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Improved Rotational Constants for HF[1]

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The ground state rotational constants for HF were recently reported (*1*). These molecular constants were determined from spectral measurements that covered the spectral range from 40 to 1100 cm^{-1} (1 to 32 THz). The high-J transitions were measured by a comparison with known spectral lines and had uncertainties in the predicted line frequencies of as much as 100 MHz (2σ).

We have remeasured the $J = 27 \leftarrow 26$ and $J = 33 \leftarrow 32$ transitions using a tunable diode laser heterodyne spectroscopy technique (*2*) with frequencies of 28 666 999 ± 8 and 32 557 132 ± 8 MHz, respectively. The uncertainty of 8 MHz (2σ) is 9 times less than the 72 MHz reported in Ref. (*1*). The HF was prepared in a 1-cm-diameter 1.2-m-long water-cooled cell by a 30 mA dc discharge in a 66 Pa 10:1 mixture of He:F and 13 Pa of H_2. The frequency of the diode laser was measured by heterodyning with a stabilized CO_2 laser.

Using the new frequencies along with the previously determined transition frequencies, we have redetermined the rotational constants as defined by the equation for the energy levels (*3*):

$$E_v(J) = B_vJ(J+1) - D_v[J(J+1)]^2 + H_v[J(J+1)]^3 - L_v[J(J+1)]^4 + M_v[J(J+1)]^5.$$

These new values for the ground state rotational constants of HF are listed in Table I. The improvement in

TABLE I

Rotational Constants of Ground State HF

	MHz[a]	MHz[b]
B_0	616365.200(10)	616365.199(75)
D_0	63.5524(4)	63.5532(41)
H_0	$4.898(2)10^{-3}$	$4.897(15)10^{-3}$
L_0	$4.44(2)10^{-7}$	$4.41(20)10^{-7}$
M_0	$2.94(8)10^{-11}$	$2.82(80)10^{-11}$

The uncertainty in the last digits (2σ) is given in parentheses.

a. This work.

b. Ref. 1.

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accuracy of these two transition frequencies shows up as a reduction in the uncertainty in the molecular constants by nearly an order of magnitude in every case.

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