DIRECT OBSERVATION OF THE 2 $^3\Pi_u$ STATE OF Rb_2 IN A PULSED MOLECULAR BEAM: ROTATIONAL-BRANCH INTENSITY ANOMALIES IN THE 2 $^3\Pi_u(1_u) - X^1\Sigma_g^+(0_g^+)$ BANDS

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The first observation of 2 $^3\Pi_u - X^1\Sigma_g^+$ transitions is reported. Rotationally resolved transitions of the 2 $^3\Pi_u(1_u) - X^1\Sigma_g^+(0_g^+)$ and 2 $^3\Pi_u(0_u^+) - X^1\Sigma_g^+(0_g^+)$ are observed by resonance enhanced 2-photon ionization (RE2PI) method in a pulsed molecular beam. Ω-doubling and interference induced rotational branch intensity anomalies are observed for 2 $^3\Pi_u(1_u) - X^1\Sigma_g^+(0_g^+)$ transitions. Both of 2 $^3\Pi_u(0_u^+)$ and 2 $^3\Pi_u(1_u)$ states are strongly mixed with singlet states by spin-orbit coupling. The former with 2 $^1\Sigma_u^+$ and the latter with 2 $^1\Pi_u$. In relatively weak 2 $^3\Pi_u(1_u)$ bands $P-$branch rotational lines disappear and the intensities of $R-$branch rotational lines are enhanced. These intensity anomalies in 2 $^3\Pi_u(1_u) - X^1\Sigma_g^+(0_g^+)$ transition, due to an interference effect between parallel and perpendicular transition amplitudes, is caused by $\Delta\Omega = \pm 1$ perturbation. The molecular constants of 2 $^3\Pi_u(0_u^+) - X^1\Sigma_g^+(0_g^+)$ transition are determined as $T_e = 19784.2588 \pm 0.0088$ cm^{-1}, $\omega_e = 42.1954 \pm 0.0060$ cm^{-1}, $\omega_e x_e = 0.1701 \pm 0.0011$ cm^{-1}, $\omega_e y_e = -0.001096 \pm 0.000057$ cm^{-1}, $B_e = 0.018503 \pm 0.000018$ cm^{-1} for $^{85}Rb_2$. The spin$-$orbit coupling constant A and Ω-doubling parameters p and q are determined by simultaneous fitting of the rotational contours of both 2 $^3\Pi_u(1_u) - X^1\Sigma_g^+(0_g^+)$ and 2 $^3\Pi_u(0_u^+) - X^1\Sigma_g^+(0_g^+)$ transitions.