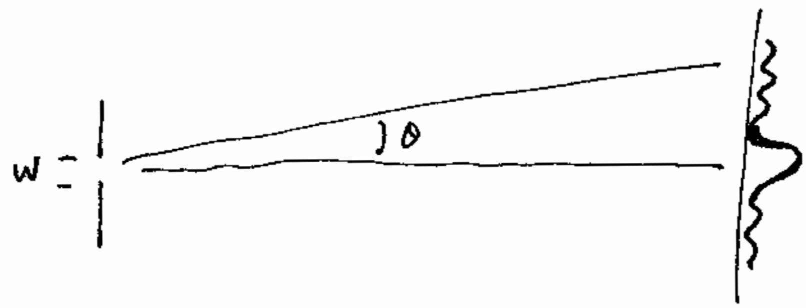
Physics 102

Lecture 32.

Fri. Nov. 26, 2004.

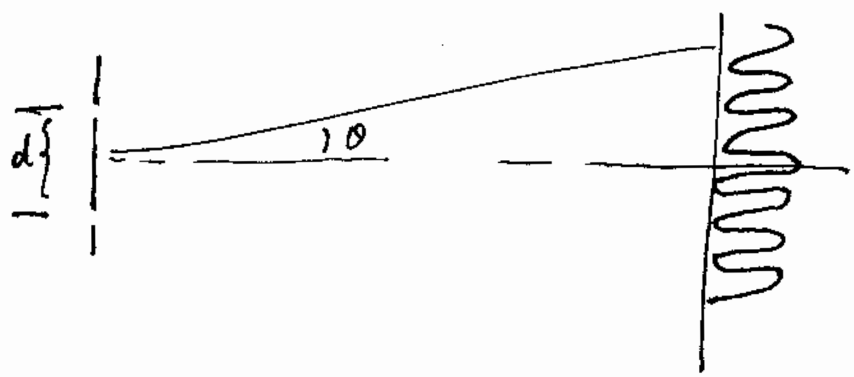
- Single slit diffraction



First minimum: $W \sin\theta = \lambda$

Dark fringes: $W \sin\theta = m\lambda$ $m = \pm 1, \pm 2, \pm 3, \cdots$

- Double-slit interference.



Bright fringes:

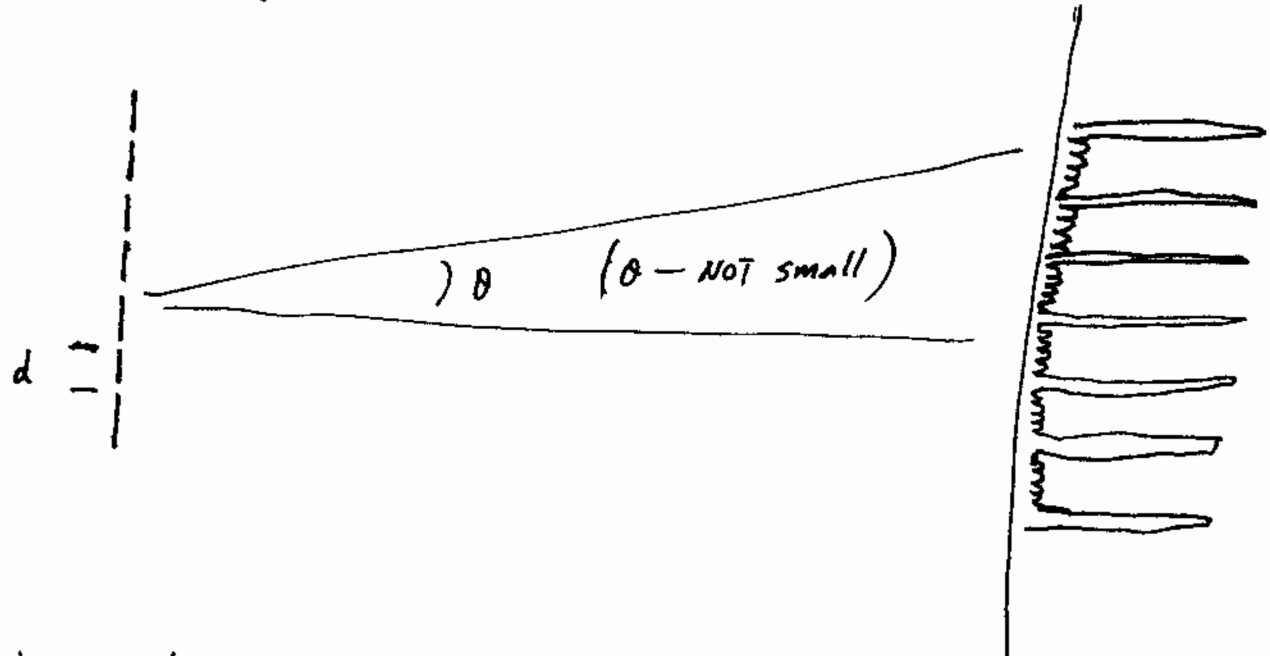
$$d \cdot \sin\theta = m\lambda \quad m = 0, \pm 1, \pm 2, \cdots$$

Dark fringes.

$$d \cdot \sin\theta = (m - \tfrac{1}{2})\lambda \quad m = 0, \pm 1, \pm 2, \cdots$$

- Multi-slit interference.

e.g.:



# of slits: $N = 6$.

- Principal Maxima: $d \cdot \sin\theta = m\lambda \quad m = 0, \pm 1, \pm 2, \cdots$

  similar to 2-slit pattern. But. θ — Not small. $\sin\theta \neq \tan\theta$.

  except: sharper, narrower.

