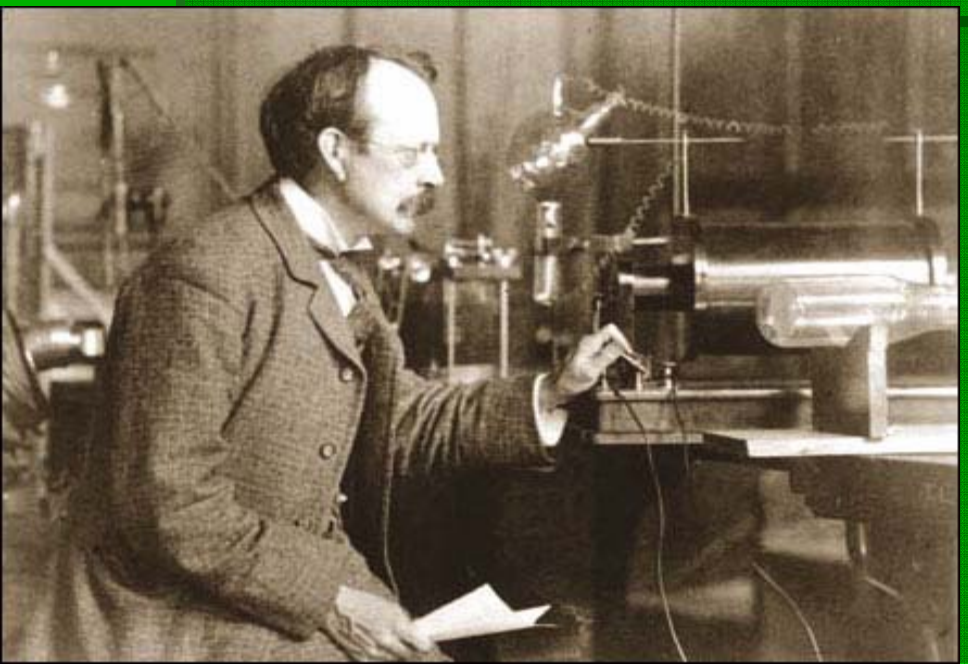
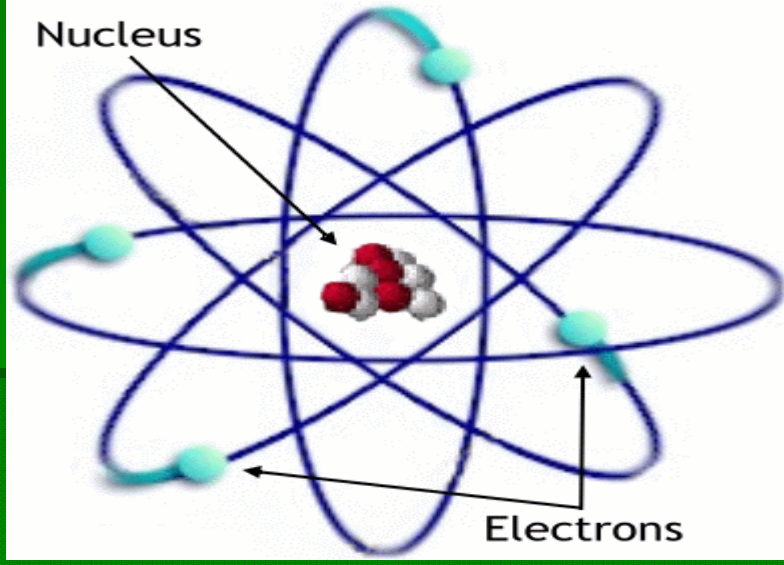
PIXE-PAN 2007

