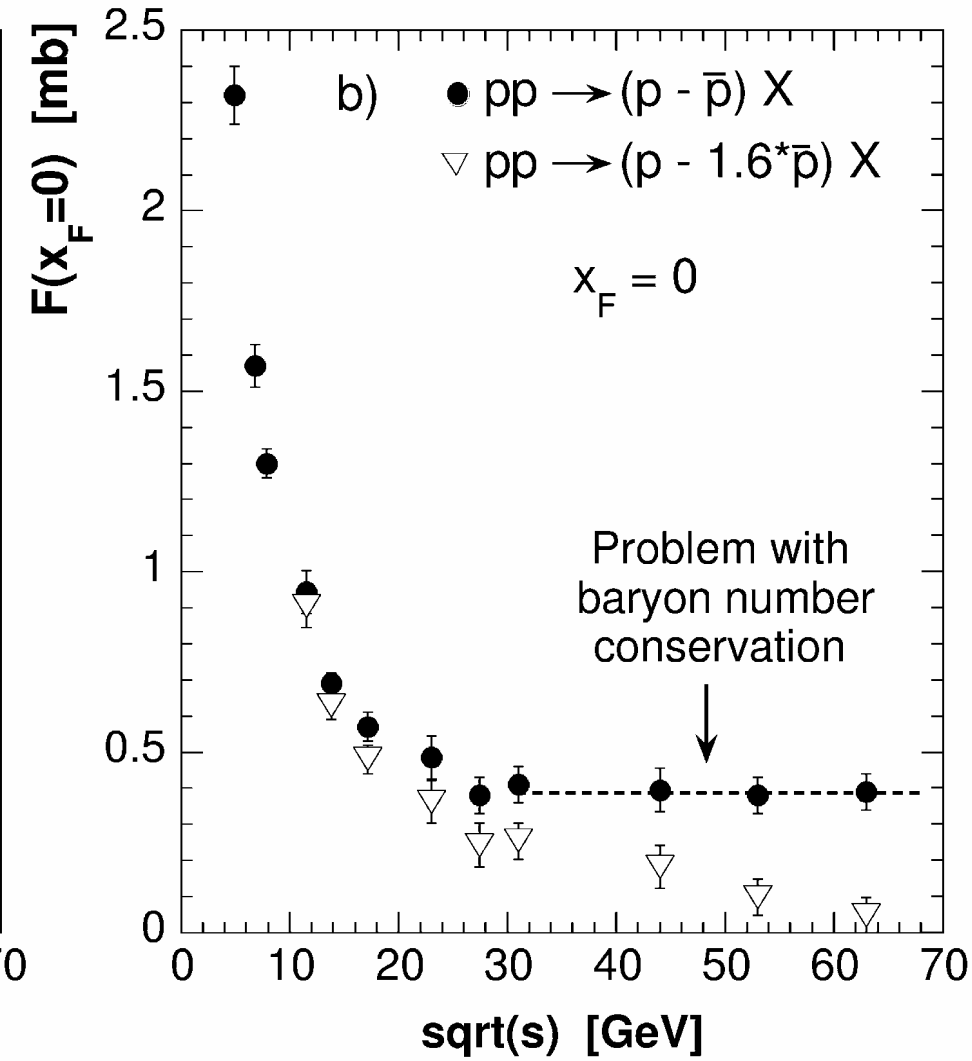


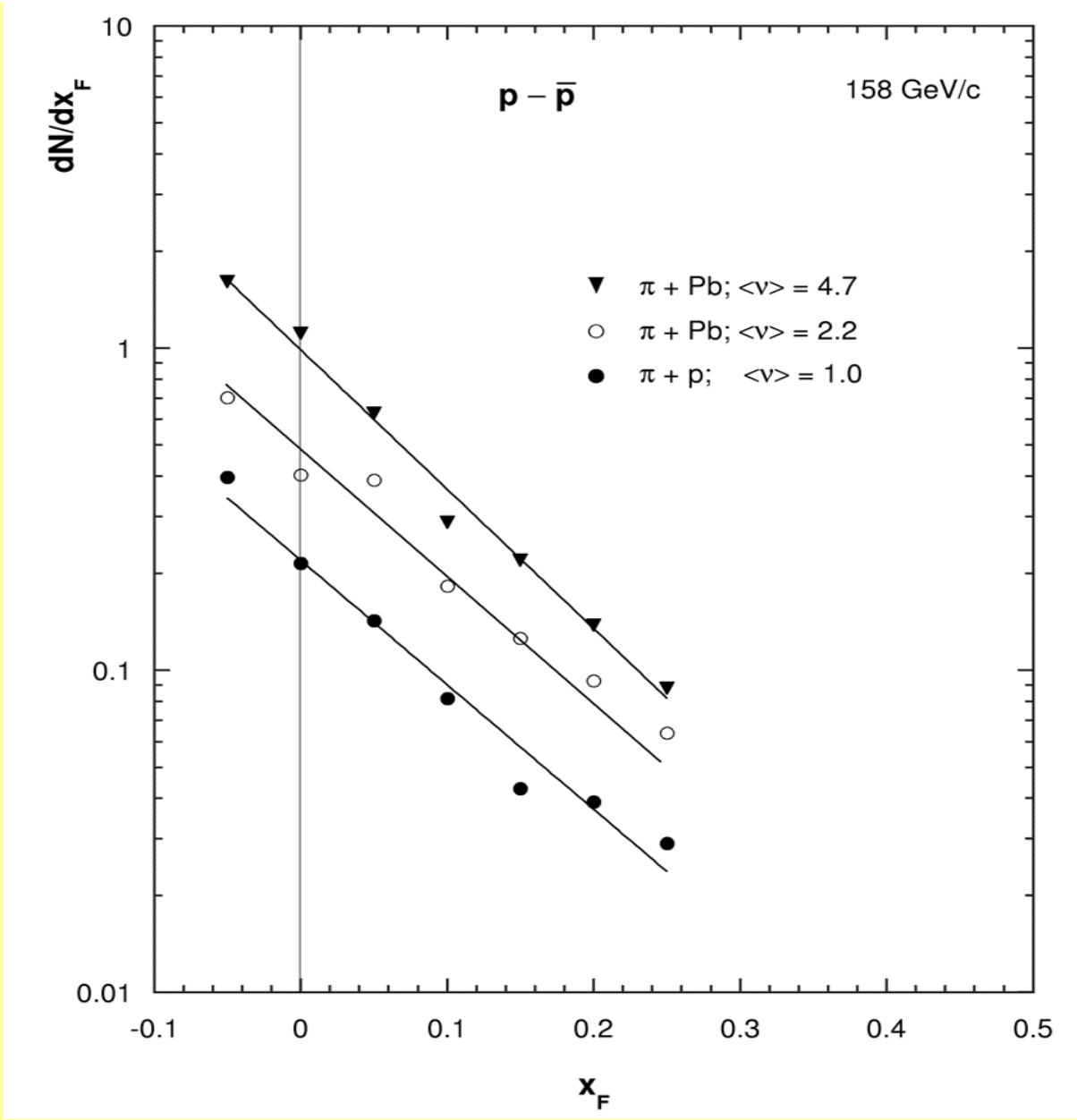
Projectiles		n		p	
Produced particles	$\bar{p}n$		$p\bar{p}$ $n\bar{n}$		$p\bar{n}$
Isospin	-1		0		+1



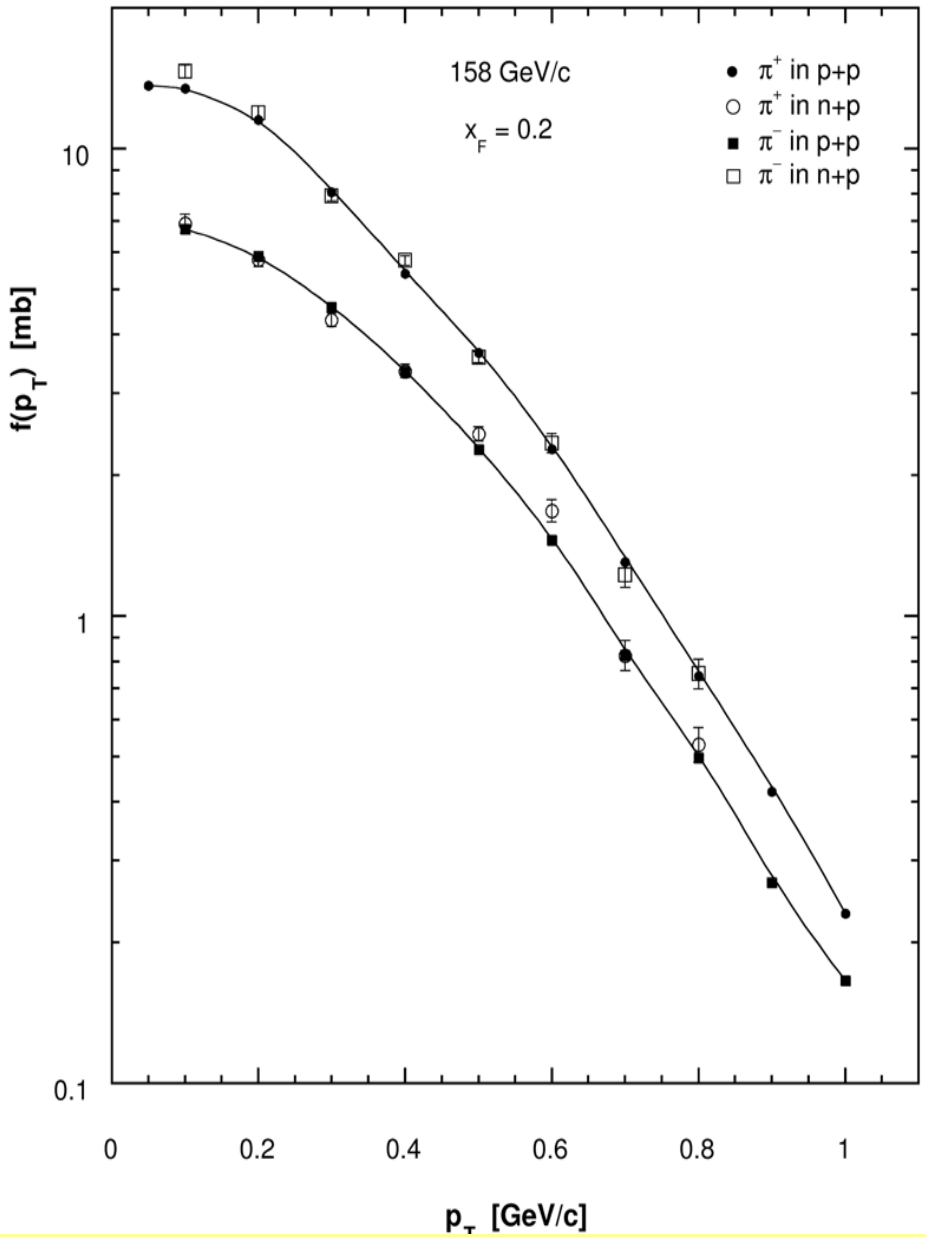
Effect of the isospin correction for produced protons

