Addendum

'Isospin violations in large P_T pion inclusive processes in perturbative quantum chromodynamics' by H. S. Mani, M. Noman, M. Rafat and R. Ramachandran, Pramana **17**, pp. 395–404, 1981.

In the calculation of isospin violation, we had considered the hard QCD processes which produce a photon such as $q + g \to q + \gamma$ and $q + \bar{q} \to g + \gamma$ etc. This was suggested by the QCD predictions for a large and increasing γ/π° ratio at high P_T. We have now realized that in addition, the interference between the gluon exchange and photon exchange diagrams in the following processes also contribute to the isospin violation:

$$q_a + q_a \to q_a + q_a, \quad q_a + \bar{q}_a \to q_a + \bar{q}_a \text{ and } q_a + \bar{q}_a \to \bar{q}_a + q_a.$$

The diagrams for first of these processes ($q_a + q_a \to q_a + q_a$) are drawn in figure 3. The interference term is of order $\alpha_e\, \alpha_s$ and contributes to isospin violation.

Our calculations show that these interference terms actually dominate over the photon production diagrams considered earlier. The isospin violation is considerably enhanced as a result of inclusion of these terms and is now of the order of a few parts per thousand. The possibility of experimental detection is therefore improved. Figure 2 is supplemented by the corrected figures 4(a) 4(b) for the asymmetries R_{1T} and R_{2T} (given as before by equations 5 and 10 but now including the interference terms). We retain figure 2 for the asymmetries R_1 and R_2 because the photon producing processes are physically distinguishable from the pure hadronic processes. The experimental possibility of distinguishing them exists in tagging a prompt γ ray while measuring $\pi^\pm$ asymmetry, as already indicated in the last para of our paper.

The approximate scaling of the asymmetries in $P_T/\sqrt{s}$ still exists but now it is less marked in case 2 ($pn \to \pi^\pm X$). This can be understood by noticing (equations (1) and (13)) that the cross-sections depend on s through the Q^2 dependence of structure functions and fragmentation functions only. (Every other factor in (1), as well as the limits of integration, give only a $P_T/\sqrt{s}$ dependence (see Gluck *et al* 1978). The

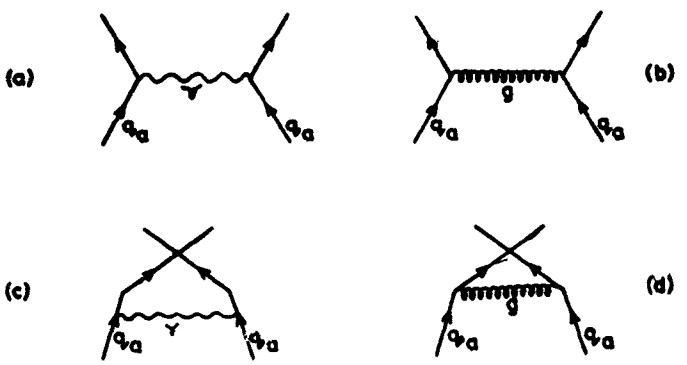

Figure 3. Feynman diagrams for $q_a\, q_a \to q_a\, q_a$, (a) and (b) are t channel diagrams for photon and gluon exchange respectively; (c) and (d) are u channel diagrams. The process $q_a\, \bar{q}_a \to q_a\, \bar{q}_a$ is obtained from these by $u \longleftrightarrow s$ crossing.