e/m EXPERIMENT





Picture from : http://www.mbe.doe.gov/me70/manhattan/images/AtomLabeledLarge.gif

Conducted by:
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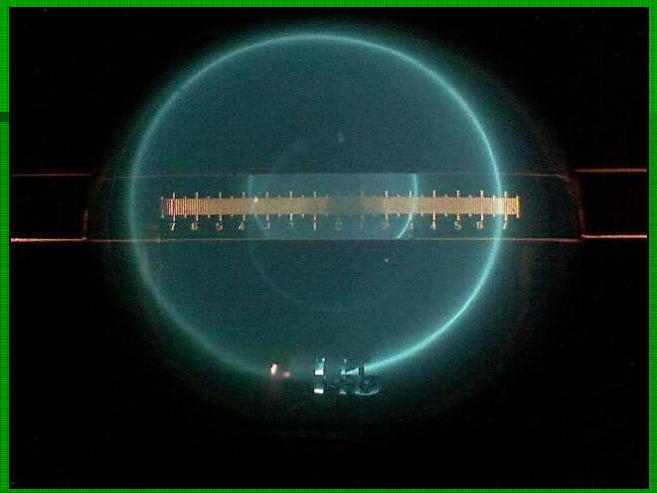
Picture from : http://universe-review.ca/I15-70-Thomson.jpg

J.J. Thomson

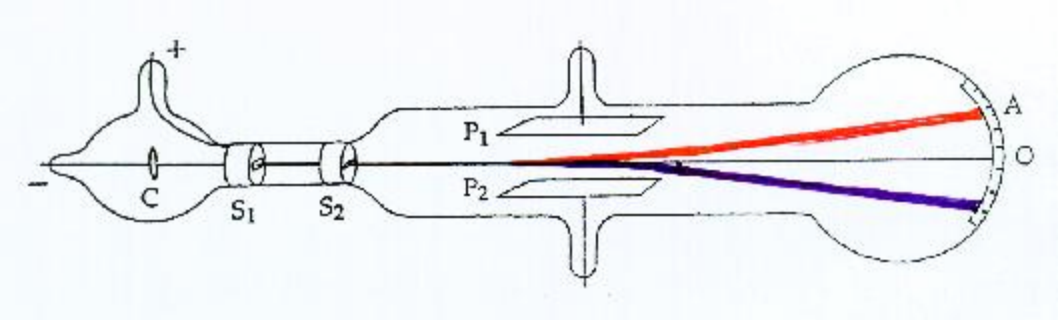
Picture from http://www.patent-invent.com/electricity/images/jj_thomson.jpg

Joseph John Thomson was originally born in England during the 1850's. He was awarded the Noble Prize in Physics in 1906 due to his discovery of the electron (1897).



