widening of the p_T region for which the soft production (controlled by N_w) matters. The effect should be stronger for baryons than mesons as they consist of more valence quarks.

2. The data show that proton yields are more strongly enhanced by nuclear targets (for proton beam) than those of mesons and antiprotons. This indicates the existence of an additional mechanism which is connected with the valence quark structure of particles. One may speculate that for protons the diquark is at the origin of the observed difference. Since pions also have a quark common with the projectile proton the mechanism should be important for them as well. In p+A collisions, the projectile undergoes ν collisions, this must leave a trace on the characteristics of its partons. Therefore, characteristics of final state particles containing these partons should also be influenced by this fact.

3. The last, third, contribution to particle production comes from true hard interactions, which scale with the number of binary nucleon+nucleon collisions. They dominate high p_T region, giving there α=1 for all particle species.

According to this hypothetical picture of p+A collisions, the Cronin effect - the anomalous nuclear enhancement - is a sum of the first two mechanisms[7]. The picture implies much more strong enhancement for nucleus+nucleus reactions, as for them N_w is much larger than for p+A. The effect should also extend to higher p_T and be more pronounced for baryons than mesons. This also means that true hard processes dominate particle production starting from different p_T values depending on the studied system. It happens earlier, at smaller p_T, for p+p interactions than for p+A, and at the largest p_T values for nucleus+nucleus reactions. One thus sees that the broadening of the p_T distribution in nucleus+nucleus collisions and its species dependence do not necessarily require collective radial flow, as these effects are already present in more elementary interactions.

$\mathbf{R_{pA}(p_T)}$ Dependence on $\mathbf{x_F}$

For the first time the x_F dependence of the nuclear modification factor - $R_{pA}(p_T)$, for p+A collisions, is studied. Transverse spectra of identified particles from central p+Pb collisions are compared to those from p+p collisions by studying the behaviour of the nuclear modification factor in different intervals of x_F. $R_{pA}(p_T)$ is calculated according to Eq. 6.2; for the p+Pb data sample $\langle N_{binary} \rangle = \bar{\nu} \approx 5.8$, and at the studied energy σ_{inel}^{pp}=31.7 mb. The results for pions, protons and antiprotons are displayed in Fig. 6.6; the errors shown are statistical only. There are also the point-to-point uncertainties involved in the measurements. The estimates of the systematic errors are below 5% for $\pi^{\pm}$, p and below 15% for $\bar{p}$. At high p_T, however, they can be as large as 15% and 35% for

[7]Such an interpretation of the Cronin effect is beyond the framework of existing theoretical/phenomenological models aiming at the description of the effect.

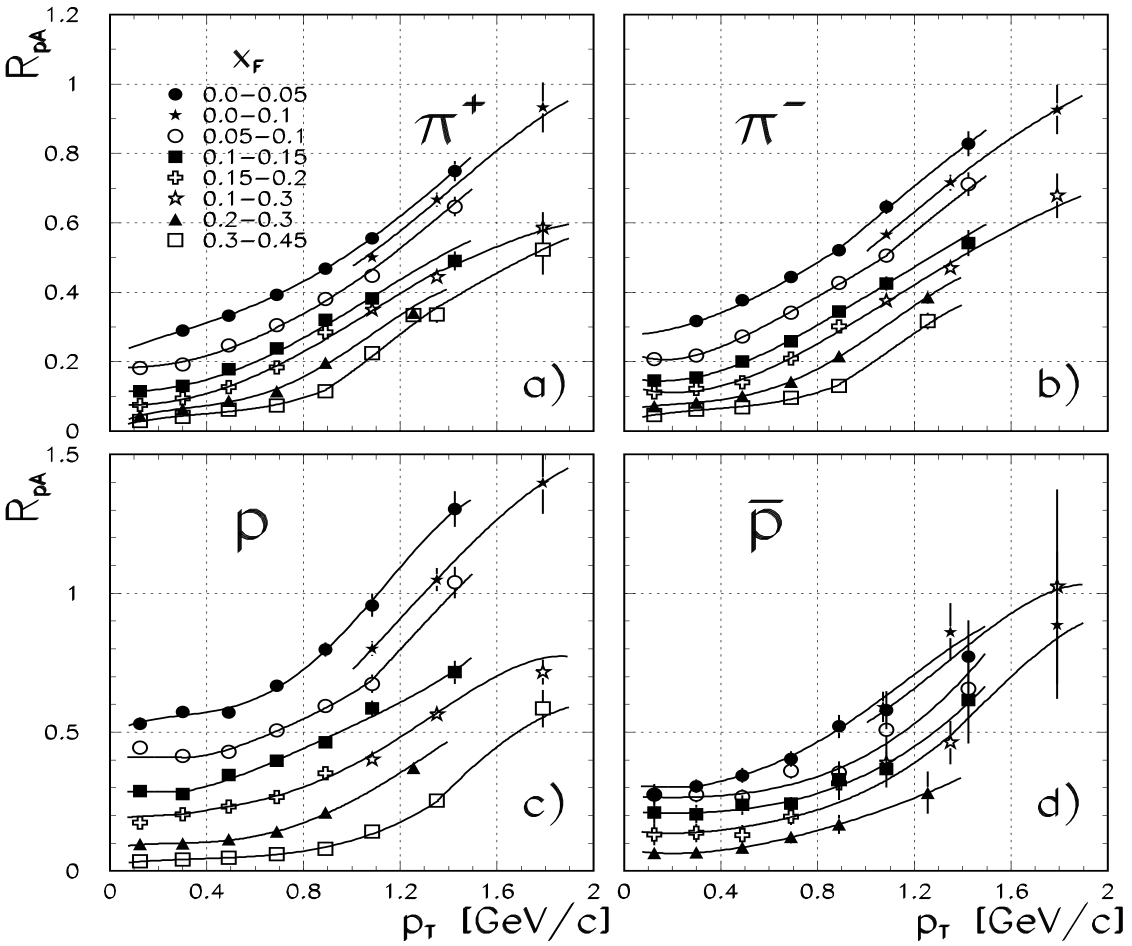

Figure 6.6: Nuclear modification factor R_{pA}, in different x_F intervals, for a) π^+'s, b) π^-'s, c) p's and d) $\bar{p}$'s produced in central p+Pb collisions at 158 GeV. Note: lines are drawn to guide the eye; errors are statistical only.

$\pi^{\pm}$, p and $\bar{p}$ respectively. Additionally, there is an overall systematic scale error of about 6%, which is the quadrature sum of the uncertainty of the $\langle N_{binary}\rangle$ determination ($\sim$4%) and the error on the trigger cross section determination for p+p collisions (4-5%). It may shift the curves up or down but does not affect their shapes.

Some observations from the presented results are given below.

- The spectra of $\pi^{\pm}$, p and $\bar{p}$ are harder in p+Pb than those in p+p collisions.

- For all particle species, with increasing x_F the reduction of $R_{pA}(p_T)$ at all p_T (<1.8 GeV/c) is visible.

- For the (x_F, p_T) region analysed here $R_{pA}^{\pi^+} \approx R_{pA}^{\pi^-} \approx R_{pA}^{\bar{p}}$, the behaviour similar to the one of the Cronin-α exponents for midrapidity particle production in this p_T range[8].

[8]It would be very interesting to perform the current analysis for larger p_T (not possible with present statistics), where at midrapidity $\alpha_{\bar{p}}>\alpha_{\pi}$, in order to check also the behaviour of large p_T particles in the forward region.