MATTERS ARISING

The ν_3 fundamental band of the methyl radical

IN discussing near-IR absorption bands in IRS7, Allen and Wickramasinghe[1] remark that "laboratory data are not available for even quite simple, incompletely bonded molecules (for example, CH_3) such as might be found in the interstellar environment".

We have recently performed a laboratory measurement of the ν_3 fundamental band ($\nu_0 = 3,160.820\ cm^{-1}$) of CH_3 in absorption using a difference-frequency laser[2]. The most prominent feature in the spectrum is the $^rQ_0(N)$ ($N = 2, 4, 6, \ldots$) sub-branch. The transition frequency of the strongest line, $^rQ_0(2)$, is $3,154.7459\ cm^{-1}$ ($= 3.16983\ \mu m$). Other strong lines at (300 K) are calculated to be: 3,101.045, 3,128.548, 3,199.730, 3,217.754, and 3,224.396 cm^{-1}. However, none of the prominent features reported by Allen and Wickramasinghe seem to fit our observed transition frequencies.

The methyl radical is expected to be an important species in certain interstellar sources[3]. In particular, estimates of the abundance of CH_3 in the atmosphere of the nearby carbon star IRC +10°216 indicate that its abundance relative to CO is $\sim 10^{-4}$ (ref. 4 and personal communications from E. M. McCabe, R. C. Smith and R. E. S. Clegg, and A. Kinney). Thus the methyl radical should be detectable in this source and we plan to conduct an IR search for it in the very near future.

T. AMANO
P. F. BERNATH
Herzberg Institute of Astrophysics, National Research Council, Ottawa, Canada K1A 0R6
C. YAMADA
Institute for Molecular Science, Myodaiji, Okazaki 444, Japan

1. Allen, D. A. & Wickramasinghe, D. T. *Nature* **294,** 239–240 (1981).
2. Amano, T., Bernath, P. F., Yamada, C. & Hirota, E. *J. chem. Phys.* (submitted).
3. Tsuji, T. *Ann. Tokyo Astr. Obs.* **9,** 1–110 (1964).
4. McCabe, E. M., Smith, R. C. & Clegg, R. E. S. *Nature* **281,** 263–267 (1979).

Saturn's rotation period

CARR *ET AL.*[1] have inferred Saturn's rotation period from data recorded by the Voyager-1 Planetary Radio Astronomy (PRA) instrument. They constructed profiles of the received power in the coordinate frame of the Saturn longitude system (SLS) determined by ourselves[2]. After comparing profiles made from month-long spans taken ~7 months apart, Carr *et al.* attributed a longitude shift to a 2-s error in the SLS rotation period.

Some problems in the work of Carr *et al.* affect the validity of their result. First is the precision of their method. From basic statistics we would expect the standard deviation in the individual rotation period determinations to scale with the square root of the number of samples. Thus, as Carr *et al.* used 2 months of data whereas we used 8 months, the former's individual standard deviation should be no better than root (8/2) times that of the latter, or ± 14 s. In addition, this value should vary with observing frequency owing to the change in emission occurrence probability with frequency. The rotation period at 500 kHz cannot be determined nearly as well as at 150 kHz because the occurrence probability is at least a factor of 4 lower at 500 kHz (ref. 3).

Using PRA data, we attempted to assess the inherent uncertainty in their method. We compared flux density longitude profiles generated over different time intervals, but at the same frequency. For example, comparing the longitude profile made at 346.8 kHz from data only 1 month apart, we found a 70° shift, which would correspond to an uncertainty of 15 s over the ~7 month time span used by Carr *et al.* We repeated the analysis at 155 kHz and at 97 kHz where we found that individual profiles were reliable to ± 10 s and ± 17 s, respectively. These are only estimates, of course, as we have not done an exhaustive analysis, but they are representative of the inherent uncertainty in determining the rotation period by aligning longitude profiles. Our error analysis[2] is sensitive to these large shifts, however, because it encompasses the entire span of data.

Second, we question the practice of combining results from several different frequencies to improve the precision of the determination. While this would be an acceptable statistical procedure in other circumstances, we have determined that the radio bursts are well correlated over a wide frequency range, and are never completely uncorrelated. Thus, receiver channels within the radio emission band contain non-independent, correlated information that cannot be averaged together, as was done by Carr *et al.*, to reduce statistical fluctuations. We believe that conservative adherence to statistical principles would dictate that only one completely independent rotation period determination is possible using a single PRA data set.

Finally, and perhaps most importantly, the longitude profiles of Carr *et al.* were generated in a coordinate system locked to the Saturn–spacecraft line. However, because Voyager-1 moved 6° relative to the Saturn–Sun line during the 7-month analysis interval in question, the data should instead be organized in fixed (sub-solar) coordinates. This angular shift will manifest itself in the longitude profiles, and hence in the rotation period, and should be taken into account. In short, given the inherent imprecision of the histogram method, the Carr *et al.* determination is certainly not statistically inconsistent with ours.

M. L. KAISER
M. D. DESCH
Planetary Magnetospheres Branch, Goddard Space Flight Center, Greenbelt, Maryland 20771, USA

1. Carr, T. D., Schauble, J. J. & Schauble, C. C. *Nature* **292,** 745–747 (1981).
2. Desch, M. D. & Kaiser, M. L. *Geophys. Res. Lett.* **8,** 253–256 (1981).
3. Kaiser, M. L., Desch, M. D. & Lechcheux, A. *Nature* **292,** 731–733 (1981).

CARR *ET AL.* REPLY—The strongest objection of Kaiser and Desch to our results is essentially that we used histograms plotted as a function of the saturnian central meridian longitude of the spacecraft instead of that of the Sun in our cross-correlations. When our oversight is corrected, we find our three rotation period measurements to be only 1 s less than they were before, and their average to be 3 s instead of 2 s less than the SLS value. This small correction does not change the situation materially.

We agree that the SLS rotation period measurement is probably more accurate than ours, but we do not believe that the difference in accuracy is large. The agreement to within 3 s increases confidence in both determinations. Our accuracy can certainly be improved by a better choice of data interval for the first histogram in each pair. We do not agree with the contention of Kaiser and Desch that little is to be gained by using data from several channels instead of just one. The redundancy resulting from the high correlation between pairs of closely spaced channels indeed tends to reduce their individual contributions to the overall precision, but is beneficial in other ways such as minimizing the effects of data gaps and of interference incorrectly identified as Saturn. The best method, in our opinion, would be to calculate the rotation period using data from each of about 10 selected channels separately by the method of Desch and Kaiser, and then to combine these values, appropriately weighted, into a single average.

T. D. CARR
Department of Astronomy, University of Florida, Gainesville, Florida 32611, USA
J. J. SCHAUBLE
C. C. SCHAUBLE
University of Florida Graduate Center, Eglin Air Force Base, Florida 32542, USA

0028–0836/82/120372—01$01.00