Water tanks, magnetic coils and other wired/weird things - Geophysics at Bradford

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MAKING KNOWLEDGE WORK

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Inspired by Arnold Aspinall

- Tanks
  - resistivity anomalies and arrays
- Coils
  - magnetic anomalies and magnetic data
- Wires
  - electromagnetism
- Weird
  - spin-torsion fields

BRADFORD INSTITUTE OF TECHNOLOGY

DEPARTMENT OF PHYSICS

REACTOR TECHNOLOGY LABORATORY

Determination of a short radioactive half-life

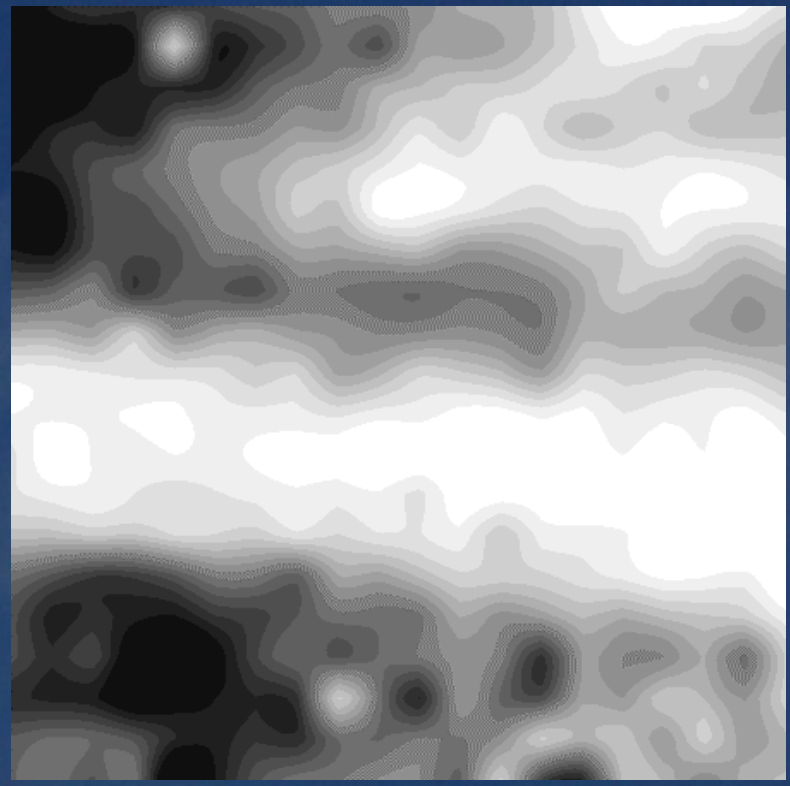
If the number of atoms in a radioactive sample is N_0 at zero time, and N_t at time t, then

$$N_t = N_0 e^{-\lambda t} \qquad (1)$$

Tanks

Resistivity Contrast

- Major ditch at Caistor St. Edmunds Roman Fort (Peter Cott)

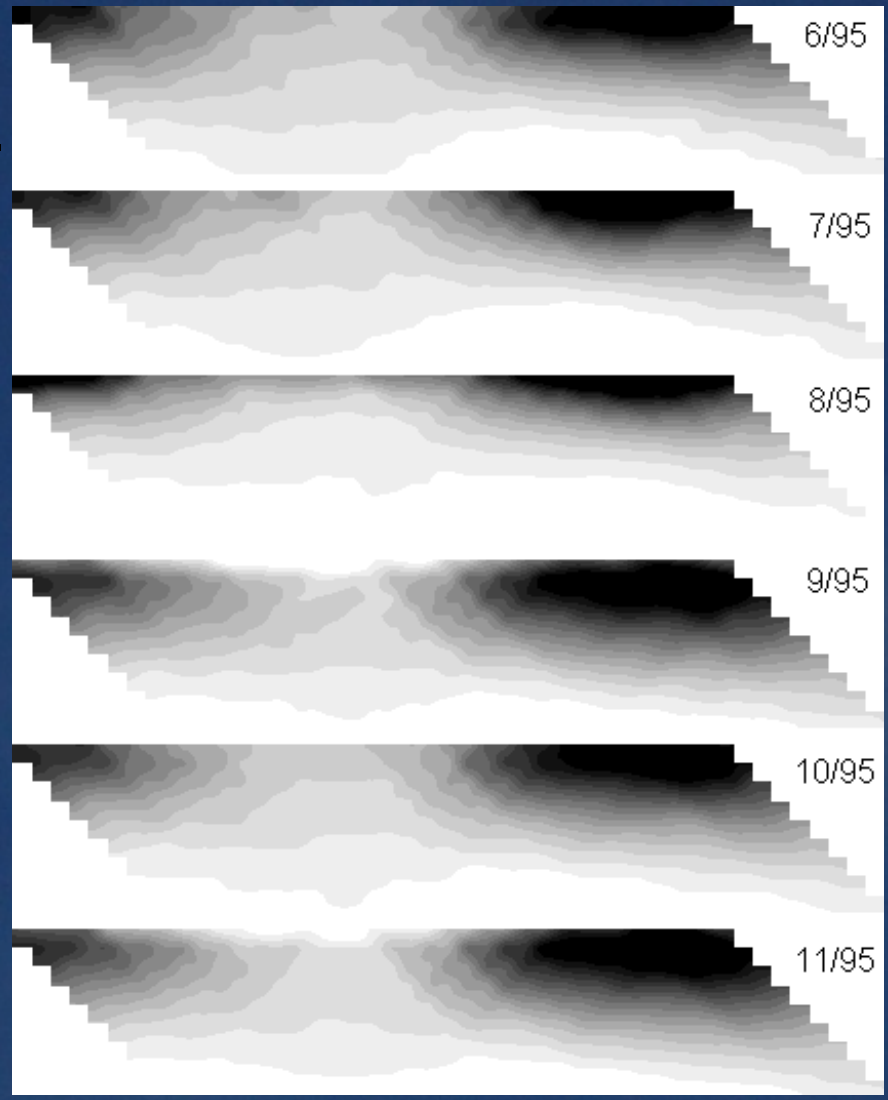


160 … 240 Ohms (white to black) 0 10m

Area survey 1m × 1m

Resistivity Contrast

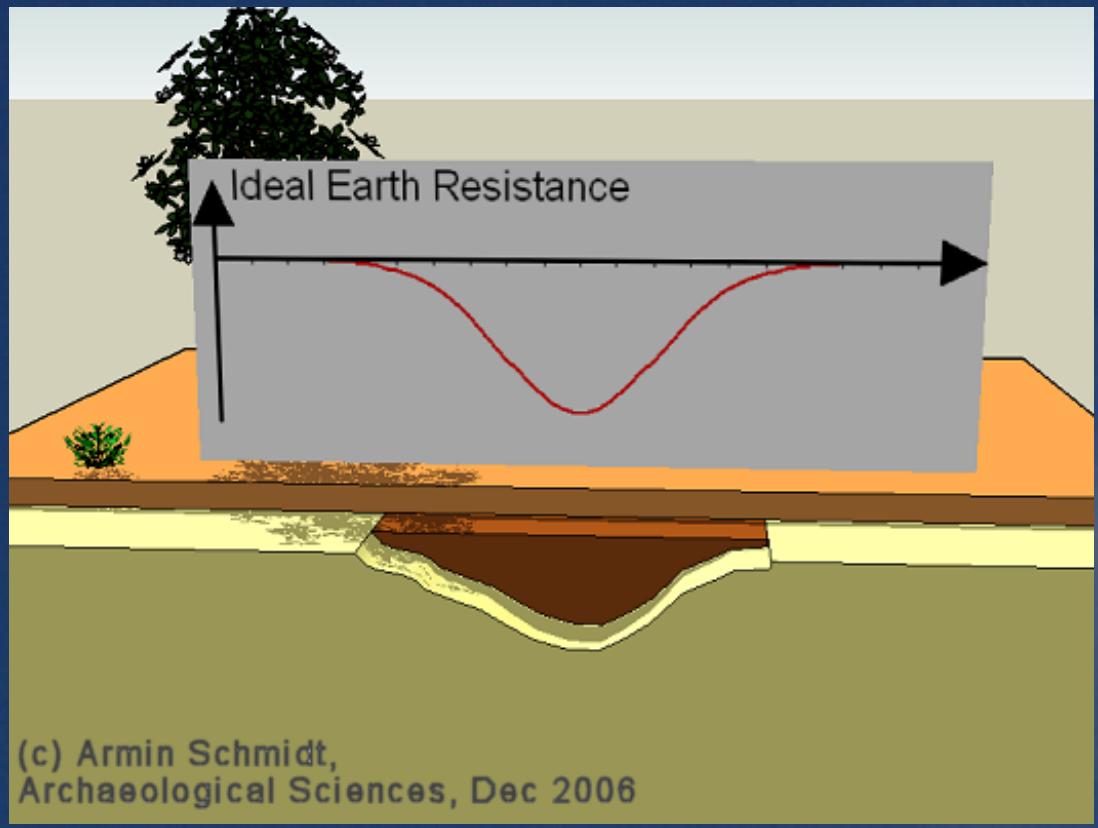
- Major ditch at Caistor St. Edmunds Roman Fort (Peter Cott)



