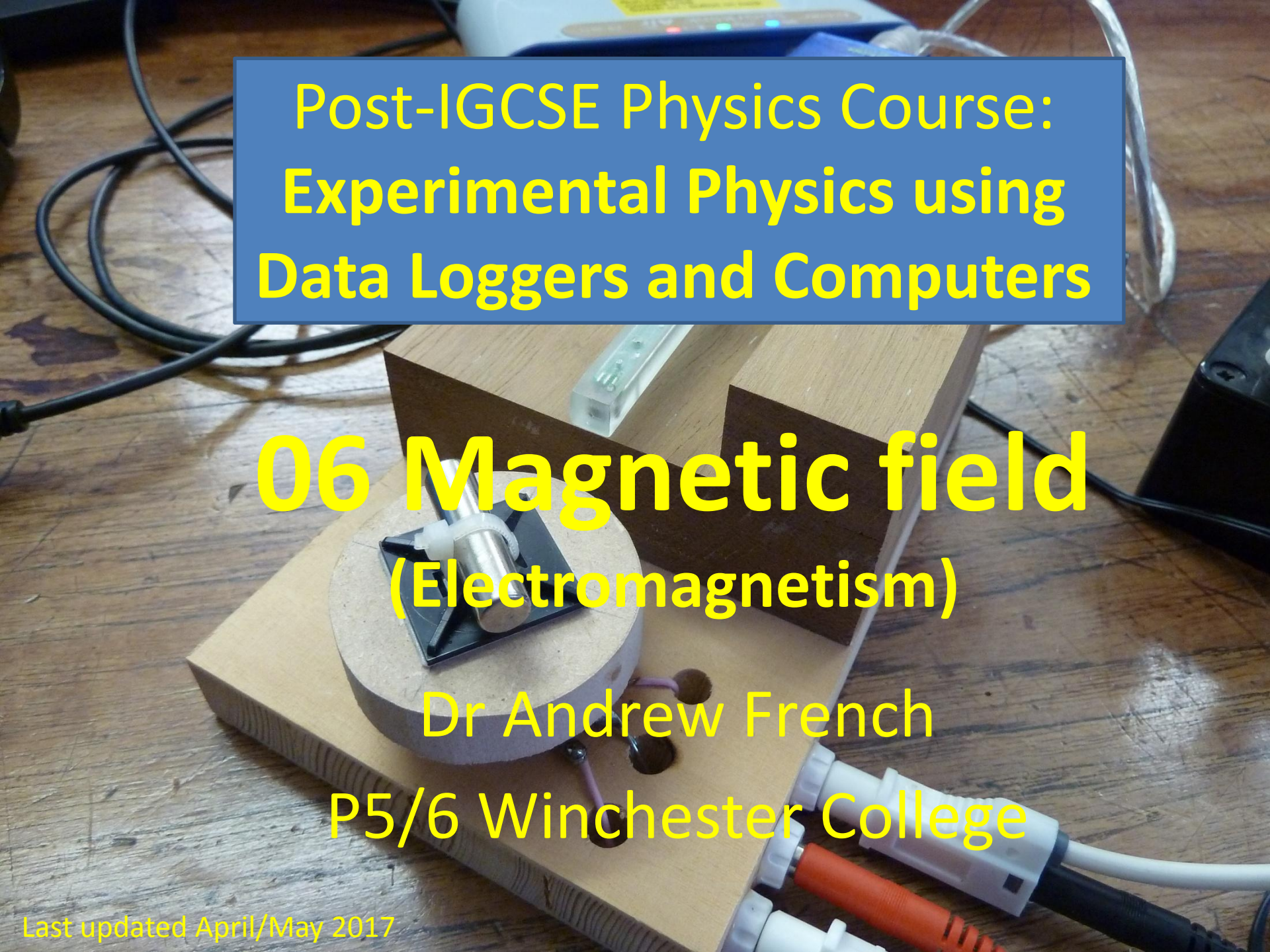

Post-IGCSE Physics Course:
Experimental Physics