

Experiment



A2-1
English (Official)

Exploring the spatial structure of the sample with optical methods (10 points)

Part A. Collimation of light and sample (1.0 points)

A.1 (0.5 pt)

Please determine the best position value (X_{sample} , Y_{sample}) for the double-slit sample.

$(X_{sample}, Y_{sample}) =$

A.2 (0.5 pt)

According to the best position value, please draw the observed interference fringes and record the position (x, y) of the dark fringes of the first and second orders and the distance S between the position (x, y) and origin. Please determine the spacing ΔS between two adjacent dark fringes.

Draw interference pattern:

| Order, fringe | -2, Dark | -1, Dark | 1, Dark | 2, Dark |
|-----------------|----------|----------|---------|---------|
| (x, y) | | | | |
| S (cm) | | | | |
| ΔS (cm) | | | | |

Part B. Exploration of sample structure size (3.0 points)

B.1 (0.5 pt)

Show the formula for the indicated microsphere distance d in terms of λ , L and S .

$d =$

Experiment



A2-2
English (Official)

B.2 (1.5 pt)

With selecting appropriate position of the screen L , please record the coordinates (x, y) of diffraction pattern on the screen for microsphere, and the estimate distance S and $\tan^{-1}(\frac{\bar{S}}{L})$ (unit: radian) in the selected three laser sources in the visible range. (record five sets on the same ring to obtain the average \bar{S} value)

$L =$

$\lambda =$

| Data | 1 | 2 | 3 | 4 | 5 |
|--------------------------------|---|---|---|---|---|
| (x, y) | | | | | |
| S (cm) | | | | | |
| \bar{S} (cm) | | | | | |
| $\tan^{-1}(\frac{\bar{S}}{L})$ | | | | | |

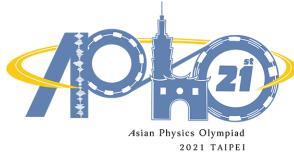
$\lambda =$

| Data | 1 | 2 | 3 | 4 | 5 |
|--------------------------------|---|---|---|---|---|
| (x, y) | | | | | |
| S (cm) | | | | | |
| \bar{S} (cm) | | | | | |
| $\tan^{-1}(\frac{\bar{S}}{L})$ | | | | | |

$\lambda =$

| Data | 1 | 2 | 3 | 4 | 5 |
|--------------------------------|---|---|---|---|---|
| (x, y) | | | | | |
| S (cm) | | | | | |
| \bar{S} (cm) | | | | | |
| $\tan^{-1}(\frac{\bar{S}}{L})$ | | | | | |

Experiment



A2-3
English (Official)

B.3 (1.0 pt)

Using the formula to estimate the corresponding distance between each microsphere d , the diameter of the microsphere a and average diameter \bar{a} in the three laser sources.

| λ (nm) | d (μm) | a (μm) |
|-----------------------------|-----------------------|-----------------------|
| | | |
| | | |
| | | |
| \bar{a} (μm) | | |

Experiment



A2-4
English (Official)

Part C. Exploration of sample structure size (2.5 points)

C.1 (0.8 pt)

Please select a visible laser for experiment. Fix the distance between the screen and the sample at $L = 90$ cm, and observe the diffraction pattern. Please mark the coordinates (x, y) of the 4th to 7th order bright fringes in the two axial directions, calculate the corresponding distance S and estimate the corresponding value of $\tan^{-1} \left(\frac{S}{L} \right)$ (unit: radian).

$$\lambda =$$

| $L = 90$ cm, Axis 1 | | | | |
|--|-----------|-----------|-----------|-----------|
| Order, fringe | 4, Bright | 5, Bright | 6, Bright | 7, Bright |
| (x, y) | | | | |
| S (cm) | | | | |
| $\tan^{-1} \left(\frac{S}{L} \right)$ | | | | |

| $L = 90$ cm, Axis 2 | | | | |
|--|-----------|-----------|-----------|-----------|
| Order, fringe | 4, Bright | 5, Bright | 6, Bright | 7, Bright |
| (x, y) | | | | |
| S (cm) | | | | |
| $\tan^{-1} \left(\frac{S}{L} \right)$ | | | | |

C.2 (0.7 pt)

Please calculate the distance ΔS_l and ΔS_w between adjacent bright fringes based on the data in the previous question. Please also estimate the length of the long (l) and short (w) sides of a single rectangle.

| ΔS_l (cm) | l (μm) | ΔS_w (cm) | w (μm) |
|-------------------|-----------------------|-------------------|-----------------------|
| | | | |