Twin Pseudosections
1m increments, black is high

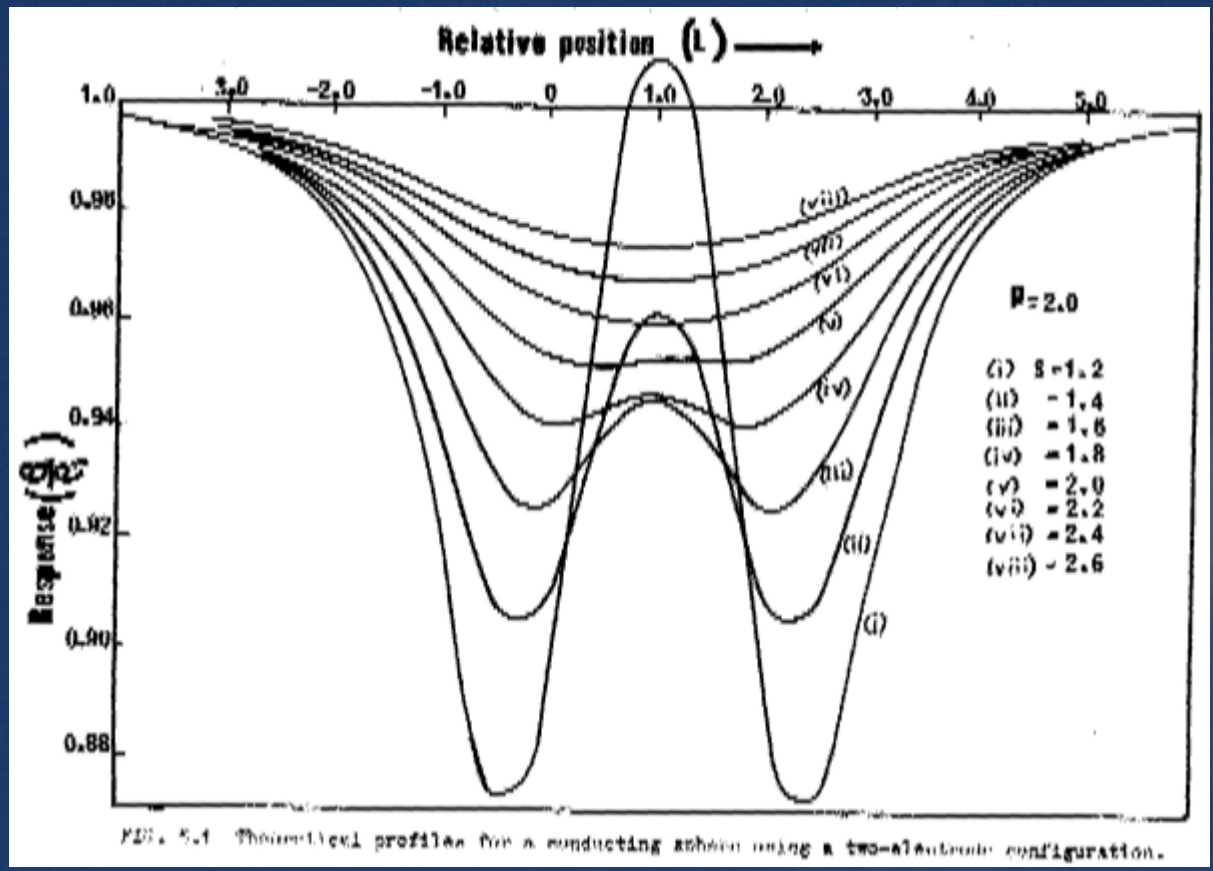
Resistivity Anomalies

- We want it simple …



Resistivity Anomalies

- … but it isn't!



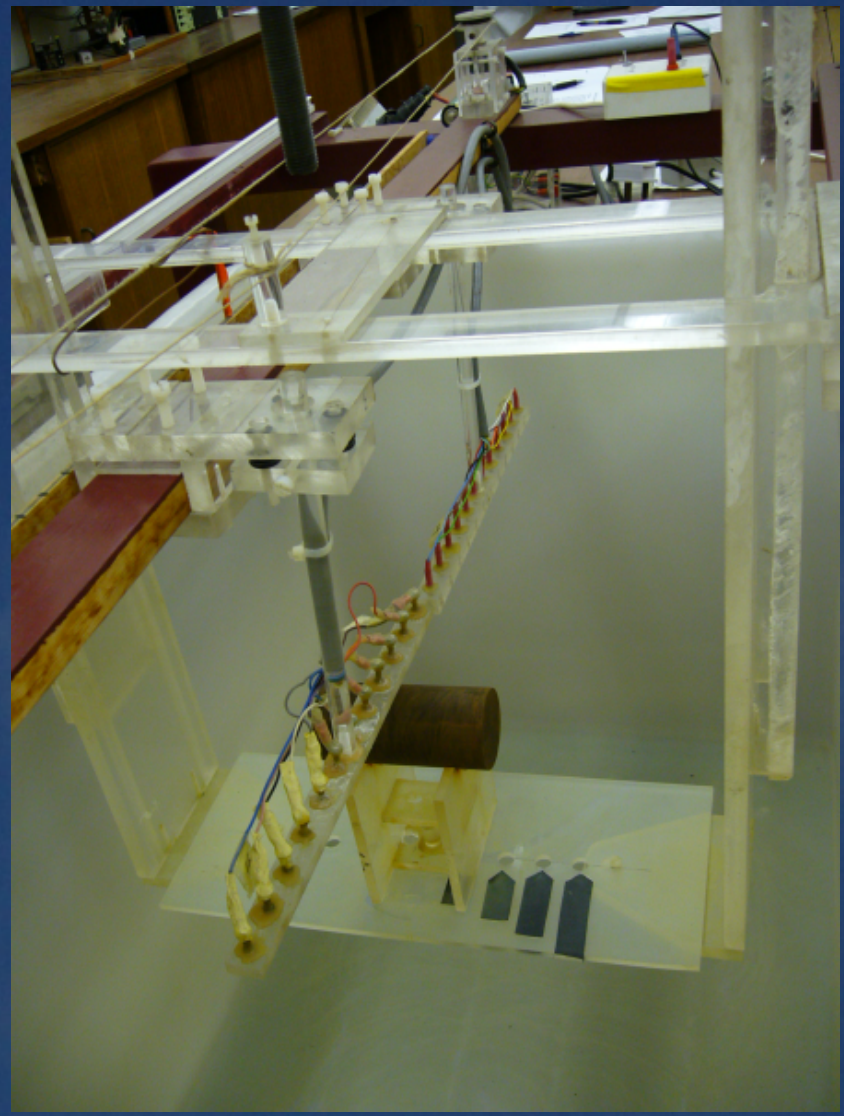
John Lynam 1970, response of twin-probe array; A=2

Resistivity Anomalies

- But who believes this?

