

Wave Patterns in Higher-Order KP-I Lumps

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The Kadomtsev-Petviashvili-I (KP-I) equation models two-dimensional shallow water waves under strong surface tension as well as the evolution of weakly nonlinear two-dimensional plasma waves. In this talk, pattern formation in higher-order lumps of the KP-I equation at large times is analytically studied. For these higher-order lumps under certain internal-parameter restrictions, we show that the large-time wave patterns comprise fundamental lumps arranged in non-triangular shapes in the outer region, which are described analytically by nonzero-root structures of the Wronskian-Hermit polynomials, together with fundamental lumps arranged in triangular shapes in the inner region, which are described analytically by root structures of the Yablonskii-Vorob'ev polynomials. When time evolves from large negative to large positive, the non-triangular pattern in the outer region switches its x and y directions, while the triangular pattern in the inner region reverses its direction along the x -axis. For higher-order lumps under generic internal-parameter values, however, we show that the large-time patterns would comprise fundamental lumps in the outer region that are described analytically by the nonzero-root structures of the Wronskian-Hermite polynomials, together with fundamental lumps in the inner region that are uniformly distributed on concentric rings. Our predicted patterns at large times are compared to true solutions, and excellent agreement is observed.