Scalars 2023

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Scalaroca stars: coupled scalar-Proca solitons

Saturday 16 Sep 2023 at 09:30 (00h15')

Content :

We construct and explore the physical properties of \textit{scalaroca stars}: spherically symmetric solitonic solutions made of a complex scalar field Φ and a complex Proca field A^μ. We restrict our attention to configurations in which both fields are in the fundamental state and possess an equal mass, focusing on the cases when (\textit{i}) the scalar and Proca fields are (non--linearly) super--imposed and do not interact with each other; and (\textit{ii}) the scalar and Proca fields interact through the term $\alpha |\Phi| ^2 A^\mu A_\mu$. The solutions are found numerically for the non--interacting case ($\alpha=0$) as well as for both signs of the interaction coupling constant α. While pure (\textit{\textit{i.e.}} single--field) Proca/scalar boson stars are the most/least massive for weakly--interacting fields, one can obtain more massive solutions for a sufficiently strong interaction. Besides, in the latter case, solutions can be either in a synchronized state -- in which both fields have the same frequency -- or in a non--synchronized state. In addition, we observe that the coupling between the two fields allows solitonic solutions with a real scalar field. We further comment on the possibility of spontaneous scalarization and vectorization of the interacting solitonic solution.
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