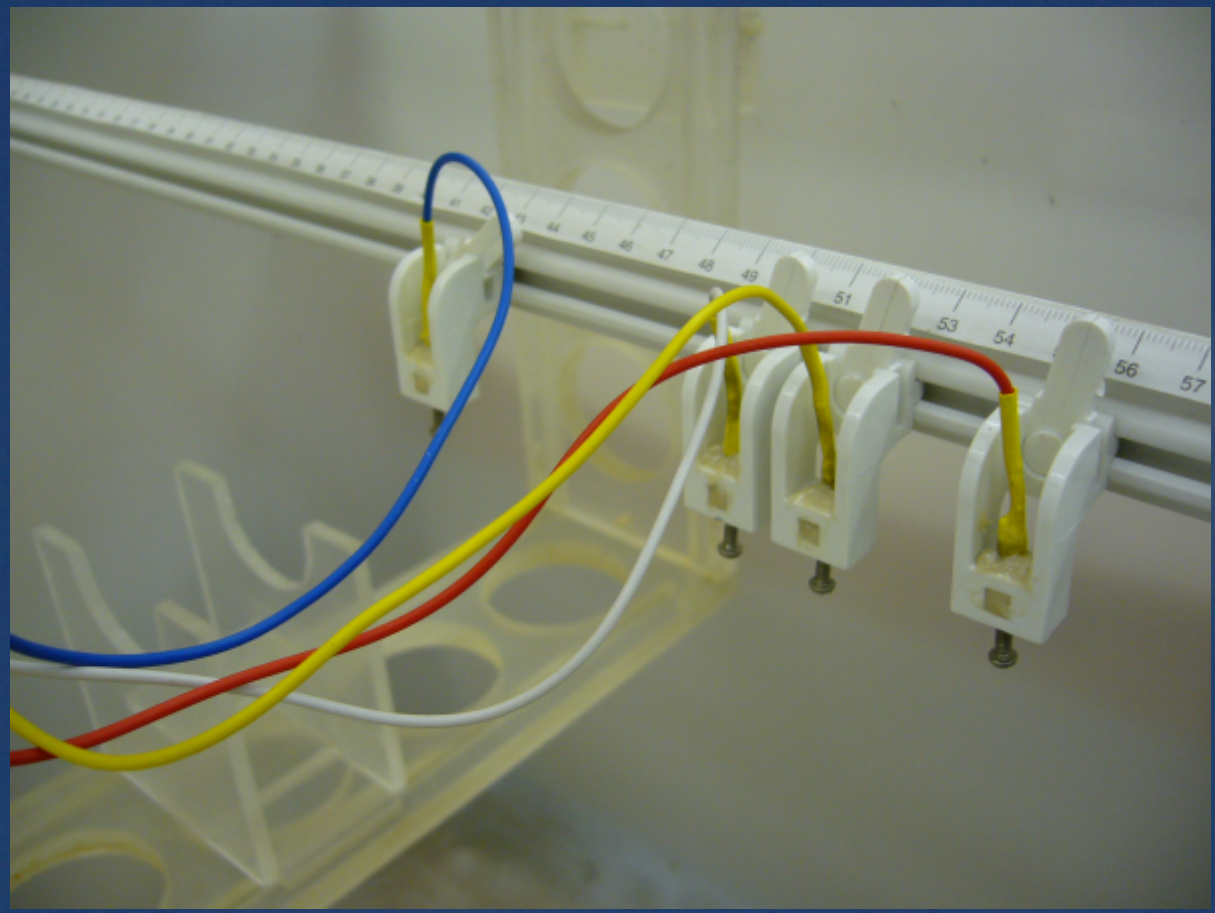
Resistivity Anomalies

- Tank experiments to demonstrate these anomalies



Anomalies in the Tank …

- Test any new array in the tank first



… and in the Field

- Then test it with students

Square array pseudosection

… and in the Field

- Then test it with students

Square array area survey

Production

- Commercialisation

Collaboration with Geoscan Research

Field Survey

- Slack Roman Fort


13
48 Ohms
0 10 20 40 60 80
Metres
N


13
48 Ohms
0 10 20 40 60 80
Metres
N

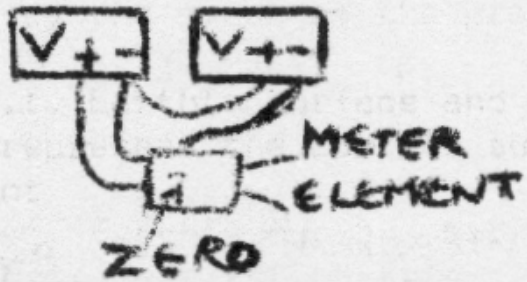

13
48 Ohms
0 10 20 40 60
Metres
N

UNDERGRADUATE SCHOOL OF ARCHAEOLOGICAL SCIENCES

VERTICAL FIELD MAGNETOMETER

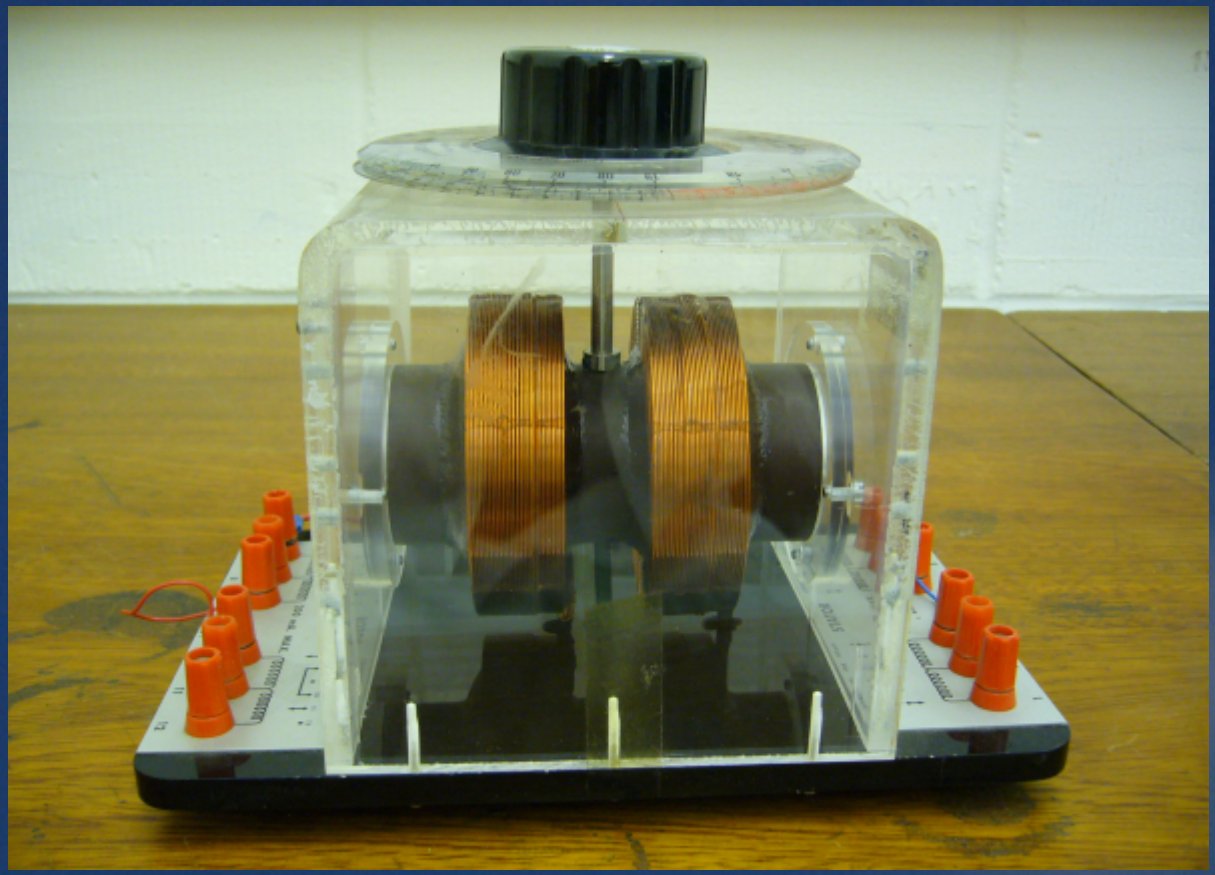
Apparatus:-

2 Kingshill Power Supplies
Advance DVM
Control Box
Fluxgate element
1 Magnet Protractor
1m 0.5m rulers



This instrument gives an output voltage V proportional to the magnetic field parallel to the axis of the fluxgate element. Small magnetic objects are modelled by a small permanent magnet. Firstly find the maximum and minimum voltages that can be obtained using the magnet close to the element. Note these and zero the voltmeter with no magnetic objects within 1m of the element using the zero adjust.

