Course Summary for "The Structure and Semantics of Scientific Theories"

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course website:
http://strangebeautiful.com/lmu/2017-winter-thermo-sm.html

Winter, 2017
[*** Day/Time C.T. TBD ***]
Ludwigstr. 31, 021

1 Course Description

Thermodynamics—roughly speaking, the study of the energetic behavior of physical systems at mesoscales (between the very small and the very large)—is one of the three fundamental theories in contemporary physics, alongside quantum field theory (the study of the very small) and general relativity (the study of the very large). Statistical mechanics is a framework within which one tries to provide a reduction of thermodynamics to underlying, "more fundamental" theories, such as a quantum description of matter. Thermodynamics on its own and statistical mechanics on its own each provides a number of fascinating foundational problems and puzzles that ramify into every major debate in the philosophy of physics and in theoretical physics itself today. The relation between thermodynamics and statistical mechanics is itself also obscure and beset with problems. Perhaps most infamously, thermodynamics presents us with its Second Law: the entropy of the world never decreases—the world seems to prefer being disorderly, and will work hard to make itself so—and statistical mechanics cannot tell us why. In this seminar, we will focus on four of these problems: the nature of equilibrium as a physical condition; the character of the Second Law as a physical principle and what it does and does not say; the problem of the arrow of time (why does time seem to "flow in the same direction" for all different types of physical systems?); and what thermodynamics may tell us about the nature of gravity and cosmology (black holes seem to possess thermodynamical properties!). We will begin with a brief survey of the historical foundations of these theories in the 19th century, reading the works of its founders (Maxwell, Boltzmann, and Gibbs), and then move to the contemporary debates over these issues.

2 Structure and Evaluation

The class period will consist of lectures by Dr. Curiel, based on the assigned reading. The schedule of lectures (topics and assigned and suggested readings) can be found here:
http://strangebeautiful.com/lmu/lectures-lmu-fndns-thermo-sm.pdf.

The course is worth 9 ECTS. The grade for the course will be determined by a term paper of approximately 5000 words, due sometime in the end of March, exact day to be determined. The paper will be on a subject of the student's choice, though I will provide suggested paper topics; I strongly urge students to consult with me before choosing a topic. I will be happy to read and comment on rough drafts of the final paper, so long as they are given to me at least two weeks before the due date.

3 Readings

Most of the required and suggested readings are available online at the course's website, though they may not be listed as such in the bibliography:
http://strangebeautiful.com/lmu/2017-winter-thermo-sm.html

4 Tentative Schedule

INTRODUCTION

Week 1 ([***)] Introduction

CRASH COURSE IN THERMODYNAMICS AND STATISTICAL MECHANICS

Weeks 2–3 ([***)] Thermodynamics

Weeks 4–5 ([***)] Statistical Mechanics

The 19th Century Founders

Week 6 ([***)] Maxwell

Week 7 ([***)] Boltzmann

Week 8 ([***)] Gibbs

THE CONTEMPORARY DEBATES

Week 9 ([***)] Equilibrium I

Week 10 ([***)] Equilibrium II

Week 11 ([***)] The Second Law I

Week 12 ([***)] The Second Law II

Week 13 ([***)] The Arrows of Time I

Week 14 ([***)] The Arrows of Time II

Week 15 ([***)] Cosmology

Week 16 ([***)] Black Holes

FINAL PAPER DUE: TBD (END OF MARCH)