

PINHOLE DIFFRACTION by

Robert William Whitby

<http://web.me.com/whitby/Octahedron/Welcome.html>

Introduction

The purpose of this paper is to show that the diffraction patterns produced by brass tubing are identical to those produced by pinholes within a sheet of lead. This, in turn, shows that the patterns are due to multiply reflected photons which are atoms or groups of atoms emitted by the heated filament of the lamp used as a light source.¹

1. This is described in detail under the heading Light in the book by Robert William Whitby entitled *Octahedron*, which can be downloaded as the file *Octahedron1stEd.pdf* at the URL—<http://homepage.mac.com/whitby/>



Tubing and light source

The light source was provided by the exposed light bulb of the Mini-Maglite flashlight shown in the figure. The two 12-inch lengths of tubing were purchased at a store selling artists' supplies.



Tubing label

Two 12-inch lengths of tubing from an art supply store. Label states "K & S Engineering, Chicago, IL. 15/32 Round Brass, Stock No 138 and 13/32 Round Brass Stock No 136"

Diffraction patterns in a single tube

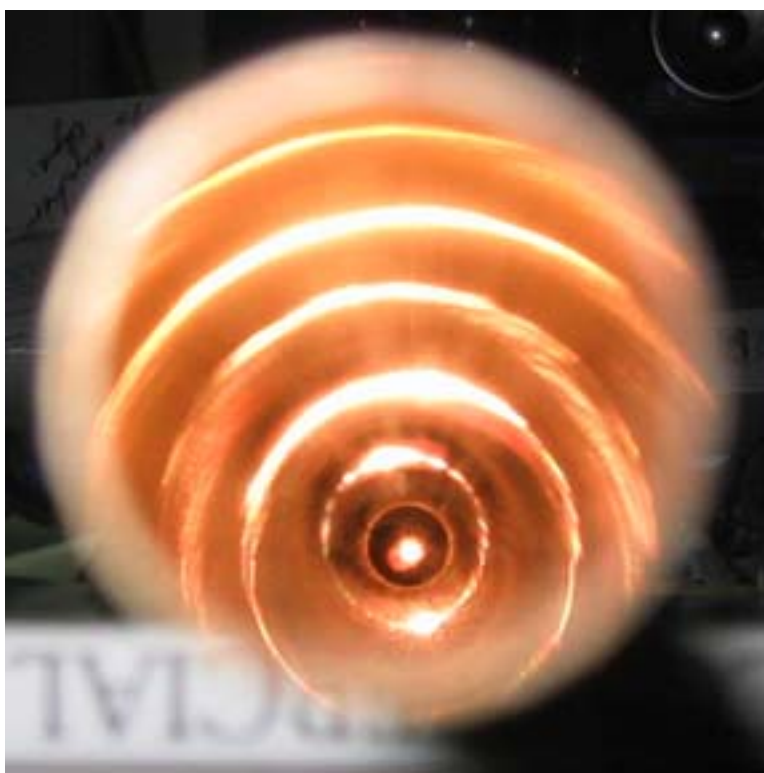
The pattern of reflections which is observed within a single tube is dependent upon the angle between the source-observer axis and the axis of the tube, the displacement between the axes, the proximity of the source to the tube opening, and the proximity of the observer's lens to the opposite opening. The five photographs which follow progress from a greater angle between the axes towards the colinearity of the axes.



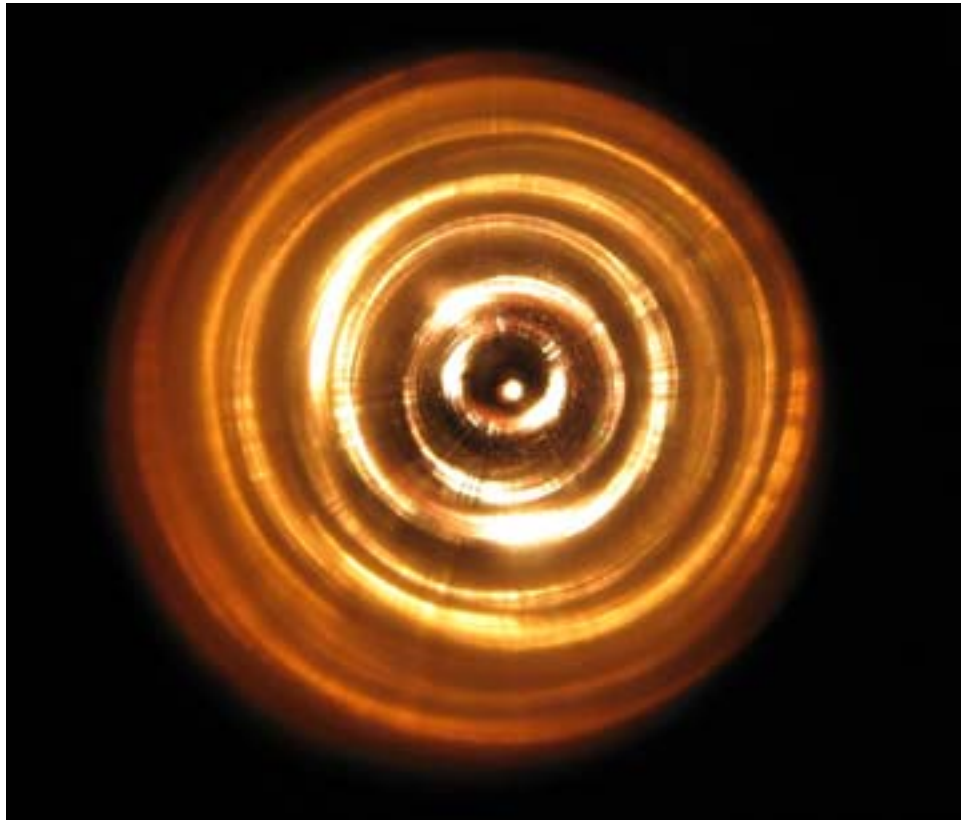
Pinhole diffraction—single tube pattern #1.