Coils



Magnetic Anomalies

- The shape of magnetic anomalies

Magnetic Anomalies

- Laboratory experiments

Magnetic Anomalies

- Laboratory experiments

Magnetic Anomalies

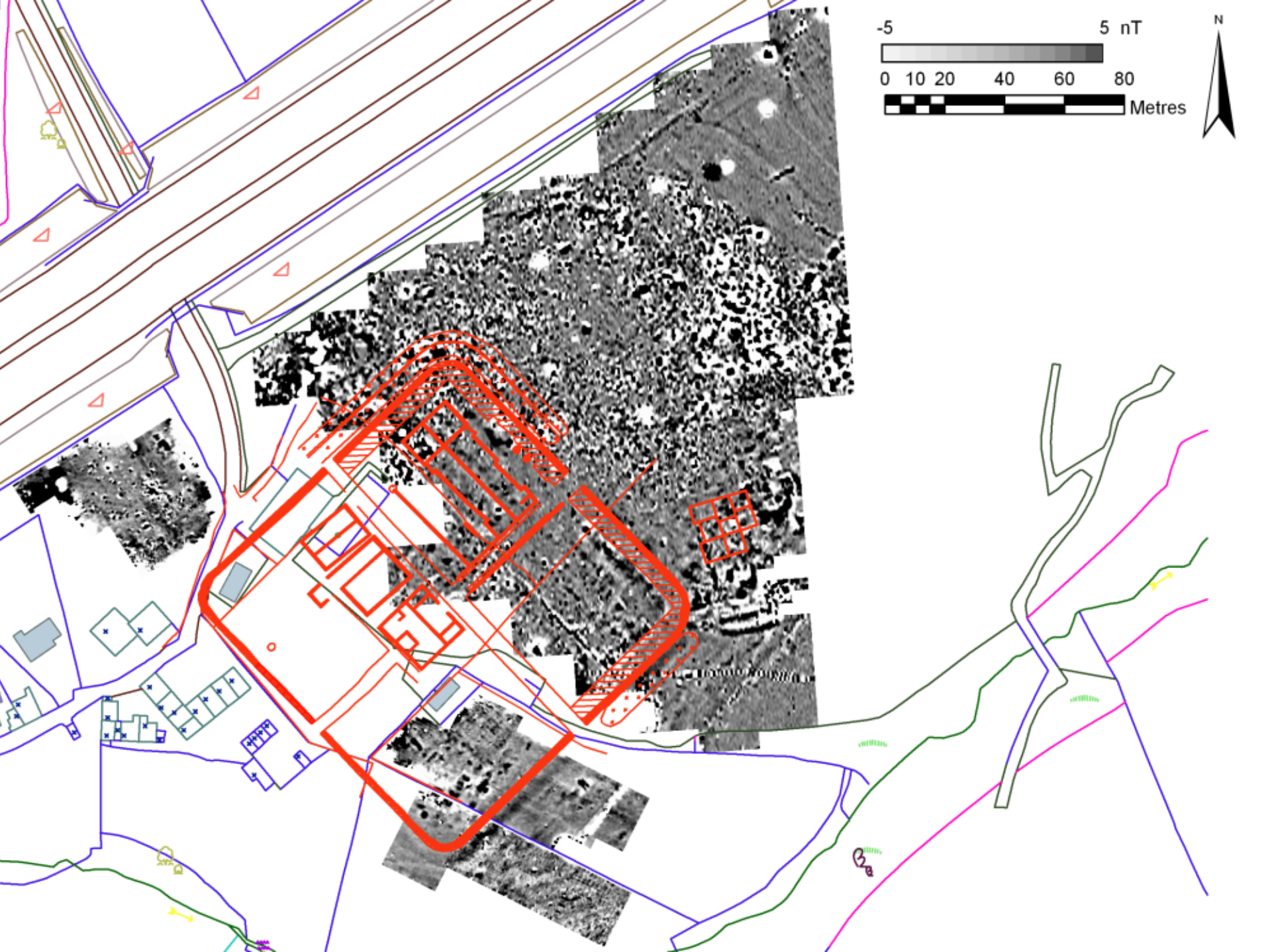
- Laboratory experiments

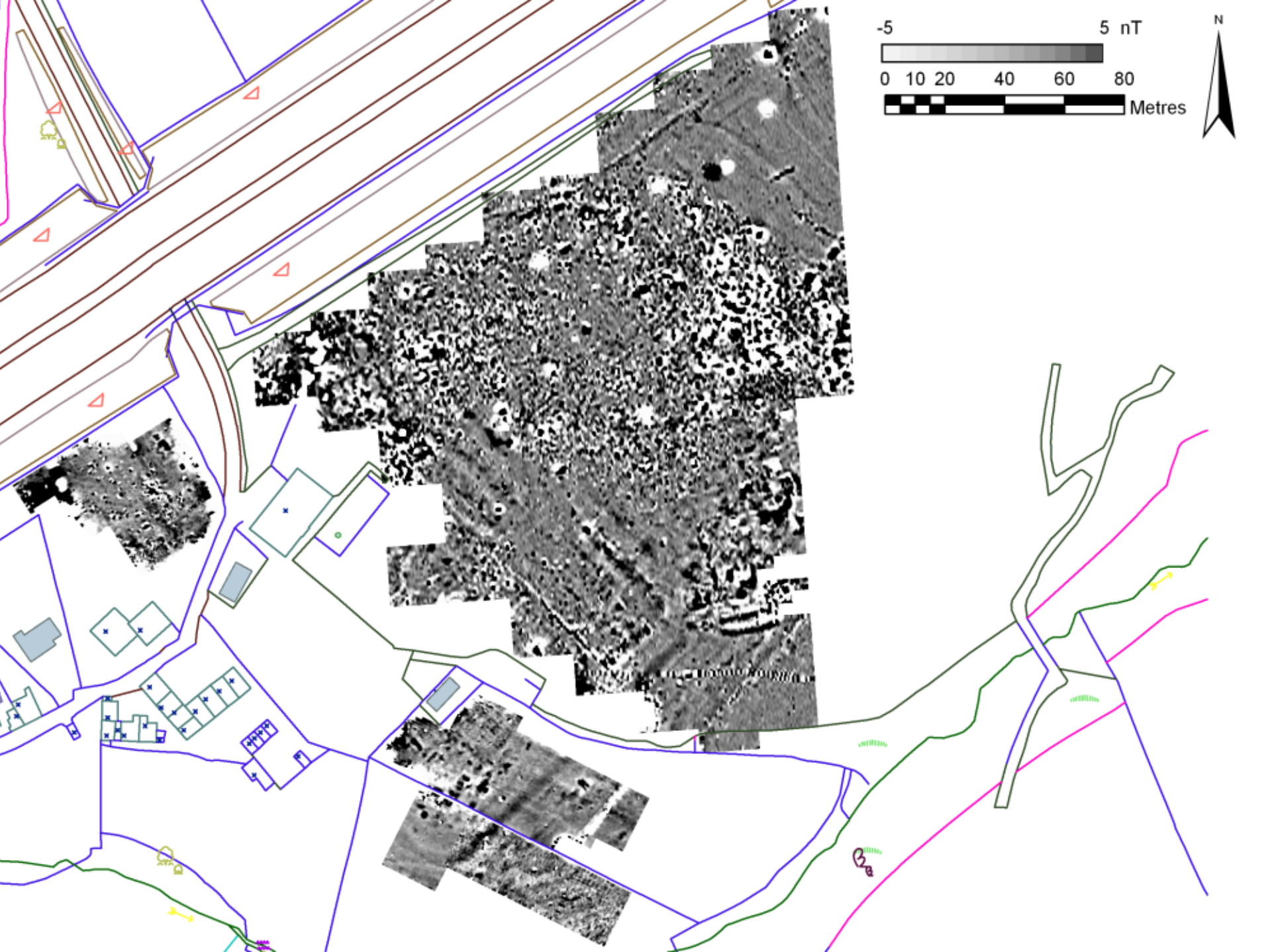
Magnetic Anomalies

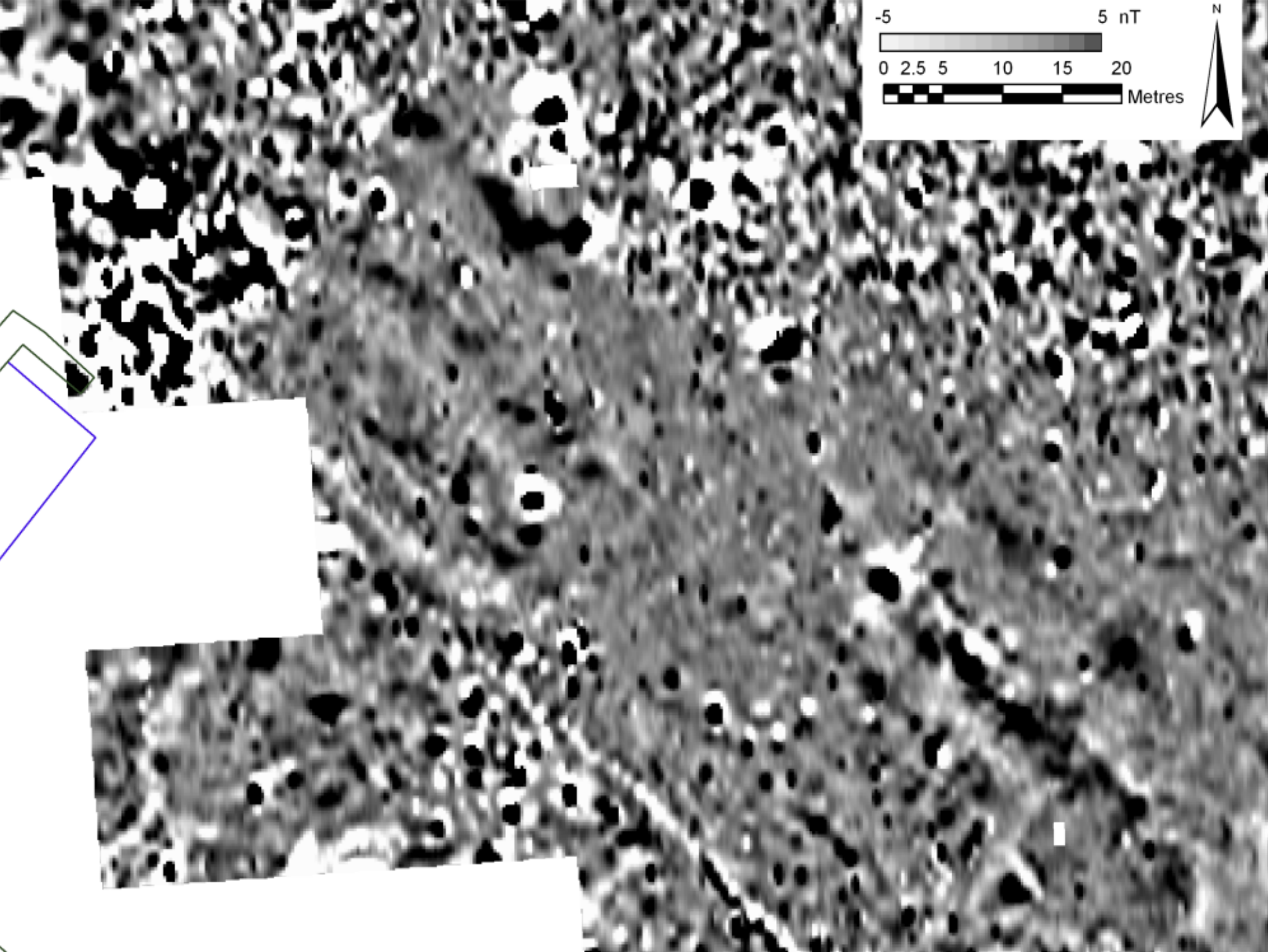
- Laboratory experiments

