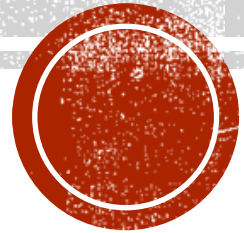
PATTERN MULTIPLICATION



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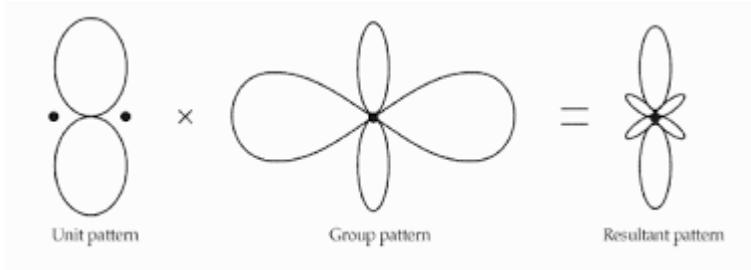
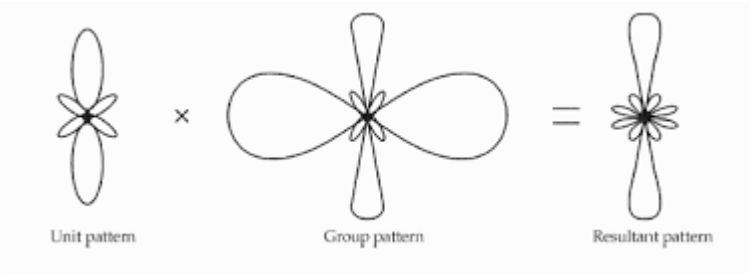
2019105586

WHAT IS PATTERN MULTIPLICATION?

The **principle of pattern multiplication** may be expressed as

"The total field pattern of an array of non-isotropic but similar sources is the product of the individual source pattern and the pattern of an array of isotropic point sources each located at the phase center of the individual source and having the same relative amplitude and phase while the total phase pattern is the sum of the phase patterns of the individual source and the array of isotropic point sources."





Let E = Total field.

$E_i(\theta, \varphi)$ = Field pattern of individual source.

$E_a(\theta, \varphi)$ = Field pattern of array of isotropic point sources.

$Ep_i(\theta, \varphi)$ = Phase pattern of individual source.

$E_{pa}(\theta, \varphi)$ = Phase pattern of array of isotropic point source.

Then the total field pattern of an array of non-isotropic but similar source, symbolically, may be written as

$$E = \underbrace{\{E_i(\theta, \varphi) \times E_a(\theta, \varphi)\}}_{\text{(Multiplication of field pattern)}} \times \underbrace{\{Ep_i(\theta, \varphi) + Ep_a(\theta, \varphi)\}}_{\text{(Addition of phase pattern)}} \quad \text{... (7.18)}$$

The angle θ and φ respectively, represent the 'polar' and 'azimuth' angles.

The principle of multiplication of pattern is true for any number of similar sources. For two dimensional case the resultant pattern is given by eqn. 7.4 (a) or 7.17 (a)

$$E = 2E_0 \cos \psi/2 \quad \text{... (7.4 a)}$$

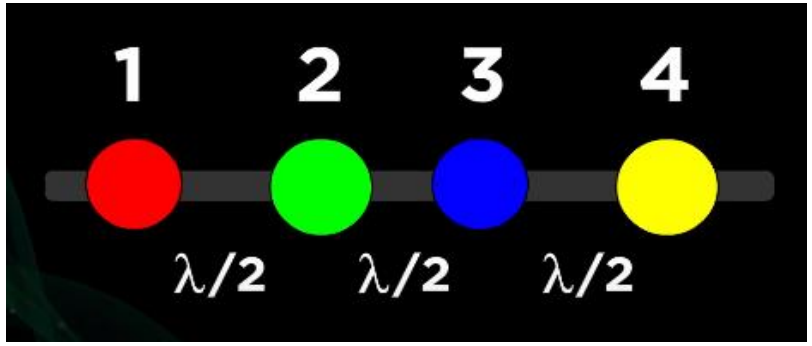
$$E = 2E_1 \sin\theta \cos \psi/2 \quad \text{... (7.17 a)}$$

