

# Speed of Light

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# Goals

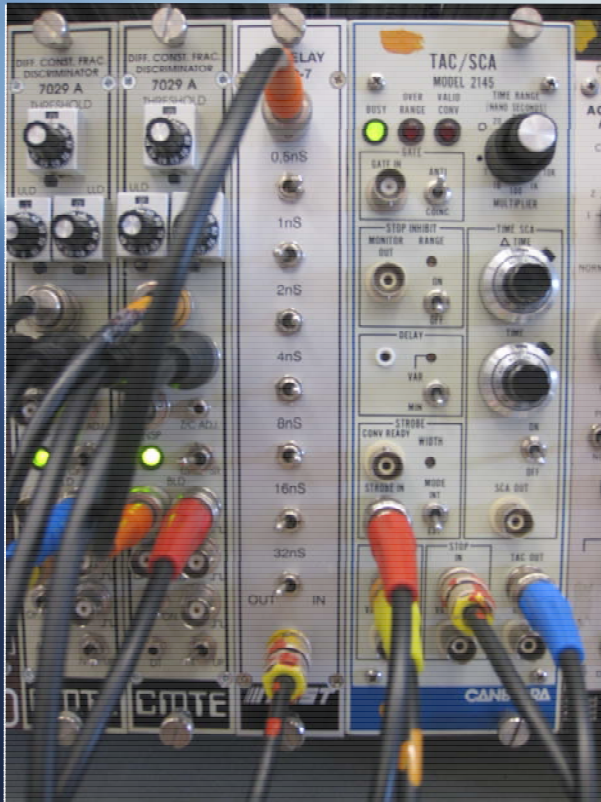
The goals of this experiment were to determine the speed of light and to learn how to use different experimental equipment.

# The Experiment

- The radioactive source, in the middle, emits gamma rays which the detectors (at the ends) pick up. The detectors then send the signal the rays emit to the computer. From the data the computer gives us, we can determine the speed of light.



# Delay Box



This is the time-delay box. It allows us to add a delay to the signal, so that we can read the signal.

The delay box allows you to add the delay in nanoseconds, which are .000000001 (one-billionth) of a second.

