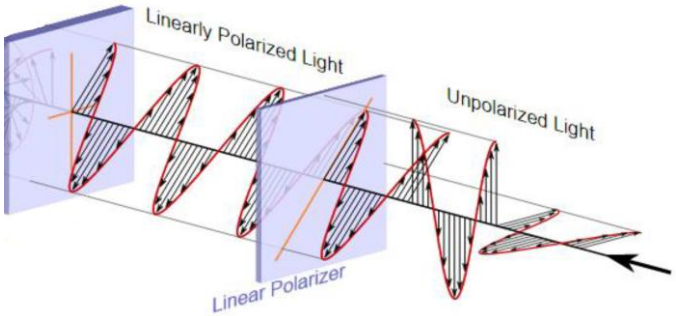
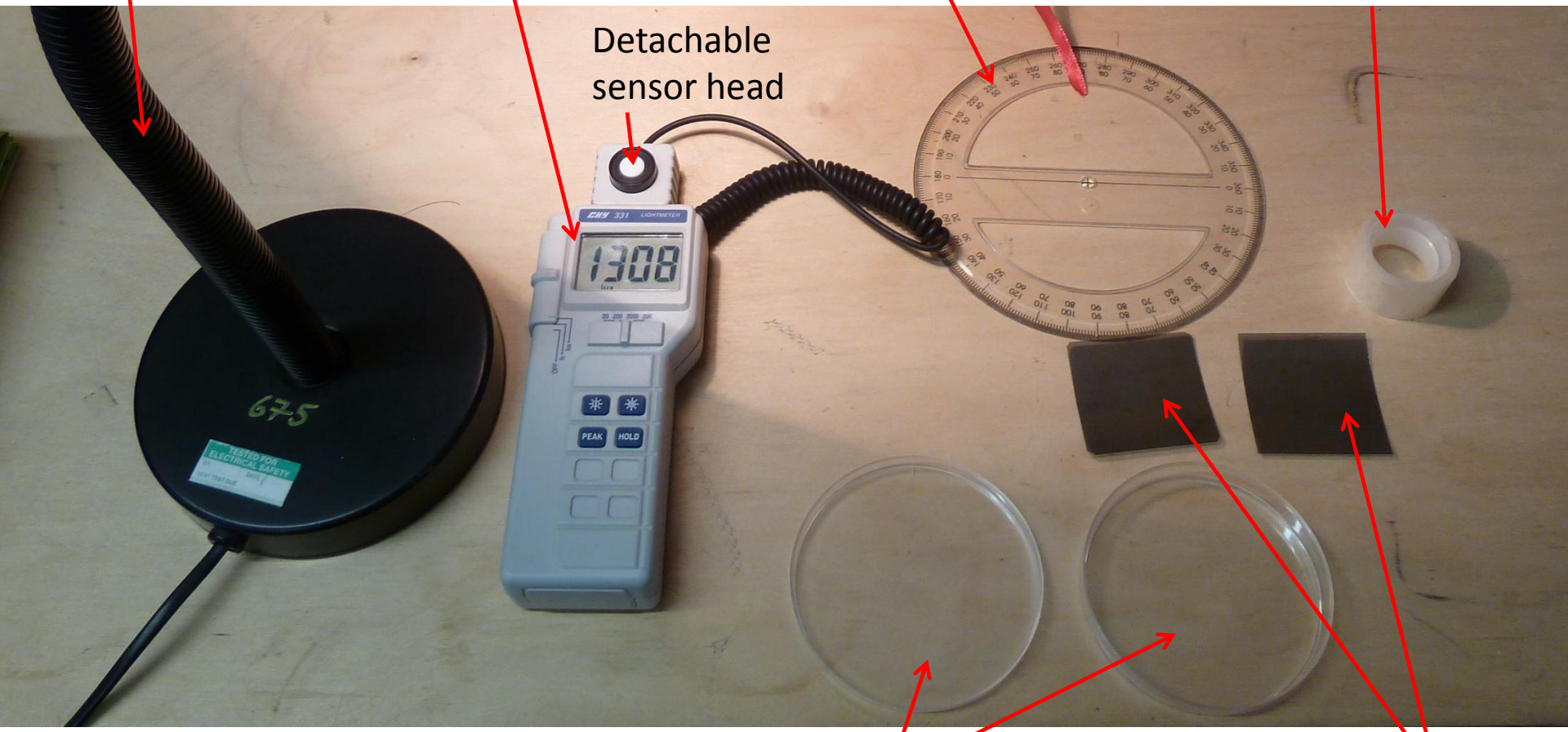
AF Jan 2021

