

Equilibrium States and Traveling Wave Solutions of the Heisenberg and M-I Spin Systems

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We obtain general expressions for the equilibrium states and traveling wave solutions of the Heisenberg and Myrzakulov I continuum spin systems, expressed as 1+1 and 1+2 PDEs, respectively in the form

$$\vec{S}_t = \vec{S} \times \vec{S}, \quad \text{and} \quad \vec{S}_t = \left(\vec{S} \times \vec{S}_y + u\vec{S} \right)_x, \quad u_x = - \left(\vec{S}, \vec{S}_x \times \vec{S}_y \right),$$

$$\vec{S} = (S_1, S_2, S_3), \quad S_1^2 + S_2^2 + S_3^2 = 1.$$

We reduce these equations to ODEs which can be solved analytically, since the original systems are known to be completely integrable by IST and, therefore, all their reductions are also expected to be integrable. Indeed, in some cases, the reduced equations are explicitly solved by trigonometric functions, while in others, we use the fact that they possess the Painlevé property. We expect that our results will be useful in terms of their continuation and stability properties when one studies small nonintegrable perturbations of the above integrable spin models.

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