Near resonance scattering of three-level system in a week laser field

Zhang Qixiang *Li Jiaming* *Han Quansheng*
Luo Zhengji *Cheng Wenqin*

(Institute of Physics, Academia Sinica, Beijing)

Studying near resonance scattering of monochromatic light in atomic ystems with collisional perturbation, we'll be able to understand further the interactions between the microscopic systems and laser fields, and obtain valuable informations regarding the interaction potential between the emitting and perturbing atoms. The collisional redistribution and near resonance scattering of laser beam in two-level systems (Sr) has been investigated[1].

We studied the near resonance scattering of weak laser beam in sodium atoms with collisional perturbation of noble gases, which can be regarded as three-level system. Using a cw tunable dye laser ($7.5 W/cm^2$), we made near resonance excitations of state 3^2P of sodium atom within the detuning range of about 40 cm^{-1}. We measured the intensity of three components of scattering light, namely the Rayleigh scattering I_R and the collision induced resonance fluorescence I_a and I_b, as a functions of incident laser frequency. From these measurements, the excitation cross-sections $\rho_{aa}(\Delta)$ and $\rho_{bb}(\Delta)$ of the states $3^2P_{1/2}$ and $3^2P_{3/2}$ of sodium atoms due to collision with the atoms of noble gases can be deduced as functions of detuning from resonance frequencies. By measuring the near resonance scattering of light in the Na-He, Na-Ne and Na-Ar systems with various pressures of buffer gas (2–30 Torr) we explained differences and tendencies of the interaction potential of these systems.

Reference

[1] J. L. Carlsten et al., Phys. Rev 15(3), 1029 (1977).

弱激光场作用下三能级系统的近共振散射

张绮香　李家明　韩全生　罗正纪　程文芹

（中国科学院物理研究所）

研究单色光受碰撞微扰的原子系统的近共振散射，可以使我们进一步了解微观系统与激光场相互作用以及辐射能量转移的规律，给出原子间相互作用势的有用的信息。激光场作用下的二能级系统（Sr）已有实验研究[1]。

我们对钠原子（作为三能级系统）在隋性气体碰撞微扰下对弱激光场的近共振散射作了研究。利用连续可调谐染料激光（7.5W/cm²）对钠原子的 3^2P 态在～40cm^{-1}范围内进行近共振激发，对散射光的三个分量：瑞利散射光 I_R 和碰撞诱导荧光 I_a 和 I_b 的积分强度随着激发光频率的变化进行实验测定。从这些测量中导出钠原子 $3^2P_{1/2}$ 和 $3^2P_{3/2}$ 态的激发截面 $\sigma_{aa}(\triangle)$ 和 $\sigma_{bb}(\triangle)$ 随激发光离共振频率偏调△的变化规律。通过对 Na-He、Na-Ne 和 Na-Ar 系统在不同微扰气体气压下（2—30 Torr）近共振散射规律的测量，可以定性地说明这些系统相互作用势的差别和变化趋势。