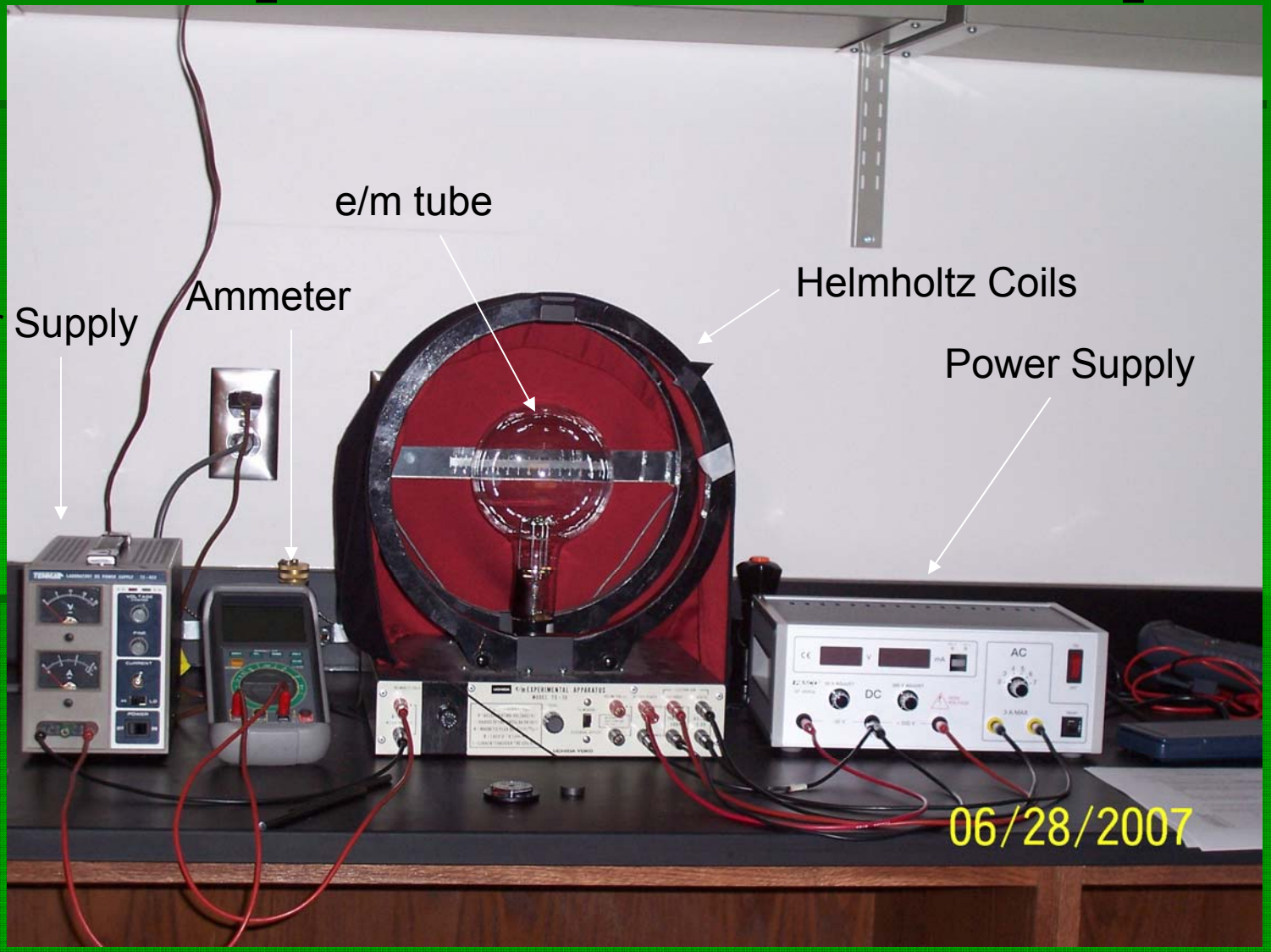
Thomson's Experiment

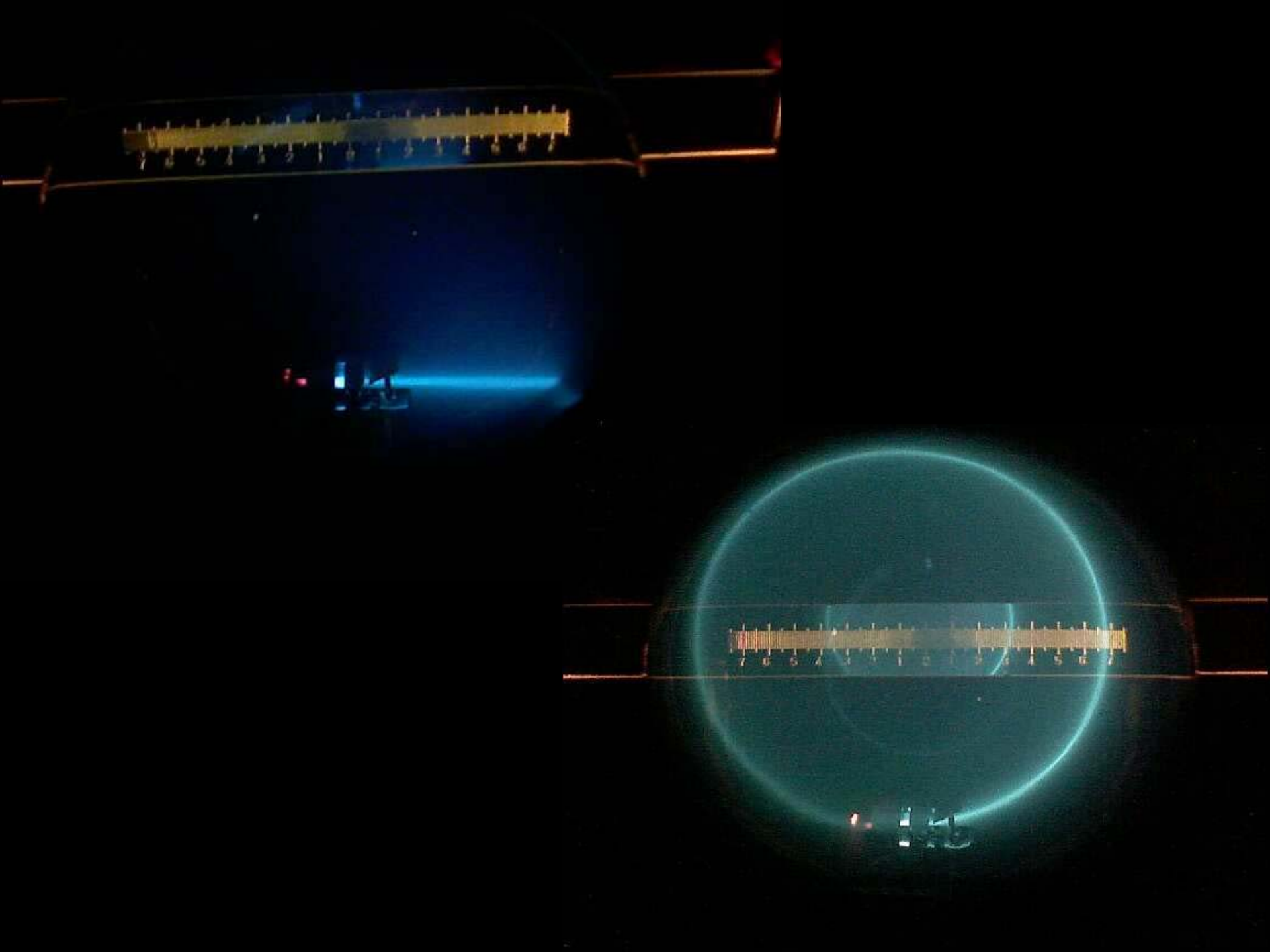
- Instead of using only an electric plate or a magnetic plate, Thomson is given credit for using both. This caused the electrons of the gas to form what