A Microwave Frequency Standard Employing Optically Pumped Sodium Vapor

W.E. Bell, A. Bloom and R. Williams. "A Microwave Frequency Standard Employing Optically Pumped Sodium Vapor." 1959 Transactions on Microwave Theory and Techniques 7.1 (Jan. 1959 [T-MTT]): 95-98.

An instrument in which a simple microwave triode oscillator is stabilized by reference to a natural atomic resonance---the field-independent hyperfine resonance of sodium---is described. Light from a sodium lamp is transmitted through an absorption cell containing sodium vapor and argon, which is placed in a resonant cavity. This light produces population differences between the two quantum levels which are involved in the desired atomic resonance and provides a means of detecting resonance, The cavity is excited by an external microwave triode oscillator which is frequency modulated to a small degree at 60 cycles. When the exciting oscillator frequency coincides with the center of the atomic resonance line, the signal observed by a photocell will be a modulation of the transmitted light at 120 cycles and higher even-order harmonics. Any deviation from line center will introduce a 60-cycle component whose phase and magnitude may be detected to produce an error signal to retune the oscillator in the usual servo loop manner. Theory predicts that an accuracy of possibly one part in 10/sup 10/ can be achieved by systems using sodium and suitable local oscillators. It is evident also that such systems can be engineered into quite small packages, making possible many new applications of microwave oscillators stabilized to high order.

- Return to main document.