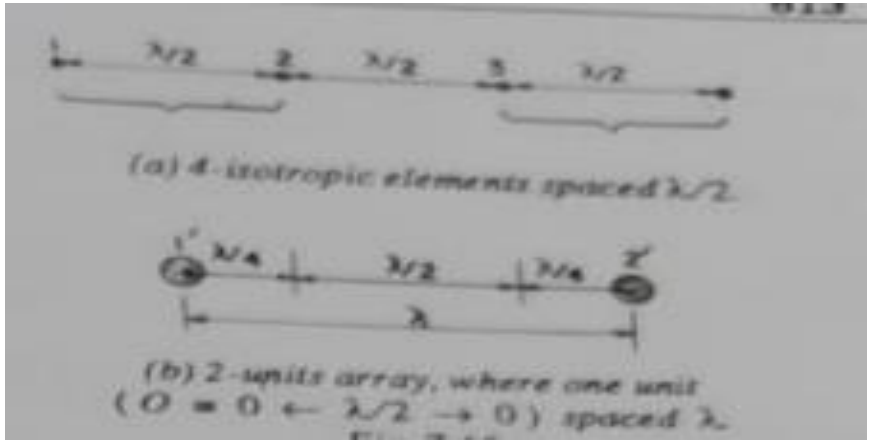
or

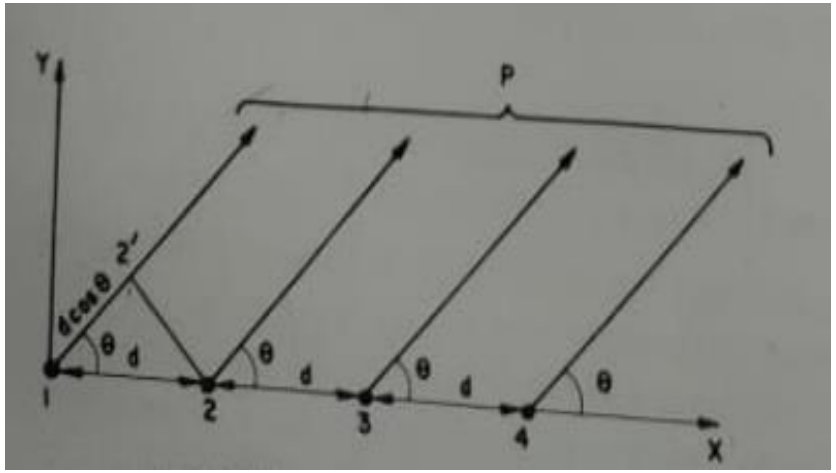
$$E = E(\theta) \cdot \cos \psi/2 \quad \text{... (7.19)}$$

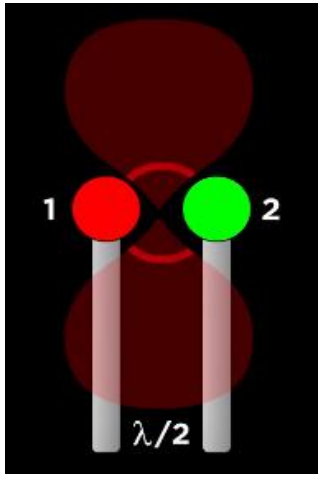
Evidently, E_0 is a function of θ say $E(\theta)$. The total field pattern, in this case, is multiplication of field pattern known as primary and $\cos \psi/2$ the secondary pattern or array factor that the principle is equally applicable to 3 dimensional case also.

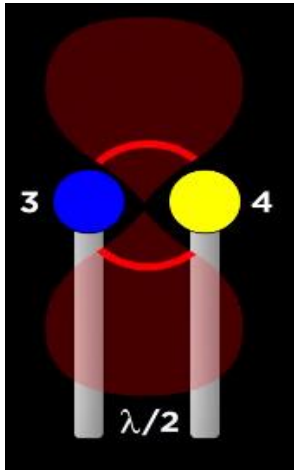
RADIATION PATTERN OF 4-ISOTROPIC ELEMENTS FED IN PHASE, SPACED λ/2 APART:

