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# LIE SYMMETRY ANALYSIS OF THE $(2 + 1)$ -DIMENSIONAL MODE-LOCKED NONLINEAR SCHRÖDINGER MEAN-FIELD MODEL

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Şeyma Gönül <sup>1,\*</sup>, Cihangir Özemir <sup>1</sup>,

<sup>1</sup>*Istanbul Technical University*

## ABSTRACT

This study presents a Lie symmetry analysis of a  $(2 + 1)$ -dimensional mode-locked nonlinear Schrödinger mean-field model. The model describes the coupled evolution of a complex optical field and a mean field, incorporating diffraction, cubic and quintic nonlinear effects, linear loss, and field-dependent coupling terms [1]. By employing the classical Lie group method, the determining equations corresponding to the infinitesimal transformations are derived and systematically solved. A systematic classification of the admitted Lie symmetries is obtained with respect to the relevant model parameters. The results show that the structure of the symmetry algebra varies significantly depending on the parameter configurations. In particular, both finite-dimensional Lie algebras and infinite-dimensional symmetry structures involving arbitrary functions are identified.

**Keywords** Lie symmetry analysis · Mode-locked · Nonlinear Schrödinger equation · cubic and quintic terms

## References

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\*Corresponding Author's E-mail: gonul20@itu.edu.tr