Experimental Procedure (simplified)

- Detune laser1 from $\nu_{ss}^{0}$ to $\nu_{ss}^{0} + \nu_{hp}$ resonance by a fixed number of GHz.
- Scan laser2 over resonances, record fluorescence.
- Compare the peak count measurements for transitions originating from a common hyperfine ground state level, terminating at $F''=3$ and $F''=4$.
- Repeat for different laser1 detuning.
- For polarization – alternate laser2 polarization while scanning.

Calculation Results

- Integrate over Doppler distribution to compare with experimental values. Neglect resonant regions.

Experimental Results

- Typical fluorescence measurement for relative transition probabilities.

Atomic System

- Excitation of Cs atom by two-photon absorption facilitated by real intermediate level sets.
- $6s^{2}S_{1/2} \rightarrow 6p^{2}P_{3/2} \rightarrow 7s^{2}S_{1/2}$ transition in Cs.
- Verify model predictions experimentally.
- Offer an interesting experiment to students.

Model Calculations

- Assume non-resonant two-quantum excitation.
- Use general expression for the two-quantum transition rate.
- Add amplitudes associated with two-quantum indistinguishable paths.
- Obtain transitions for two-quantum transition probabilities, relative transition amplitudes for transitions originating from a common ground state.
- and for polarization degree

$$P_2 = \frac{I_{2P}^{s}}{I_{2P}^{s}}$$

- Integrate over Doppler distribution to compare with experimental values. Neglect resonant regions.

Motivation for Experiment

- Demonstrate quantum interferences of transition amplitudes.
- Use simple model to evaluate transition strengths for hyperfine and polarization degrees.
- Offer an interesting experiment to students.

References


Illustrations

- Typical fluorescence record for Polarization Degree.
- Typical fluorescence measurement for relative transition probabilities.

Experiments

- Laser1 detuning from 6P_{1/2} to 7S_{1/2} reveals couple of interesting phenomena.
- Number of narrow peaks determined by selection rules for both beams.
- Unusual transition probabilities, peaks found at different laser frequency shift proportional to frequency.
- When laser1 frequency changed by $\Delta \nu$, peaks found at different laser frequency shifted by $\Delta \nu$. Two-photon resonance peaks of specific velocity groups are propelled up, and are missing from the ground state population.