

BASIC APPARATUS FOR CT ANAOLGY

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Note: This is a work in progress and has not yet been tested with students. We anticipate making some changes as a result of feedback at the Washington AAPT Meeting.

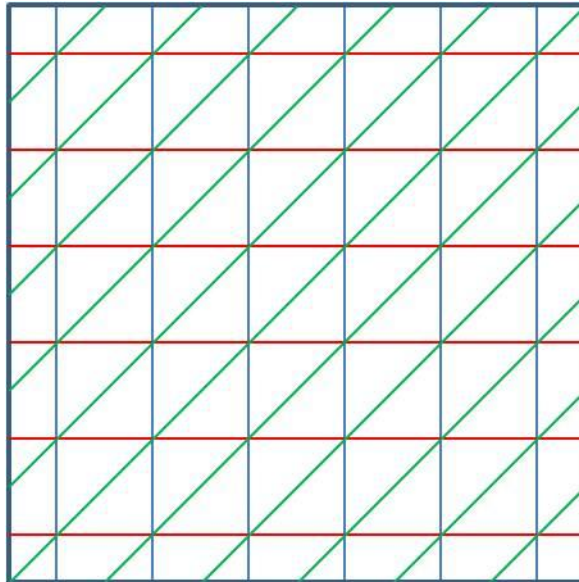
Components:

- Foam core – this will become the holder for the beam blocks as described below
- Beam blocks (2 x 2 inch pieces of manilla folder)
- Laser pointer
- Pasco detector
- Legos to create the detector and laser holder, along with the bridge to connect the two
- Shim material to align the detector with the laser (currently folded pieces of paper)
- Extra pieces of foam core to raise one end of foam core board to level of laser pointer beam
- Shim material to raise other end of foam core board to the level of the detector (currently extra legos)

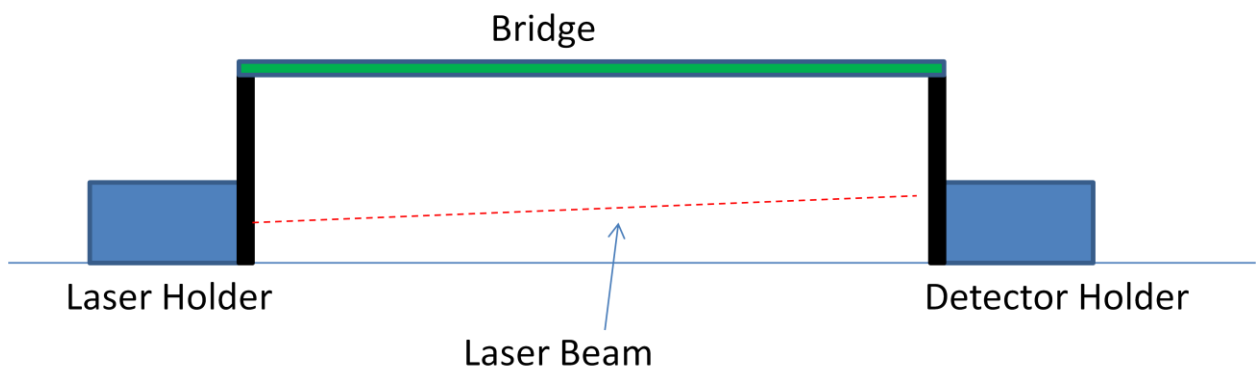
Apparatus construction:

- Foam core base for holding beam blocks. Cut slits in the foam core along the lines indicated.
 - The beam blocks fit into these slits.
 - When the beam blocks are placed in the blue slits, the laser will be aligned with the red slits (and vice versa). When the beam blocks are placed in the diagonal slits, the laser beam will be aligned with unmarked diagonals.
 - For the purposes of tracking the measurements, the lines followed by the laser beam in the three directions have been represented with numbers, letters, and symbols.