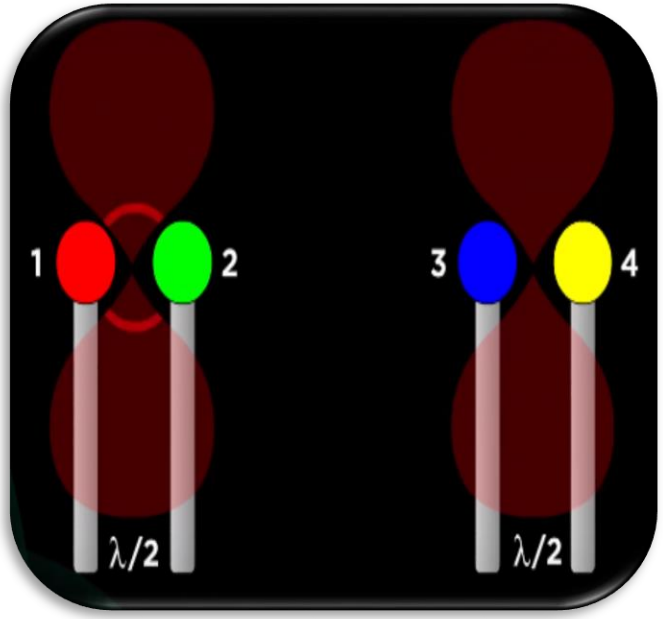


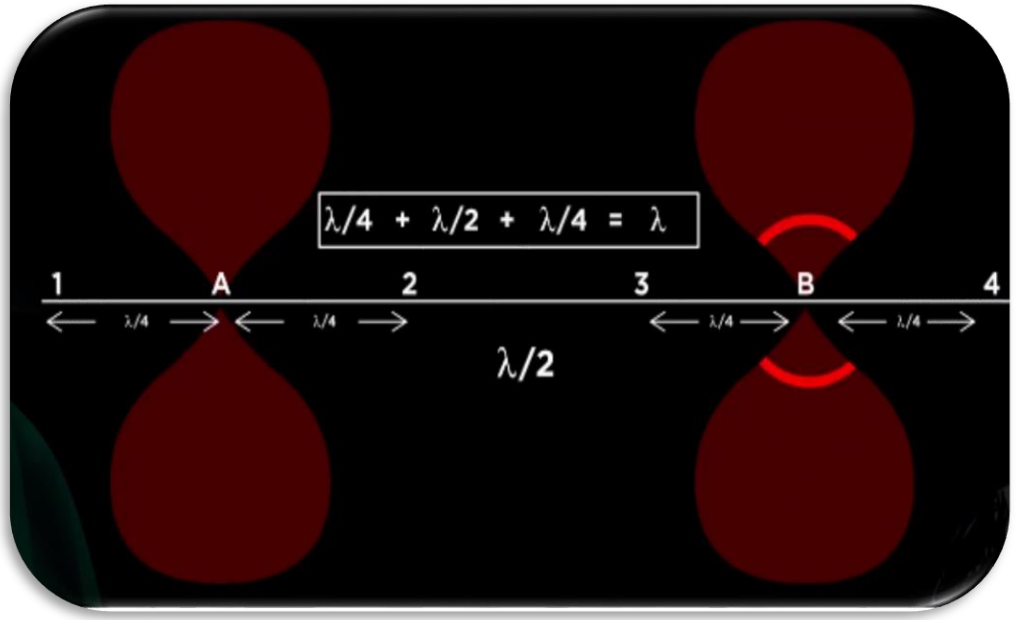


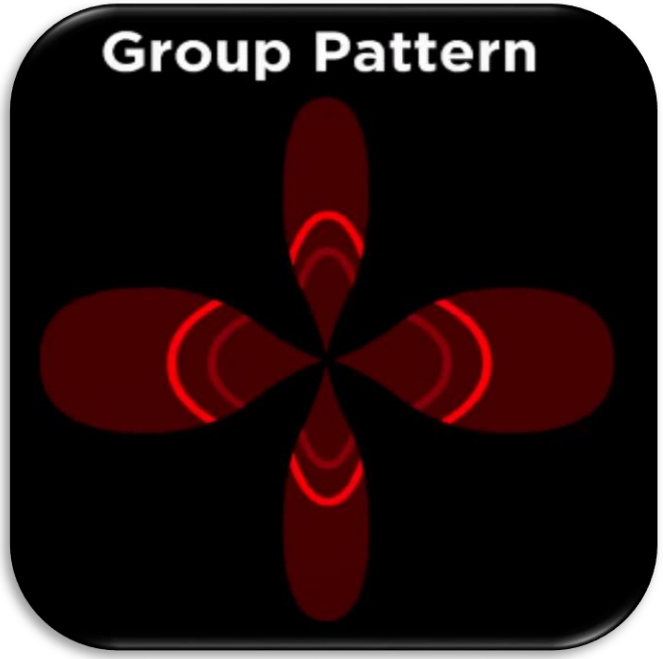


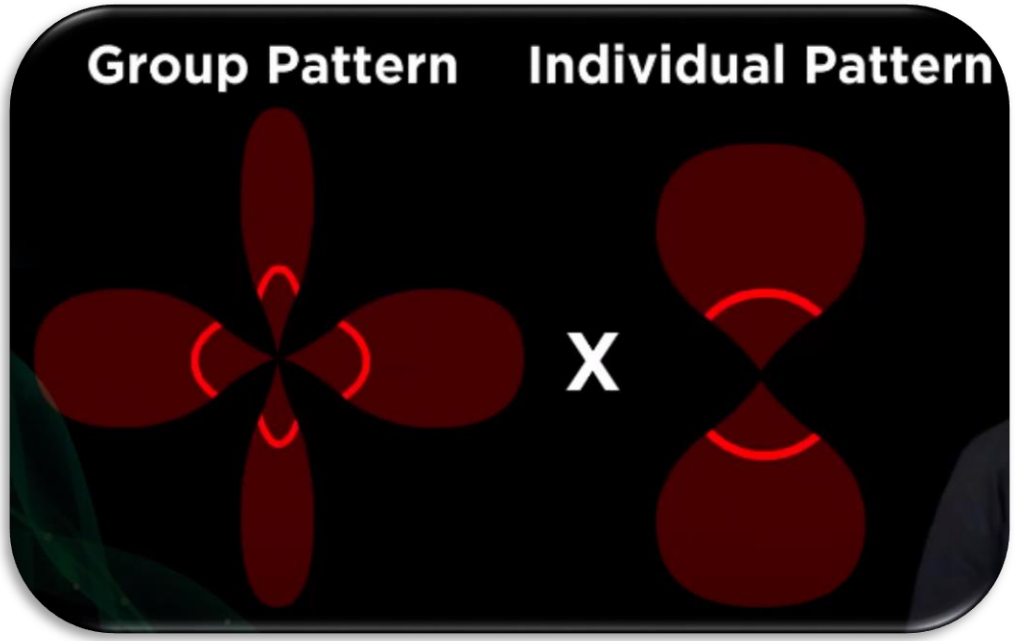





1
2
3
4
λ/2
λ/2

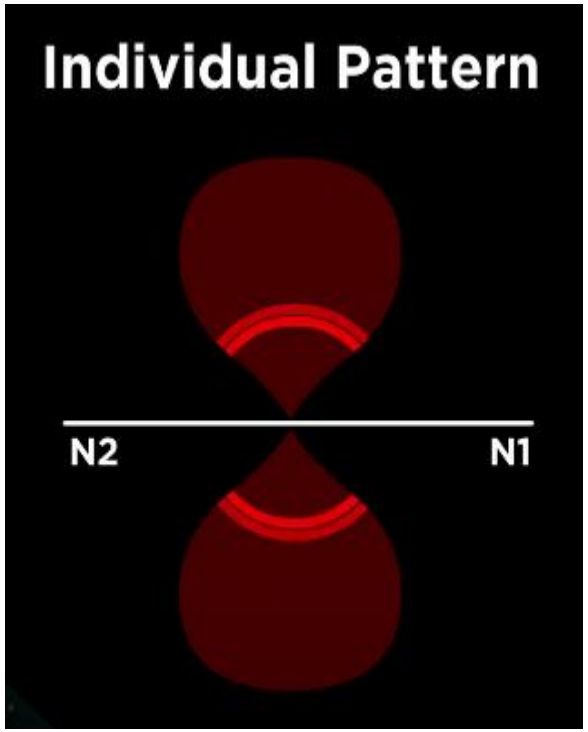