using Data Loggers and Computers

06 Magnetic field
(Electromagnetism)

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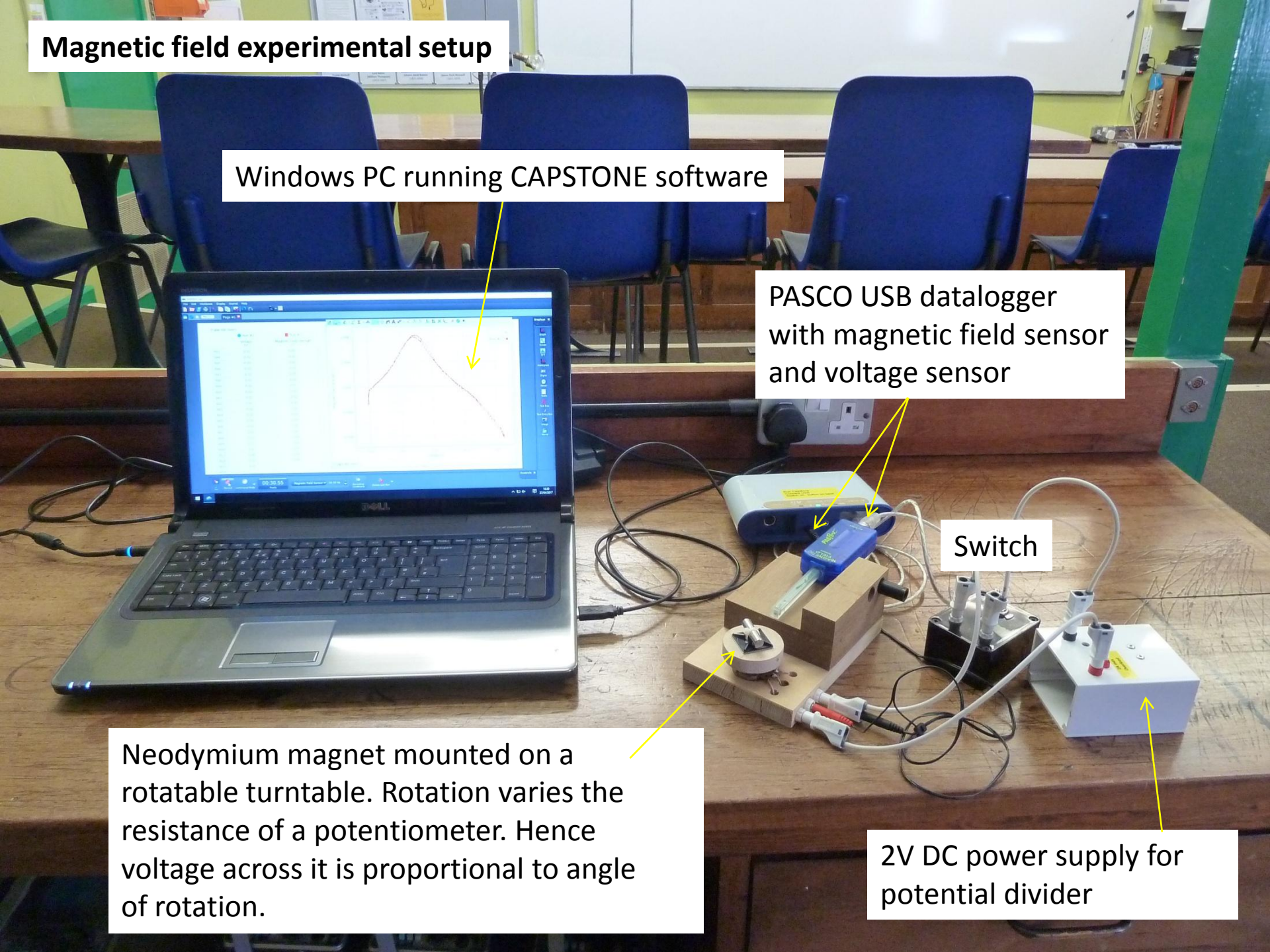
