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DEMONSTRATION OF THE DOPPLER EFFECT IN ACOUSTICS

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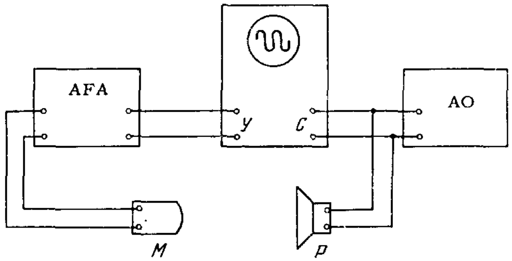
THE well known demonstrations of the Doppler effect have the important disadvantage that in order to carry them out successfully it is necessary to displace the source or the receiver of sound with considerable velocity.

For a direct measurement of a small frequency shift in the Doppler effect one could utilize oscillographic methods involving elliptical display [1,2] or alternatively methods using precision phasemeters [3,4]. However, in every such case it would be necessary to construct more or less complicated apparatus and the lecturer would require additional time to explain the demonstration.

We have shown at Novosibirsk University a demonstration which can be carried out without requiring the construction of any apparatus. The measurement of the frequency difference is carried out by a simple and obvious method with good accuracy. For the demonstration it is sufficient to displace the loudspeaker of the microphone with a very low velocity—as low as 1 cm/sec.

The essence of the demonstration consists of the following. The oscillograph operates in the usual regime of continuous time base display, but is switched to external synchronization. A low frequency voltage from an audio oscillator is applied in parallel to the loud speaker and to the external synchronization terminals. The amplified signal from the microphone is applied to the vertical input Y. The loudspeaker and the microphone are first held stationary and a stable pattern is obtained by regulating the level of the synchronizing signal in the oscillograph.

If we now make the loudspeaker and the microphone approach one another then the frequency of the signal coming from the microphone will be somewhat increased or, what is the same thing, the phase of the incoming signal will be varied continuously and monotonically, and this is visually recorded as a motion towards the left of the pattern on the oscillograph screen. As the loudspeaker is moved away the pattern will move in the opposite direction towards the right. It is obvious that the pattern on the screen will move through exactly one sinusoidal wavelength when the loudspeaker traverses a distance (towards the microphone) equal to the wavelength of the emitted frequency. The frequency difference due to the Doppler effect will be numerically equal to the number of sinusoidal waves displaced with respect to a point fixed on the screen during 1 sec. The experiment enables one to observe the Doppler effect qualitatively.



Block diagram of demonstration.
P – loudspeaker; M – Microphone; AFA – audio frequency amplifier; Y – input of vertical amplifier of oscillograph; C – terminals for external synchronization; AO – audio oscillator.

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[3] V. F. Lubentsov and S. Ya. Rombro, Izm. Tekhn. (Techniques of Measurement) 2, 20 (1955).

[4] M. E. Zhabotinskiĭ and E. I. Sverchkov, PTÉ **3**, 74 (1956).

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