Contribution ID: **8** Type: **Oral Presentation**

Clifford Fourier Transforms in (2+1)D Lattice Simulations of Soliton Propagations

Wednesday, August 10, 2022 5:10 PM (20 minutes)

In Non Destructive Testings (NDT), ultrasonic Time Revesal based Nonlinear Elastic Wave Spectroscopy (TR-NEWS) turned out to be an efficient method. In order to find out anomalies in the convolution of scattered phonetic waves one of which is time reversed (TR) phonon of the other, it is necessary to perform Fourier transforms of signals.

The energy flow of nonlinear waves detected in TR-NEWS has symmetry structure of quaternions, the path of phonetic waves are confined on a $2D$ plane spanned by e_1, e_2. The space can be regarded as projected one from the $(2+1)D$ space containing $e_1 \wedge e_2$.

In one loop approximation, we consider 7 A type loops which sit on $2D$ plane spanned by e_1, e_2, and 13 B type loops which include a pair of path proportional to $e_1 \wedge e_2$ and $e_2 \wedge e_1$ that connect two $2D$ planes.

We adopt a model of bosonic phonons propagating in Fermi-sea of neutral Weyl spinors which follow the Clifford algebra. Configurations in momentum space is transformed to real position space via Clifford Fourier Transform (CFT).

We propose application of Machine Learning (ML) or Neural Network (NN) technique for the analysis of optimal weight of 20 kind of topological loops.

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Session Classification: Theoretical Developments

Track Classification: Theoretical Developments and Applications beyond Particle Physics