Experiment

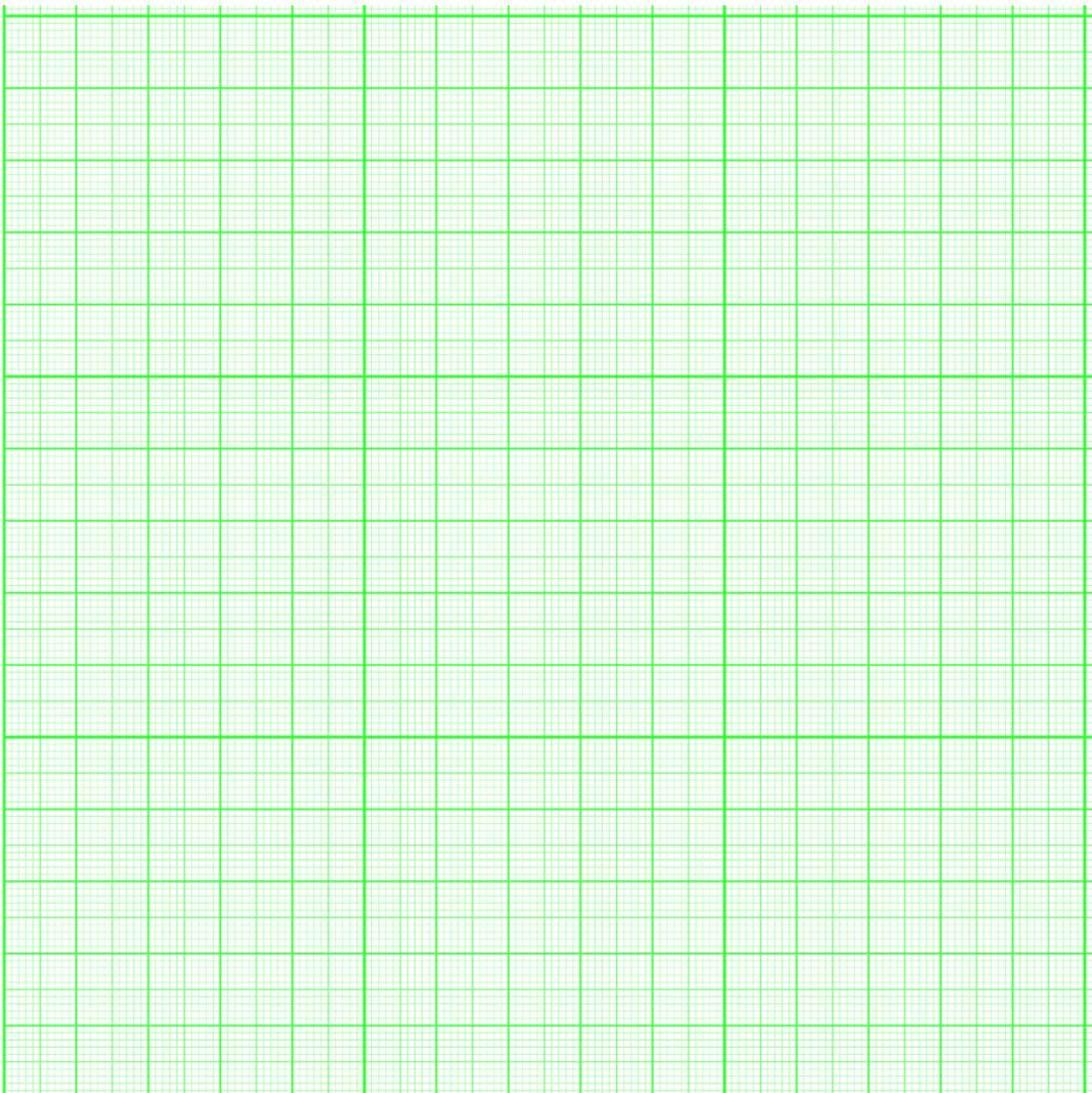


A2-5
English (Official)

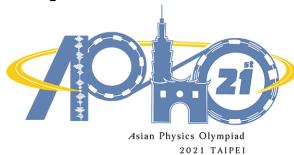
C.3 (1.0 pt)

Estimate the orientation angle: Draw a line to estimate the angle. Four coordinates (x, y) of the bright patterns should be marked. Estimate the orientation angle ϕ of the long side of a single rectangle with respect to the horizontal axis.

$\phi =$



Experiment



A2-6
English (Official)

Part D. Exploration of sample structure size (2.5 points)

D.1 (1.9 pt)

Please set the screen position at 95 cm, select one infrared laser for the experiment, and use the photodetector to identify the fine diffraction spot patterns on the screen. In the table, please write down the laser wavelength and the center coordinates of a set of 4×4 fine diffraction bright spots on the screen. Draw the 4×4 spot pattern, denote the distances between adjacent spots, ΔS_x and ΔS_y , in the diagram, and calculate the values.

| | | | |
|--|--|--|--|
| Laser wavelength λ = | | | |
| The center coordinates of the 4×4 fine diffraction bright spot (x, y) | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| Calculate the distances between adjacent spots ΔS_x and ΔS_y | | | |
| | | | |