Acquire

VFS = 64

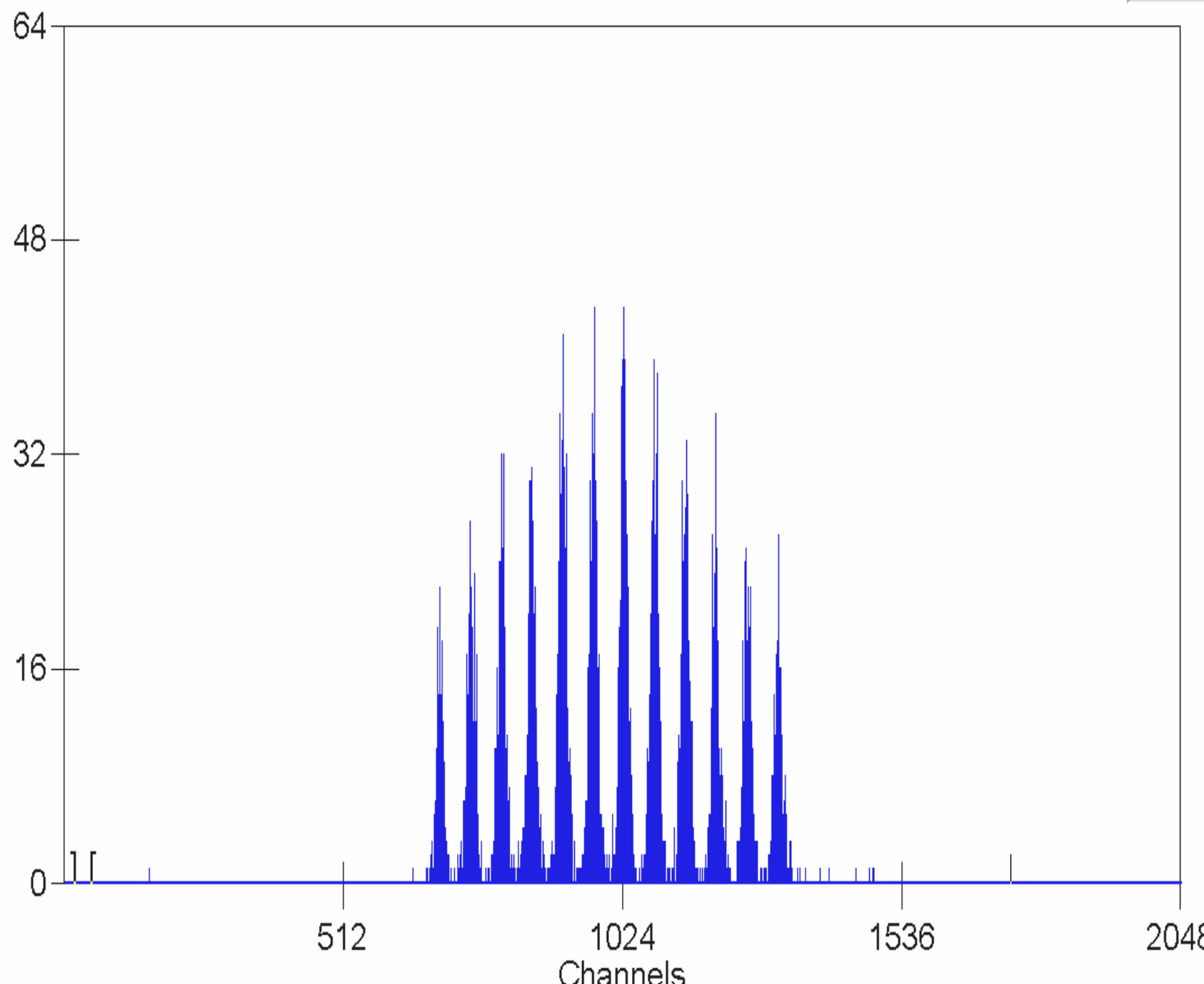
Start Stop  
Expand On  
Clear

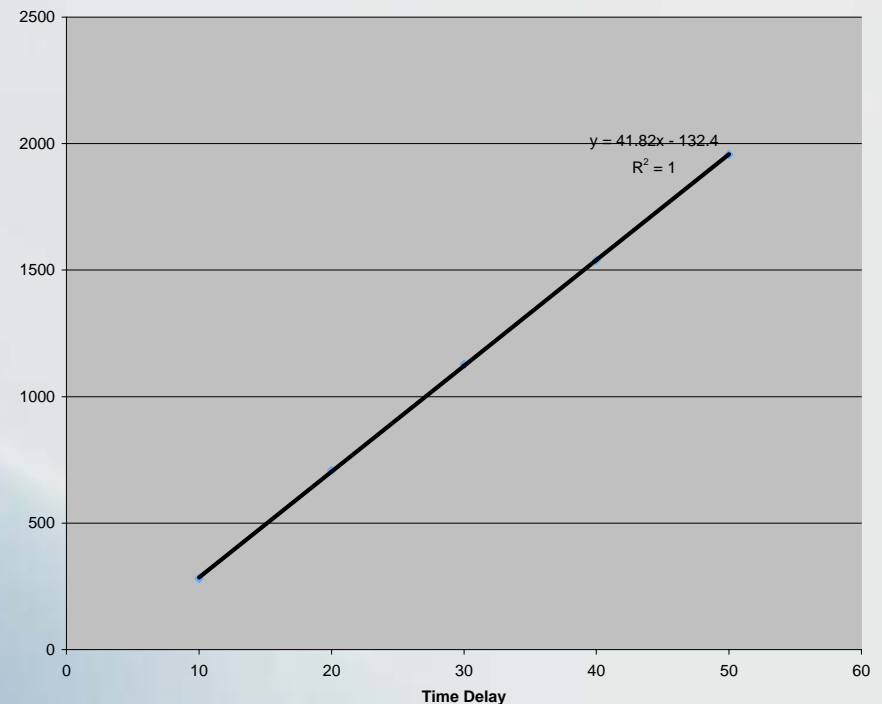
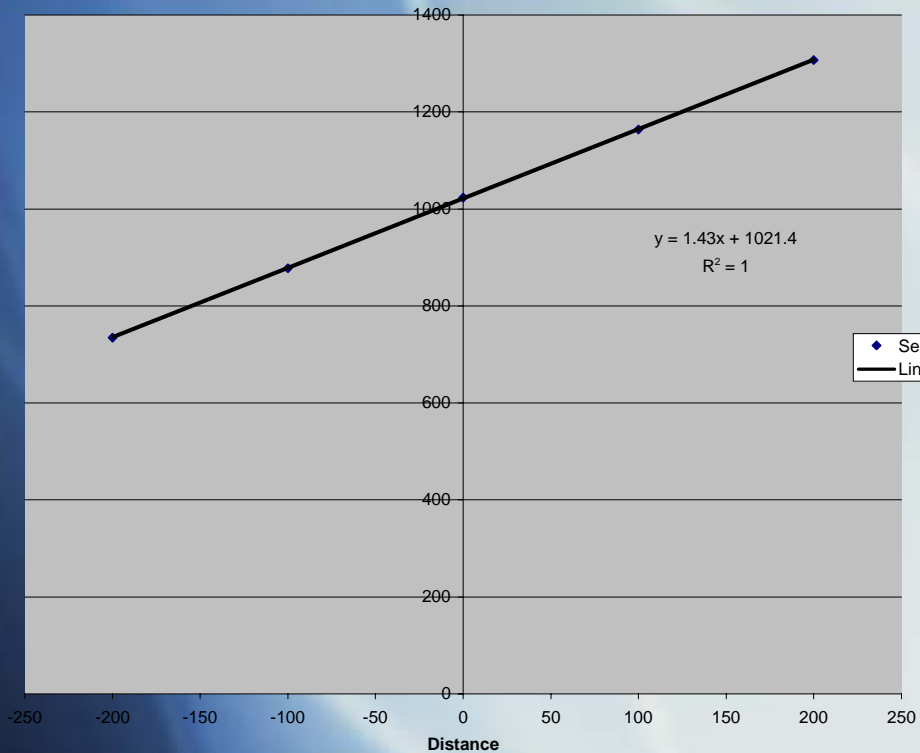
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# Results

