

Due: Thursday, 03/05

8. Hypothetical anomalous hydrogen. Consider an atom that has a proton and an electron just like the normal hydrogen, but with the interaction potential between the proton and the electron given by

$$\varphi = -C/r^S,$$

where C is a constant with appropriate dimensions, and S is a dimensionless positive number.

- For what values of S is there a solution that qualitatively resembles the usual hydrogen?
- Using the “uninhabited-island” approach discussed in class, figure out the analog of the first Bohr radius.
- Does your answer agree with the usual-hydrogen case for $S=1$?
- Optional part.** If you feel like it, figure out other things about our exotic atom, for example, the characteristic speed of the electron. Suppose $S=1+\delta$, $|\delta|\ll 1$. What would be a manifestation of the anomaly? Can you propose an experiment to look for such an anomaly?

9. Suppose the Stern-Gerlach experiment was done with phosphorus atoms. What would the spot pattern on the screen be? Qualitatively and quantitatively compare the energy splittings of the ground-state magnetic sublevels of phosphorus atoms to those of silver atoms. Ignore nuclear spins.

10. Reading/reviewing assignment.

- The Instructor will e-mail the text to read/review (no need to e-mail to request).
- Read the text (which will be partially relevant to the material covered in class).
- E-mail the Instructor with a review which should be as short as possible; however, would contain whatever critical comments you might have about the text.

Please note: this time, the entire assignment (#3) should be sent to the Instructor by e-mail. Consult the Instructor if you have difficulties solving the problems.