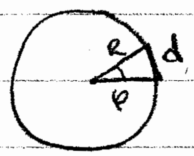
4.2.8 Uniform Circular Array

$R = 4\lambda \qquad d = 0.4\lambda$



$$d = 2R\sin(\varphi/2) = 2R\sin(\pi/N) \approx 2R\pi/N \text{ for } N \text{ large}$$

$$N \approx \frac{2\pi R}{d} = \frac{2\pi(4\lambda)}{0.4\lambda} = 20\pi \approx 63$$

let $N=63$, $d = 2(4\lambda)\sin(\pi/63) = 0.3988\lambda$

with $R=4\lambda$, we can excite $N_p = 2M+1$ phase modes with $M = 2\pi\frac{R}{\lambda} = 25$, $N_p = 51 < 63$ ✓

a) $\theta = \pi/2$ in x-y plane $\sin(\pi/2) = 1$

$$W_{hamm}(m) = 0.54 + 0.46\cos\left(\frac{2\pi m}{N_p}\right)$$

$$m = -\frac{(N_p-1)}{2} : 1 : \frac{(N_p-1)}{2}$$

The derivation in section 4.2.3 provides the relationship between the phase mode weights and the array weights

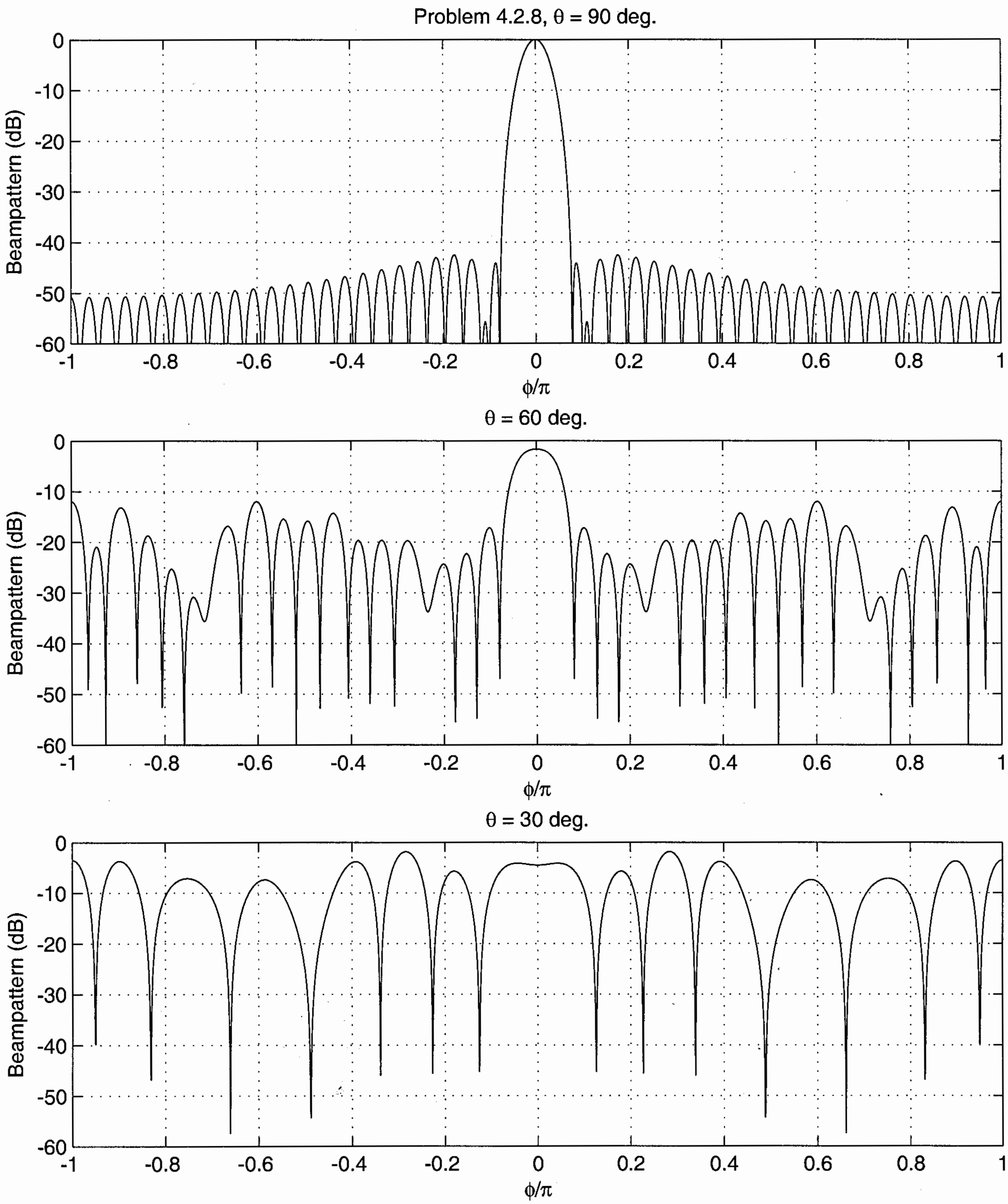
$$\underset{(N\times 1)}{w} = \underset{N\times N_p}{B_1}\ \underset{N_p\times N_p}{H}\ \underset{N_p\times 1}{w_{hamm}(m)}$$

$$B_{1,nm} = \frac{1}{\sqrt{N}} e^{-j\frac{2\pi}{N}nm} \qquad H_{k\ell} = \begin{cases} \dfrac{1}{(-j)^k J_k(2\pi R/\lambda\sin\theta)} & k=\ell \\ 0 & k\neq\ell \end{cases}$$

Plots attached

- at $\theta = \frac{\pi}{2}$ (90°) get regular ($N_p = 51$) Hamming pattern
- at other elevations $\theta = 60°$, $\theta = 30°$, degradation in pattern
- 3-D plot shows $B(\theta, \phi)$

4.2.8 3



Problem 4.2.8, θ = 90 deg.
Beampattern (dB)
φ/π
θ = 60 deg.
Beampattern (dB)
φ/π
θ = 30 deg.
Beampattern (dB)
φ/π

4.2.8 (4)

Problem 4.2.8