Why it Matters

Movie Theater Sound

Think about the last movie you watched in a theater. What would the movie have been like without sound? The soundtrack of a movie contributes a great deal to the mood of each scene. For instance, a scary scene often becomes much less frightening if the sound is muted.

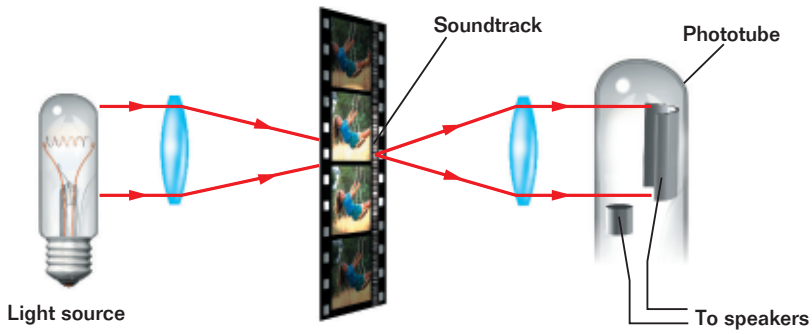
The soundtrack of a movie is located along the side of the film in the form of an optical pattern of light and dark lines. A beam of light in the projector is directed through the soundtrack toward a *phototube,* as shown in the diagram below. The phototube contains a cathode and an anode. The cathode, which is made of a material that exhibits the photoelectric effect, is connected to the negative terminal of a power source. The anode is connected to the positive terminal. Thus, a potential difference exists between the cathode and the anode. When a beam of light shines on the cathode, electrons are ejected from it. Because of the potential difference, the photoelectrons are pulled toward the anode, producing a current.

The variation in shading on the soundtrack varies the light intensity falling on the plate of the phototube. When the light intensity increases, the number of photoelectrons also increases because there are more photons striking the surface. Likewise, when the intensity decreases, the number of photoelectrons decreases. Thus, the current is constantly changing as the intensity changes. This changing current electrically simulates the original sound wave. The sound wave is then reproduced by speakers for all moviegoers in the theater to enjoy.

Because the shading on an optical soundtrack varies through a range of values, this type of signal is an example of an *analog* signal. *Digital* signals, on the other hand, are discrete values of "on" and "off." Digital sound is clearer than analog sound—for instance, a compact disc sounds clearer than a cassette tape.

Some newer movies also contain a digital soundtrack. The first commercial movie to use digital sound was *Jurassic Park,* in 1993. Because a theater must have special equipment to play a digital soundtrack, the analog optical soundtrack is still included. The analog soundtrack is used in theaters that do not have digital capabilities, or in situations where there are problems with the digital sound.

The digital soundtrack is compressed onto compact discs. A time code is placed directly on the film, between the images and the optical soundtrack, as a series of dots and dashes. A device mounted on the projector reads the code in a manner similar to the one described above for optical soundtracks. The reader translates the code into pulses of current, which are sent to a computer. The computer controls the CD players that play the soundtrack, using the time code to ensure that the sound remains synchronized with the movie.



The shading on the soundtrack varies the light intensity reaching the phototube, which varies the current sent to the speaker. This changing current reproduces the original sound waves in the speaker.