- The detector and laser holders are currently constructed out of legos – as is the bridge that connects them (as shown below).
 - The laser pointer does not emit a beam that is along the axis of the pointer (as shown below).
 - Laser pointer holder and detector holder appear to be unaligned when laser is not on.
 - Align laser and detector before taking measurements. Shim the detector in its holder as needed.
 - Foam core holder for the beam blocks needs to be shimmed such that the laser line will hit all the beam blocks. (This would be more necessary if the beam blocks were filter holders instead.)
 - The bridge that connects the two holders needs to be long enough such that the foam core holder for the beam blocks can fit diagonally between the laser and detector. It needs to be tall enough to allow the foam core, shims, and beam blocks underneath it in all orientations.



Procedure:

- Place beam blocks into slits of the foam core at the desired locations. Start by placing them such that they are perpendicular to the numbered slits.
- Take measurements along the numbered slits. Keep track along which numbered slits the detector reads light and which it doesn't. (This is a basic on/off measurement scheme.)
- Rotate the beam blocks 180° such that they are now perpendicular to the lettered slits.
- Take measurements along the lettered slits, again keeping track of which slits the detector reads and which it doesn't. (This will also require adjusting the shims beneath the foam core.)
- Rotate the beam blocks into the diagonal slits. They will now be perpendicular to the penciled in diagonal lines that are labeled with symbols.
- Take measurements along the diagonal lines marked with symbols, again keeping track of which slits the detector reads and which it doesn't.
- Take the data and organize into a table like the one shown below. Determine which intersections (row and column) are likely to have a beam block. (A sample data set and analysis chart are shown on the next page.)
- Compare to the actual layout.

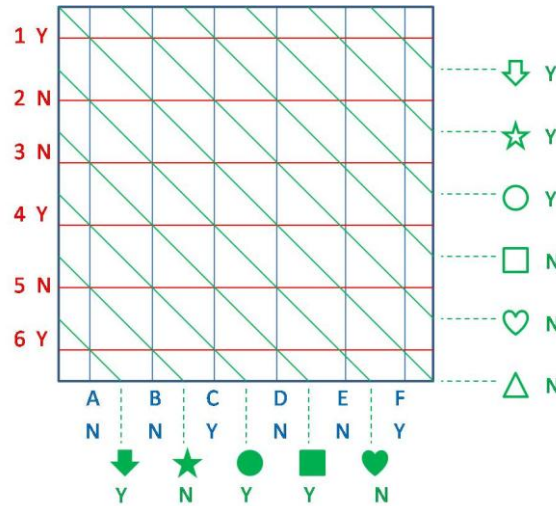
	A	B	C	D	E	F
1						
2						
3						
4						
5						
6						

Plans for the future:

- Place the foam core beam block holder in a box so that the beam blocks cannot be seen as the measurements are being taken.
- Replace solid beam blocks with optical filters. This will allow a more advanced and theoretically more accurate measurement scheme. This measurement scheme will also be more similar to the operation of a CT scan.
- Develop, test and refine a learning activity based around this hands-on activity to teach the basics of CT scans.

Sample Data Set:

- Lines represent laser path, not the slits.
- Y – light reaches the detector
- N – light does not reach the detector



Analysis of Sample Data:

	A	B	C	D	E	F
1	- N -	- N -	N N -	- N N	- N N	N N N
2	---	---	N --	---	-- N	N - N
3	-- N	---	N --	---	---	N - N
4	- N N	- N N	N N -	- N -	- N -	N N -
5	---	-- N	N - N	---	---	N --
6	- N N	- N -	N N N	- N N	- N -	N N -

- Each cell has three entries, one for each measurement direction.
 - “-“: Measurement in that direction does not preclude a beam block
 - “N“: Measurement in that direction precludes a beam block
 - First entry: Lettered measurement
 - Second entry: Numbered measurement
 - Third entry: Symbolled measurement
- Any cell that does not contain at least one “N” is a possible location for a beam block.
 - Possible beam block locations: A2, A5, B2, B3, D2, D3, D5, E3, or E5
 - Actual beam block locations: A5, B2, D3, D5, and E3