Rogue wave patterns

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Abstract

We show that universal rogue wave patterns exist in integrable systems. These rogue patterns comprise fundamental rogue waves arranged in shapes such as a triangle, pentagon and heptagon, with a possible lower-order rogue wave at the center. These patterns appear when one of the internal parameters in bilinear expressions of rogue waves gets large. Analytically, these patterns are determined by the root structures of the Yablonskii-Vorob’ev polynomial hierarchy through a linear transformation. Thus, the induced rogue patterns in the space-time plane are simply the root structures of Yablonskii-Vorob’ev hierarchy polynomials under actions such as dilation, rotation, stretch, shear and translation. Which level of the Yablonskii-Vorob’ev hierarchy is determined by which internal parameter is chosen to be large, and which polynomial at that level of the hierarchy is determined by the order of the underlying rogue wave. As examples, these universal rogue patterns are explicitly determined and graphically illustrated for the nonlinear Schrodinger equation, the derivative nonlinear Schrodinger equation, the Boussinesq equation, and the Manakov system. This talk is based on joint work with Dr. Bo Yang.

References:

[1] B. Yang and J. Yang, "Rogue wave patterns in the nonlinear Schrodinger equation", Physica D 419, 132850 (2021).

[2] B. Yang and J. Yang, "Universal rogue wave patterns associated with the Yablonskii-Vorob'ev polynomial hierarchy", Physica D 425, 132958 (2021).