We calculated, from our data, the speed of light to be 293,000,000 meters per second.

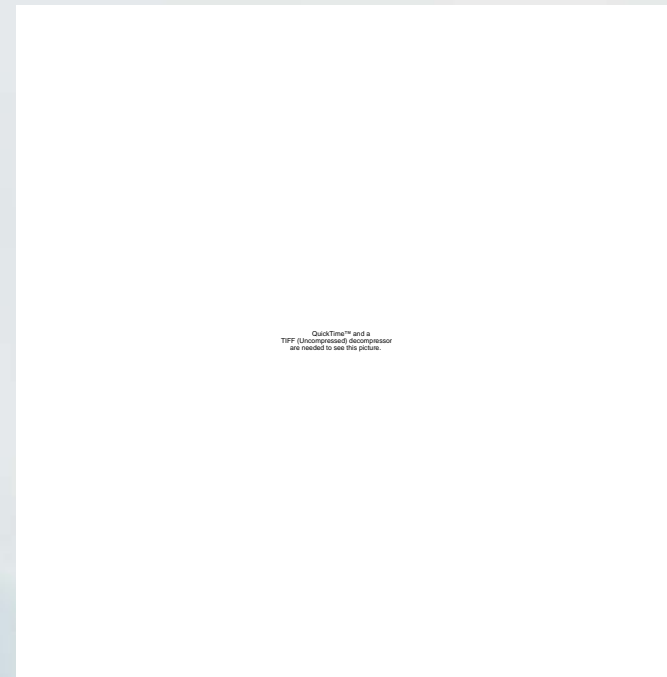
The speed of light is really 300,000,000 meters per second.

When we calculated our percent error, we were off by 2.3%



# PIXE Tests

For our PIXE test, we used two multivitamins, Centrum, white, and One Choice, red. We analyzed them whole, first, and found Titanium on the outside. We suspect the titanium gives it the coloring. We then proceeded to open them and got:





# Centrum

The Centrum multivitamin  
contains:

P (Phosphorous)

Cl (Chlorine)

Ca (Calcium)

Mn (Manganese)

Fe (Iron)

Cu (Copper)

Zn (Zinc)

K (Potassium)

# One Choice

The One Choice multivitamin  
contains:

Cl (Chlorine)

K (Potassium)

Ca (Calcium)

Cu (Copper)

P (Phosphorus)

Zn (Zinc)

Fe (Iron)

# Conclusion

- The speed of light can be calculated directly, with a computer, two detectors, a radioactive source, and three people who want to calculate it.
- The speed of light is 300,000,000 (Three hundred million) meters per second.
- No multivitamins contain Arsenic or Uranium (That's good).
- We highly recommend any high school student to experience the PIXE-PAN program.
- Thank you Notre Dame for allowing JINA to host the PIXE-PAN program.