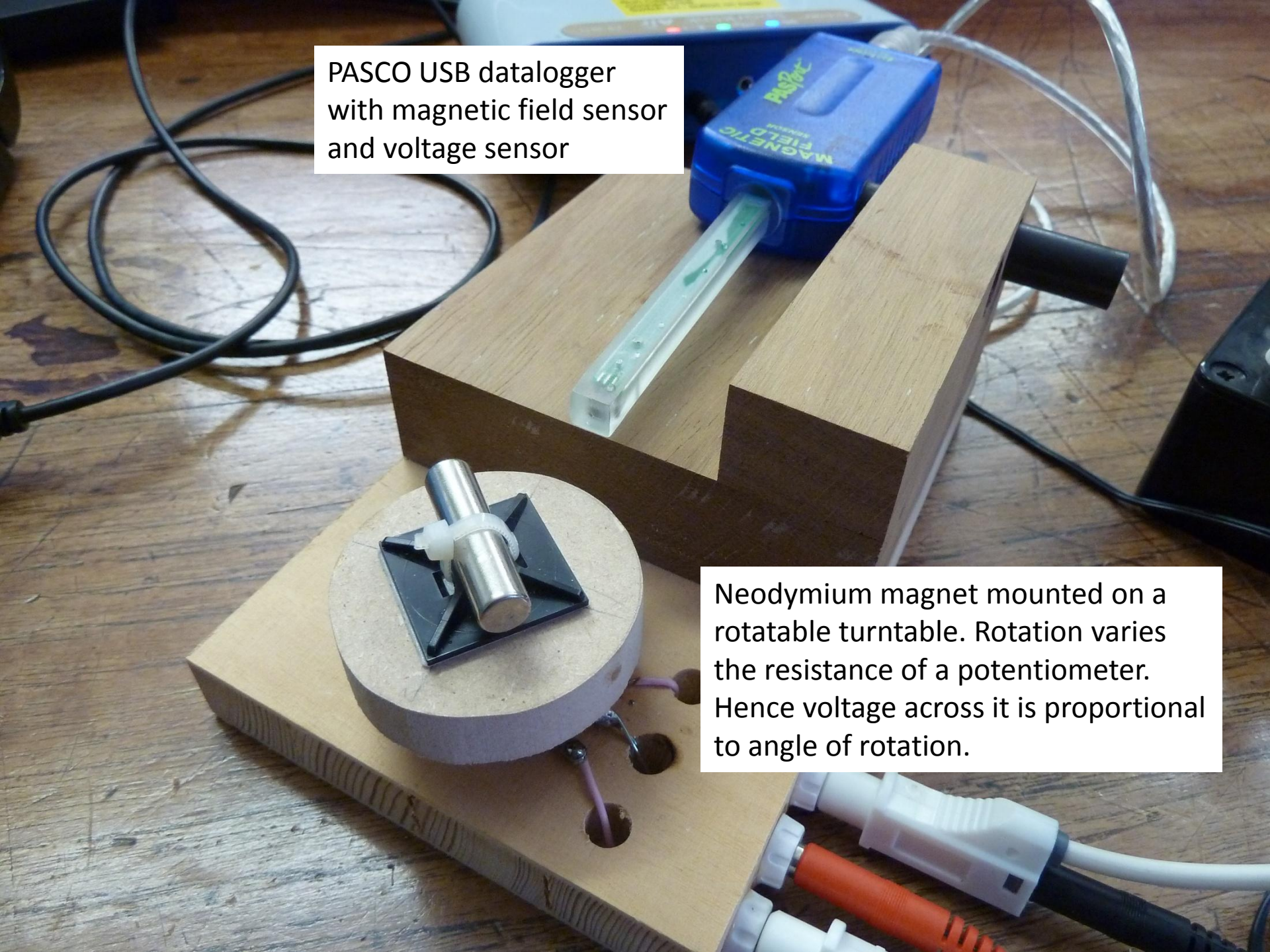
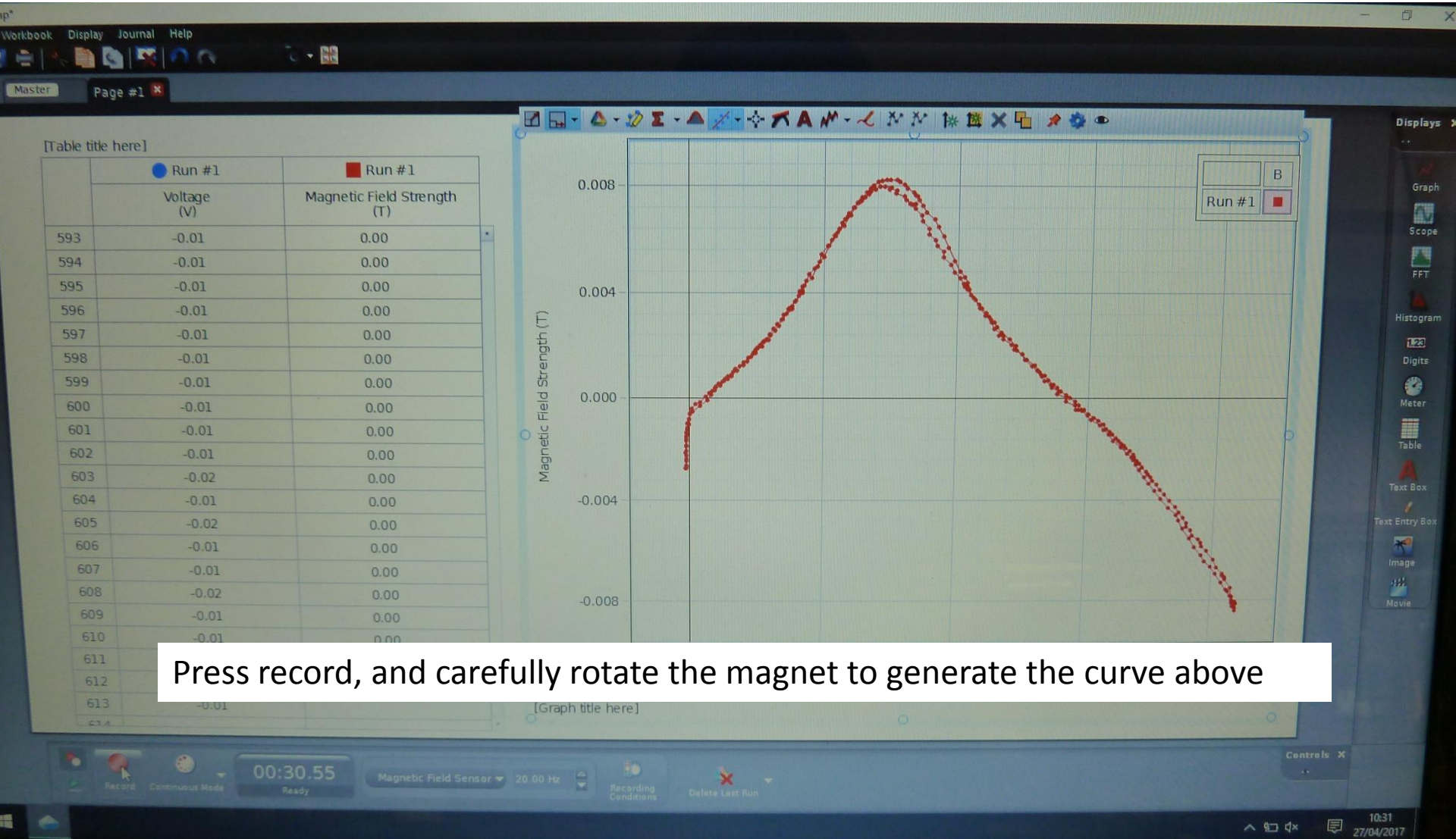
Last updated April/May 2017


