PH3521701 现代原子物理 **2019-05-10**

Lecture summary

- Doppler broadening
- Doppler-free spectroscopy
    - Cross-beam method
    - Two-photon spectroscopy
    - Saturation spectroscopy
        - Energy-momentum conservation in photon absorption
        - Recoil shift
- Spontaneous scattering force
- Cycling transition
- Bending of an atomic beam
    - Capture velocity
- Zeeman slowing
- Doppler cooling
    - Cooling mechanism
    - Heating mechanism
    - Cooling limit

Homework (due on Tuesday 5/14)

1. You are given the task of ordering a rubidium vapor cell for a laser spectroscopy experiment. Calculate how long the cell should be. The cell is intended to reference laser light at 780 nm tuned to the resonance of the $5\ ^2S_{1/2} - 5\ ^2P_{3/2}$ transition. $5\ ^2S_{1/2}$ is the ground level. $5\ ^2P_{3/2}$ is the first excited level with a lifetime of 30 ns. The cell should be long enough so that a laser beam on resonance with this transition is absorbed by 10% - 50%. Room temperature operation is assumed.

2. Textbook exercise (8.5) Hyperfine structure in laser spectroscopy.

3. Textbook exercise (9.5) Slowing H and Cs with radiation.

4. Textbook exercise (9.8) Laser cooling of a trapped ion.

5. Textbook exercise (9.13) Laser cooling of atoms with hyperfine structure.

Reading Assignments:

- *About Lock-In Amplifier*, Application Note #3, Stanford Research System
  http://www.thinksrs.com/downloads/PDFs/ApplicationNotes/AboutLIAs.pdf