was thought to be a beam of light. Thomson was able to bend these particles, proving they were indeed electrons and not light.

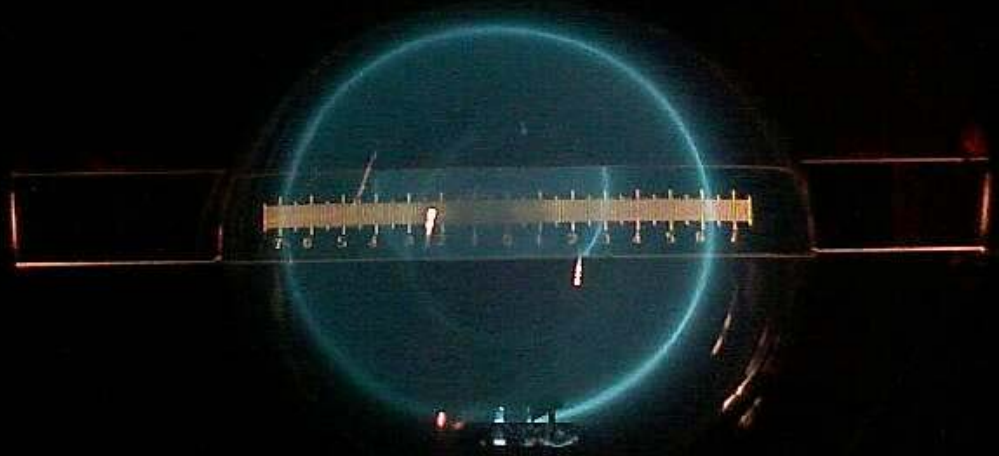


Picture from : http://www.phy.cam.ac.uk/cavendish/history/electron/description.php