Magnetic field experimental setup
Windows PC running CAPSTONE software
PASCO USB datalogger with magnetic field sensor and voltage sensor
Switch
Neodymium magnet mounted on a rotatable turntable. Rotation varies the resistance of a potentiometer. Hence voltage across it is proportional to angle of rotation.
2V DC power supply for potential divider


PASCO USB datalogger
with magnetic field sensor
and voltage sensor
Neodymium magnet mounted on a
rotatable turntable. Rotation varies
the resistance of a potentiometer.
Hence voltage across it is proportional
to angle of rotation.


PASCO USB datalogger
with magnetic field sensor
and voltage sensor
PASPort
MAGNETIC FIELD SENSOR

- Run CAPSTONE and choose the **Table and Graph** option.
- Set the graph axis and table columns to correspond to **Voltage** and **Magnetic field strength.**
- You may wish to set the units of magnetic field strength to be *milli-tesla* (mT)



Press record, and carefully rotate the magnet to generate the curve above

Export data health warning!

Simply exporting the data to a .csv file **may not work very well for this experiment.**

This is because the variations in magnetic field are quite small and the exporting option tends to round the numbers to a low precision.

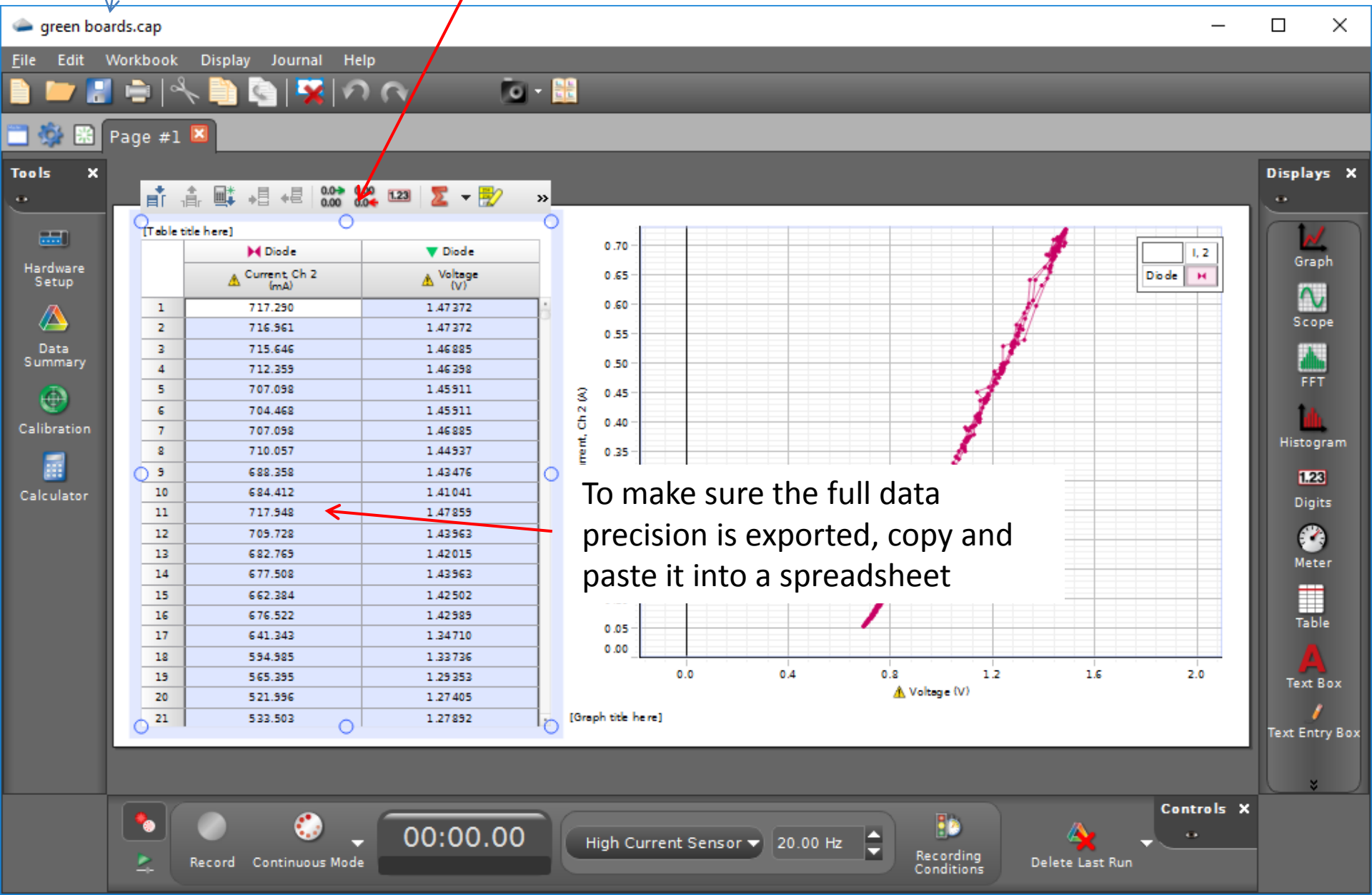
Instead, **save the Capstone data to a memory stick**, and then open the file in a PC which runs *both* Capstone and a spreadsheet (such as Excel, WPS Offfice etc).