λ/4 + λ/2 + λ/4 = λ
1
A
2
3
B
4
λ/4
λ/4
λ/4
λ/4
λ/2

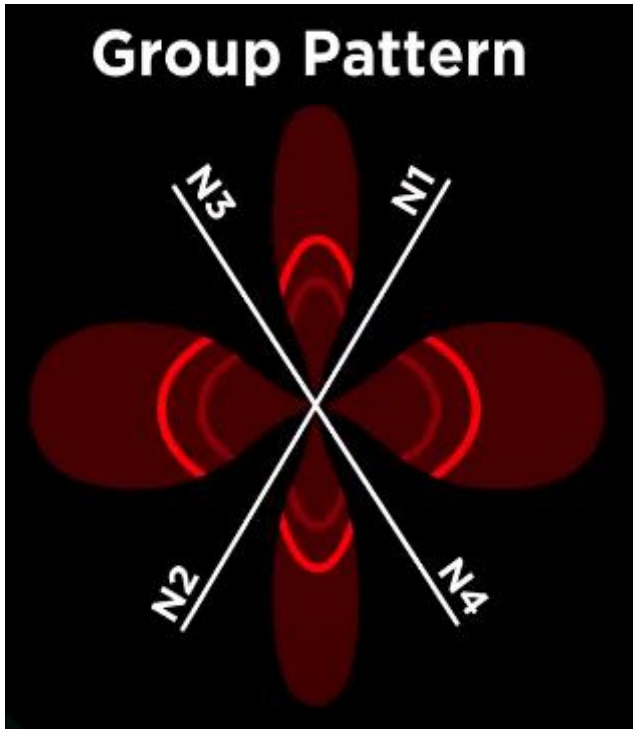

Group Pattern

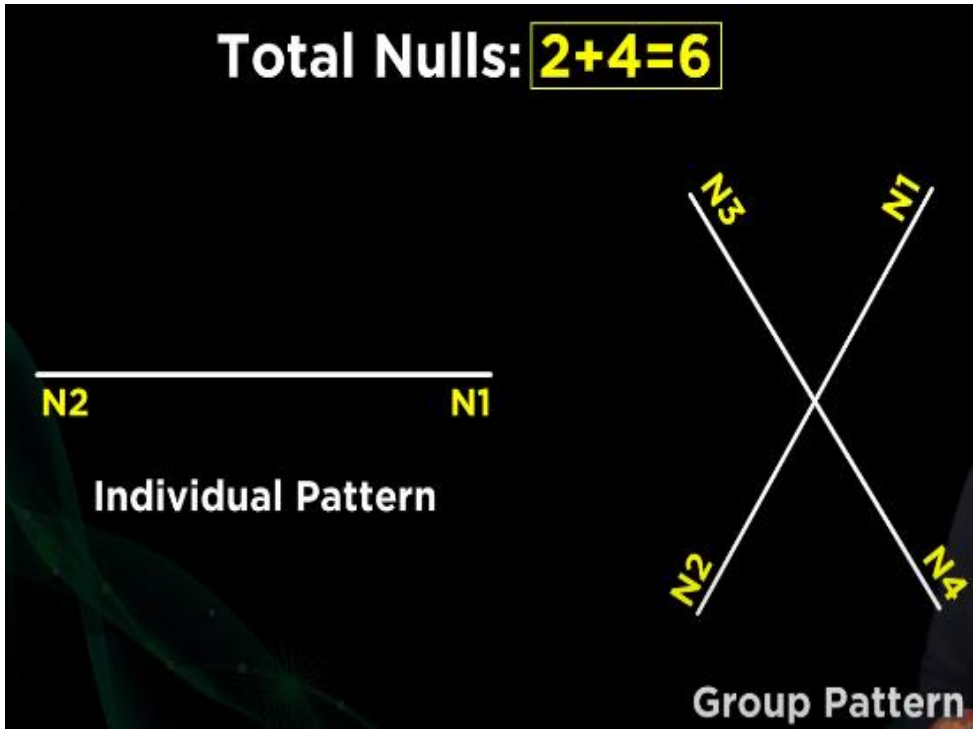

Group Pattern
Individual Pattern
X

NULLS:

