Title: Introduction to the Bethe Ansatz: the Coordinate Bethe Ansatz (2 hrs.)

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Abstract: In the first part of this lecture the spin-1/2 Heisenberg model will be introduced. The model itself will be constructed and its symmetries will be presented. In the second half of the lecture the coordinate Bethe ansatz will be applied to solve the one-dimensional version of this model. In particular it will be shown how the complexity of the original model is reduced by applying the Bethe ansatz wavefunction.

A comprehensive theory of conduction (1 hr.)

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This presentation will deal with recent advances in describing current, flow and conduction. An outline of the presentation is as follows:

- the modern theory of polarization: polarization as a Berry phase
- expressing the drift current as a Berry phase
- dc conduction in terms of a topological invariant: are all insulators "topological"?
- a simple proof of Kohn`s hypothesis: many-body localization is insulation
- three different types of current: superfluid flow, supercurrent in paired systems, and normal conduction
- three different transport coefficients: the superfluid weight, the Meissner weight, and the Drude weight
- a comprehensive theory of conductivity: distinguishing superfluids, superconductors, normal conductors, and insulators based on the appropriate transport coefficients
- connecting transport coefficients with off-diagonal long-range order
- the answer to a very old question: the difference between a Bose-Einstein condensate and a superfluid
- application to other models: understanding conduction in strongly correlated systems, with some surprising results

References:

1. J. Phys. Soc Japan vol. 81 article 124711 (2012).
2. Physical Review B vol. 87 235123 (2013).
3. J. Phys. Soc. Jpn. 83 034711 (2014).