Title: Introduction to Bethe ansatz techniques and some of their applications to models of quantum matter

Abstract: The Bethe ansatz (BA) techniques from which we shall choose the topics of our discussions include the

- coordinate Bethe ansatz (CBA): the original ansatz
  - ansatz for the wave function of a quantum Hamiltonian
  - phase shifts, boundary conditions, and Bethe ansatz equations
  - thermodynamic limit and integral equations
  - low–lying excitations
- algebraic Bethe ansatz (ABA): from vertex models to quantum integrability
  - connection between two–dimensional Ising–like lattice models of classical statistical mechanics, so–called vertex models, and quantum models in one dimension
  - Yang-Baxter relations and fundamental commutation relations (FCR)
  - quantum integrability
    - Application: integrability of the quantum Tavis–Cummings and Rabi models of Quantum Optics
- thermodynamic Bethe ansatz (TBA): finite temperatures
  - holes and particles, string hypothesis
  - densities of holes and particles in the thermodynamic limit
  - partition function, entropy and infinite set of coupled, nonlinear integral equations
- Bethe ansatz for finite systems (FSBA)
  - application of Euler–Maclaurin formula to transform BA equations into a Wiener–Hopf integral equation
  - i.e. a finite–size expansion around the thermodynamic limit
    - Application: conformal spectrum of the critical Heisenberg spin chain

We shall introduce these Bethe ansatz techniques to lay the foundations for the more advanced methods and applications addressed by the other lecturers of this summer school.

References:
The topics outlined above are, by and large, standard topics in the field of Bethe ansatz integrable models. They and more will be treated in a forthcoming book:
Hans-Peter Eckle: A First Course on Bethe Ansatz and Integrable Models of Quantum Matter, Oxford University Press, to be published.
Excerpts from this book will be provided as lecture notes.