Phys434 Lab 1 Alignment

Phys434L Quantum Mechanics Lab
2018

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A very important experimental aspect of the setup of these quantum experiments is the precise alignment of optical beams. Thus, one has to be methodical about setting up the optical elements. Here we start with an alignment exercise that leads to best practices. There is no way around these procedures because the down-converted light is so weak that it cannot be seen projected on a piece of paper or even with a standard digital camera. We start then by learning how to align optical beams to be parallel to the rows of holes of an optical breadboard. This alignment will be good to within 10^{-4} radians, or 20 arc-seconds. The parts needed are listed in the table below, and refer to labels in Fig. 1.

Qty	Part	Description/Comments
1	2-ft × 5-ft optical breadboard or larger optical table	Vibration isolation is not needed.
1	HeNe laser	It is already installed on the table.
3	3 mirrors with mounts (A, B, C)	Mirror B is a square mirror.
1	Iris with mount	On a magnetic mount.
4	Threaded knurled knobs	Should easily be screwed on the holes of the optical breadboard.

For this first meeting **each** student has to do the alignment. It should take no more than a 30 min, likely much less. When you are done you have to *undo* the alignment so that the next person can do the same alignment. The only item you should not remove is the laser.

1 Basic Alignment Procedure

Following the diagram of Fig. 1. The goal is to align the laser beam so that after each reflection it is parallel to the rows of holes on the breadboard. We will also use this exercise to place two of the elements that will be part of the experiments: mirrors A and B.

1. Set up the HeNe laser (or equivalent) as shown in Fig. 1(a). Add mirror A as shown. Place two pairs of screws/knobs along the same row of holes, parallel to the intended direction of the beam: two screws, adjacent to each other, near mirror A, and the

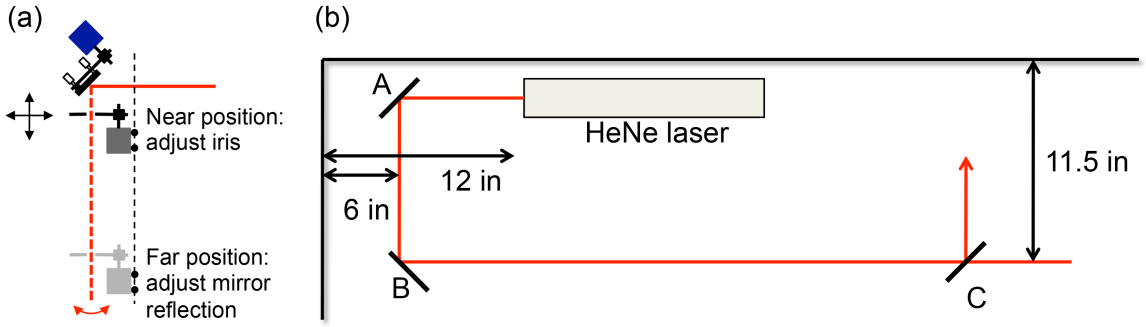

Figure 1: Arrangement for practicing the basic alignment of optical beams. (a) Method using tilted mirror and adjustable iris displaced along the rows of holes of the breadboard. (b) Layout of the exercise: It uses a HeNe laser and three mirrors, labeled A, B and C. The distances to the edge of the breadboard are only approximate.

other two, adjacent to each other in the farthest position from A. This procedure uses the following recursive method, shown in Fig. 1(a) (see also Fig. 2):

(a) Place the mount of the iris up against the two screws/knobs in the near position, and adjust the **position** of the iris relative to its mount so that the beam goes through the iris.

(b) Place the iris so that the mount is aligned up against the two screws/knobs in the far position. Now **adjust the tilt** of mirror A so that the beam goes through the iris.

(c) Place the iris back to the near position. Keep repeating the previous two steps until no adjustments are needed in the near and far position. That is, until the beam goes through the iris at both the near and far positions without the need to adjust the mirror or the iris position. This procedure converges, so it can be repeated as many times as necessary (4-5 times is typical).

2. Place mirror B (with a straight edge) in the location shown in Fig. 1(b). The beam must hit the mirror as close to the edge of the mirror as possible. Align the reflection off mirror B using the procedure outlined previously so that the beam is parallel to the holes on the breadboard.

3. Place mirror C and align the reflected beam. If you are the last person in the group, mirror C can be removed. We will only use mirrors A and B for the next lab.

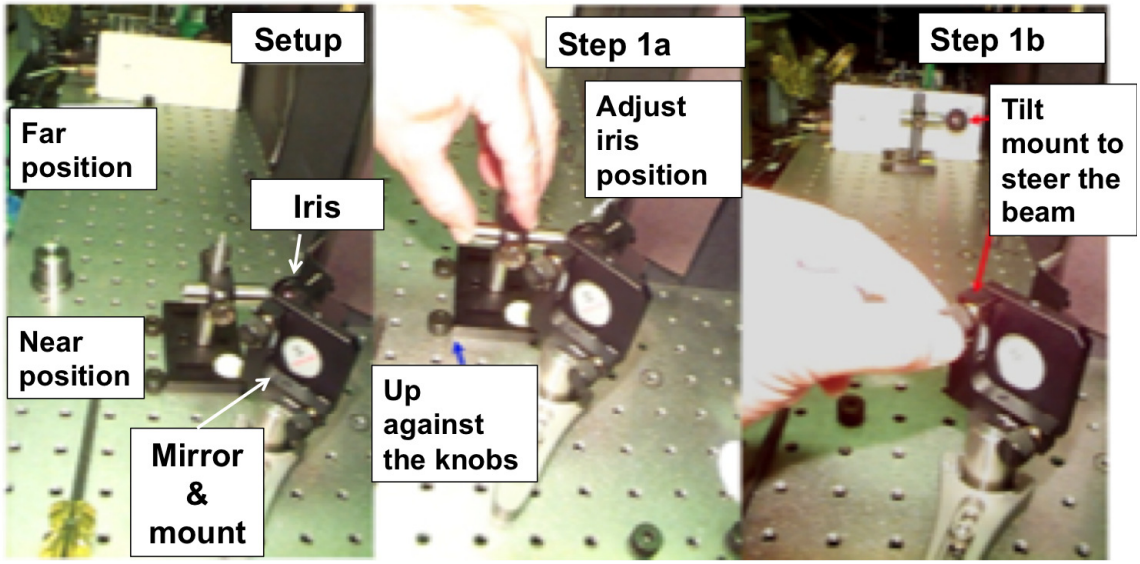

Figure 2: Alignment steps.