Experimental Setup







Data

	V_1 = 296 volts	V_2= 210 volts
I_1 = 1.43 amps	r_{11} = 5.4 cm	r_{12} = 4.5 cm
I_2 = 1.25 amps	r_{21} = 5.5 cm	r_{22} = 4.9 cm

Applications of Mathematics

- Three different formulas were needed to find how our findings compared to the accepted value of e/m for electrons.

- The accepted value of e/m for electrons is 1.76×10^{11} C/kg.

Formulas Used

$$B = \frac{N\mu_0 I}{a} \quad x \quad \left(4/5\right)^{3/2}$$

This equation is used to determine the magnetic field, B.

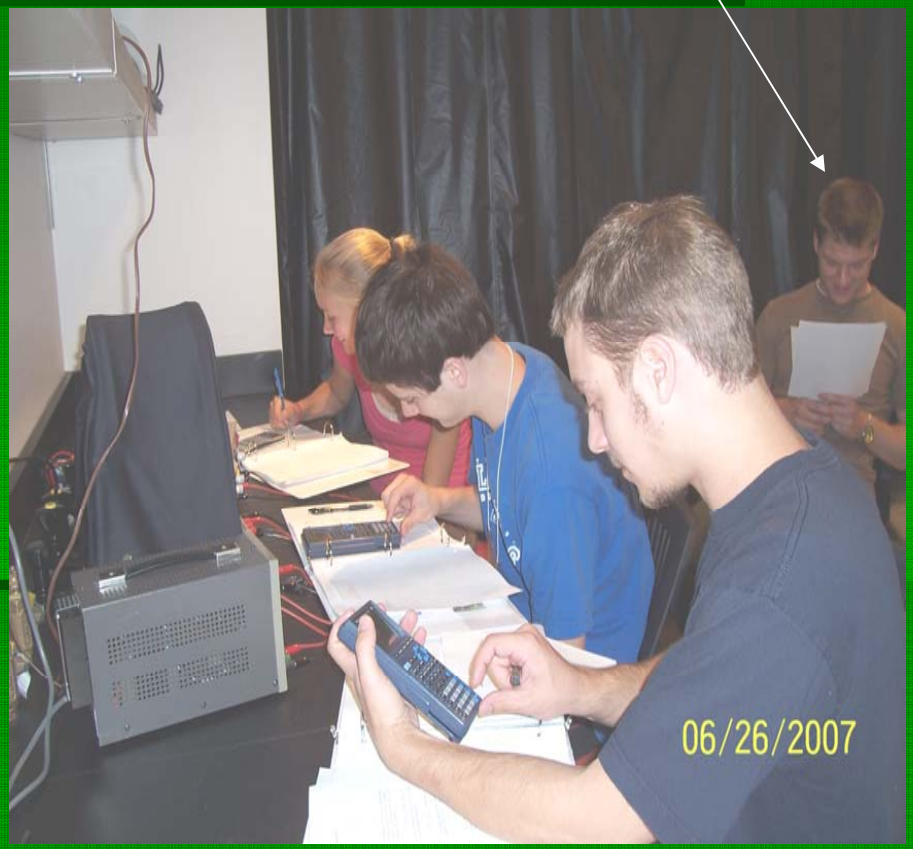
- N = number of turns in each Helmholtz coils
- I = the current through the coils
- a = the radius of the coils
- μ_0 = the magnetic permittivity of free space