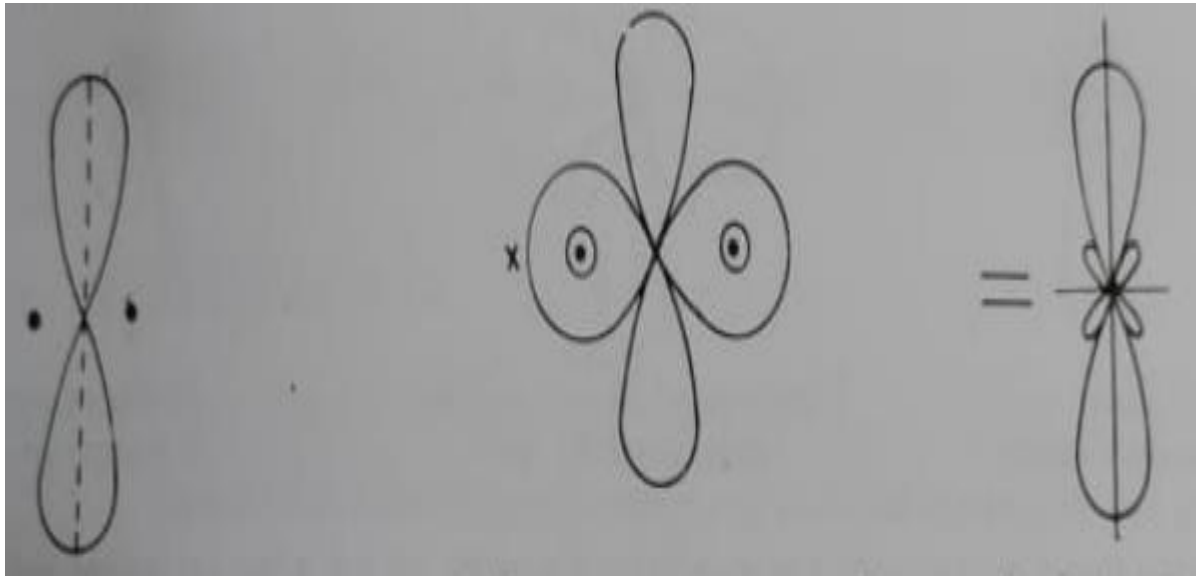
A null is a direction in an antenna's radiation pattern where the antenna radiates almost no radio waves, so the far field strength is local minimum.