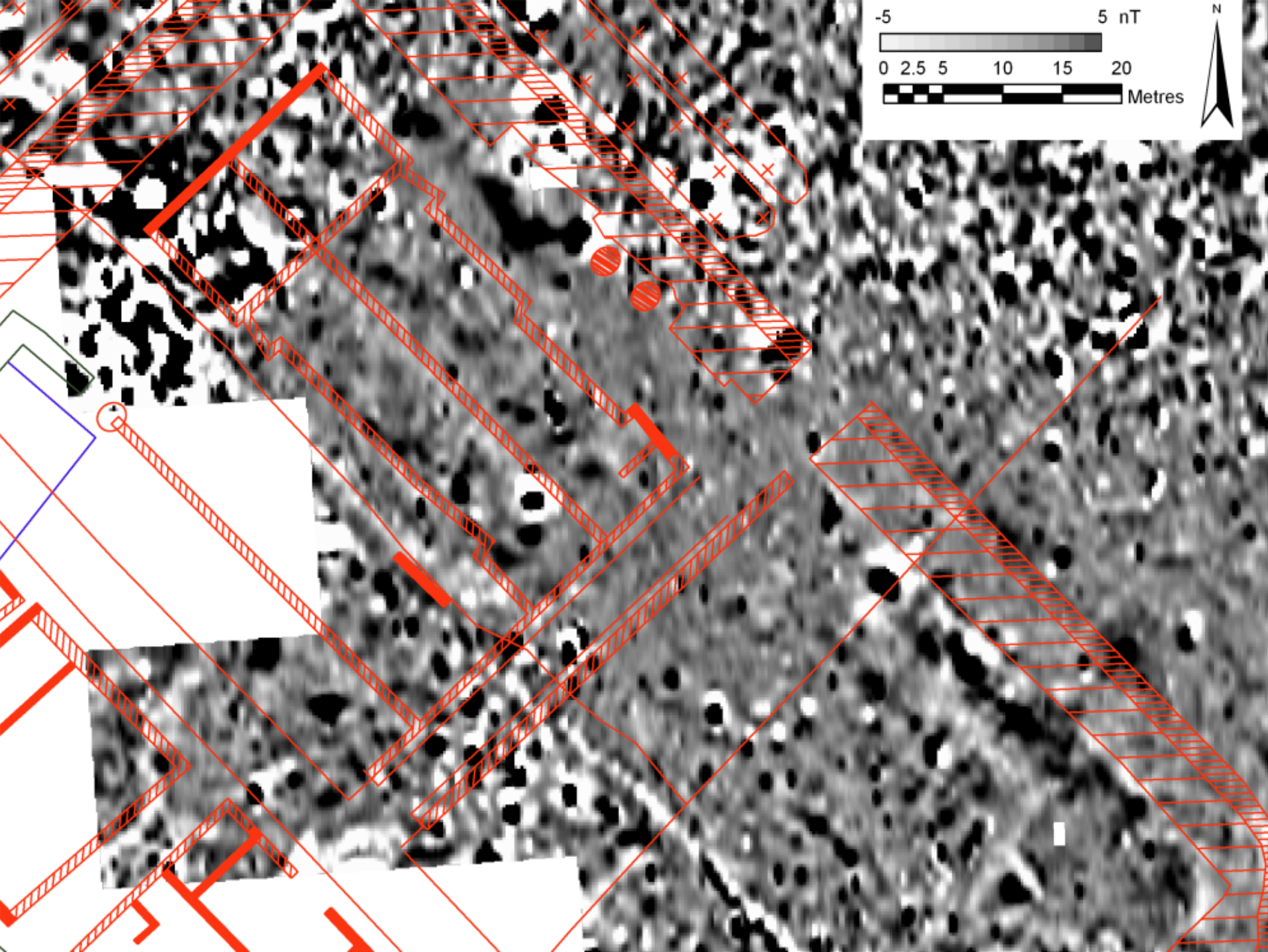
Field Survey

- Slack Roman Fort

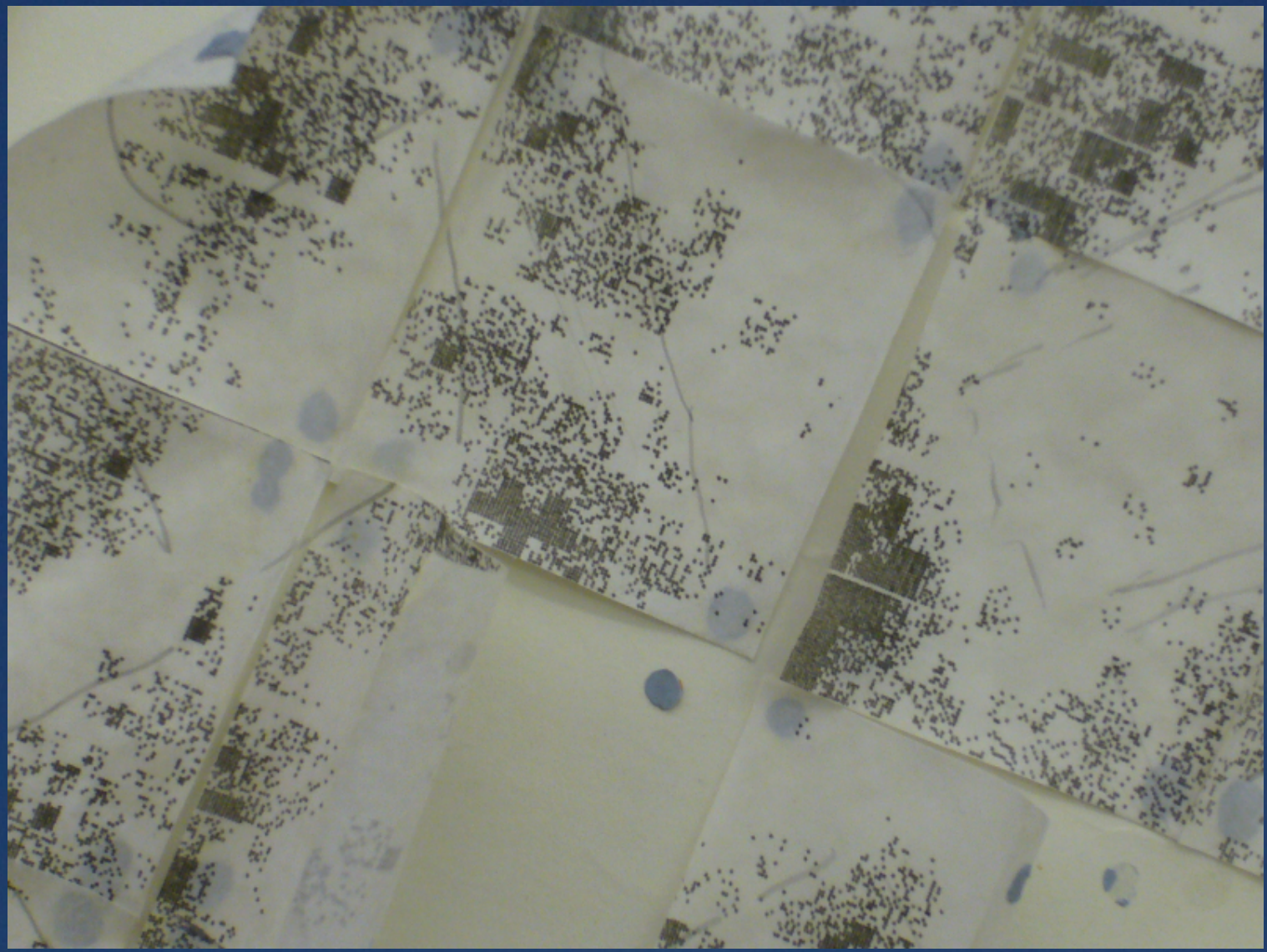

-5
5 nT
0 10 20 40 60 80
Metres
N


-5
5 nT
0 10 20 40 60 80
Metres
N

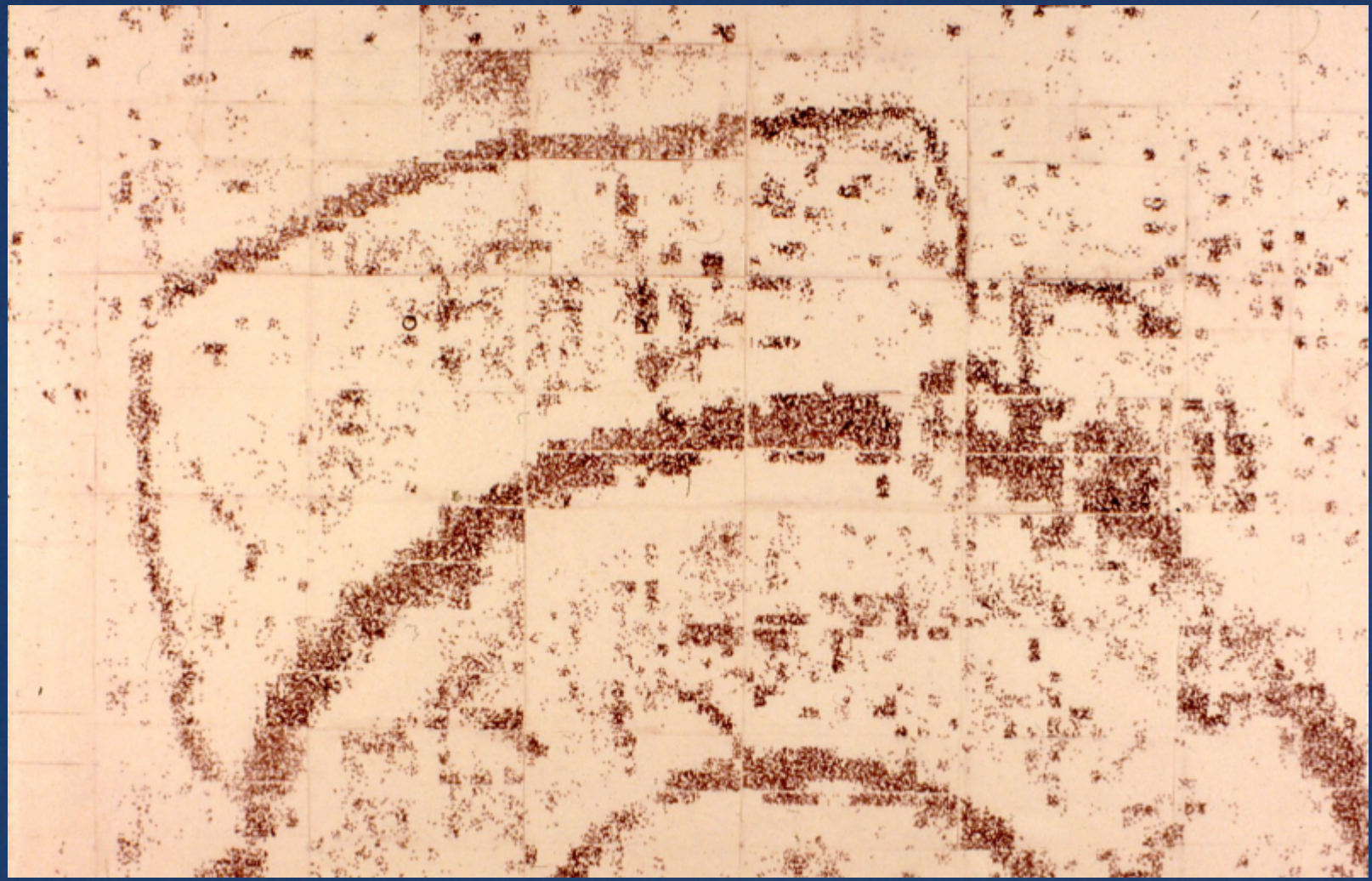

-5
5 nT
0 2.5 5 10 15 20
Metres
N


-5
5 nT
0 2.5 5 10 15 20
Metres
N

Data Presentation



Thwing Hillfort (Y. Wolds)



