A Simple Way to Generate non-zero Collins Fragmentation Function

Rajen Kundu
Vrije Universiteit, Amsterdam, the Netherlands

The Collins function belongs to the so-called *time-revarsal-odd* fragmentation functions. It appears in the fragmentation of a transversely polarized quark into an unpolarized hadron like a pion, $q^* \to \pi X$, when the decaying quark to start with has some transverse momentum. Being chirally-odd, it is one of the most prominent candidates to probe the transversity distribution, which contains important information regarding the nucleonic spin structure complementary to what is stored in the helicity distribution and yet to be experimentally explored.

The Collins function merits a lot of attention towards understanding the physics governing the fragmentation process itself. It is generally believed that in the fragmentation processes *final state interaction* (which always lies behind the scene) play the crucial role in generating all the time-reversal-odd functions like Collins function. However, when it comes to the Collins function, this final-state-interaction has been suspected to average out, thereby making it to vanish and therefore suggesting instead to put more emphasis on the interference-fragmentation functions, which also probes the transversity distribution but experimentally more challanging too. Until now, no *a priori* calculation has ever displayed the possibility of providing a simple model for this final-state-interaction and thereby generate a non-zero Collins functions.

On the experimental side, the HERMES collaboration reported the first observation of a single-spin asymmetry in semi-inclusive pion production, which could be interpreted as arising from the contribution of the Collins function. Analogously, large single-spin asymmetries in $p^\uparrow p \to \pi X$ could also be explained using the Collins function. The situation is far from clear, but further investigations are among the priorities of the HERMES, COMPASS and possibly eRHIC programs.

In this situation, generating a non-zero Collins function in a simple yet consistent model seems to be an interesting and relevant task. And that is exactly what we are going to present in this talk. We use a simple pseudo-scalar coupling between pions and quarks to model the fragmentation process and we show that the inclusion of one-loop corrections can be interpreted as *a model* for possible final-state-interaction giving rise to non-trivial phases, which do not cancel among themselves and hence generate a non-zero Collins function. We do not pretend our calculation to be complete or realistic, but it provides a first theoretical support to its existence. The model can always be improved to better describe the phenomenology.

References

1) J.C. Collins, Nucl. Phys. B 396, 161 (1993).
2) A. Bacchetta, R. Kundu, A. Metz and P.J. Mulders, Phys. Lett. B 506, 155 (2001).