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A Tiny Microphone Diaphragm Based on Fly Ears

A tiny microphone diaphragm based on fly ears has been built by researchers (Ronald Miles, Binghamton University, 607-777-4038, miles@binghamton.edu), offering such possibilities as compact hearing aids that respond only to sound in front of the wearer.

The diaphragm is the part of a microphone that vibrates in response to incoming sound waves; other components then convert the diaphragm's vibrations into electrical signals which can then be amplified or recorded.

The researchers based their novel diaphragm on *Ormia ochracea*, a small parasitic fly that uses sound to track down its cricket host even in complete darkness. The fly can detect changes as small as two degrees in the direction of an incoming sound, as good as humans. This is remarkable since the fly's ears are just a couple hundred microns apart. Mammals, on the other hand, rely on the fact that their ears are well separated from one another, so that sound can arrive at each ear at sufficiently different times and with sufficiently different intensities.

What's even more remarkable about the fly is that its hearing organs, a pair of rectangle-shaped membranes, are connected to each other. Specifically, they are "torsionally coupled" so that a sound wave that lands on one membrane can deflect the other membrane. The connection between the membranes enables them to vibrate in several different ways so that the fly can obtain both the average pressure of an incoming sound and its pressure gradient, the change in sound pressure as you move from one ear to the other. This provides lots of information with which to determine the direction of the sound.

The researchers built a silicon nitride prototype microphone diaphragm that closely reproduces the characteristics of the fly ears. While the researchers face challenges in mass-producing such a design, they hope that its unconventional approach to localizing sound will inspire lots of applications. ([Paper 2aEA1](#) at [Acoustical Society of America](#) meeting in Ft. Lauderdale, 3-7 Dec 2001.)