Change the table settings **such that an appropriate number of significant figures are displayed**, **select all** the data (Ctrl+A)
and **copy** (Ctrl+C) and **paste** (Ctrl+V) into a blank spreadsheet.

Save the spreadsheet. This can then be used to generate graphs, perform further analysis etc.

.cap files are saved
Capstone files

Select a column of data and increase the data precision here

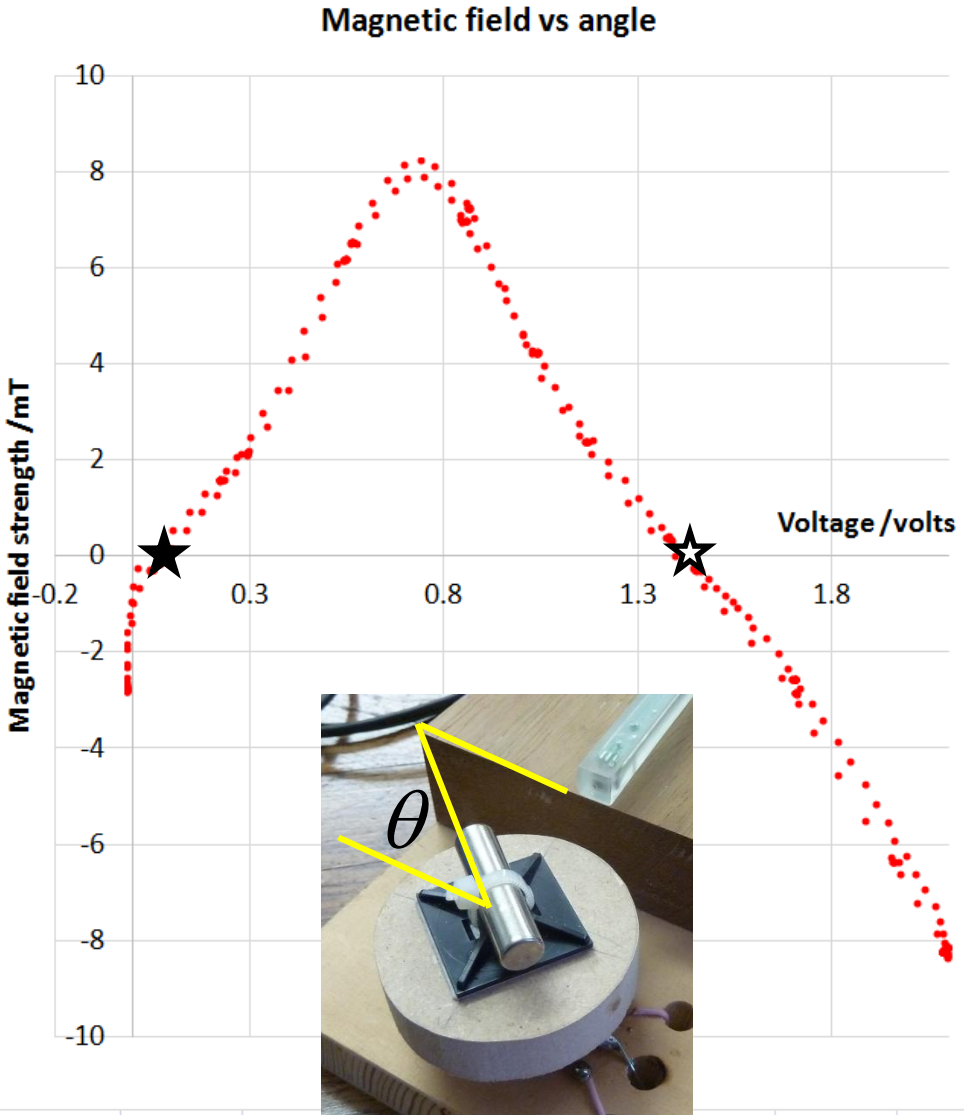


Analysis