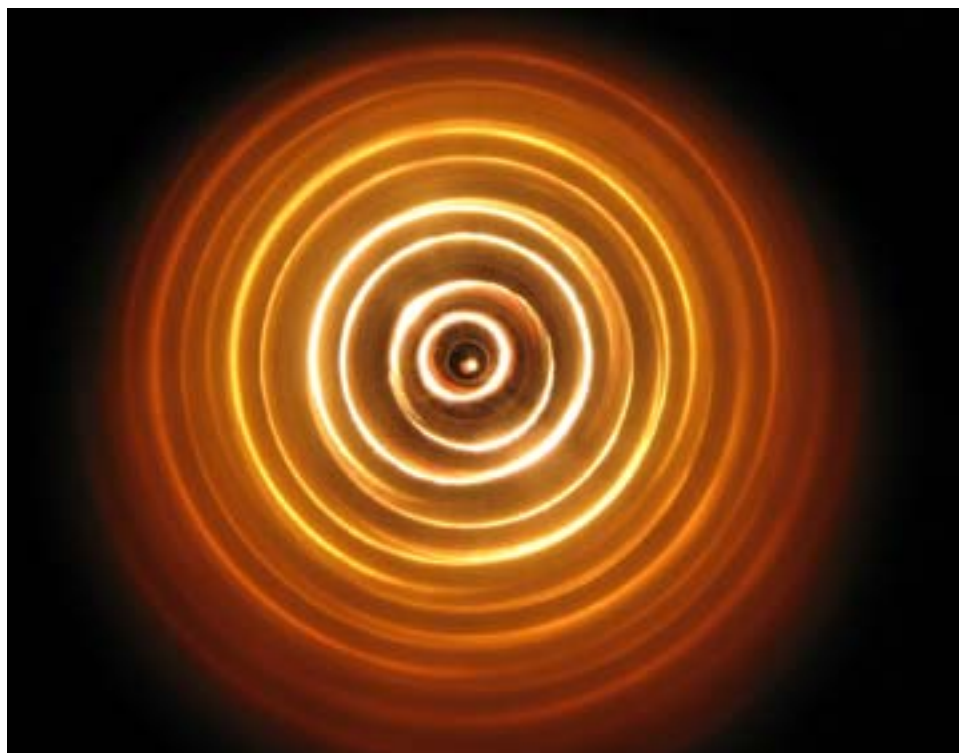
Pinhole diffraction—single tube pattern #2



Pinhole diffraction—single tube pattern #3



Pinhole diffraction—single tube pattern #4



Pinhole diffraction—single tube pattern #5



Pinhole diffraction: Desk lamp source

A vent hole in a desk lamp provided a larger relative light source. The desk lamp is depicted above with the vent hole used as the light source framed by a square. An enlargement of the vent hole is shown on the left. A portion of the incandescent light bulb is visible through the vent hole.

Effect of larger light source

A larger light source results in a broadening of the circular rings of light as can be seen in the next two photographs.



Pinhole diffraction—Rings produced by larger diameter source#1



Pinhole diffraction—Rings produced by larger diameter source#2

Pinhole diffraction—two tubes

Two brass tubes were bundled with a third tube to simulate the diffraction of twin pinholes. The patterns which result are caused by the axes of the tubes being offset from the light source-camera axis. If the axis of one tube is colinear with the light source-camera axis,

then the other must be offset from it. The photographs were taken so that the tubes shared the light source so that the axis of each was offset from the light source-camera axis.

The larger light source was used for each of the diffraction patterns which follow.