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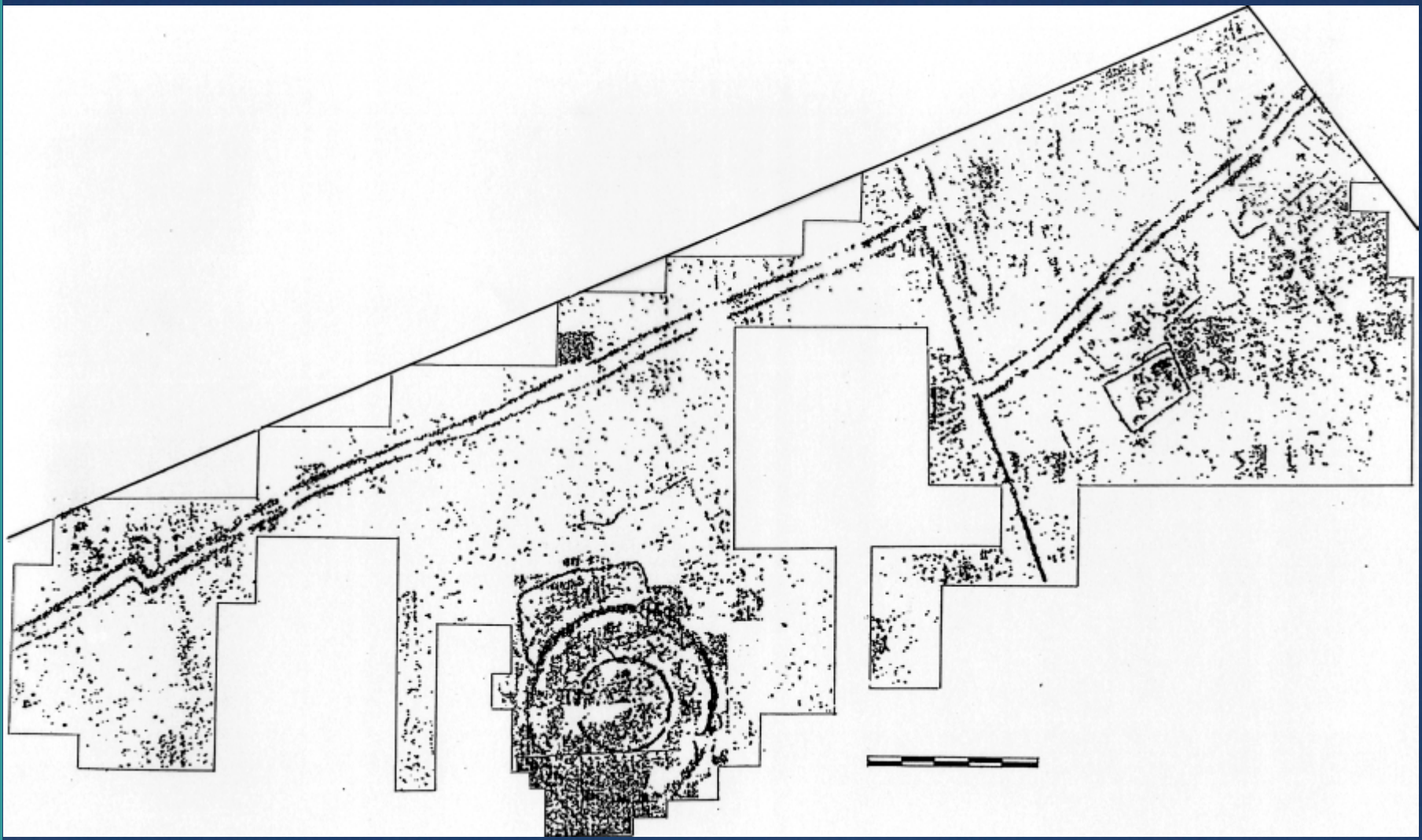

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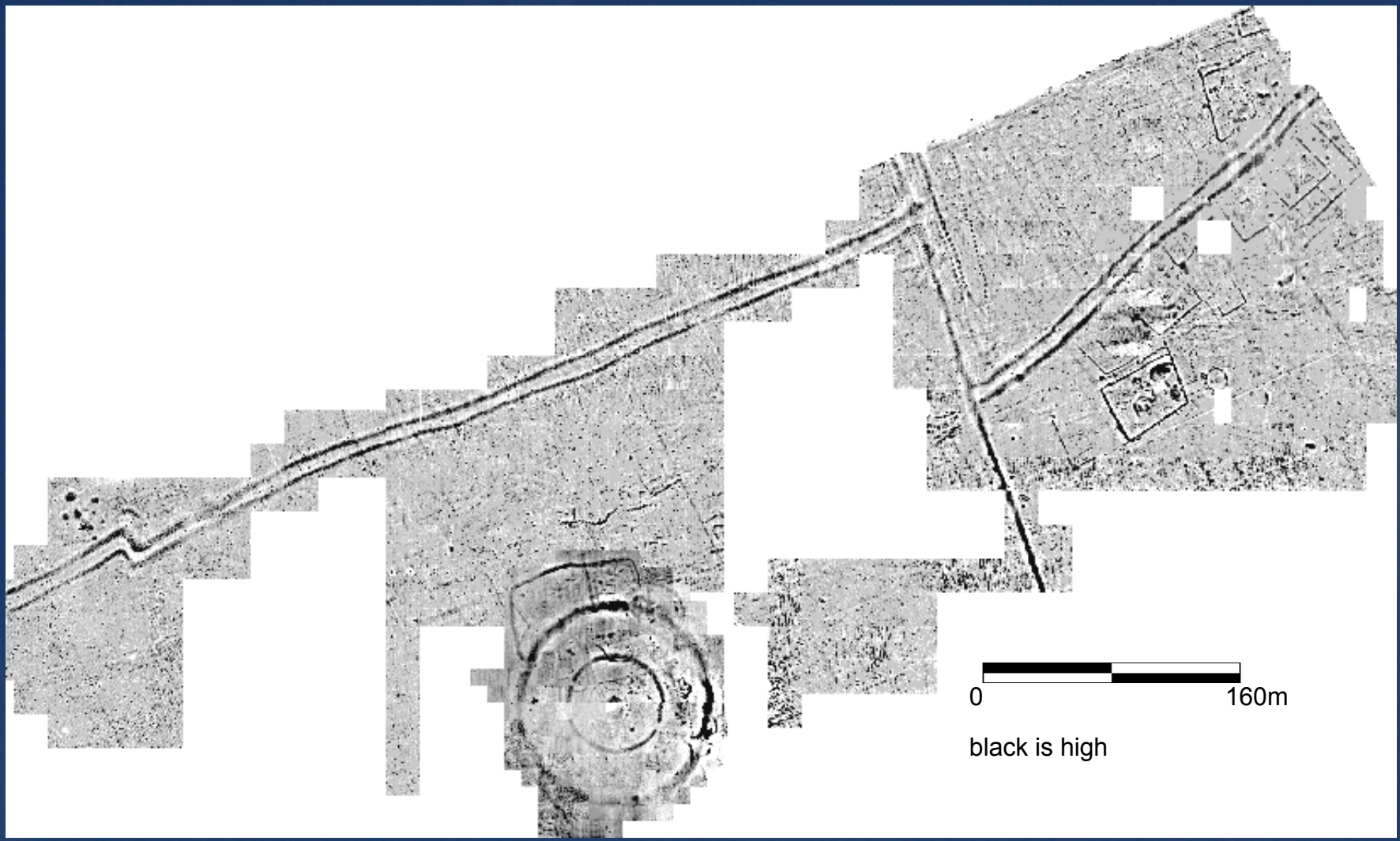


UNIVERSITY OF BRADFORD

Undergraduate School of Studies in Applied Physics

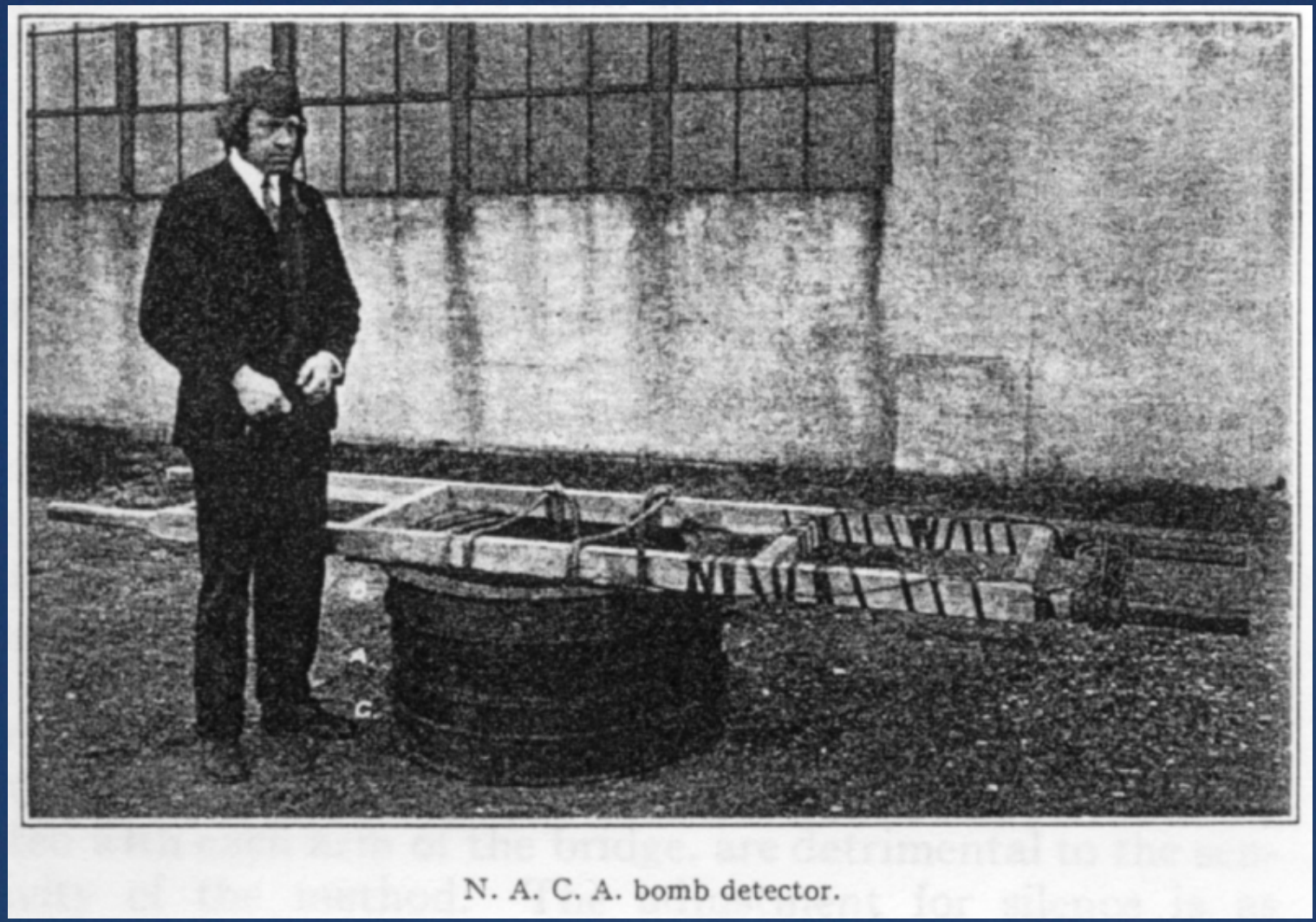
Half-Life of a Radioactive Nuclide

Experiment 1

The artificial nuclide indium 116 ($^{116}_{49}In$) is a radioactive isotope of indium and undergoes β-decay to the nuclide $^{116}_{50}Sn$ which is a stable, naturally occurring isotope of tin. The objects of the experiment are to measure the disintegration constant and hence the mean-life and half-life of indium 116.