Determine the linear relationship between voltage and rotation angle, and hence **calibrate** the voltage measurement. This is easily done by assuming the minimum *radial* magnetic field strength corresponds to the magnet in a position perpendicular to the magnetic field sensor.

$$\frac{V - V_{\min 1}}{V_{\min 2} - V_{\min 1}} = \frac{\theta}{180^{o}}$$

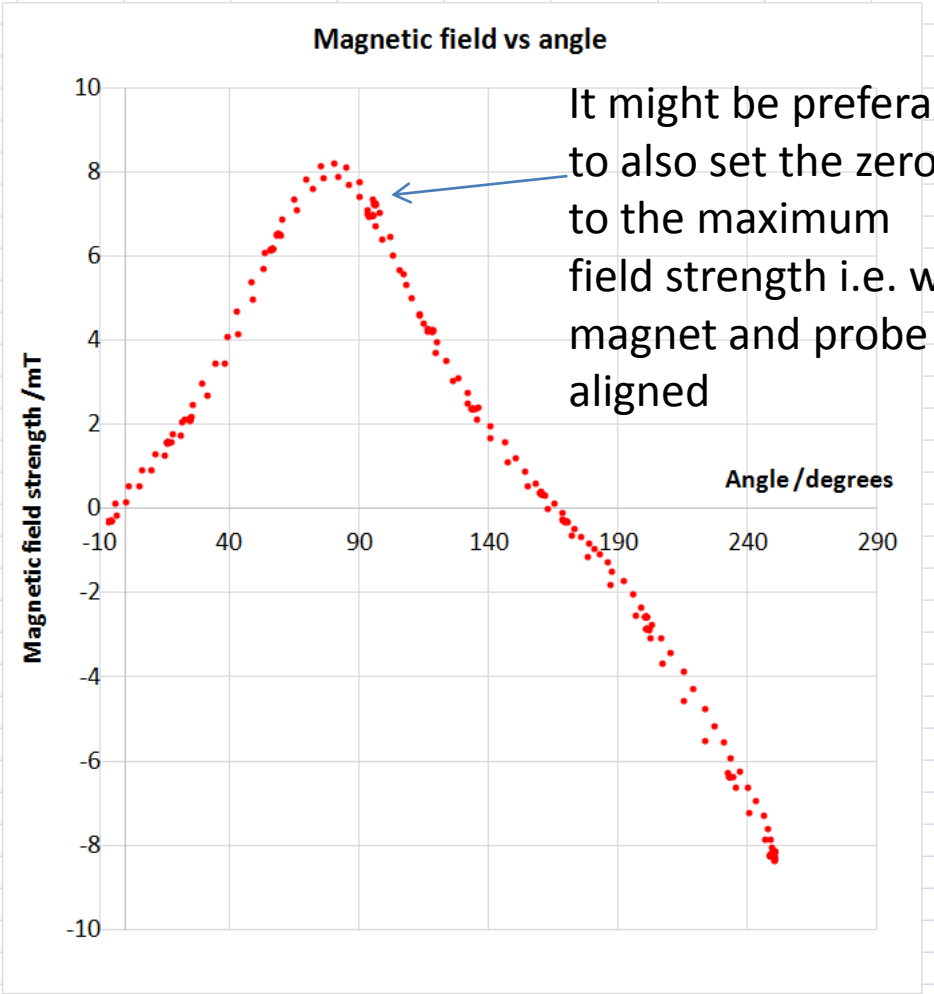
Voltage at zero degrees (perpendicular magnet position)	0.0955
Voltage at 180 degrees (perpendicular magnet position)	1.44



