Lecture Series: From Micro To Macro: Basic Ideas and Techniques of Statistical Mechanics

by Dimitris Tsagkarogiannis (University of l'Aquila) suitable for students of semester 4 and above

A physical gas can be described as a very large number of tiny particles that move according to relatively simple laws, but their sheer number makes such a description quite impractical. A first step is to switch to a stochastic model, which however is still microscopic, i.e. describes many particles. On the other hand, the laws of thermodynamics or the Boltzmann equation allow a description of a gas through through analysis, where the individual particles are not part of the theory. The mathematical passage from a (microscopic) particle model to a (macroscopic) analytic model is one of the main topics of statistical mechanics.

In this mini-series, Dimitris will give an introduction to different aspects of the theory. The lectures can be followed individually if you don't have time to attend all of them, but together they present a more complete picture.

Prerequisites: if you are currently following the *Einführung in die Stochastik* and have heard *Analysis 1-3*, you will have all the prerequisites you need to follow the lectures.

Schedule:

Lecture 1, Monday, 7. July, 13.30, Room S2|15 234: Introduction:

Observables, microcanonical ensemble, entropy, Shannon-McMillan Theorem; Lattice models.

Lecture 2, Tuesday, 8. July, 16.10, Room S2|15 234: The Curie-Weiss model. The simplest model of statistical mechanics, that can be treated rather completely.

Lecture 3, Wednesday, 9. July, 9.50, Room S2|15 244: The Ising model. The most important model in statistical mechanics. Thermodynamic limit, Peierls' argument.

Lecture 4, Thursday, 10. July, 13.30, Room S2|15 244: Perspectives and Outlook. *Dynamics:* from Interacting Particle Systems to Partial Differential Equations *Simulations:* Metropolis algorithm

Recent applications: neural networks (Hopfield model), machine learning.

Lecture 5, Friday, 11. July, 11.40, Room S2|15 234: Discussion, Lunch, l'Aquila.

This session will be a joint lunch (we provide some food), where you can ask questions, discuss about the topics of the week, or just have a good time. There will also be some information about the **Double Degree program**me that Darmstadt has with the University of l'Aquila. You can find more information on the programme on our web page, just scan the QR code on this announcement!