Wires

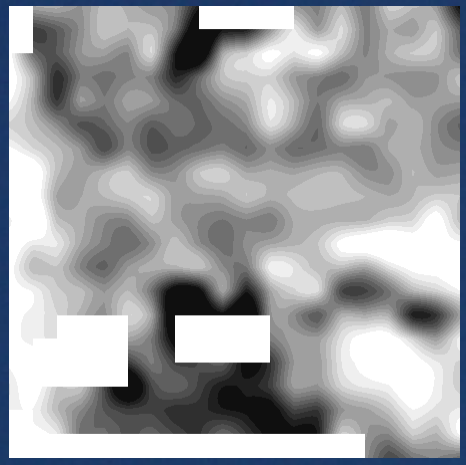
Electromagnetism



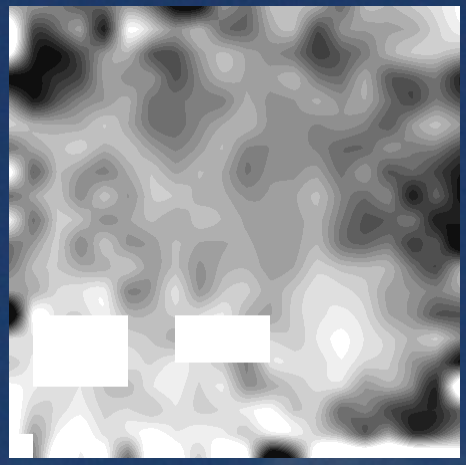
N. A. C. A. bomb detector.

