

## PHYS3220 – Spring 11 – Tutorials

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I taught PHYS3220 in Fall 09 and Spring 11. I reused much of the material from Fall 09, below I give some comments about changes.

In general, I shortened (or revised) the Tutorials to about 4 pages. My experience is that students get easily discouraged if they did not even finish half of the Tutorial in the given time. Four pages seem to be ideal to me for a 50 min Tutorial. Usually one or two of the groups finished slightly early (5-10 mins). But, even the slowest (or, most thoroughly working) group finished in about 60-65 mins. And, at the end of the regular time they were motivated to stay these 10-15 extra minutes.

**Tutorial 1** (Wave particle duality): Used an (lower-level) UW tutorial. Nice as intro, if you give a review and do not start with the SE right away.

**Tutorial 2** (Wave Functions and Probability): I skipped the “Classical Current” part (used it in class instead).

**Tutorial 3** (Stationary States): In section I. part A. (classical expectation) and C. (physical interpretation) are added. Instead, the parts about measurement (III.C.) and time dependence (IV. C. and D.) are dropped. In its current version the tutorial focuses more on the nature of a stationary state (with two examples) and superpositions.

**Tutorial 4** (Energy measurements): It is based on the old UW tutorial on the same topic, but together with Steve Goldhaber we changed it in a form that it does not rely on the harmonic oscillator example. Thus, in the present form the tutorial can be used even if the harmonic oscillator was not discussed in class.

**Tutorial 5** (Fourier): This is a tutorial from the University of Maryland, which is in particular helpful for students who did not practice with Fourier series and analysis much before.

**Tutorial 6** (Scattering): Used before in the same form. A very much needed tutorial (in my view), which is missing in the original set of tutorials ... Thanks to the effort of Steve Goldhaber and Steve Pollock, we now have a nice one.

**Tutorial 7** (Sketching Wave Functions): I shortened this tutorial to 4 pages by dropping a few parts (mainly some more advanced thinking). To my experience it can be now done within 50 mins.

**Tutorial 8** (Time dependence in QM): Well, I revised the tutorial in order to avoid the usage of the transparencies in the UW tutorial. But, that did not work out very well. The students had a harder time to “visualize” the states. So, I would recommend using the original version.

**Tutorial 9** (Treating Functions as vectors): Used the original tutorial, but skipped (did not hand out) the last page about operators. This I used instead as intro in the Quantum mouse tutorial (see below).

**Tutorial 10** (Quantum mouse): As mentioned above, I used an intro on operators from the original “Treating functions as vectors” tutorial here. The, I divided the (long, but most favorite among students) Quantum Mouse tutorial into two tutorial 10 and 11. Used in Tutorial 10 the first four pages of the revised tutorial only.

**Tutorial 11** (Quantum mouse 2): Since I decided to split up the tutorial, I added a short intro/reminder about the first part here ... works out fine, if you spent some more time on the formalism, in particular operators, as I do.

**Tutorial 12** (Degenerate states): Used the original UW tutorial on degenerate states.