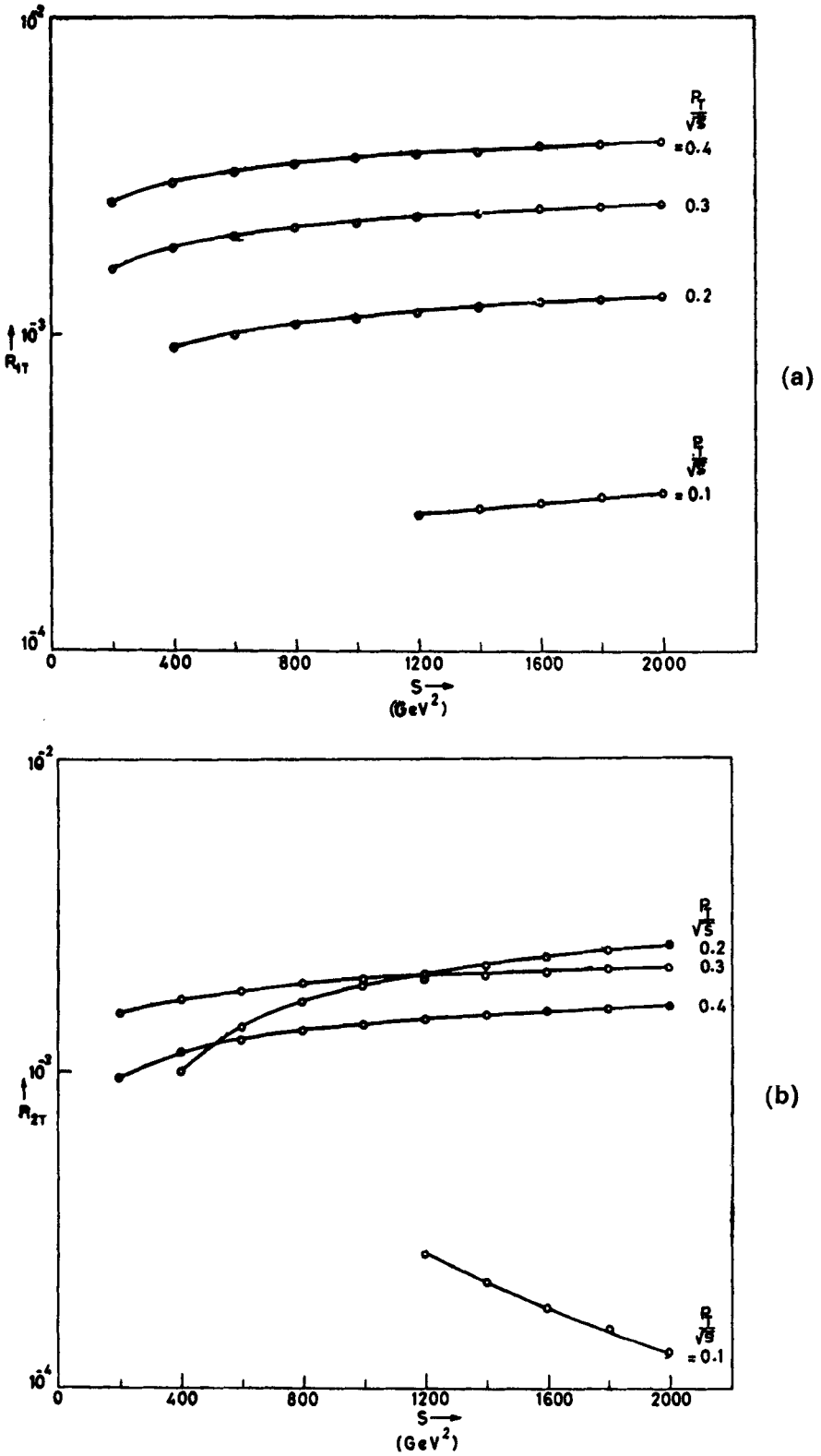

Figure 4. (a) R_1T (see text) *vs* s (centre of mass energy squared) at various values of $P_T/\sqrt{s}$. (b) R_2T *vs* s at various values of $P_T/\sqrt{s}$. Circles denote the values of s at which calculations have been made.

Q^2 dependence of these functions therefore determines the extent to which we expect the $P_T/\sqrt{s}$ scaling to be violated. The Q^2 dependence of quark structure functions in nucleon is stronger than in pion (see Gluck and Reya 1977; Gluck *et al* 1978). One would therefore expect $P_T/\sqrt{s}$ scaling to be less marked in *pn* scattering, in agreement with our calculations.

References

Gluck M and Reya E 1977 *Nucl. Phys.* **B130** 76
Gluck M, Owens J F and Reya E 1978 *Phys. Rev.* **D18** 1501