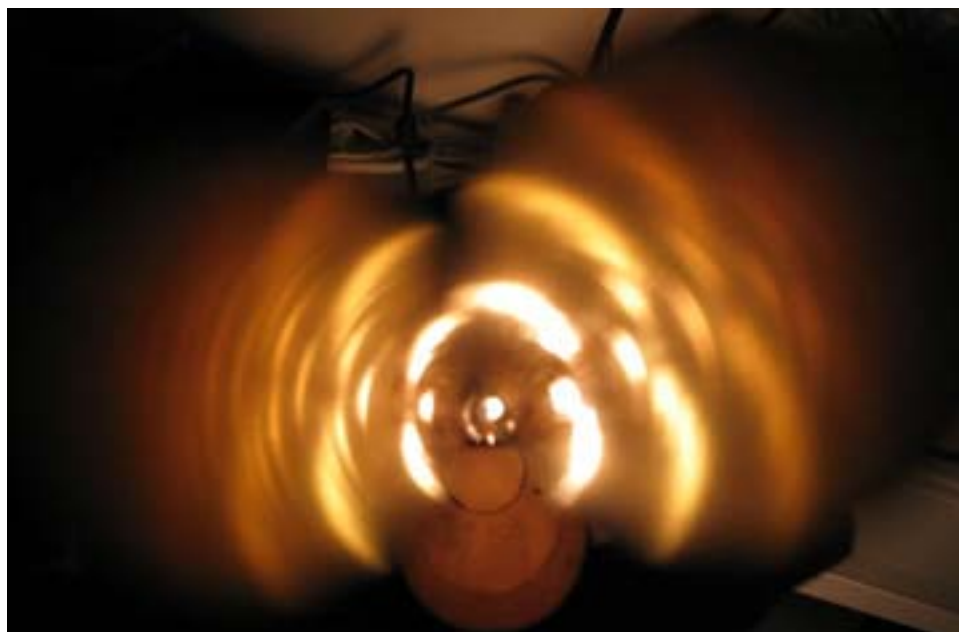
Pinhole diffraction—two tubes

The two foot-long tubes have been bundled with a shorter length of 3/4-inch tubing to examine the diffraction patterns resulting from the multiply reflected photons of the light source.



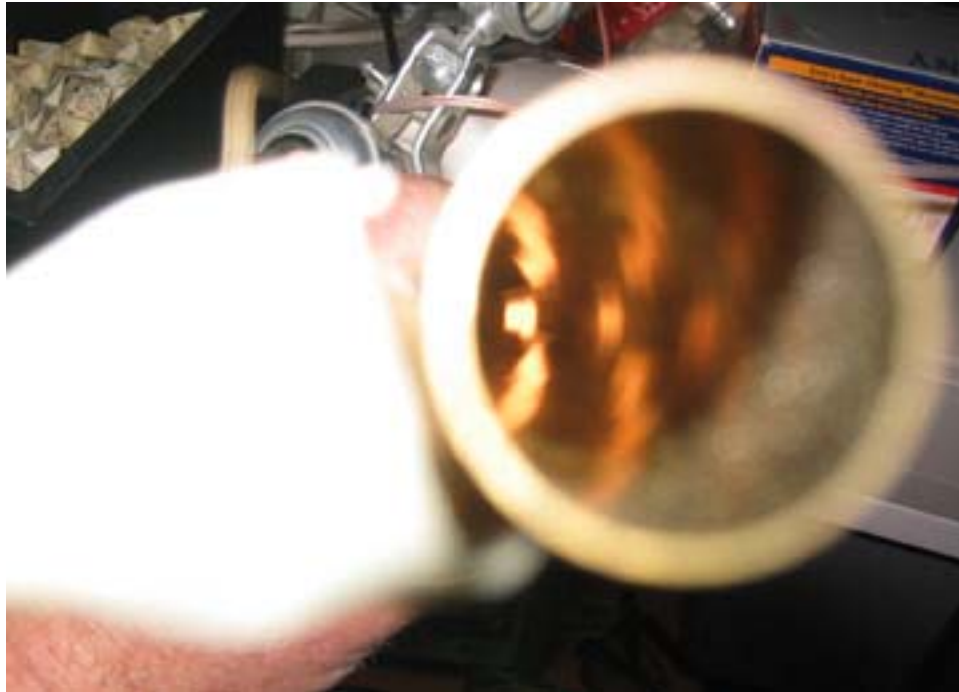
Pinhole diffraction—two tubes, axial view.

The three tube bundle is shown end on in the figure. The 13/32-inch tube is on the left; the 15/32-inch tube is on the right; and the 3/4-inch tube is below them.



Pinhole diffraction—two tube, diffraction patterns.

The figure shows a pair of photographs taken with the camera-light source axis nearly parallel to the axes of the tubes and in the plane which is tangent to each of the tubes along their line of contact.



Pinhole diffraction—twin tube with one tube covered.

The left tube is covered in the top photograph; the right tube is covered in the bottom photograph. The relationship of the light source-camera axis to the tubes is similar.



Pinhole diffraction—two tubes, with right hand tube covered.

Two photos taken of the two tube assembly with the light source-camera axis in the same relationship to the tube axes as in the previous photographs. The right hand tube is covered in each of the photos.



Pinhole diffraction—uniformly concentric rings

This pattern results from the camera-light source axis being nearly colinear with the axis of the tube. The camera is off center towards the lower right. Nine rings can be distinguished moving outward from the source towards the upper left.

