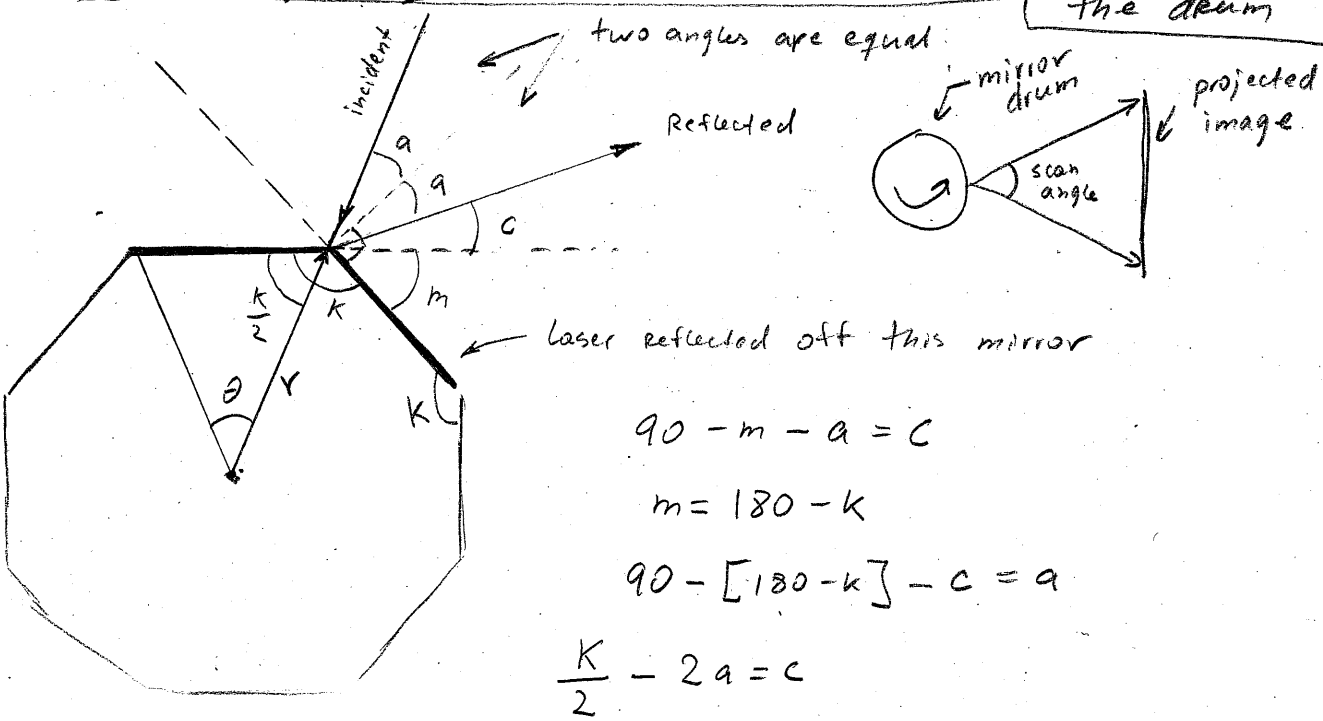
Mirror Drum Design Geometry

11. 15. 12

Scan angle If laser is pointed to the center of the drum



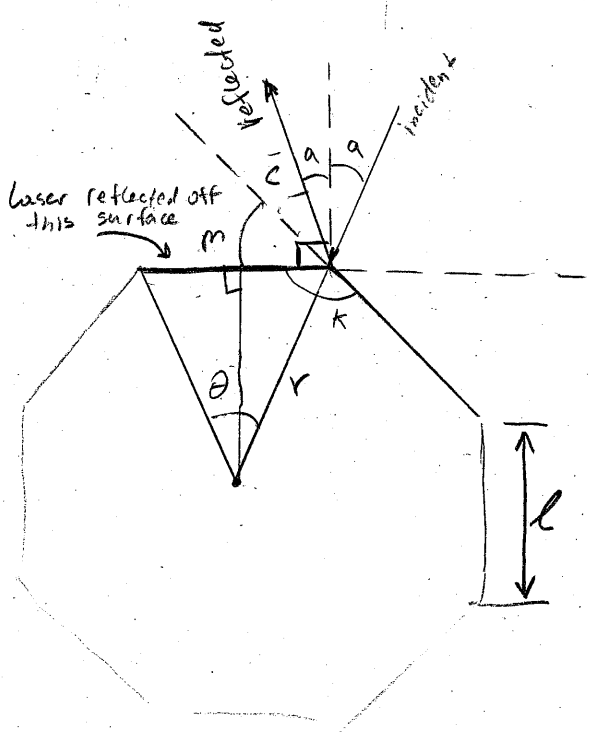
$90 - m - a = c$

$m = 180 - k$

$90 - [180 - k] - c = a$

$\frac{K}{2} - 2a = c$

$90 - [180 - k] - \frac{k}{2} + 2a = a$ $\quad a = 90 - \frac{1}{2}k$



$k = 180 - \theta$

$a = 90 - 90 + \frac{\theta}{2}$

2

$90 - m - a = c$

$m = 180 - k$

$90 - 180 + k - c = a$

$2a + c = \frac{k}{2}$

$a = 90 - \frac{1}{2}k$

} analagous

Total scan angle is 4.a. (OR) $360 - 2k$ = Scan angle

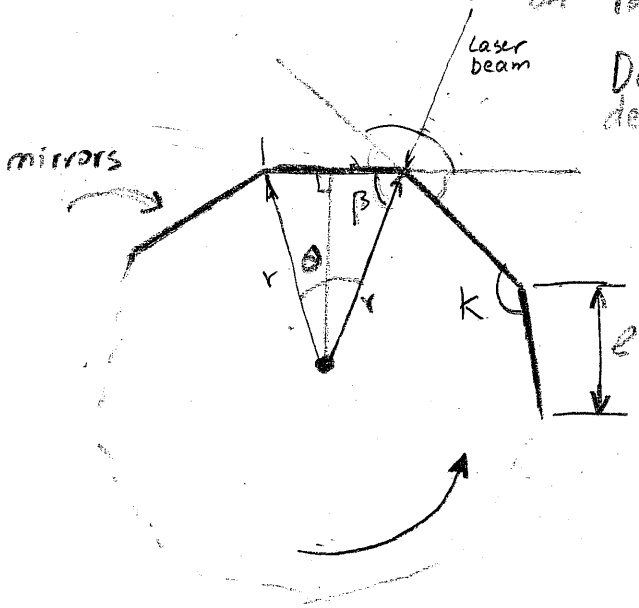
$k = 180 - \theta$

(1) Scan angle $= 2\theta$ OR $360 - 2k$

11.15.12

Determining drum radius & length of mirror

Laser beam scan angle χ as mirrors rotate depends on radius r and # of mirrors



Determining scan angle will determine image length at distance

r - radius of the drum

ℓ = length of mirror N - # of mirrors

* sum of all interior angles χ is $(N-2)\cdot 180$

- Assuming laser beam is aimed at the center of the drum. to avoid distortions.
- If circumference is aprox. equal number of mirrors times ℓ

$$N \cdot \ell$$