AL1

Formulas Cont.

$$v = \frac{2V}{Br}$$

- v = the speed of the electron
- B = the magnetic field
- r = the radius of the electron beam circle
- V = the voltage, or accelerating potential



Formulas Cont.

$$\frac{e}{m} = \frac{v}{B\,r}$$

- B = the magnetic field
- r = the radius of the electron beam circle
- v = the speed of the electron
- e = the charge of the electron
- m = the mass of the electron

Comparison of e/m values

- The average ratio between e and m in our data was:

  1.8×10^{11} C/kg

- The accepted value of e/m is:

  1.76×10^{11} C/kg

- Our value was 97.7% accurate

Comparison of Speeds

- The average speed of the electrons in our data was:

  9.47×10^{6} m/s

- The speed of light is:

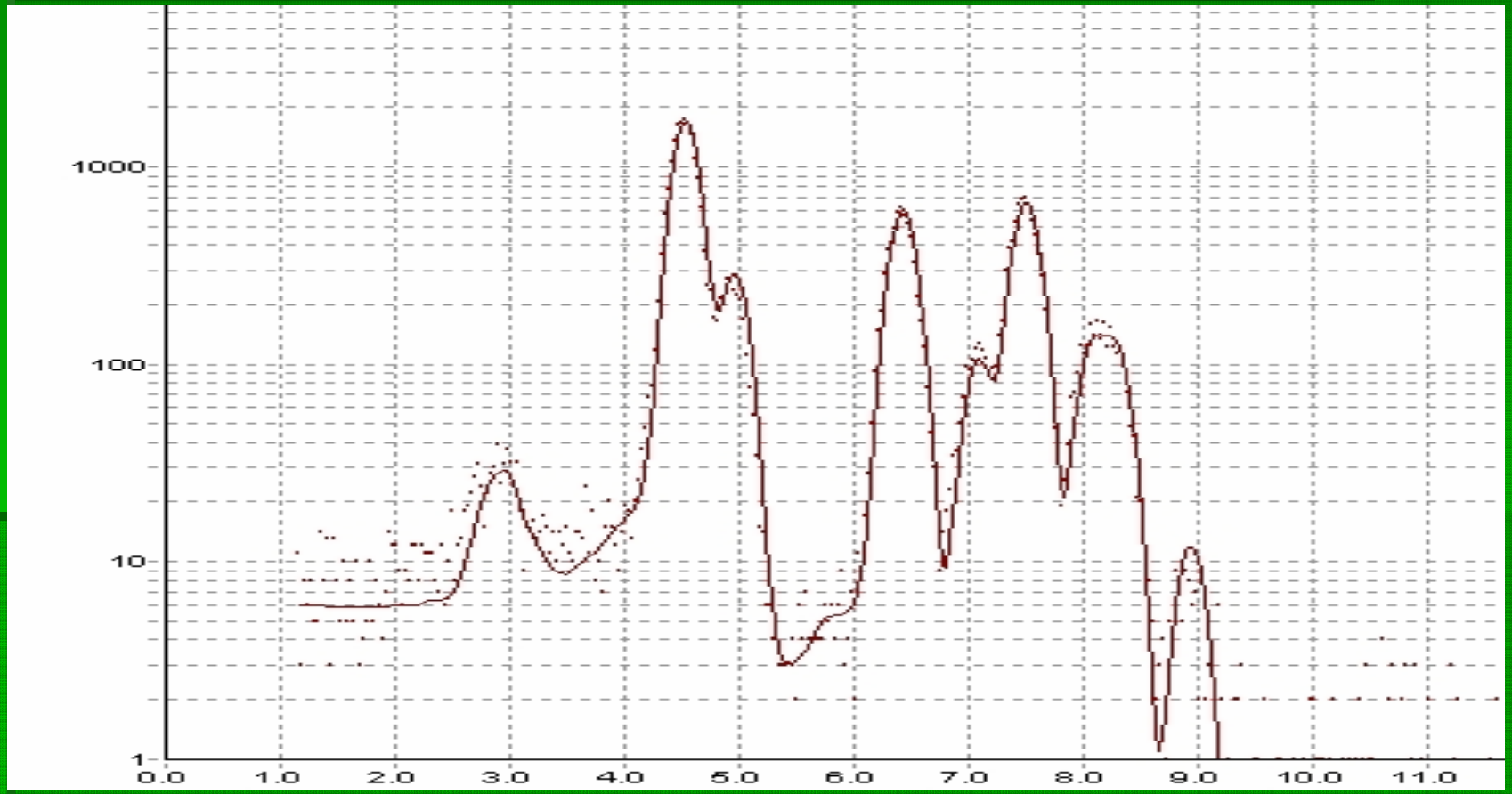
  3.0×10^{8} m/s

- The average speed of the electrons in our data was 3.2% of the speed of light.

Ball Marker

This is my ball marker. I keep it on my hat. I don't golf. I just like the hat.

PIXE Graph



PIXE Results

Element Z	Sym	#	Area counts	value (-5)	/uC/ ppm	Eff. (-3)	Trans. (-5)	Conc. ppm	§Stat. Error	§Fit Error	LOD ppm	
22	TiK	1	19757.5	400	3994	712	99927	307363.9	0.60	0.81	697.2	Y
26	FeK	1	7248.1	400	1805	882	99961	201223.6	1.02	1.15	961.6	Y
28	NiK	1	8130.9	400	951.1	920	99968	410680.2	0.98	1.19	761.8	Y
29	CuK	1	1407.2	400	824.6	933	99970	80846.1	3.89	3.89	4245.5	Y

In the matrix iteration section it was found that a correction needed to be applied to the H or uC value in order for the concentrations to sum to unity. The concentrations listed in the table above include this correction value. With the user supplied H & uC values alone the conc would be the above values multiplied by 1.134E-02 (See the documentation for further discussion.)