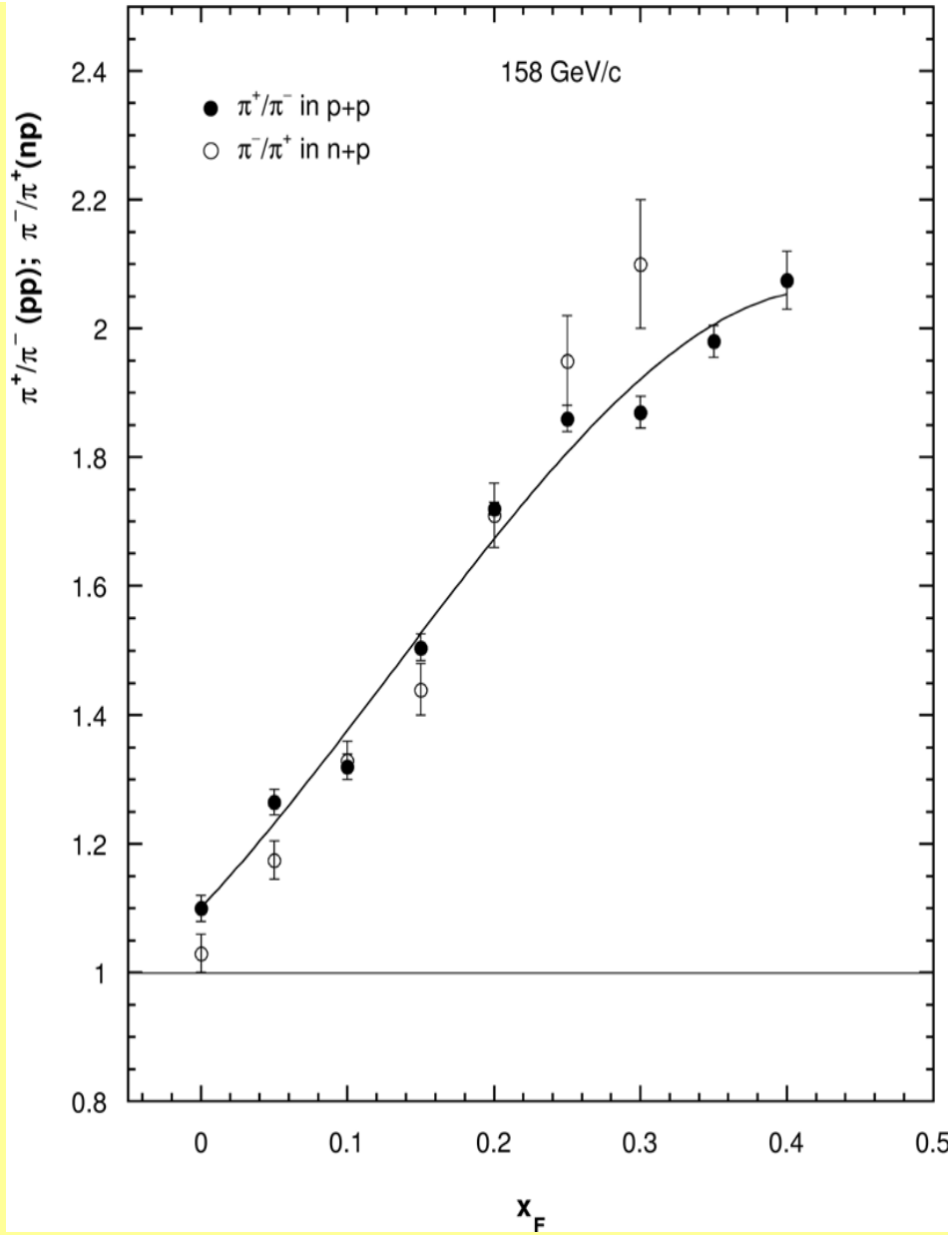

a)
pp → p X
pp → p̄ X
x_F = 0
F(x_F=0) [mb]
sqrt(s) [GeV]


b)
pp → (p - p̄) X
pp → (p - 1.6*p̄) X
x_F = 0
Problem with
baryon number
conservation
F(x_F=0) [mb]
sqrt(s) [GeV]

