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Dressing networks: towards an integrability approach for understanding network structures

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A large variety of real world systems can be naturally modelled by networks, i.e. graphs whose nodes represent the components of a system linked (interacting) according to specific statistical rules. A network is realised by a graph typically constituted by a large number of nodes/links. Fluid and magnetic models in Physics are just two among many classical examples of systems which can be modelled by simple or complex networks. In particular "extreme" conditions (thermodynamic regime), networks, just like fluids and magnets, exhibit a critical collective behaviour intended as a drastic change of state due to a continuous change of the model parameters.
Using an approach to thermodynamics, recently introduced to describe a general class of van der Waals type models and magnetic systems in mean field approximation, we analyse the integrable structure of corresponding networks and use the theory of integrable conservation laws combined with a suitable "dressing" procedure to calculate order parameters outside and inside the critical region.

Primary author: Dr MORO, Antonio (Northumbria University Newcastle)

Presenter: Dr MORO, Antonio (Northumbria University Newcastle)