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Höhere Quantenmechanik, Frühjahrsemester 2017

The course will be based on
T. Lancaster and S.J. Blundell, *Quantum Field Theory for the Gifted Amateur*,
which is available in electronic form in the Unibib.

The goal is to cover a macroscopic fraction of the book. This will require students to read and prepare part of the material on their own. We will then discuss the more important and more difficult concepts in class, and there will be ample opportunity to ask questions.

0. Overture

I. The Universe as a set of harmonic oscillators

II. Writing down Lagrangians

III. The need for quantum fields

IV. Propagators and perturbations

V. Interlude: wisdom from statistical physics

VI. Path integrals

VII. Topological ideas

VIII. Renormalization: taming the infinite

IX. Putting a spin on QFT

X. Some applications from the world of condensed matter

XI. Some applications from the world of particle physics

Prerequisites:

M. Srednicki, *Quantum Field Theory*, Cambridge University Press, p. ix
"In order to be prepared to undertake the study of quantum field theory, you should recognize and understand the following equations:

$$\frac{\mathrm{d}\sigma}{\mathrm{d}\Omega} = |f(\theta,\phi)|^2 \,,$$

$$a^\dagger|n\rangle = \sqrt{n+1}|n+1\rangle \,,$$

$$J_\pm|j,m\rangle = \sqrt{j(j+1)-m(m\pm1)}|j,m\pm1\rangle \,,$$

$$A(t) = e^{+iHt/\hbar}Ae^{-iHt/\hbar} \,,$$

$$H = p\dot{q} - L \,,$$

$$ct' = \gamma(ct-\beta x) \,,$$

$$E = (\mathbf{p}^2c^2 + m^2c^4)^{1/2} \,,$$

$$\mathbf{E} = -\dot{\mathbf{A}}/c - \boldsymbol{\nabla}\varphi \,.$$

This list is not, of course, complete; but if you are familiar with these equations, you probably know enough about quantum mechanics, classical mechanics, special relativity, and electromagnetism to tackle the material in this book."

I would add

$$x^\mu = g^{\mu\nu}x_\nu \,,$$

$$j'^\mu = \Lambda^\mu{}_\nu j^\nu \,.$$