Lecture:
Soft Matter and Biological Physics

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In this **lecture** I will give an introduction into the fields of *soft matter* and *biological physics*. Students who would like to attend this lecture should have a background in statistical mechanics and quantum mechanics. Familiarity with biological concepts beyond high school knowledge is not assumed but will be developed during the lecture. Below you find an outline of the lecture, the theoretical concepts you will learn during this course, and a list of systems and processes from the realm of biology and soft matter.

There will also be **exercise classes** with a twofold intention. On the one hand, they will give you the opportunity to test whether you have understood the material presented in the lecture. On the other hand, there will also be some more challenging problems which will give you a flavor of what theoretical research is like.

In addition to exercise classes there will be a **project seminar** for a limited number of students (see the second pdf file), which is meant as an introduction to research in the area of soft matter and biological physics. Participants will be guided by a teaching assistant, and are expected to give a seminar talk and write a small research paper. Those interested should write me an email.

Outline of the lecture.

1. Introduction: polymers and random walks
2. Statistical mechanics of biopolymers
3. Field theories of soft matter systems
4. Nonlinear dynamics and pattern formation
5. Brownian motion: from colloids to strings and membranes
6. Stochastic processes: "it's a noisy world"

Theoretical concepts. probability theory, path integrals, diffusion equation, Monte Carlo simulations, polymer physics, Landau theory, critical phenomena, renormalization group theory, scaling, elasticity theory, hydrodynamics, disorder, fractals, Brownian motion, Langevin equation, Master equation, Fokker-Planck equation, Brownian dynamics and stochastic simulations, correlation functions, linear response theory, nonlinear dynamics

Biological systems and processes. DNA, protein filaments, protein folding, membranes, molecular motors, biochemical oscillations, networks, system biology, enzyme kinetics, ion channels, population genetics, gen regulation.

Soft matter systems. colloidal suspensions, polymers, membranes, microemulsions, liquid crystals, flux lines and polymeric liquids, gels and polymer networks.

Literature. There will be lecture notes. I will also make suggestions for further reading during the lecture. As an appetizer I have appended some recent review articles, which appeared in "Physik Journal".