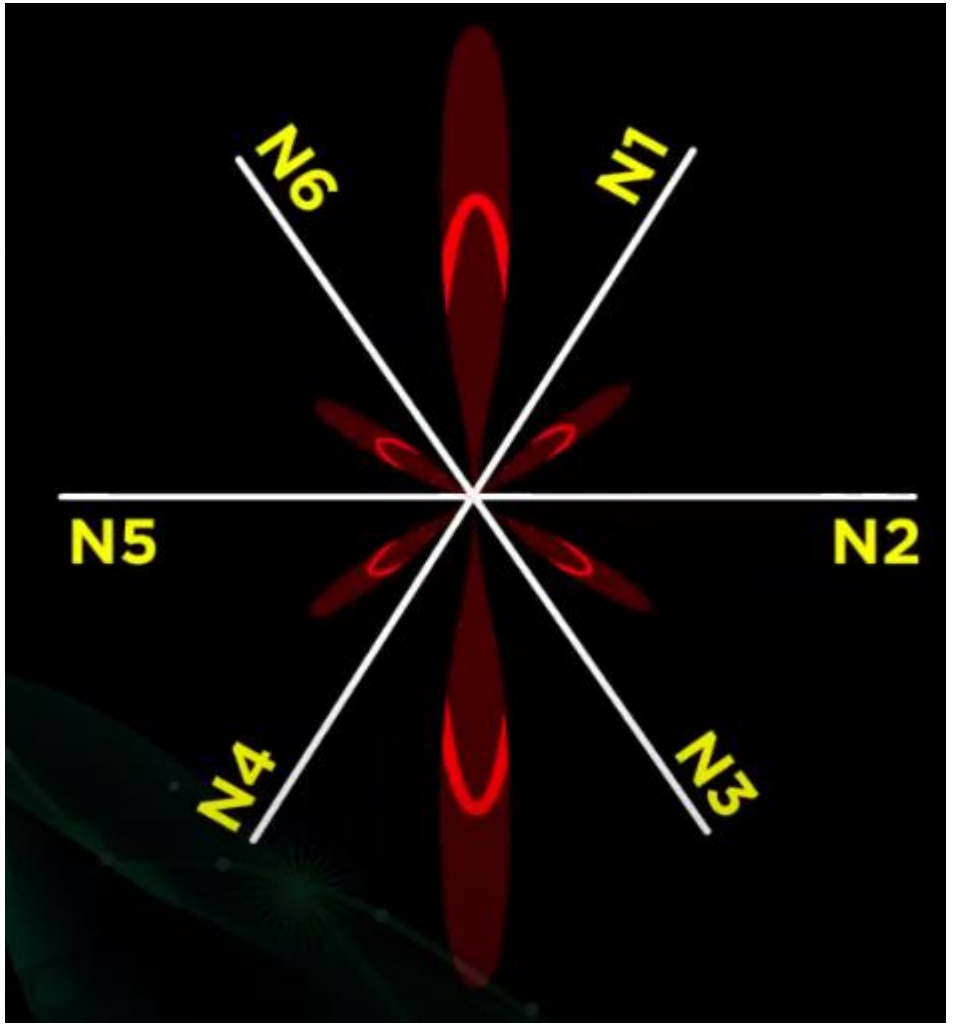




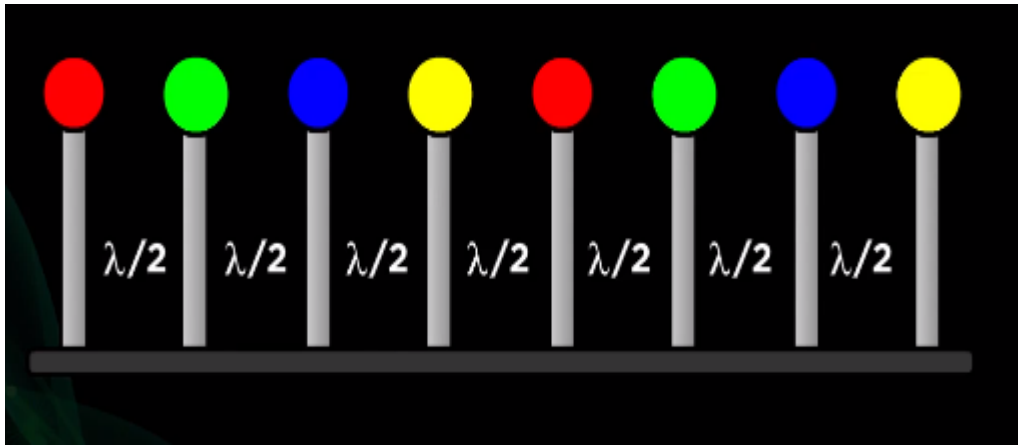


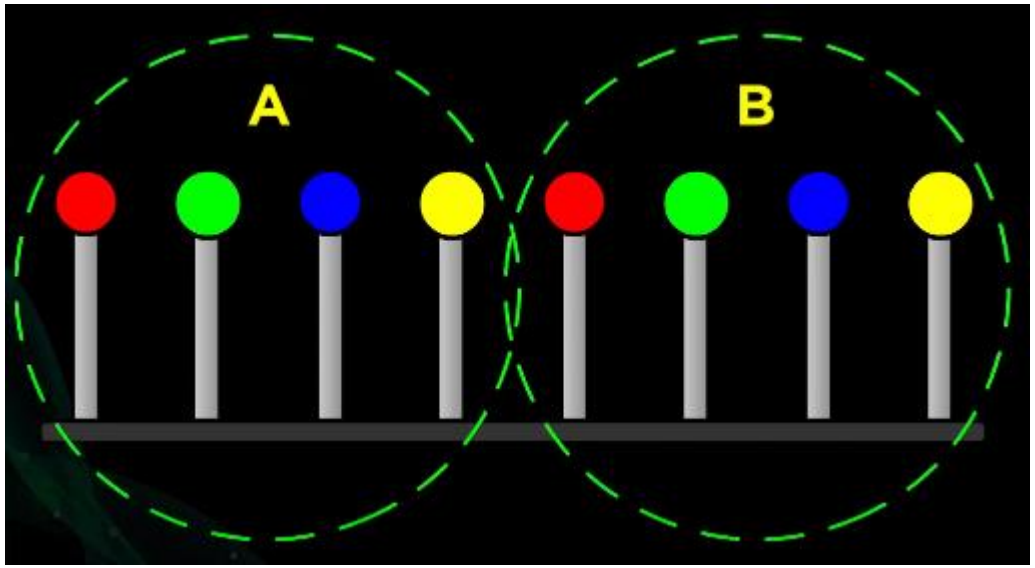
OUTPUT RADIATION PATTERN:



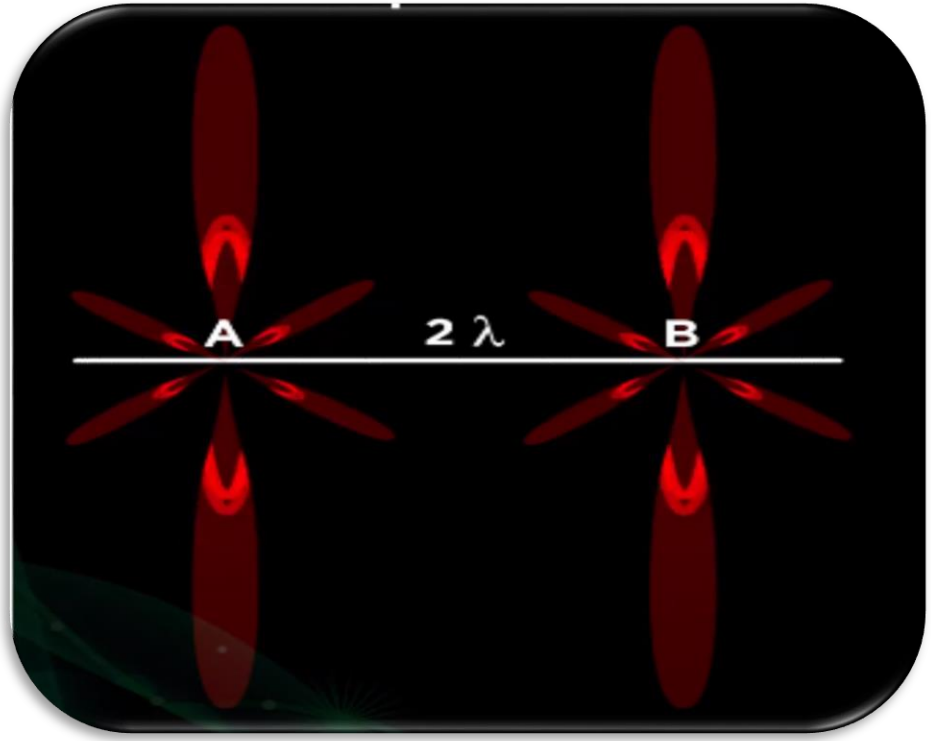


RADIATION PATTERN OF 8-ISOTROPIC ELEMENTS FED IN PHASE, SPACED λ/2 APART:



