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## A Talk at the 2nd ISNMP Conference

Bad Ems, 28 June to 4 July 2026

### Regular Session:

**Speaker:** Laurent Delisle (LyRIDS, ECE Engineering School, OMNES Education, 10 rue Sextius Michel, 75015 Paris, France)

**Title:** *A vector Hirota bilinear framework for integrable systems*

**Abstract:** We investigate the integrable structure and soliton dynamics of a coupled modified Korteweg–de Vries (cmKdV) system with a real symmetric coupling matrix. We introduce a vector reformulation of Hirota’s bilinear formalism in which both the bilinear equations and their solutions are expressed directly at the vector level, rather than through a component-wise construction. This formulation preserves the intrinsic structure of the coupled system and provides a compact framework for multi-component nonlinear wave dynamics. Within this approach, we construct explicit one-, two-, and three-soliton solutions in closed vector form and recover the three-soliton condition directly at the vector level, confirming consistency with integrability. The method enables a unified treatment of focusing, defocusing, and mixed-sign regimes. In particular, for indefinite coupling, it reveals the existence of nontrivial vector ground states, leading to soliton solutions on non-zero backgrounds. These results highlight the structural advantages of the vector bilinear approach and open perspectives for the study of more general nonlinear excitations in multi-component integrable systems.