MALUS' LAW OF POLARIZATION

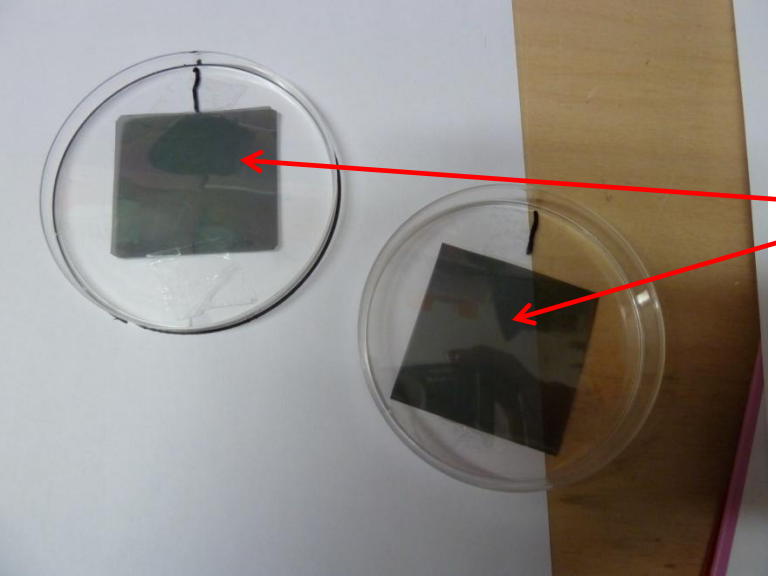


$$\frac{I - I_{\min}}{I_{\max} - I_{\min}} = \cos^2\theta$$

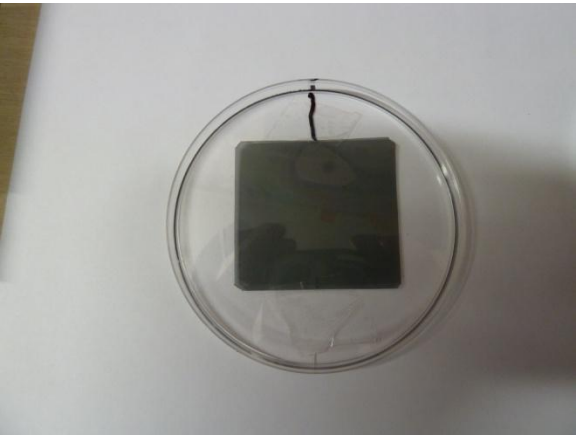
EQUIPMENT


Lamp
Lux meter
Protractor
Sticky tape
Detachable sensor head
1308
PEAK
HOLD
Petri dishes
Polaroids

