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Laser Spectroscopy

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PROGRESS IN SATURATED DISPERSION SPECTROSCOPY OF IODINE

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By making use of the ring interferometer described in [1] it has been possible to obtain very narrow unmodulated dispersion signals in iodine. The peak to peak width of these signals (corresponding to the full width at half maximum for saturated absorption) is currently of the order of 600 kHz. Half of that width is still due to the residual frequency jitter of the argon laser which is slaved on the side of a transmission fringe of a confocal Fabry-Perot. The other half results from collision broadening, natural width and transit time broadening. The saturated dispersion curves have been used as error signals to stabilize the frequency of commercial argon lasers without any frequency modulation of the lasers. The sensitivity of the ring interferometer method with crossed polarizations has been analyzed and the applicability of the Kramers-Kronig relations to saturation experiments has been discussed [2]. These are shown to be valid in the limit of an infinite Doppler width (compared with the homogeneous width) and of small saturation parameters.

[1] C. BORDÉ, G. CAMY, B. DECOMPS, L. POTTIER: C.R. Acad. Sc. (Paris) 277B, 381 (1973).
[2] D.R.M.E. Contract Report No. 7234293 (1974).

MAGNETIC OCTUPOLE INTERACTION IN I_2

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We have observed magnetic octupole and scalar spin-spin interactions in the optical spectrum of I_2 at 5145 Å. The lines excited are the hyperfine transitions on the P(13) 43-0 $B^3\Pi$-$X^1\Sigma$ line in I_2^{127}. The experimental set-up is similar to that described earlier [1], where two single frequency 5145 Å argon ion lasers were individually stabilized to hyperfine transitions excited in two independent molecular beams of I_2. The line positions were determined with a precision of one part in 10^{11} (5 kHz) using a heterodyne technique employing two argon ion lasers individually stabilized to I_2 hyperfine lines excited in molecular beams.
In order to describe the hyperfine structure accurately it was necessary to construct a Hamiltonian which included the following interactions

$$H_{HFS} = H_{NEQ} + H_{SR} + H_{TSS} + H_{SSS} + H_{NMO}$$

The first three terms of the Hamiltonian have been included in previous analyses [2] of iodine hyperfine spectra. These are, respectively, the nuclear electric quadrupole, the magnetic spin rotation and tensor spin-spin interactions. Whereas previously it was sufficient to calculate the quadrupole energy to second order, in the