

Acousto-Optics

Acousto-Optical devices are usually made of a material like tellurium because it has a large acousto-optic coefficient; however, water has an acousto-optic effect large enough to be used in a laboratory experiment. With the IDP Sound Heads, a simple acousto-optic modulator can be made with an arrangement shown schematically in figure 1. Due to the relatively small acoustic amplitudes and the narrow width of the acoustic beam, the modulation will be in the Raman-Nath regime.⁽¹⁾

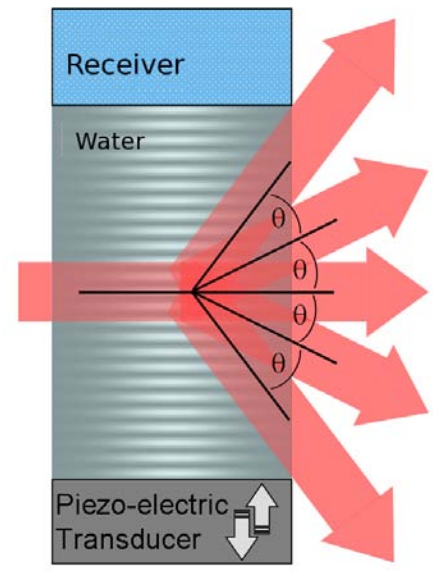


Figure 1.

The book by Korpel in reference 1 is an advanced text on the subject of acousto-optics. In it there is formula for calculating whether the Raman-Nath regime or the Bragg regime is appropriate. It depends on the amplitude of the sound wave, the width of the sound beam, and the geometry of the arrangement. In the Raman-Nath regime, there are several orders of diffracted light waves in the output, whereas in the Bragg there are just two.

With just the Sound Heads, and a laser, the angular diffraction of the laser beam can be measured, and from that, the Raman-Nath diffraction formula can be confirmed. With the addition of a sensitive light meter, measurements can be made on the power in the diffracted orders; and from that, the acousto-optic constants of water can be calculated. More sophisticated experiments can be devised by putting a solid in the water or using acoustic lenses on the sound beam.

An example of an educational acousto-optics experiment can be found at this web site: <http://www.physics.umd.edu/courses/Phys621/gradlab/glhb/acousto.html>

1. Korpel, A., Acousto-Optics, 2nd edition, 1997, Marcel Dekker, Inc.