- Dark fringes. —— $(N-1)$ dark fringes between 2 principal maxima.

- Secondary maxima —— $(N-2)$ secondary maxima between 2 principal maxima

Why? Need to work out the math.

One way to help memorizing the facts:

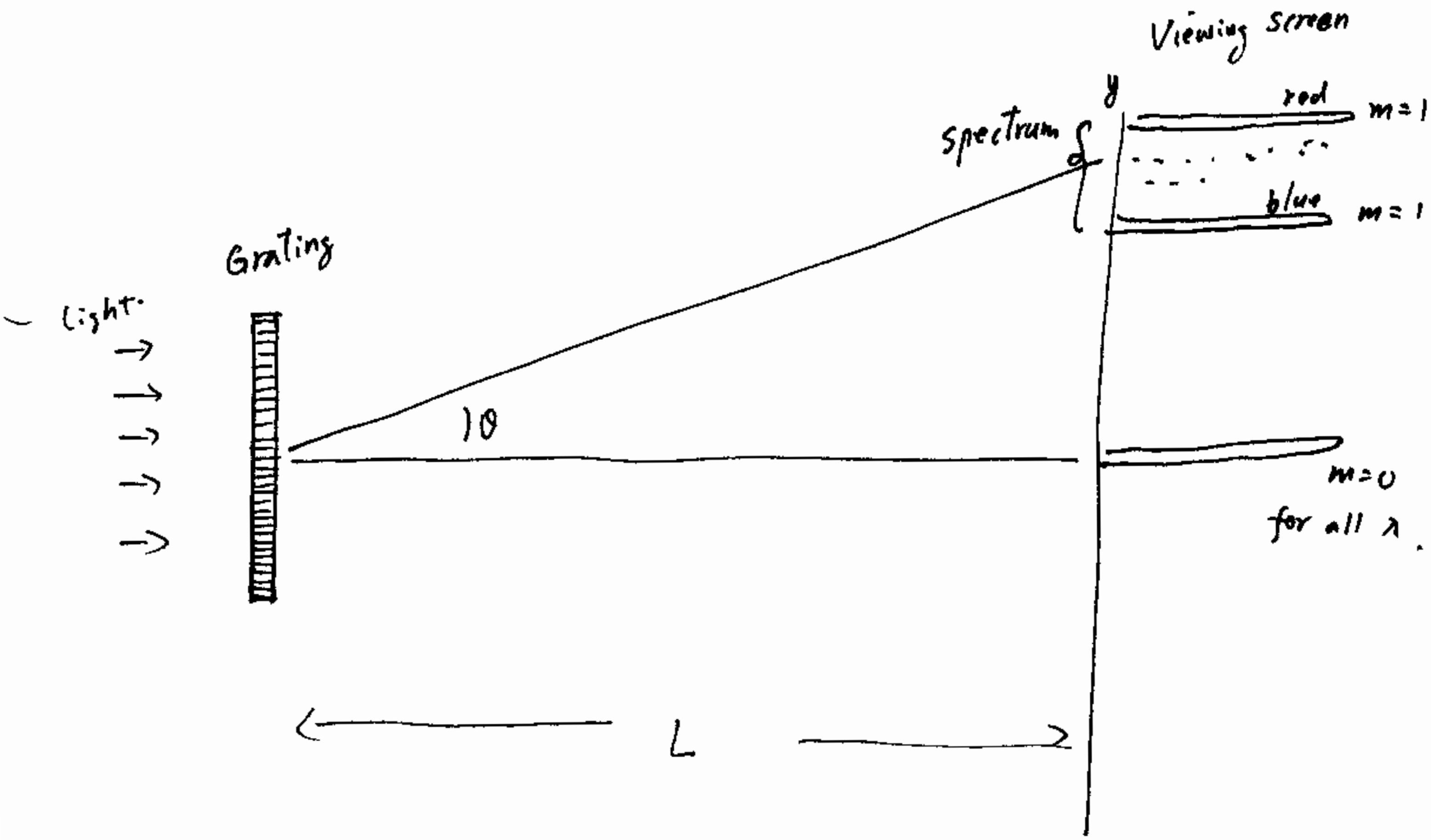
Secondary maxima correspond to the bright fringes due to the 2 far-apart slits. fringe spacing $\propto \frac{1}{d}$.

- Grating spectrometer.

↑
Many Many slits (e.g. 5000 slits per cm).

Only the principal maxima are visible — very sharp and bright.

In practice, usually $m=1$ is used.



Grating equation : $d \cdot \sin\theta = m\lambda$

when $m=1$, $d \sin\theta = \lambda$. (bright maximum)

position of bright maximum depends on λ. $y = y(\lambda)$

∴ We see a spectrum on the viewing screen.