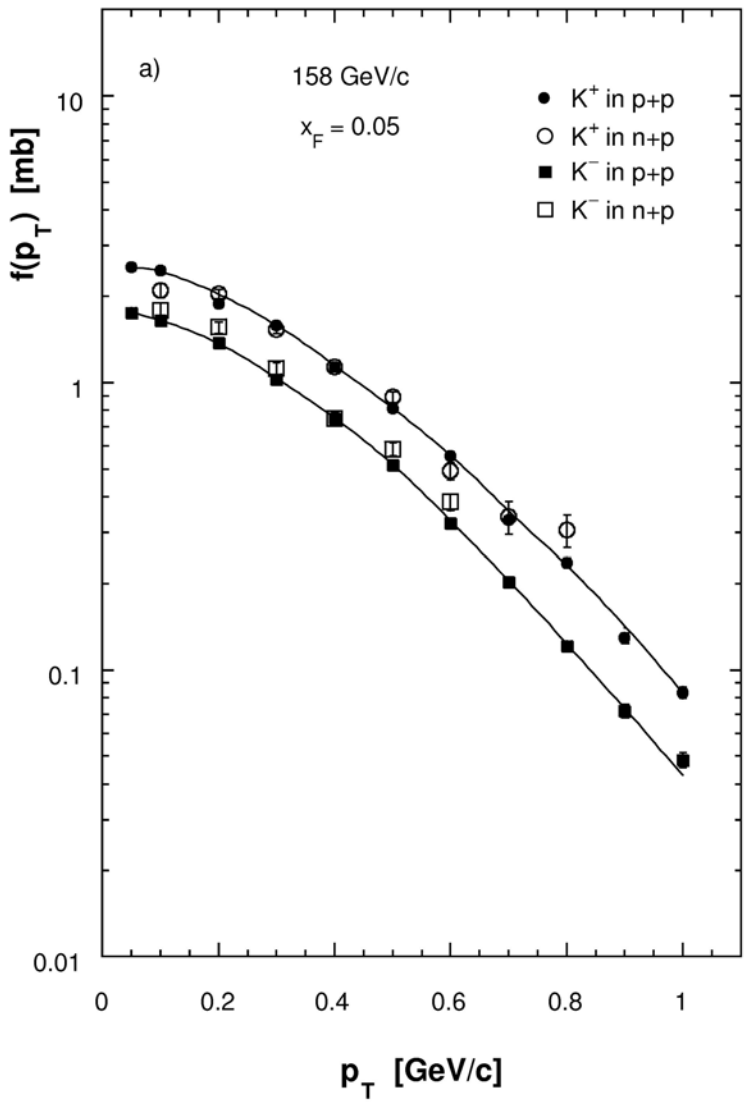


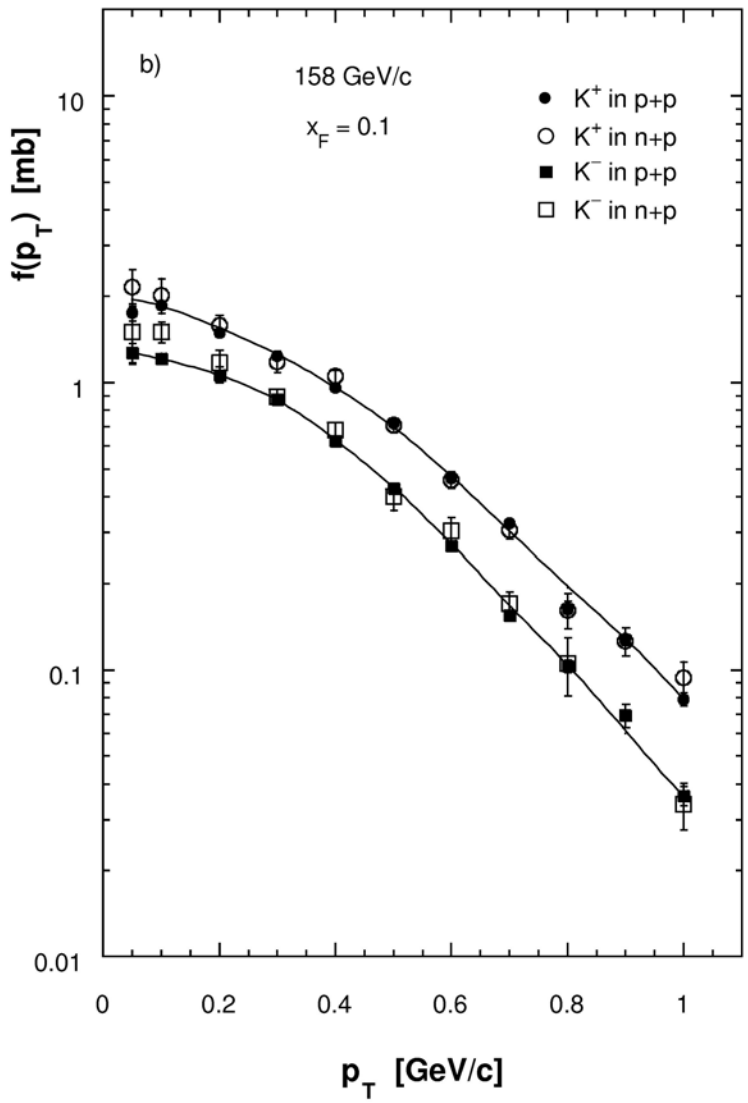
Net proton spectra at averaged π beam