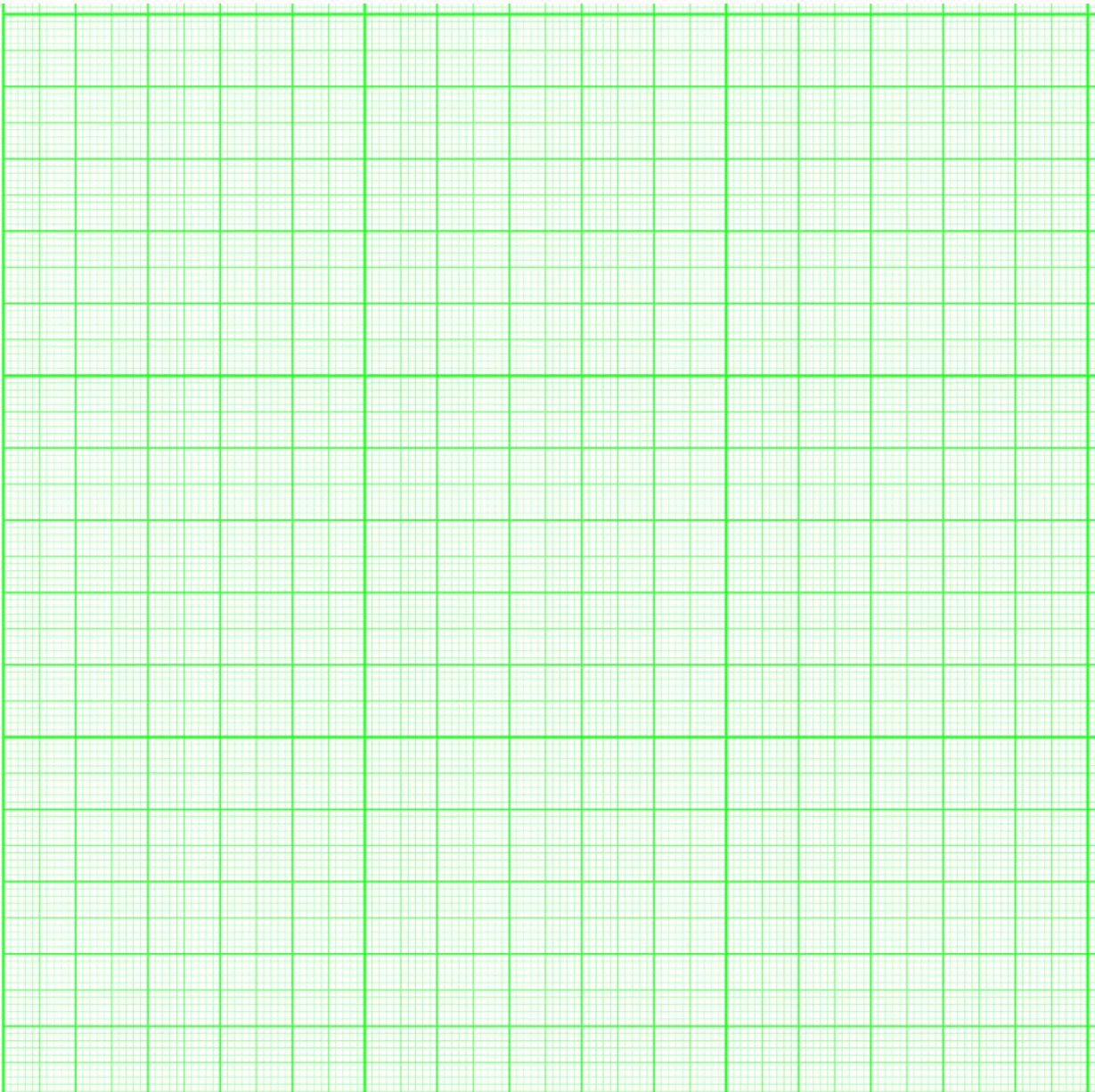
Experiment



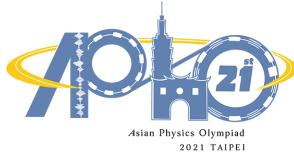
A2-7
English (Official)

D1

Draw 4×4 spot pattern



Experiment



A2-8
English (Official)

D.2 (0.6 pt)

Determine the spacings d_x and d_y of the sample grid from the results of the infrared experiments.

| | |
|-------------------------|--|
| d_x (μm) | |
| d_y (μm) | |

Part E. Exploration of sample structure size (1.0 points)

E.1 (1.0 pt)

Please draw the periodic arrangement of the sample: Please represent it by a 3x3 rectangular array and mark the sizes (l and w), spacings (d_x and d_y) and orientation angle (ϕ) corresponding to the question Part C and Part D in the pattern with symbols (l, w, d_x, d_y, ϕ).