$$r \approx \frac{N \cdot \ell}{2\pi}$$

$$r = \frac{0.5\,\ell}{\cos(\beta)}$$

$$\beta = \arccos\frac{\ell}{2r}$$

② $$k = 360 - 4\arccos\left(\frac{\ell}{2r}\right)$$

$$k \approx 360 - 4\arccos\left(\frac{\pi}{N}\right)$$

alternate: ③ $$r = \frac{0.5\,\ell}{\cos\left(\frac{360}{N}\right)}$$

N # of mirrors or # of horizontal lines on the image

$$k = [N-2]\cdot 180$$

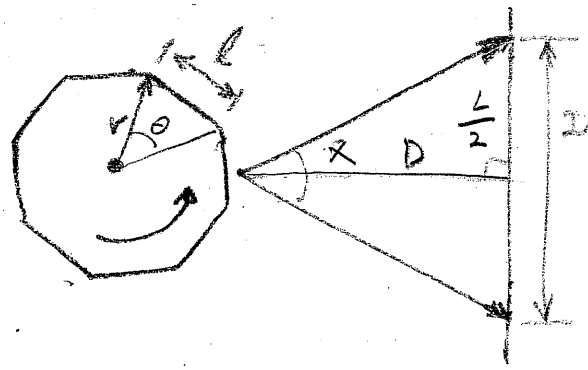
Scan angle in terms of r and ℓ:

$$360 - 2\left[360 - 4\arccos\left(\frac{\ell}{2r}\right)\right]$$

(4) $$8\arccos\left(\frac{\ell}{2r}\right) - 360 = \text{scan angle}$$

r depends on # of mirrors which depends # of horizontal lines chosen for the projected image.

Image length at distance D:



Projected Image length L

$$\tan\left(\frac{X}{2}\right) = \frac{\frac{L}{2}}{D} = \frac{L}{2D}$$

$$L = 2 \cdot D \tan\left(\frac{X}{2}\right)$$

X - horizontal scan-angle

from eq 4:

$$L = 2D \cdot \tan\left[\frac{2\arccos\left(\frac{l}{2r}\right) - 360}{2}\right]$$

$$L = 2D \tan\left[4\arccos\left(\frac{l}{2r}\right) - 180\right]$$

$$L = 2D \tan\left[\theta -\right]$$

r - radius of the drum

N - # of mirrors

D - distance to projection