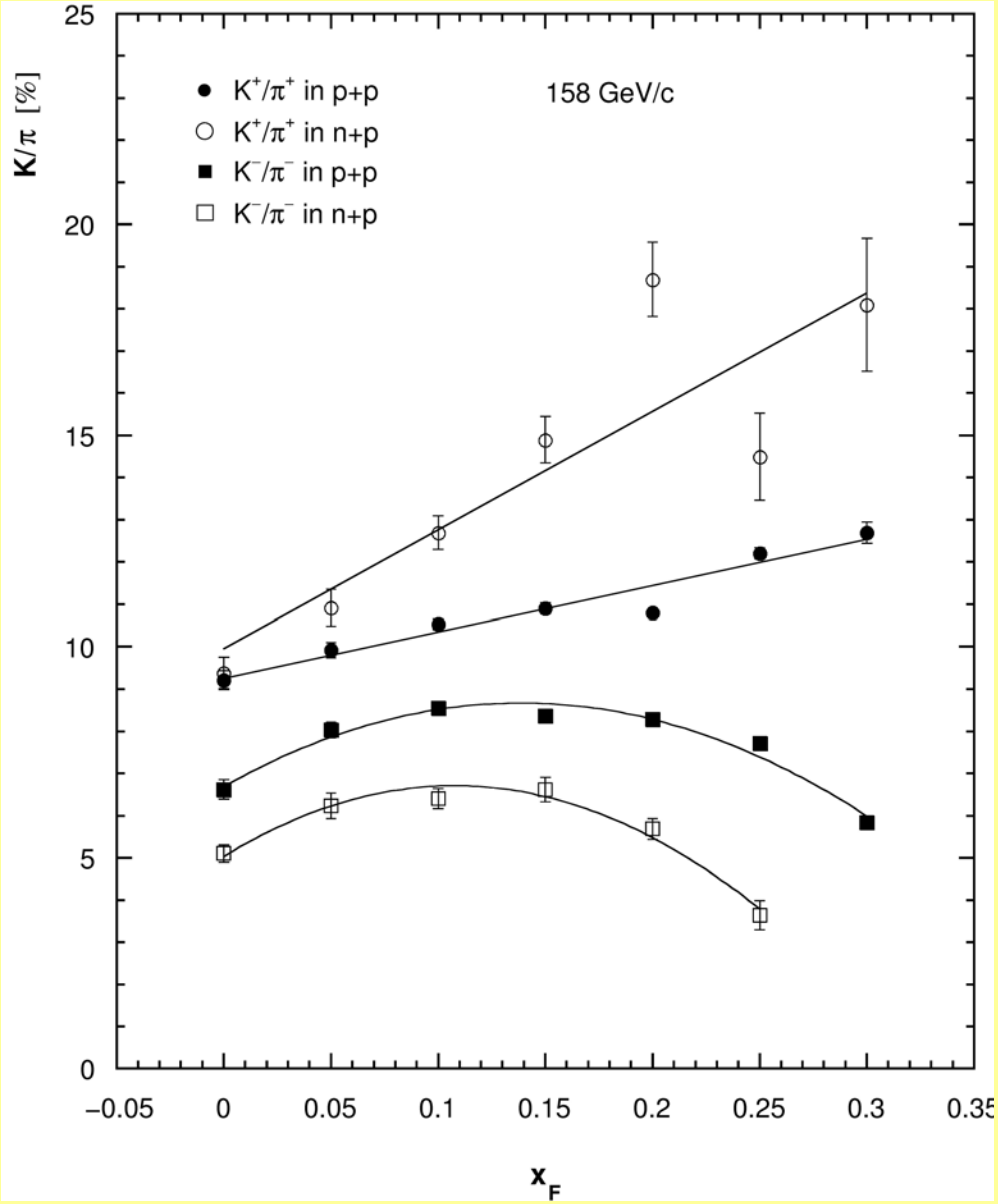
Projectiles		n		p	
Produced particles	π^-		π^0		π^+
Isospin	-1		0		+1