Assemble rotating crossed-polaroid

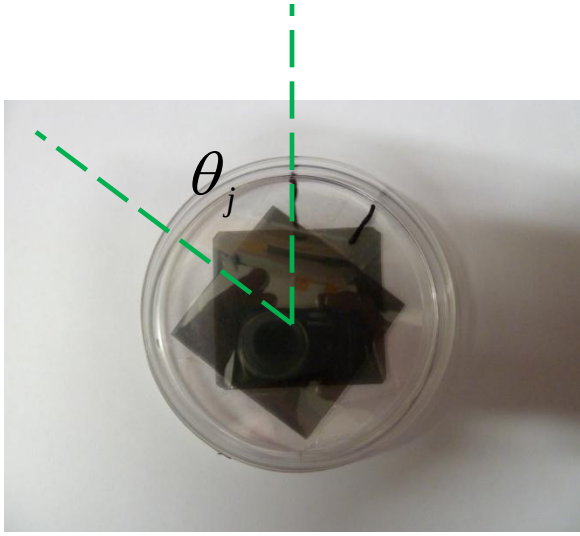


Pair of linear polarisers stuck to plastic transparent petri dishes



$\theta = 0^{o}$

i.e. polarisers aligned



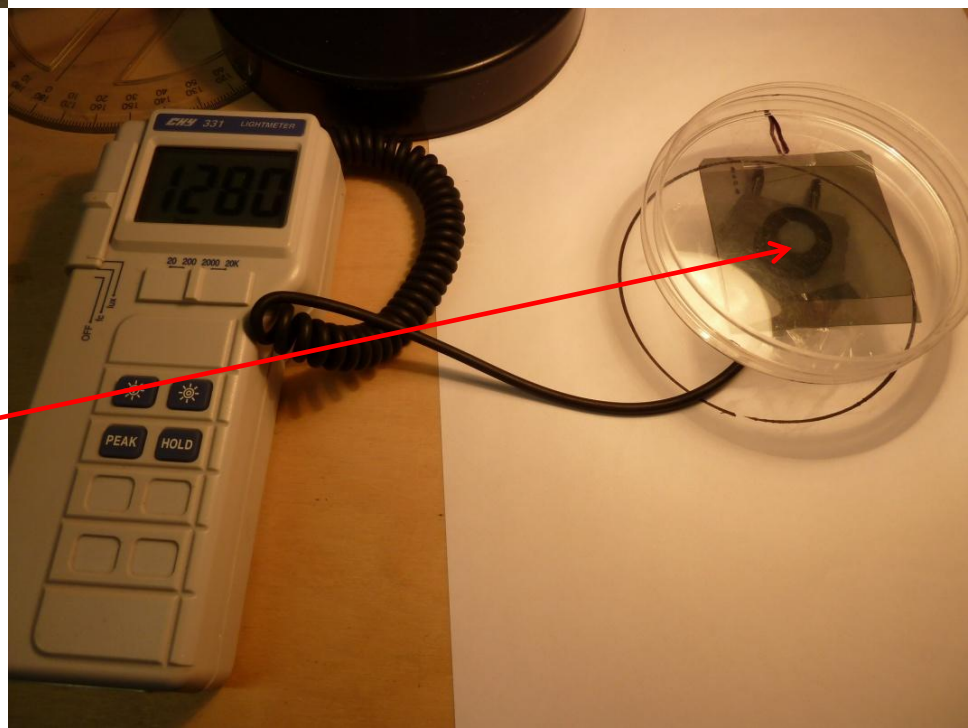
Rotate angle between polarisers.
Measure this angle using the protractor.

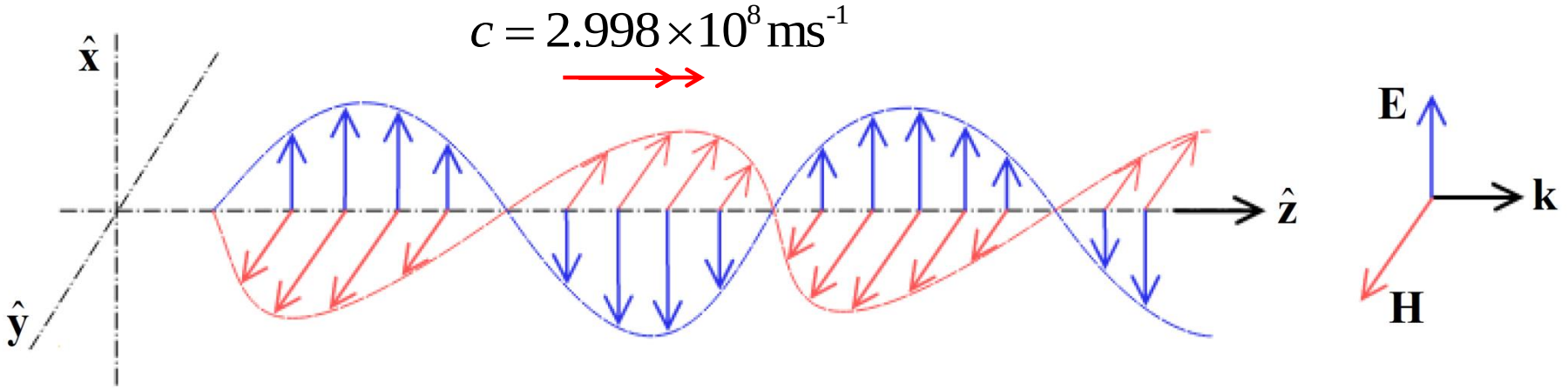
Use a **lamp** to increase the range of lux (light intensity) values

