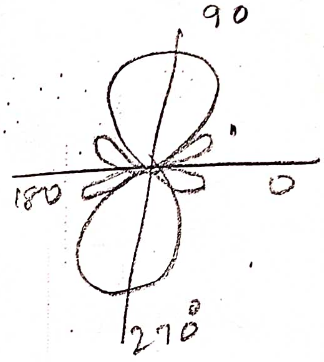
Two cases.

1. Broad side array

- Sources with equal magnitude & same phase.
- Max radiation is ⊥r to the axis of array.

$\alpha = 0, \quad \psi = \beta d \cos\theta.$



Maxima.

$\psi = 0.$

$\beta d \cos\theta = 0 \Rightarrow \cos\theta = 0$

$$\theta = 90^\circ \text{ or } 270^\circ.$$

Beam width

$\theta_{min} = \cos^{-1}\left[\pm \frac{N\lambda}{nd}\right]$

$90 - \gamma = \cos^{-1}\left[\pm \frac{N\lambda}{nd}\right]$

$\cos(90 - \gamma) = \pm \frac{N\lambda}{nd}$

$\sin\gamma = \pm \frac{N\lambda}{nd}$

$\gamma \to$ small $\quad \sin\gamma = \gamma.$

$\gamma = \pm \frac{N\lambda}{nd}.$

First null occures when $N = 1$

$\gamma_1 = \pm \frac{\lambda}{nd}.$

BWFN $= 2 \times \gamma_1 = \frac{2\lambda}{nd} = \frac{2\lambda}{L}$ radian

n - No. of elements

d - spacing.

where $L = (n-1)d.$ For large n

$L = nd.$

$\text{BWFN} = 2\gamma_1 = \frac{2 \times 57.3}{L/\lambda}$ degree.

$$\text{BWFN} = \frac{114.6}{L/\lambda} \text{ degree}$$

$$\text{HPBW} = \frac{\text{BWFN}}{2} = \frac{57.3}{L/\lambda} \text{ degree}$$

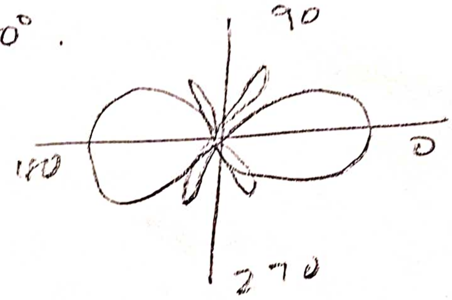
(7)

2. End fire array.

(3)

- point sources with equal amplitude and opposite phase.
- max radiation is along the axis of the array.

(ie) $\theta = 0°$ or $180°$.



$$\psi = \beta d \cos\theta + \alpha$$

$$0 = \beta d \cos 0 + \alpha$$

$$\alpha = -\beta d = \frac{-2\pi d}{\lambda}$$

phase difference is retarded progressively by spacing b/w the sources

Beam width

$$\theta_{min} = 2 \sin^{-1}\left[\pm\sqrt{\frac{N\lambda}{2nd}}\right]$$

$$\sin\left(\frac{\theta_{min}}{2}\right) = \pm\sqrt{\frac{N\lambda}{2nd}}$$

small θ

$$\frac{\theta_{min}}{2} = \pm\sqrt{\frac{N\lambda}{2nd}}$$

$$\theta_{min} = 2\left[\pm\sqrt{\frac{N\lambda}{2nd}}\right]$$

$$\theta_{min} = \pm\sqrt{\frac{2N\lambda}{nd}} = \pm\sqrt{\frac{2N\lambda}{L}}$$

$$BWFN = 2 \times \theta_{min} = 2 \times \left(\pm\sqrt{\frac{2N\lambda}{L}}\right)$$

For $N=1$

$$= 2\sqrt{\frac{2\lambda}{L}} \times 57.3 \text{ degree.}$$

$$\boxed{BWFN = 114.6\sqrt{\frac{2\lambda}{L}}}$$

Half Power Beam width.

$$\boxed{HPBW = \frac{BWFN}{2} = \pm 57.3\sqrt{\frac{2\lambda}{L}}}$$