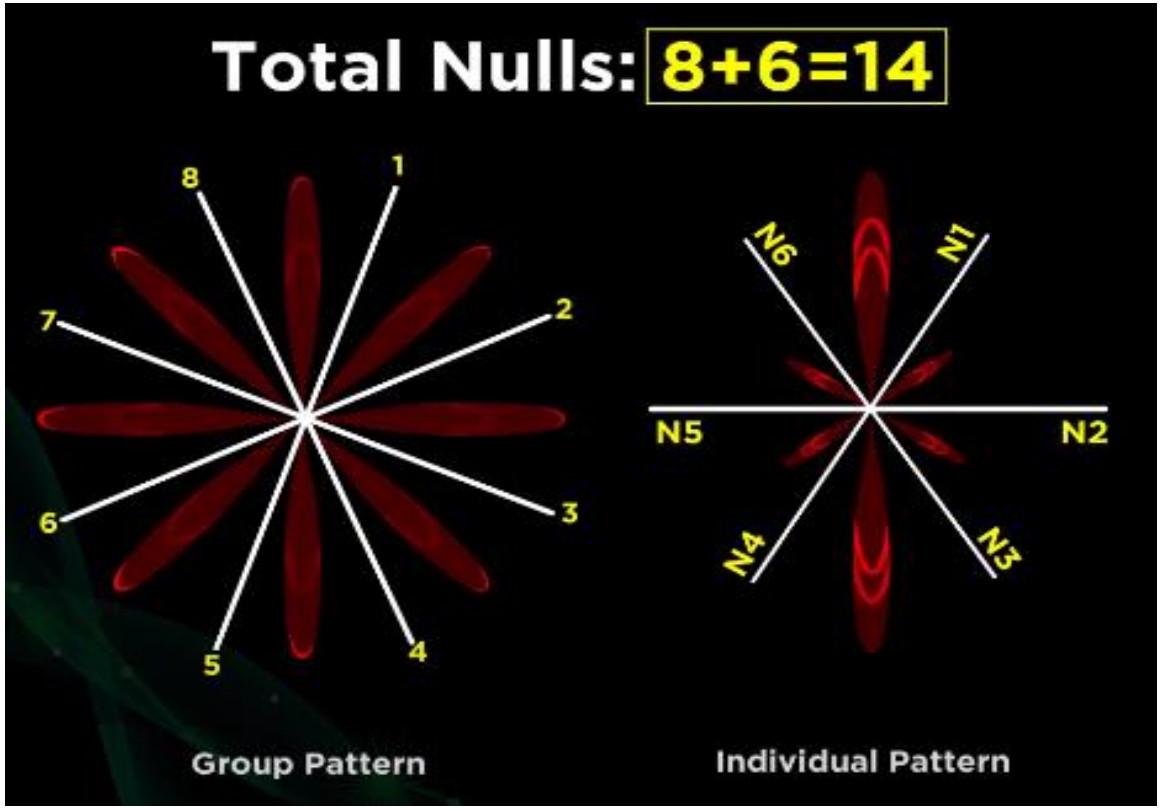


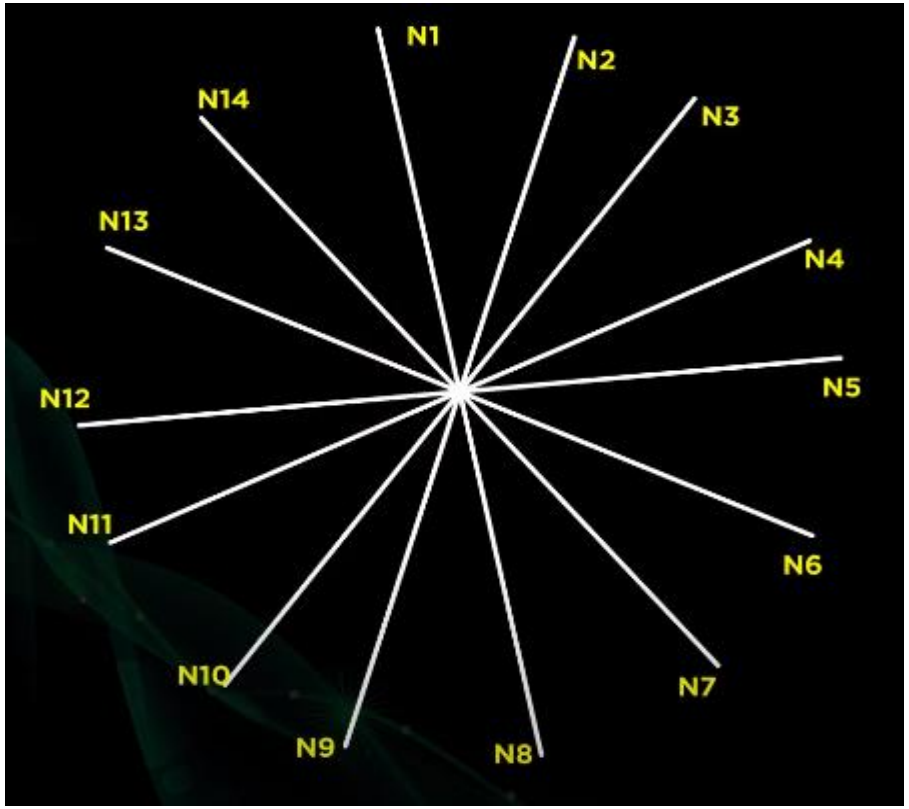
Individual Pattern


A
2 λ
B

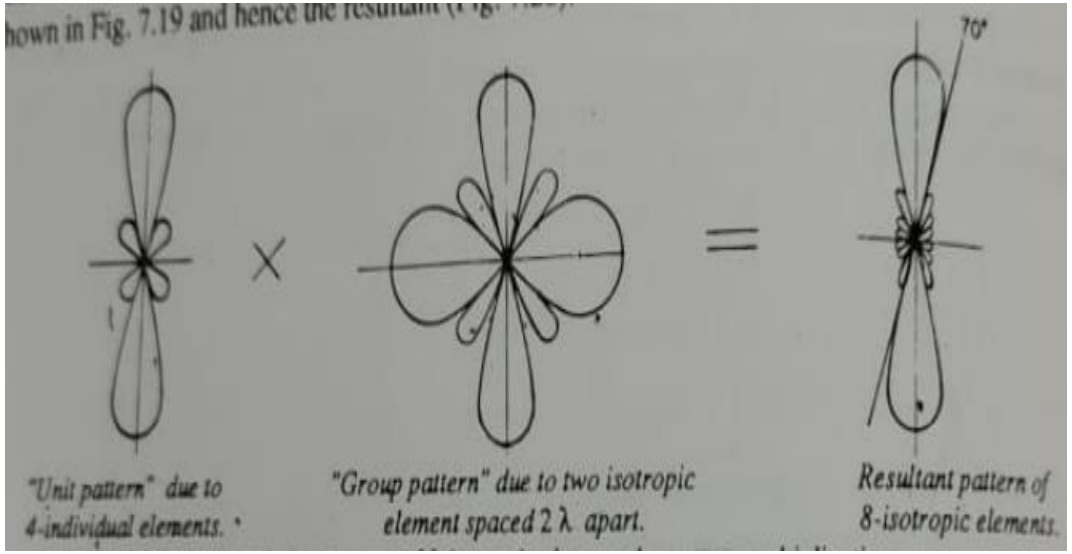
Group Pattern

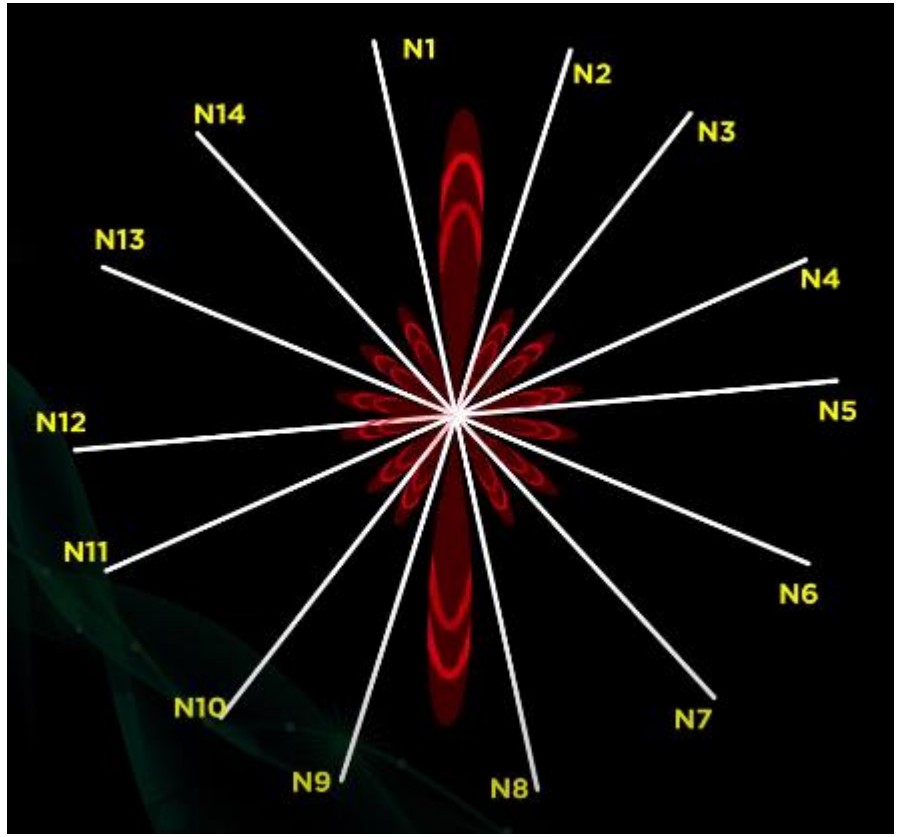
NULLS:


Total Nulls: 8+6=14
8
1
7
2
6
3
5
4
N6
N1
N5
N2
N4
N3
Group Pattern
Individual Pattern


N1
N2
N14
N3
N13
N4
N5
N12
N11
N6
N10
N7
N9
N8

OUTPUT RADIATION PATTERN:





ADVANTAGES:

- Speedy method for sketching the pattern of complicated arrays just by inspection
- Useful tool in design of antenna arrays
- Exact and point by point multiplication of patterns of the resultant

DISADVANTAGES:

- Only applicable for arrays containing similar/ identical elements.

THANK YOU!