No light

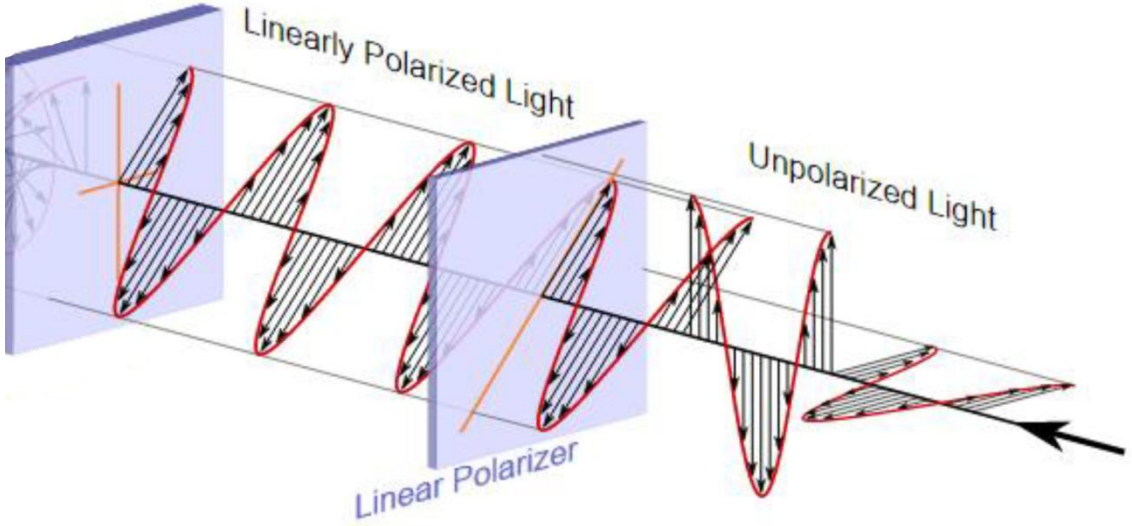
Place rotating polaroids on the (detachable) lux meter sensor

Lamp illuminated





Light is an electromagnetic wave with electric field **E**, magnetic field **H** and propagation vectors **k** all *mutually perpendicular.*