Electromagnetism

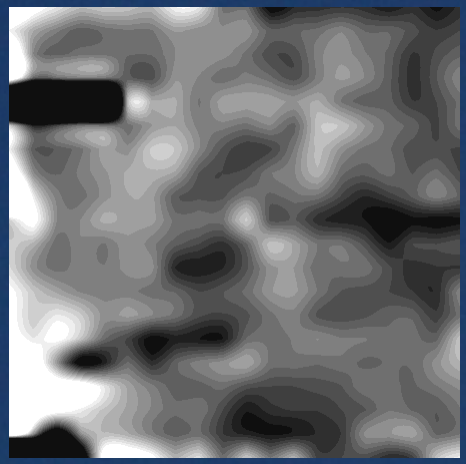
- Halifax Parish Church



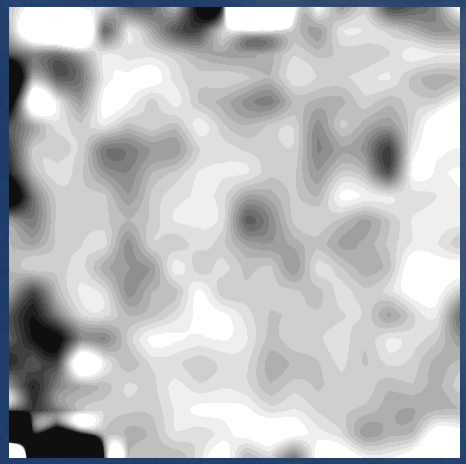
Res



MS



Cave



Metal

20m × 20m, black is high

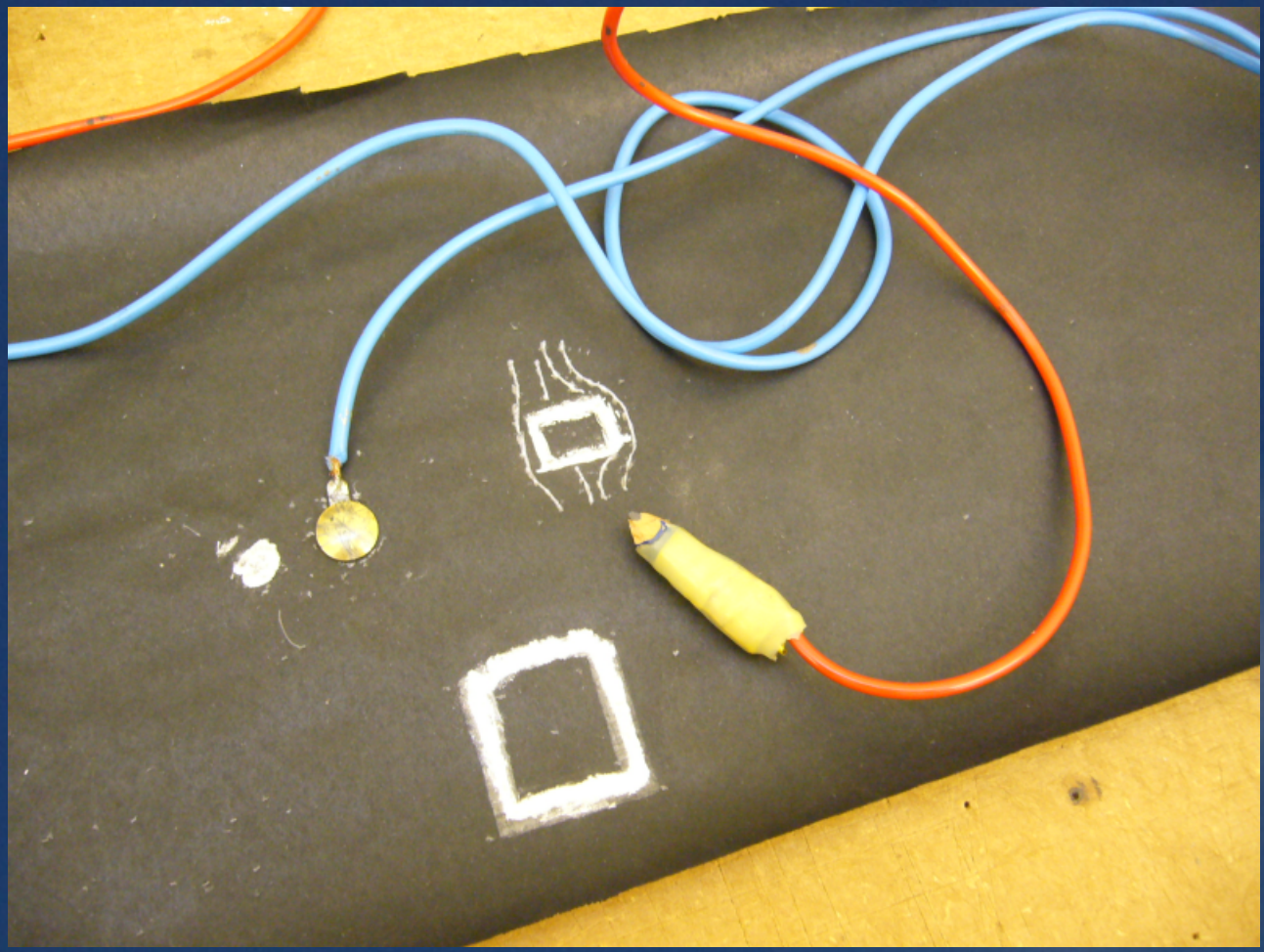
UNIVERSITY OF BRADFORD

Schools of Physics and Physical Electronics
First Year

Schuster's Method for Spectrometer Adjustment

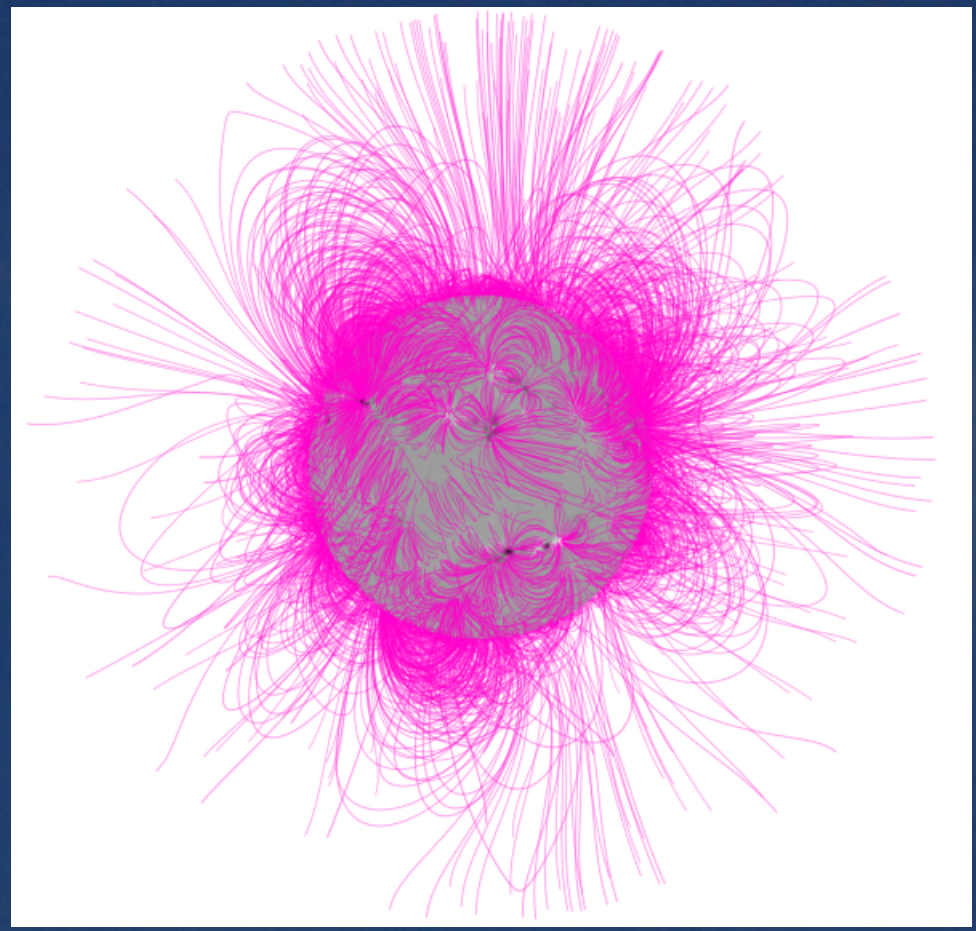
It is often impossible (such as when working at night or in a darkened laboratory) to focus a telescope on a distant object. The following method is strongly recommended for spectrometer adjustment. MONOCHROMATIC LIGHT MUST BE USED.

Weird



Spin Torsion Fields

- Rotating masses create long range fields
- Einstein Cartan Theory



Spin Torsion Fields

- Spin-Torsion detector is usually referred to as ‘dowsing rods’

Spin Torsion Fields

- Detectable with interferometric methods

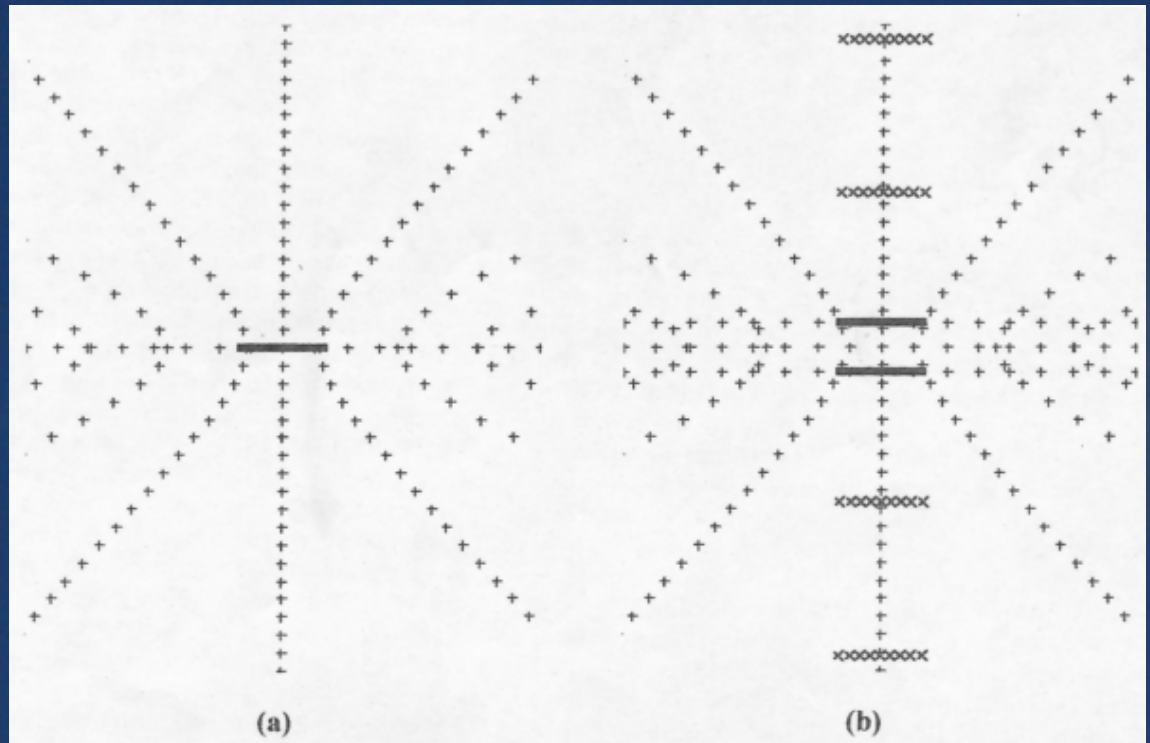


Figure 1 Representational plan view showing the loci of the fringes from (a) a single tube and (b) a pair of parallel tubes (shown as solid lines) laid on the ground; the parallel fringes discussed in this paper are shown by crosses; the scale of the figure applies to the period November to April for tubes 1 m in length at Edinburgh.

Patterns created by tubes laid on the ground
Dodd *et al.* 2002

Spin Torsion Fields

- Spatial and temporal variation

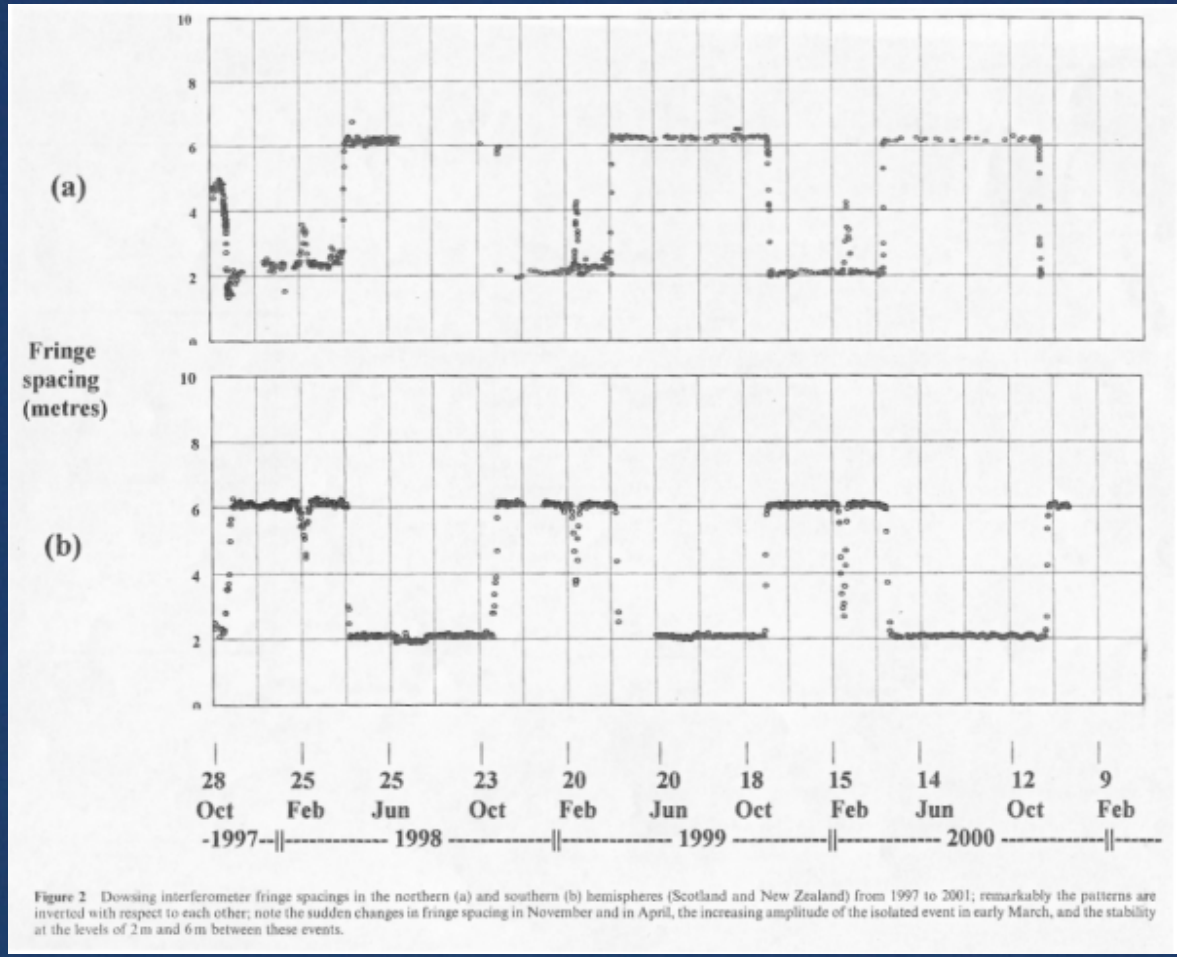


Figure 2 Dowsing interferometer fringe spacings in the northern (a) and southern (b) hemispheres (Scotland and New Zealand) from 1997 to 2001; remarkably the patterns are inverted with respect to each other; note the sudden changes in fringe spacing in November and in April, the increasing amplitude of the isolated event in early March, and the stability at the levels of 2 m and 6 m between these events.

Variation of wavelengths in the northern and southern hemisphere
Dodd *et al.* 2002

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DISCHARGE TUBE WAVELENGTHS

These are expressed in nano metres (1 nano-metre = 10^{-9} m) Underlined wavelengths can usually be identified by their brightness in comparison with neighbouring lines, but this may depend on the design of the discharge tube. Colours are indicated by the initials; r, o, y, g, b, v.

Conclusion

- We haven't left the path of proper science …
- … instead, by stressing its applications in archaeology it is brought to new generations of students