Mark Weitzman Resources for Physics With Friends Advanced Study Group: Quantum Field Theory

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Abstract

In this document, I will present some resources links, videos, notes etc. for Physics With Friends Advanced Study Group: Quantum Field theory. The videos are hosted on my YouTube site: Theoretical Physics with Mark Weitzman, and can also be accessed from several of my sites on Piazza, particularly Quantum Field Theory - A Students Perspective.

1 Background

Almost a decade ago after the completion of the MIT MOOC Mastering Quantum Mechanics 8.05x course (where I served as a community TA) [1], there was a desire among students to continue their education with material on more advanced quantum mechanics (what is now MITx 8.06x Applications of Quantum Mechanics) and Quantum Field Theory. To that end I formed several sites on Piazza which is an online discussion forum used by instructors for some of their courses (mostly STEM) at actual schools such as Stanford and MIT . In addition to excellent discussion forums supporting LaTeX, there was excellent support for hosting resources and for student polls. Even though I was not an actual instructor/School I was allowed for free to set up several Piazza sites, and since I am non-profit, I have been allowed to continue these sites free of charge.

2 YouTube: Theoretical Physics with Mark Weitzman

Links to my YouTube Site as well as some playlists particularly relevant to quantum field theory are listed below:

Theoretical Physics with Mark Weitzman

Quantum Field Theory I

Quantum Field Theory Review Video Blog

3 Piazza

The QFT Piazza site was intended to be an actual one term course following the first third of Srednicki's book [2] on scalar fields. The site is far from complete, and I have also expanded it to include material from many other textbooks on QFT. The Theoretical Physics site is intended to be a general site hosting many discussions and materials on theoretical physics. The Piazza Group Theory in Physics site was also intended to be a course on group theory in physics following an old book by Schensted [3]. Again lessons are far behind schedule.

4 Links to MW Piazza sites

The sign-up links for my Piazza sites are given below. On the sign-up page use 'Other' for the course term, and use the associated access code given below next to the link.

8.323 Quantum Field Theory - A Students Perspective - Term: Other, Access Code: QFT

PH 200 Topics in Theoretical Physics - Term: Other, Access Code: Ph200

PH 300 Group Theory in Physics - Term: Other, Access Code: ph300

5 Videos

The initial version 1 videos for Quantum Field Theory - A Students Perspective were produced in front of a whiteboard and are of poor production quality - best to watch on a large computer monitor. Most of these have been replaced by version 2 videos which use an iPad Pro tablet. These suffer (as do version 1 videos) from my horrible handwriting. On the piazza sites there are also handwritten notes, and pdf's of the tablet video.

With respect to the QFT course, the videos were intended to be used in a flipped course format - where the text was expected to be read first, and then the videos watched. Often the videos present the material from an alternative viewpoint or textbook. Additionally some of the videos present deep dives into material that is optional. Overall I would give the videos a rating of C at best. Feedback is definitely welcome, and time permitting I may remake some of the videos that may align more with the current group's focus. While the videos can be accessed from my YouTube channel, the pdf's and other written material can only be accessed from my piazza QFT site, and the links won't work unless you are signed up for the class.

6 Recommended videos and other material for Chapters 1-4 of Srednicki

Chapter 1 Attempts at Relativistic Quantum Mechanics

1. pdf - Lesson Plan
2. video - Attempts at Relativistic Quantum Mechanics
3. video - Recitation Problem 1.3 Srednicki p. 14
4. optional video - DeepDive: Galilean Covariance of the Schrodinger Equation
5. pdf - Handwritten Notes Attempts at Relativistic Quantum Mechanics
6. pdf - iPad Pro Tablet Notes Recitation Problems and Deep Dive

Chapter 2 Lorentz Invariance

1. pdf - Lesson Plan
2. Video - Lorentz Invariance Part A
3. Video - Lorentz Invariance Part B
4. Optional Video - Tutorial I on Rapidity Parameter and Uniformly Accelerated Motion
5. Optional Video - Tutorial II on General Boosts and the Factor Theorem
6. Video - Recitation Srednicki Problems 1,2,3
7. pdf - Handwritten Notes Lorentz Invariance
8. pdf - iPad Pro Tablet Notes on Tutorials and Recitation

Chapter 3 Canonical Quantization of Scalar Fields

1. pdf - Lesson Plan
2. Video - I Canonical Quantization of Scalar Fields
3. Video - II Canonical Quantization of Scalar Fields
4. Video - IIIA Canonical Quantization of Scalar Field
5. Video - IIIB Canonical Quantization of Scalar Fields
6. Optional Video - IV Recitation Massive Spin 1 Particle Classical Formalism
7. Video - V Recitation Problem 3.4 Srednicki

8. Optional Video - VI Recitation on Angular Momentum
9. pdf - Handwritten Notes
10. pdf iPad Pro Tablet Notes

Chapter 4 The Spin-Statistics Theorem

1. pdf Lesson Plan
2. Video 1 The Spin-Statistics Theorem Summary
3. Video 2 The Spin-Statistics Theorem Summary
4. Video 3 The Spin-Statistics Theorem Summary
5. Video 4 Srednicki Solution Problem 4 1
6. pdf Problem 4.1Solution Handwritten Notes and References
7. pdf iPad Pro Tablet Notes for Problem 4.1 Solution
8. Handwritten Notes

References

[1] Currently hosted by MITx Online. The course runs roughly once every two years.

[2] Srednicki M., *Quantum Field Theory*. Cambridge University Press, New York, 2007. An authorized almost complete draft version is also available at Mark Srednicki's QFT Textbook.

[3] Schensted, I., *A Course on the Application of Group Theory to Quantum Mechanics*. NEO Press, Peaks Island, Maine, 1976.