Contribution ID: **48** Type: **Contributed talk**

Light-front dynamic analysis of the transition form factors in $1+1$ dimensional scalar field model

Thursday 2 December 2021 13:30 (15 minutes)

We investigate the "scalar pion" $\to \gamma^*\gamma^*$ transition form factor for the two emitted virtual photons of momentum squares q^2 and q'^2 in both space-like and time-like regions. In 1+1 dimensional scalar field model, we use the direct method in the light-front dynamics (LFD) to access the time-like region without resorting to analytic continuation. In particular, we define the contributions from individual x^+-ordered amplitudes in LFD to the form factor in a novice way applying both the plus and minus components of the current and confirm that the individual x^+-ordered amplitudes are dependent on the component of the current taken for the computation while the sum of all the contributions is the same as it must be. We present the analytic result for the one-loop triangle diagram covering the whole ranges of q^2 and q'^2, both from a manifestly covariant calculation and from the LFD calculation, and show that the end result is identical. We also verify that this analytic result satisfies the dispersion relation in the entire q^2 and q'^2 ranges.

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Session Classification: Parallel Session