

1:

Q: How can you observe a transition with a sharp line (e.g. the natural linewidth) in a very hot (Doppler broadened) atom gas?

A: Use Doppler-free method such as saturation spectroscopy.

2.

Q: When performing spontaneous Raman scattering experiments, how does the transition rate depend on the laser power?

A: Proportional to laser power.

3.

Q: When performing resonant fluorescence imaging, the atom absorbs a photon and gets into an excited state and then emits a photon back to ground state. Is this a spontaneous Raman process or a coherent Rabi flopping process?

A: Spontaneous Raman process. Note the received imaging photons are not in the same mode as the injecting light.

4.

Q: Can the Doppler-free spectroscopy cure 2nd order Doppler shift? If not, what is the order of magnitude, say, for the relative shift at liquid helium temperatures?

A: No, because it is caused by time dilation. At $T=4\text{K}$, $v^2/c^2=10^{-13}$.

5.

Q: Name at least one practical application of a two-photon process in modern AMO physics.

A: Raman coupling between two levels, Doppler-free spectroscopy, bridging dipole-forbidden states, etc.