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Rigorous Results Concerning Light Cone Dominance in Deep Inelastic Lepton-Hadron Scattering*

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Abstract. We consider a class of distributions, appearing in electro-production and satisfying a Jost-Lehmann-Dyson representation. We then prove without further assumptions that only their singularity structure near the light cone is relevant for the behaviour of their Fourier transform in the Bjorken limit. Furthermore we study the ambiguity in this singularity structure introduced by the fact, that scaling is known only in the space like region of momentum space.

1. Introduction[1]

A great deal of theoretical interest has been shown in deep inelastic lepton-nucleon scattering experiments such as inelastic $e-p$ scattering. This has to do with the claim, often expressed in the literature, that in these experiments one is measuring the commutator of two currents in a region of the configuration space where the theoreticans may have some intuition, namely for light-like separations. This has led to the development of the so-called light cone physics [2]. However the arguments put forward as justification for the close relation between light cone and Bjorken limit are somewhat formal and not totally convincing [3].

In this paper we study rigorously the distribution theoretical problem of the dependence of the momentum space asymptotics on the configuration space structure of a structure function [4–6]. Because of the special singularity structure expressed by a Jost-Lehmann-Dyson representation it is possible to answer this question completely:

It is indeed the degree of singularity on the light cone which determines the Bjorken limit of structure functions (see our Theorem II).

This goes far beyond the general statements on asymptotic behaviour of Fourier transforms which can be found in standard books on distribution theory [7, 8].

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[1] This work is a slightly improved version of the author's thesis [1].