High Energy Physics - Theory

Dimer Models and Integrable Systems

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We explore various aspects of the correspondence between dimer models and integrable systems recently introduced by Goncharov and Kenyon. Dimer models give rise to relativistic integrable systems that match those arising from 5d N=1 gauge theories studied by Nekrasov. We apply the correspondence to dimer models associated to the Y^{p,0} geometries, showing that they give rise to the relativistic generalization of the periodic Toda chain originally studied by Ruijsenaars. The correspondence reduces the calculation of all conserved charges to a straightforward combinatorial problem of enumerating non-intersecting paths in the dimer model. We show how the usual periodic Toda chain emerges in the non-relativistic limit and how the Lax operator corresponds to the Kasteleyn matrix of the dimer model. We discuss how the dimer models for general Y^{p,q} manifolds give rise to other relativistic integrable systems, generalizing the periodic Toda chain and construct the integrable systems for general Y^{p,p} explicitly. The impurities introduced in the construction of Y^{p,q} quivers are identified with impurities in twisted sl(2) XXZ spin chains. Finally we discuss how the physical concept of higgsing a dimer model provides an efficient method for producing new integrable systems starting from known ones. We illustrate this idea by constructing the integrable systems for higgsings of Y^{4,0}.

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