SIERRA COLLEGE OBSERVATIONAL ASTRONOMY LABORATORY EXERCISE		
NUMBER **II-Ba** **TITLE: Field of View**		
DATE-	**PRINT NAME/S AND INITIAL EACH**	**GROUP** ☐
DAY-		
LOCATION		

OBJECTIVE:

Be able to:

Compute the magnification power of a telescope.
Calculate the true field of a telescope, given the apparent field of the eyepiece and with a camera attached.
By observation, measure the true field of a telescope using the Direct Measure method

DESCRIPTION:

Celestial objects come in a variety of sizes and shapes. When observing the moon, a planet, star cluster, or any celestial object, the size of the field of view (True Field) of a telescope will determine how much of the object will fit into the area of sky viewable through the eyepiece or camera. This activity will provide the opportunity to predict and measure the area of sky accessible by a Celestron-8 telescope using a variety of eyepieces and a camera. The field of view of the *TELRAD* finding device will also be examined.

PROCEDURES AND OBSERVATIONS:

True Field and Apparent Field are measured in degrees.

EQ. #1

$$M = F_o/F_e$$

M is magnification
Fo is objective focal length
Fe is eyepiece focal length

EQ. #2

$$TF = AF/M$$

TF is true field of telescope
AF is apparent field of eyepiece.

Step 1:
Given that F_o for a C-8 telescope is 2000 mm, complete Table A by calculating the magnification, and true field (in both degrees and arcminutes) you would obtain with the three different eyepieces. The fields of view are given for a SLR cameras (mounted at the C-8's prime focus) with a 24 mm detector (digital camera) or 35 mm film (film camera), and a Telrad.

TABLE A: Calculating True Fields of View

Eyepiece	M	AF	TF (degrees)	TF (arcmin)
13 mm		50°		
25 mm		50°		
40 mm		43°		
Digital camera			0.7°	
Film Camera			1.0°	
Telrad inner			0.5°	
Telrad mid			2.0°	
Telrad outer			4.0°	

Step 2:
Place a strip of paper about 2 meters long on a distant wall. View it through the telescope using the smallest focal length eyepiece, making certain that an edge of the paper passes exactly through the center of the eyepiece. The optical tube of the telescope should be level. Do not bump the telescope throughout this method of TF measurement. Have someone mark the edges of the paper that appear at the outer edges of the telescope field of view. Repeat this method for all eyepieces, camera and the Telrad. When you are finished, remove the paper from the wall and return to the laboratory for measurement. Enter data in the table below. Note: Instructor may provide student with pre-marked strip of paper to measure Fields-of-View.

The true field (**TF**^{o}) may be calculated in this method by using the following equation, which will be derived by instructor. It is reasonably accurate for small angles.

EQ. #3 $$\mathbf{TF = 57.3^o \times S/D}$$

Given the observation distance (D) to the paper strip, and the fields of view recorded on the paper strip, use Equation #3 to complete Table B.

TABLE B: Measuring True Fields of View			
Distance (D) to paper strip: _____m = _____mm			
Eyepiece	Size of field (S) (mm)	TF (degrees)	TF (arcmin)
13 mm			
25 mm			
40 mm			
Telrad inner			
mid			
outer			

Step 3:
If they are available, select one of the finder scopes. Determine by visual estimation how much larger the image through the finder scope is as compared to the naked eye.

Measure the magnification power of each finder scope combination by a method described by instructor. Enter these results in Table C for comparison with given values.

TABLE C: Finder Scope Magnifications			
Finder Scope	Measured M (size in finder/size in naked eye)	Actual M (on finder)	TF (degrees)
A			
B			
C			
D			
E			

Questions and Analysis

1. If an eyepiece used with a telescope of focal length = 2000 mm gave a magnification of 75x, what magnification would it give if used on a telescope of focal length = 4000 mm?

2. If the true field in the first telescope from Question #1 (F_o=2000 mm) was 56', what would be the true field of view in the second telescope (F_o=4000 mm), using the same eyepiece?

3. Given that a standard lens of a digital SLR camera has a focal length of 50 mm and a detector size of 24x16 mm, what is the expected TF along the long dimension when using that lens?

4. The sizes of various celestial objects are listed in Table D. Transfer the appropriate True Fields from Table A (in arcminutes) to the top of Table D. Then, indicate (with an X) those objects that would entirely fit into the field of each camera or telescopic setup.

TABLE D: Celestial Object Angular Sizes

		Fields of view (in ')		
		Digital SLR (24mm sensor)	40 mm	13 mm
Celestial Object	Size in ' or "			
Sun	32'			
Moon	31'			
Jupiter	40"			
Saturn with rings	42"			
Venus	20"			
Mars	8"			
Small comet	49'			
M-1 Crab Nebula	6'			
M-8 Lagoon Nebula	90'			
M-13 Hercules Cluster	12'			
M-27 Dumbbell Nebula	8'			
M-31 Andromeda Galaxy	160'			
M-35 Open Cluster/Gemini	28'			
M-41 Open Cluster/Canis Major	38'			
M-42 Orion Nebula	59'			
M-44 Beehive Cluster	90'			
M-45 Pleiades (7 Sisters)	120'			
M-57 Ring Nebula	90"			
M-51 Whirlpool Galaxy	12'			