Letters

Pulsar Clock

We read with fascination M. Mitchell Waldrop's article about the "Millisecond Pulsar" (Research News, 18 Feb., p. 831). There is, however, some confusion in the article in the statements about accuracy. Waldrop writes that the pulsar's "period seems to be slowing at a steady rate of 10^{-19} seconds per second." This is an apparent drift in frequency of this pulsar clock, that is, a $\delta /v$ or a $\delta /0$, where $v$, the frequency, is equal to the reciprocal of the period, $0$.

The corresponding frequency drift rate for the clocks at either the National Bureau of Standards (NBS) or the U.S. Naval Observatory (USNO) is estimated to be on the order of $3 \times 10^{-20}$ seconds per second. The accuracy of the USNO atomic time is quoted as being "one part in 10^{10}." This is in fact our estimate of the day-to-day or week-to-week fractional frequency fluctuations ($I$), which are random and not a systematic "slowing." It often takes many months to observe any such systematic trends in cesium atomic clocks, whereas the $10^{-19}$ seconds per second systematic trend of the Millisecond Pulsar can, in principle, be measured in a matter of days. In practice, of course, measuring the slowing of the pulsar's frequency is clouded by the uncertainty in modeling the earth's position relative to the pulsar's coordinates, as well as by instabilities in the reference clock used to measure this slowing.

The accuracy of the length of the second is determined by primary frequency standards such as the one for the United States at NBS in Boulder, Colorado. Its current accuracy is 8 parts in $10^{14}$ (2). This accuracy is ascribed to the uncertainty associated with the realization of the definition of the second. This definition is based on the ground state radiation frequency between the two hyperfine levels of cesium-133. Because there is no intrinsic way to define the frequency of a pulsar in terms of an adopted standard, and because of the observed drift, its accuracy has no meaning in the sense typically used in the time and frequency community. As time goes on, however, it may well turn out that the slowing of the Millisecond Pulsar is very predictable—possibly making it the most predictable clock known to man. One may in fact need to use as a reference an optimum weighted average of the best atomic clocks on the earth to assign an upper bound for its quality of predictability.

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References

Antiviral Effects Without Interferon

In a recent article about the 185th National Meeting of the American Chemical Society (Research News, 15 Apr., p. 292), my work on 2-5A analogs (I) is quoted incorrectly. I was not at the meeting and do not know what the speakers said, but I never showed or even suggested that the 2-5A analogs may be effective antiviral agents when introduced into cells. On the contrary, I do not believe that these compounds can selectively inhibit viral replication when administered in this way, and I am convinced that the antiviral effects observed in such experiments can be accounted for by the general inhibition of protein synthesis resulting from the activation of endonuclease activity by 2-5A. I might add that a solution of the "longevity problem" for 2-5A (that is, how to overcome its rapid degradation by a phosphodiesterase) was published some time ago (I). In addition, there are some factual errors in the article. Double-stranded DNA introduced into cells does not provoke a sharp inhibition of protein synthesis, but double-stranded RNA does. And it is not "messenger DNA" that codes for proteins.

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References