

Peer Review

Review of: "On the Fractional Dynamics of Kinks in sine-Gordon Models"

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The authors explore the dynamics of single kinks, kink-anti-kink pairs, and bound states in the prototypical fractional Klein-Gordon example of the sine-Gordon equation. By modifying the order β of the temporal derivative to that of a Caputo fractional type, they find that, for $1 < \beta < 2$, this imposes a dissipative dynamical behavior on the coherent structures. Furthermore, the variation of a fractional Riesz order α on the spatial derivative is examined. Here, depending on whether the harmonic value $\alpha < 2$ or $\alpha > 2$, respectively, monotonically attracting kinks, or non-monotonic and potentially attracting or repelling kinks, with a saddle equilibrium separating the two, are found. Finally, the interplay of the two derivatives is also explored when both Caputo temporal and Riesz spatial derivatives are involved.

The results are significantly new and very interesting, as they demonstrate a distinctive feature of the Fractional Klein-Gordon equation that is not met by the standard sine-Gordon models. For example, the authors consider the dynamics of head-on collisions of kink-anti-kink pairs in the Caputo time derivative case with $\beta < 2$. Contrary to the standard integrable sine-Gordon equation, the dynamics of the fractional Klein-Gordon is dissipative. To escape, the kinks need to overcome both each other's attraction and the reduction of their speed due to dissipation.

I strongly recommend the publication of this paper in Qeios.

Declarations

Potential competing interests: No potential competing interests to declare.