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Soliton decomposition in the Box Ball System in \mathbb{Z}

The Ball Box System (BBS) is a cellular automaton in $\{0,1\}^{\mathbb{Z}}$ introduced by Takahashi and Tsumura in 1990 as a discrete analog of the KdV partial differential equation, a system with interacting soliton solutions. In the BBS a box is placed at each integer and can either be empty or contain a ball. A carrier with infinite capacity visits successively the boxes from left to right. The carrier picks balls from occupied boxes and leaves carried balls at empty boxes. The automaton has countable many conserved quantities which travel at different speeds (solitons) and interact locally. We exhibit a soliton decomposition of the ball configuration which completely describes the interaction and has striking factorization properties.

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