Datalogging Experiment 06: Magnetic (Electromagnetism)

Winchester College. April 27th 2017. A. French & A. Chesters

Magnetic Field Strength (T)	Magnetic Field Strength (mT)	Voltage (V)	Angle /deg
-0.008132426	-8.132426225	2.09708	250.1975
-0.008132773	-8.132772891	2.09708	250.1975
-0.008132773	-8.132772891	2.09708	250.1975
-0.008132773	-8.132772891	2.09708	250.1975
-0.008132426	-8.132426225	2.09708	250.1975
-0.008132773	-8.132772891	2.09708	250.1975
-0.008132773	-8.132772891	2.09708	250.1975
-0.008132773	-8.132772891	2.09708	250.1975
-0.008132426	-8.132426225	2.09708	250.1975
-0.008132426	-8.132426225	2.09708	250.1975
-0.008132773	-8.132772891	2.09708	250.1975
-0.008132773	-8.132772891	2.09708	250.1975
-0.008132773	-8.132772891	2.09708	250.1975
-0.008132773	-8.132772891	2.09708	250.1975
-0.00813312	-8.133119556	2.09708	250.1975
-0.008220826	-8.220825931	2.09708	250.1975
-0.008302292	-8.302292326	2.09708	250.1975
-0.008332452	-8.332452225	2.09708	250.1975
-0.008366079	-8.36607878	2.09708	250.1975
-0.008314079	-8.314078953	2.09708	250.1975
-0.008264852	-8.26485245	2.09708	250.1975
-0.008166399	-8.166399445	2.08734	248.98
-0.008034667	-8.034666551	2.08734	248.98
-0.007860294	-7.860293799	2.08247	248.3713
-0.007600295	-7.600294666	2.0776	247.7625
-0.007278589	-7.278589071	2.06299	245.9363
-0.006938857	-6.93885687	2.03864	242.8925
-0.006600858	-6.600857997	2.01429	239.8488
-0.006238939	-6.238939204	1.98994	236.805
-0.005899207	-5.899207003	1.96072	233.1525
-0.005516142	-5.516141613	1.94124	230.7175
-0.005138276	-5.138276206	1.91202	227.065
-0.004726784	-4.726784244	1.8828	223.4125
-0.004277506	-4.277505742	1.84384	218.5425
-0.003838627	-3.838627205	1.81462	214.89
-0.003422629	-3.422628591	1.77566	210.02
-0.00305759	-3.057589808	1.74644	206.3675
-0.002743511	-2.743510855	1.71722	202.715



It might be preferable to also set the zero angle to the maximum field strength i.e. when magnet and probe are aligned