NEEDS 2009 Workshop
Nonlinear Evolution Equations and Dynamical Systems
Isola Rossa, May 16–23, 2009.

An exactly solvable supersymmetric spin chain

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March 3, 2009

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Supersymmetric spin chains of Haldane–Shastry type have recently received considerable attention. In this communication we report on a new exactly solvable supersymmetric spin chain related to the BC_N extended root system, which includes as a particular case the BC_N version of the Polychronakos–Frahm spin chain. The new chain is constructed by taking the strong coupling limit of an associated supersymmetric spin dynamical model of Calogero type, which is also integrable. The chain sites, which are the coordinates of the unique minimum of the scalar part of the potential, coincide with the zeros of a suitable Laguerre polynomial. This connection between the chain and the dynamical model is exploited to derive two different closed-form expressions for the chain's partition function by means of Polychronakos's freezing trick. We also establish a boson-fermion duality relation for the new chain's spectrum, which is in fact valid for a large class of (not necessarily integrable) spin chains of BC_N type. The exact expressions for the partition function are also used to study the chain's spectrum as a whole, showing that the level density is normally distributed even for a moderately large number of particles. We also determine a simple analytic approximation to the distribution of spacings between consecutive (unfolded) levels which fits the numerical data with remarkable accuracy. Our results provide further evidence that spin chains of Haldane–Shastry type are exceptional integrable models, in the sense that their spacings distribution is not Poissonian, as posited by the Berry–Tabor conjecture for "generic" quantum integrable systems.

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