

**Measurements in Astronomy**  
**SCM Re-sit**  
**Experiment 8**

**Summer 2013**

For the SCM re-sit you will not have access to the laboratory and so you are being provided with the raw measurements for the long experiment 8 which normally would take four weeks to complete. For the re-sit you are expected to use and analyse the data given below as if you had taken the observations yourself. Follow the procedure given in the SCM booklet and write up the experiment as a complete lab report including an abstract, introduction, theory section, as well as results and conclusions.

Ensure that all units are consistent when performing calculations (i.e. do not mix mm and m!) and estimate the uncertainty on all derived quantities. Additional data such as wavelengths of visible light etc are given in the SCM booklet.

The submission deadline is **4pm Friday 2<sup>nd</sup> August**. All reports must be handed in to the student administrators on the first floor as paper copies. We cannot accept electronic submissions because I do not have the time to fix printing problems in your documents. It is your responsibility to ensure that a complete hard copy is submitted by the deadline. The pass mark is 50% and the mark will be capped at 40%.

A number of students have been caught plagiarising reports from each other and from the SCM booklet itself. Any students guilty of plagiarism will automatically fail the re-sit and the matter will be referred to the Head of Department and Dean of Faculty.

Part A

Telescope measurements:

Aperture of telescope ,  $A = 110 \pm 1$  mm

Distance of primary mirror to resolution test card ,  $D = 10.3 \pm 0.2$  m

Distance between smallest lines that were resolved,  $d = 0.75 \pm 0.03$  mm

Resolution measurements with the eye:

Diameter of pupil,  $A = 3 \pm 1$ mm

Distance to resolution test card,  $D = 1.0 \pm 0.1$  m

Distance between smallest lines that were resolved,  $d = 1.57 \pm 0.01$  mm

Part B

Below is the table of the measured spectrometer angles using a diffraction grating with 600 lines per mm. The diffraction maximum is measured on both left and right sides for orders 1, 2 and 3 where they are visible.

You may ignore the section on chromatic resolution.

The uncertainty on the angular measurements from reading the vernier scale is estimate to be  $\pm 10' = 20$  arcminutes. Another source of uncertainty would be the standard deviation of the straight through spectrometer readings.

Colour	Order	Left	Right	Accepted Value $\lambda$ (nm)
<b>Mercury</b>				
Violet	1	147° 42'	177° 40'	404.7
Turquoise	1	144° 30'	179° 52'	435.8
Green	1	142° 36'	181° 18'	546.1
Yellow	1	141° 21'	182° 03'	577.0
Yellow	1	141° 12'	182° 10'	579.1
Violet	2	130° 38'	193° 25'	404.7
Turquoise	2	125° 05'	198° 50'	435.8
Green	2	120° 32'	203° 35'	546.1
Yellow	2	117° 45'	206° 10'	577.0
Yellow	2	117° 24'	206° 50'	579.1
Violet	3	109° 35'	214° 03'	404.7
<b>Hydrogen</b>				
Blue	1	146° 06'	178° 28'	434.0
Turquoise	1	145° 05'	179° 20'	486.1
Red	1	138° 28'	185° 50'	656.3
<b>Sodium</b>				
Violet	1	145° 35'	178° 05'	n/a
Turquoise	1	144° 20'	180° 11'	n/a
Green	1	144° 10'	180° 20'	n/a
Yellow/Green	1	142° 14'	182° 20'	n/a
Yellow	1	141° 40'	183° 42'	589.0
Yellow	1	141° 36'	183° 46'	589.6
Red	1	140° 40'	184° 45'	n/a
Yellow	2	116° 35'	207° 41'	589.0
Yellow	2	116° 26'	207° 51'	589.6
<b>Cadmium</b>				
Dark Blue	1	145° 40'	178° 11'	467.8
Light Blue	1	145° 24'	179° 53'	480.0
Green	1	144° 38'	180° 15'	508.6
Red	1	139° 44'	185° 10'	643.8
Dark Blue	2	127° 30'	196° 50'	467.8
Light Blue	2	126° 24'	197° 03'	480.0
Green	2	124° 30'	200° 55'	508.6
Red	2	111° 10'	213° 02'	643.8
Dark Blue	3	104° 12'	219° 22'	467.8
Light Blue	3	101° 14'	222° 11'	480.0
Green	3	94° 20'	228° 16'	508.6

## Doppler Shift of Spectral Lines

Using the photograph of spectral lines from the SCM booklet calculate the scale of the photograph allowing you to convert nm to mm. Then, using the measured distances in the table below, and the unshifted wavelengths given in the SCM booklet, determine the shifted wavelength of each spectral line.

Distance measured $\pm 0.5\text{mm}$	
a-H	140.0
b-H	127.0
c-H	116.8
d-H	116.0
e-H	77.0
f-A	146.8

### Part C

For this part of the experiment you can make the measurements yourself using the photocopy of the galaxy photographs provided.