PIXE

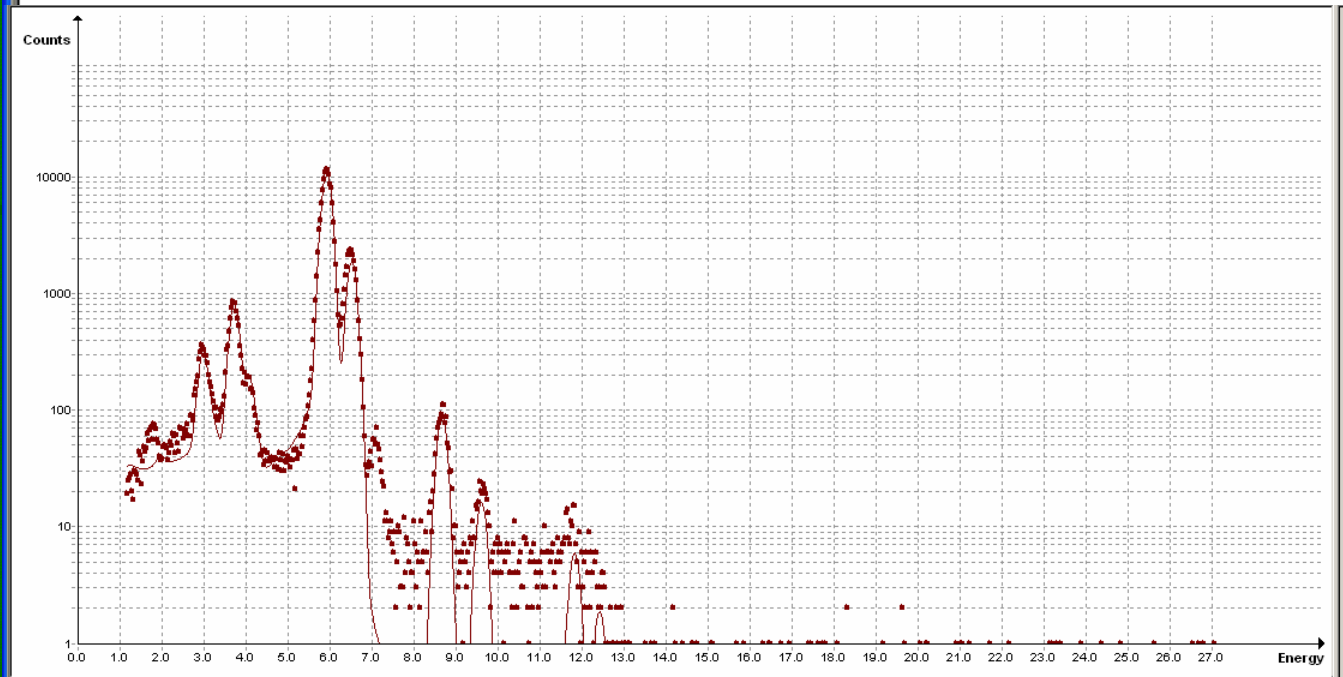
Rhodochrosite

GUPIX RESULTS

File:pinkrock.gpx Sec: 301. uC: 0.500 nA: 1.661 PUcor:1.0017
The last column is a decision on the presence of that element in the spectrum.
Y: present at level of quantization, N: not present at limit of detection
?: may be present near LOD levels (user must decide) H or uC Corr[T]: 0.030
Det Res(eV): 253.7 Chi**2: 8.977 (8.977)

Element Z	Sym	Layer #	Area counts	H value (-5)	Yield /uC/ ppm	Det. Eff. (-3)	Filter Trans. (-5)	Conc. ppm	%Stat. Error	%Fit Error	LOD ppm	
20	CaK	1	9140.9	400	5108	541	99883	55376.4	0.98	1.50	455.4	Y
25	MnK	1	137370	400	2975	854	99956	904451.4	0.23	0.49	602.3	Y
30	ZnK	1	1103.7	400	487.4	943	99972	40187.9	3.05	3.46	739.4	Y

In the matrix iteration section it was found that a correction needed to be applied to the H or uC value in order for the concentrations to sum to unity. The concentrations listed in the table above include this correction value. With the user supplied H & uC values alone the conc would be the above values multiplied by 2.994E-02 (See the documentation for further discussion.)



PIXE-PAN Item

Energy Levels of Shell

Elements in Shell

File:shell.gpx Sec: 110. uC: 0.500 nA: 4.545 PUcor:1.0037
The last column is a decision on the presence of that element in the spectrum.
  Y: present at level of quantization, N: not present at limit of detection
  ?: may be present near LOD levels (user must decide) H or uC Corr[T]: 0.058
Det Res(eV): 260.6 Chi**2: 5.194 (5.194)

Element Z	Sym	Layer #	Area counts	H value (-5)	Yield /uC/ ppm	Det. Eff. (-3)	Filter Trans. (-5)	Conc. ppm	%Stat. Error	%Fit Error	LOD ppm	
14	SiK	1	1644.1	400	6491	5	98915	470961.7	4.10	4.22	31537.0	Y
15	P K	1	0	400	2383	27	99305	0	0	0	39461.6	N
20	CaK	1	121576	400	3767	541	99883	518872.2	0.24	0.35	594.6	Y
26	FeK	1	1248.0	400	1235	882	99961	9958.0	3.26	3.76	330.9	Y
27	CoK	1	0	400	1112	904	99965	0	0	0	842.8	N

In the matrix iteration section it was found that a correction needed to be applied to the H or uC value in order for the concentrations to sum to unity. The concentrations listed in the table above include this correction value. With the user supplied H & uC values alone the conc would be the above values multiplied by 5.775E-02 (See the documentation for further discussion.)