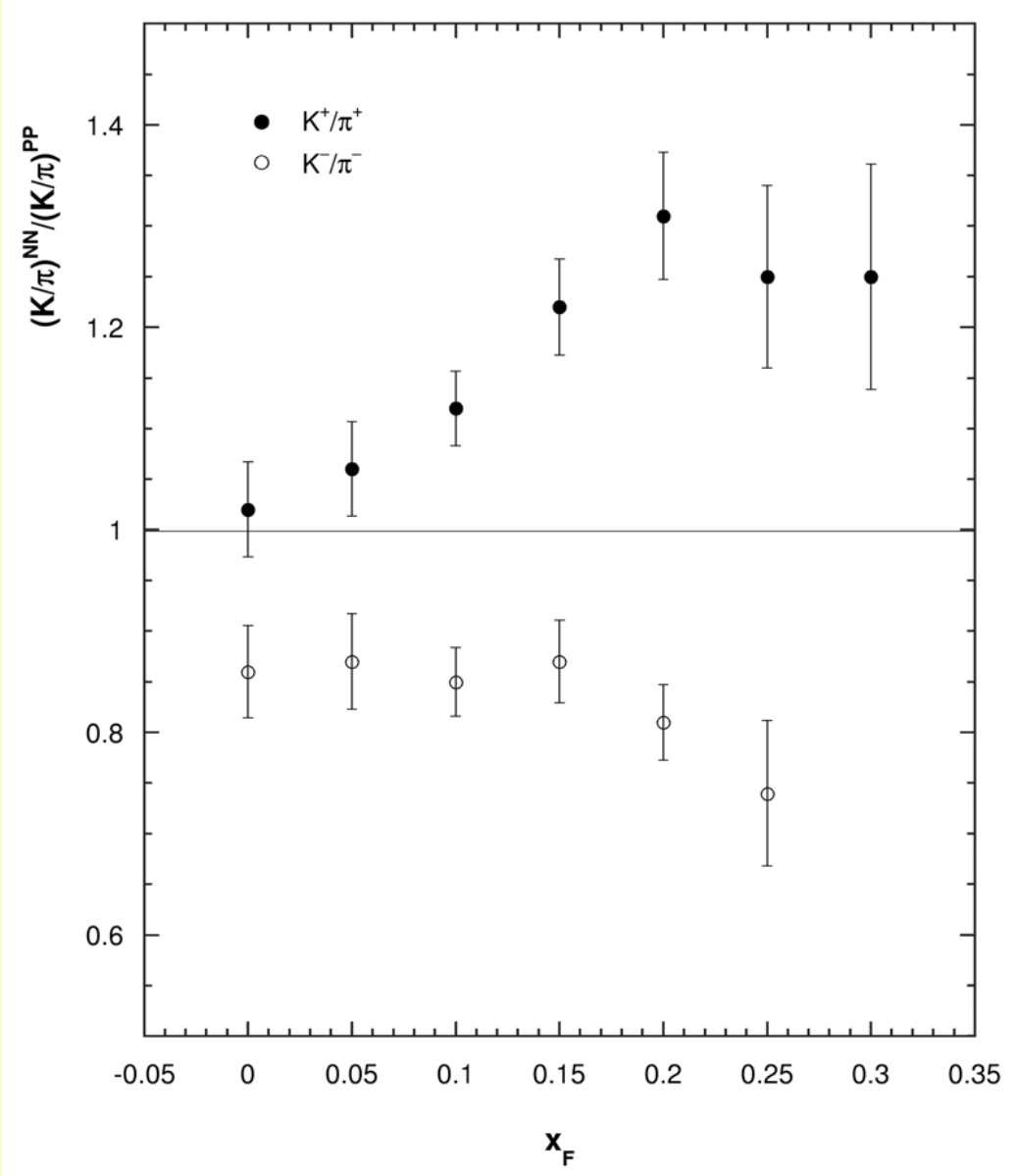




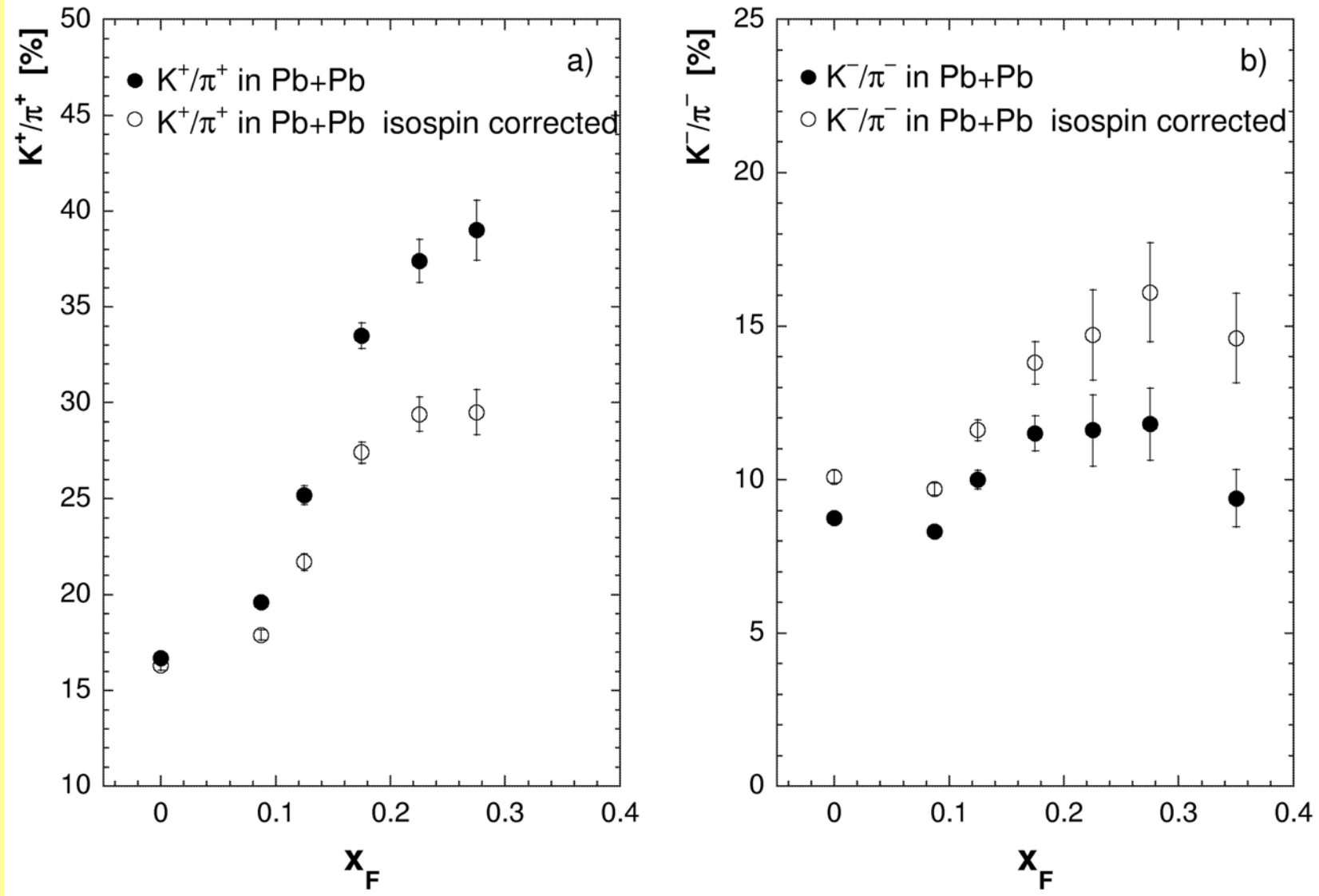
			Strangeness
Projectiles	n	p	
Produced particles	K^0 K^-	K^+ $\overline{K}^0$	1 -1
Isospin	-1/2	+1/2	

