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Spin-orbit coupling of the NaK $3^3\Pi$ and $3^1\Pi$ states: Determination of the coupling constant and observation of quantum interference effects[1]

S. ECKEL, J. HUENNEKENS, Lehigh University — We have studied the mutually perturbing $3^3\Pi_{\Omega=0}(v=32, J=19) \sim 3^1\Pi_{\Omega=1}(v=6, J=19)$ levels of NaK that are coupled together by the spin-orbit interaction. This coupling is nominally forbidden by the $\Delta\Omega = 0$ selection rule for spin-orbit perturbations. However $3^3\Pi$ levels labeled by different values of Ω are mixed by rotational coupling; i.e. the $3^3\Pi_\Omega$ levels are best described by a coupling scheme intermediate between Hund's cases (a) and (b). Thus the $3^1\Pi_{\Omega=1}$ level couples to the $3^3\Pi_{\Omega=0}$ level via the small admixture of $3^3\Pi_{\Omega=1}$ character in the latter. The $3^3\Pi_{\Omega=0}(v=32, J=19) \sim 3^1\Pi_{\Omega=1}(v=6, J=19)$ f symmetry pair is of particular interest since it appears to be very close to a 50-50 mixture of triplet and singlet character, and the splitting between these levels provides a direct measure of the $3^3\Pi \sim 3^1\Pi$ spin-orbit coupling constant. Excitation spectra of the $3^3\Pi_{\Omega=0}(v=32, J=19) \sim 3^1\Pi_{\Omega=1}(v=6, J=19)$ e symmetry pair through the mixed "window" levels $1(b)^3\Pi_{\Omega=0}(v=17, J=18, 20) \sim 2(A)^1\Sigma^+(v=18, J=18, 20)$ display dramatic quantum interference effects associated with "singlet" and "triplet" excitation channels. Complete cancellation for one or the other of the two upper states is observed for excitation from the predominantly triplet members of the window level pairs.

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John Huennekens
Lehigh University

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