Quantum Physics, Preparation for Friday, Apr. 5

Nuclear Physics from 1896-1911

You have pp. 19-40 of *The History and Science of the Manhattan Project* by Bruce Cameron Reed. This is the best short, scientific summary of nuclear physics I know of. It begins in 1896 with Becquerel's discovery that uranium fogs film. The pages I have chosen end in 1911 with the explanation of scattering of alpha particles off of gold foil by Rutherford.

Remember, these scientists don't know any quantum mechanics! The atomic and subatomic phenomena they are discovering are what is ultimately explained by quantum mechanics and quantum field theory. It isn't until the late 1920s that quantum mechanics is invented and understood. Quantum field theory isn't developed until after WW II.

Study Moore Q13.1, Q13.2 and Q13.6

We'll do Moore Chapter 13 in two bites. We will save Q13.3, Q13.4 and Q13.5 for Tuesday.

Q13.1, Q13.2 and Q13.6 go well with Reed, pp. 19-40.

Plan for Class / Presentations

I think **it would be fabulous if three groups of two people self-organized and coordinated with one another to do three substantial presentations.**

Anything in the 1896-1911 reading would be great to go deeper into. In other words, it is wide open for you to decide what is important, and I am curious what you will pick. The presentations could range from historical documents, personalities and experimental techniques to theoretical ideas.

You can even go beyond 1911 if you like. In fact, **it would be great if one of the groups recounted the discovery of the neutron which doesn't happen until 1932.** It is the discovery of the neutron that finally sets the world up for the unleashing of fission chain reactions and the atomic bomb.

PROBLEM SET 15 IS ON THE REVERSE

For Problem Set 15

Exponential Decay

Even though Moore has marked two of these problems as “basic” all three of them require you to understand the equations on p. 212 of Moore and on pp. 26-27 of Reed.

1. Q13B.11, p. 214

2. Q13B.12, p. 214

3. Q13D.5, p, 215

Nuclear Collisions

4. Q13M.2, p. 214, you can use that the radius of a gold nucleus is 7.0 fm. The radius of the alpha particle isn’t needed because Moore intends you to treat it as a negligibly-sized point particle. By “inside the gold nucleus” I think Moore just means “at the surface of the nucleus.”

5. Q13M.3, p. 214, you can use that the radius of a silver nucleus is about 4.7 fm, and otherwise this is the same as the problem above with slightly different charge and mass values. If you want to be fancy, make a table for Problems 4 and 5 and include uranium, which has a nuclear radius of 7.4 fm.

Binding Energy

6. Q13M. 4, p. 214, part (a) only. Requires Eq. Q13.4, p. 203.