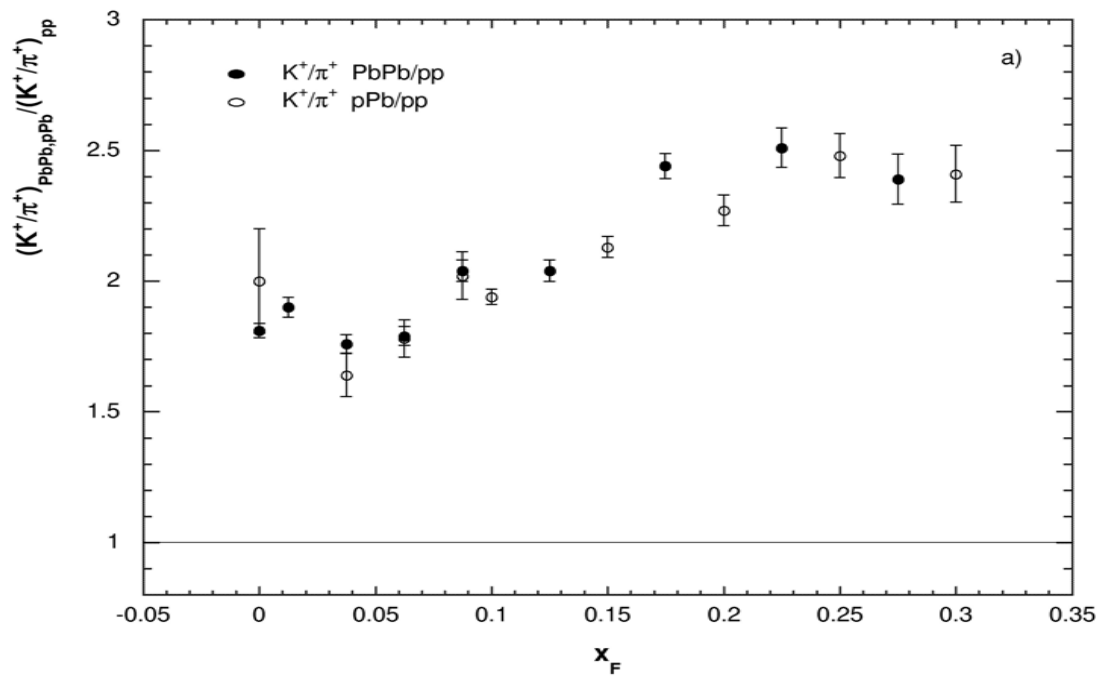
						Strangeness
Projectiles		n		p		
Produced particles	K^-K^0		K^+K^- $K^0\overline{K}^0$		$K^+\overline{K}^0$	0
Isospin	-1				1	