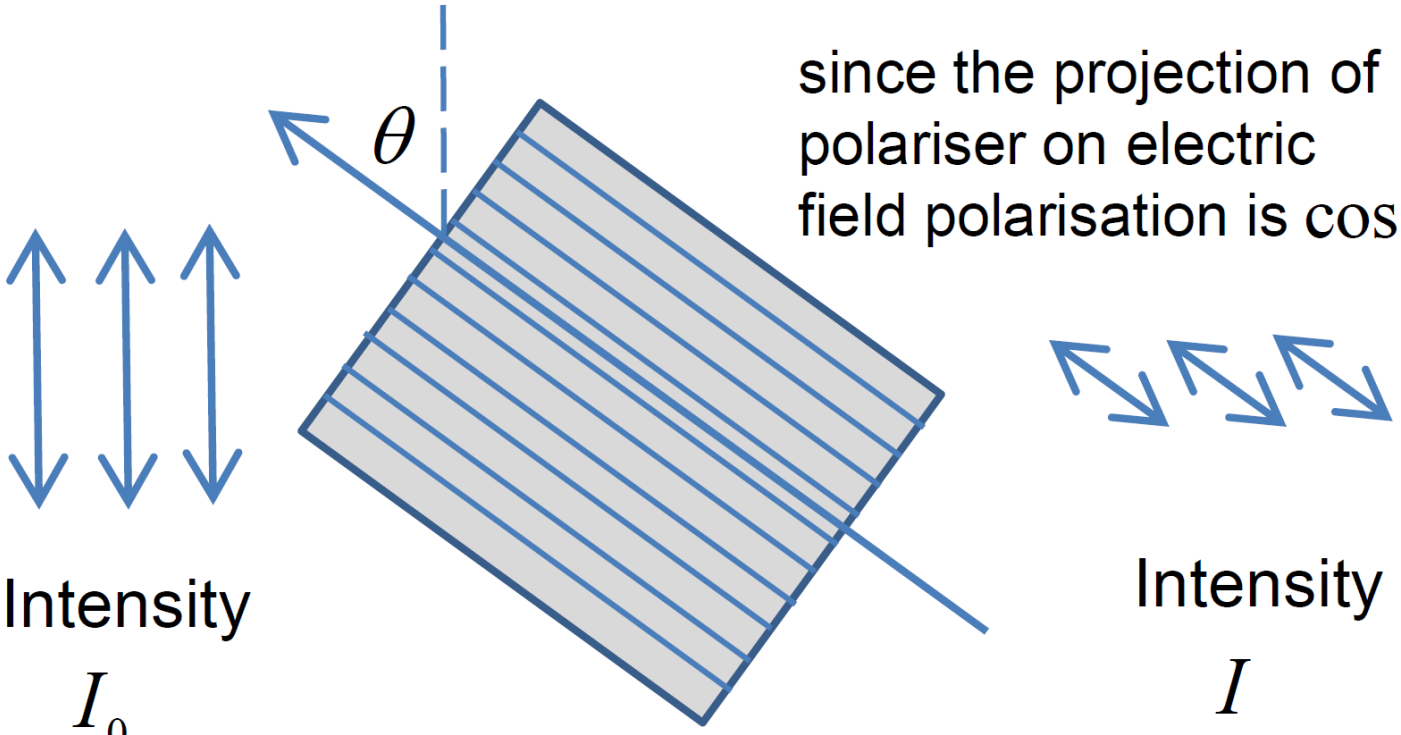


Select a particular electric field direction using a **linear polarizer**

Note if linear polarised light is incident upon a linear polariser with polarisation direction tilted by θ from the polarisation of the incident light

Malus's Law states $I = I_0 \cos^2 \theta$

since the projection of polariser on electric field polarisation is $\cos\theta$



Intensity I_0 watts m^{-1}

Linear polariser

Intensity I watts m^{-1}

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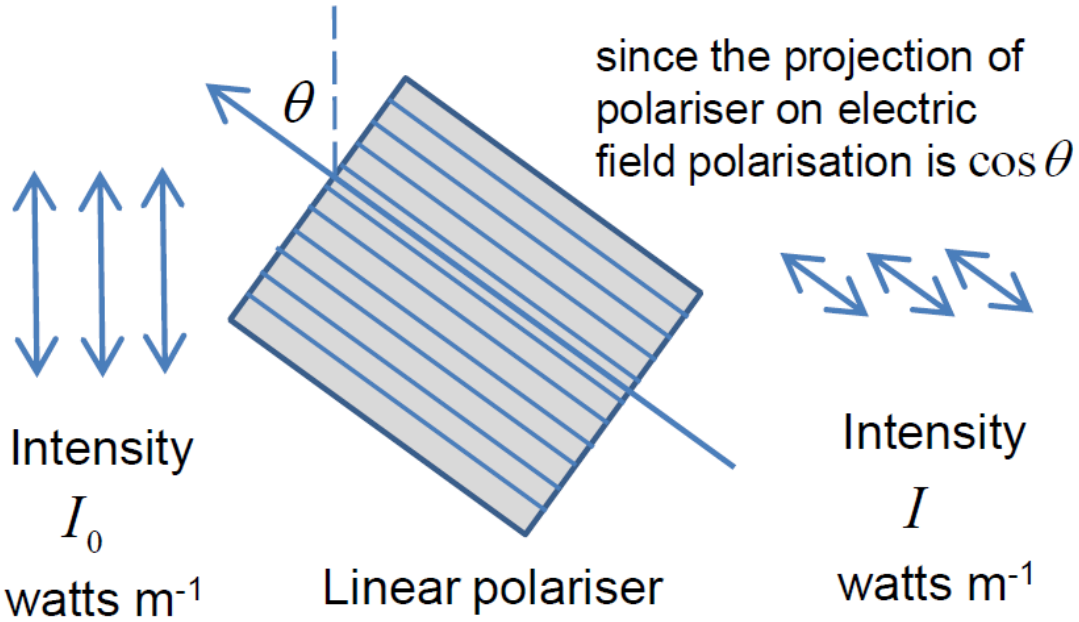

In our case unpolarized light passes through a fixed polarizer and then another (of the same material) which is rotated by angle θ. We therefore expect the light intensity I to vary as:

$$\frac{I - I_{\min}}{I_{\max} - I_{\min}} = \cos^2 \theta$$

Malus' Law of polarization

6/12/16. Winchester College. 4P1

min lux	760
max lux	1790

Angle between the crossed polaroids /deg	cos^2(theta)	Light intensity /lux	(I-Imin) /(Imax-Imin)
0	1.00	1790	1.00
10	0.97	1740	0.95
20	0.88	1710	0.92
30	0.75	1590	0.81
40	0.59	1450	0.67
50	0.41	1310	0.53
60	0.25	1200	0.43
70	0.12	950	0.18
80	0.03	840	0.08
90	0.00	760	0.00
100	0.03	840	0.08
110	0.12	950	0.18
120	0.25	1200	0.43
130	0.41	1310	0.53
140	0.59	1450	0.67
150	0.75	1590	0.81
160	0.88	1710	0.92
170	0.97	1740	0.95
180	1.00	1790	1.00