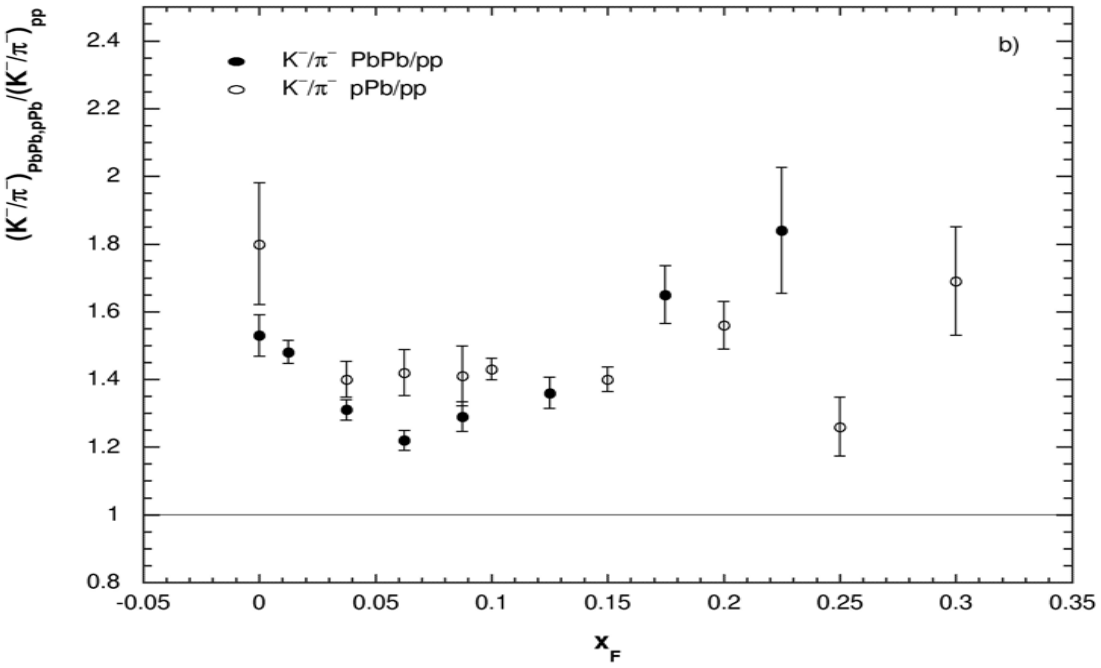

K/π [%]
25
20
15
10
5
0
−0.05
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
x_F
158 GeV/c
K⁺/π⁺ in p+p
K⁺/π⁺ in n+p
K⁻/π⁻ in p+p
K⁻/π⁻ in n+p



The correction factor for the comparing Pb+Pb and p+p interactions in order to account for the proper isospin composition of the Pb nucleus (60% n and 40% p projectiles)


a)
K^+/π^+ in Pb+Pb
K^+/π^+ in Pb+Pb isospin corrected
K^+/π^+ [%]
x_F
b)
K^-/π^- in Pb+Pb
K^-/π^- in Pb+Pb isospin corrected
K^-/π^- [%]
x_F


a)
K^+/π^+ PbPb/pp
K^+/π^+ pPb/pp
$(K^+/\pi^+)_{PbPb,pPb}/(K^+/\pi^+)_{pp}$
x_F


b)
K^-/π^- PbPb/pp
K^-/π^- pPb/pp
$(K^-/\pi^-)_{PbPb,pPb}/(K^-/\pi^-)_{pp}$
x_F

	pp	pBe	pPb	pPb	pPb	PbPb	PbPb
	NA49	WA97	WA97	NA49	NA49	WA97	NA49
NW	2	2.5	4.7	4.7	6.7	350	362
ν	1	1.5	3.7	3.7	5.7	4.5	4.5
Ξ^-	0.00074	0.0015	0.003	0.004	0.0058	1.5	1.49
$\overline{\Xi}^+$	0.00036	0.00068	0.0012	0.0014	0.0018	0.37	0.33

			isospin corrected	
	Ξ	$\overline{\Xi}$	Ξ	$\overline{\Xi}$
p+p	0.00074	0.00036	0.00096	0.00028
Pb+Pb	0.0082	0.0019		
PbPb/pp	11.0	5.3	8.54	6.8

Summary

- It was demonstrated that the isospin effect plays an important role at HI reactions and we have to take into account.
- The NA49 continue running in this year, and we want to have more p+p and p+Pb events, to be able to measure the Ω yields
- We want to measure more n induced events, for the better study of the isospin effects at 158 GeV triggering for neutrons.
- The statistics of 40 GeV n,p measurements is limited and we do not have more beam time to continue at SPS. Can we continue at GSI200 ?