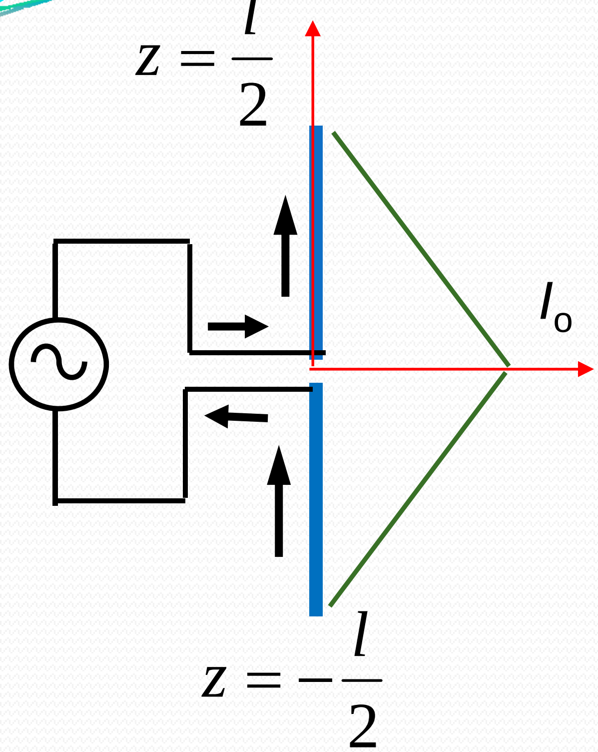
Isi Pembahasan Week 4:

Antena Dipol Pendek

Antena Dipol Panjang

Dipol Pendek

panjang dipol $\frac{\lambda}{50} < l \leq \frac{\lambda}{10}$



Aproksimasi arus yang mengalir di sana

$$I(z') = \begin{cases} I_o \cdot \left(1 - \frac{2z'}{l}\right) \text{untuk } 0 \leq z' \leq \frac{l}{2} \\ I_o \cdot \left(1 + \frac{2z'}{l}\right) \text{untuk } -\frac{l}{2} \leq z' \leq 0 \end{cases}$$

$$\vec{A}(\vec{r}) = \frac{\mu \vec{a}_z}{4\pi} \left(\int_0^{l/2} \frac{I_o \cdot \left(1 - \frac{2z'}{l}\right) e^{-jk|\vec{r}-\vec{r}'|}}{|\vec{r}-\vec{r}'|} dz' + \int_{-l/2}^{0} \frac{I_o \cdot \left(1 + \frac{2z'}{l}\right) e^{-jk|\vec{r}-\vec{r}'|}}{|\vec{r}-\vec{r}'|} dz' \right)$$

untuk pengamatan far field

$$\vec{A}(\vec{r}) = \frac{\mu I_o \vec{a}_z}{4\pi}\left(\int_0^{l/2}\left(1-\frac{2z'}{l}\right)dz' + \int_{-l/2}^{0}\left(1+\frac{2z'}{l}\right)dz'\right)\frac{e^{-jkr}}{r}$$

$$\vec{A}(\vec{r}) = \frac{1}{2}\frac{\mu I_o}{4\pi}\frac{e^{-jkr}}{r}\vec{a}_z$$

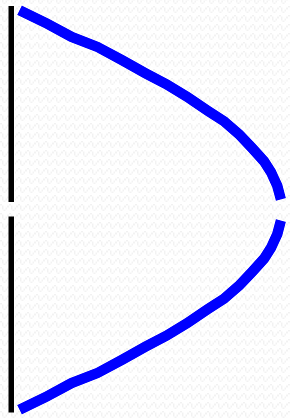
Hasil ini sama dengan hasil pada dipol Hertz, karena aproksimasi nya sama. Yang berbeda adalah faktor ½ pada vektor potensial magnetis, yang disebabkan oleh bentuk arus yang besar di tengah (I_o) dan nol di pinggir.

$$\vec{H} = \frac{1}{2}\cdot\frac{jk}{4\pi}\cdot I\cdot l\cdot\frac{e^{-jkr}}{r}\cdot\sin\vartheta\cdot\vec{a}_\varphi = H_\varphi\vec{a}_\varphi$$

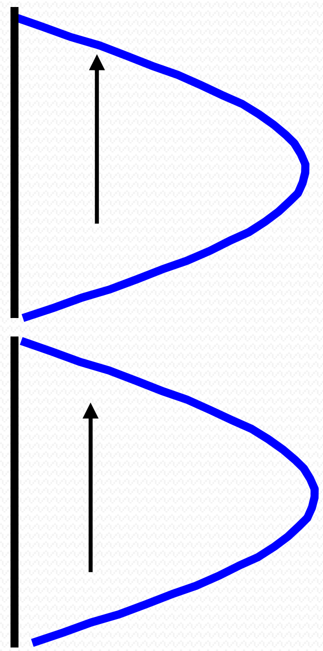
$$\vec{E} = Z_o\cdot H_\varphi\cdot\vec{a}_\vartheta$$

Pada antena panjang mengalir arus yang bisa didekatkan dengan fungsi sinus (dengan nilai batas, pada ujung antena selalu arus nol)

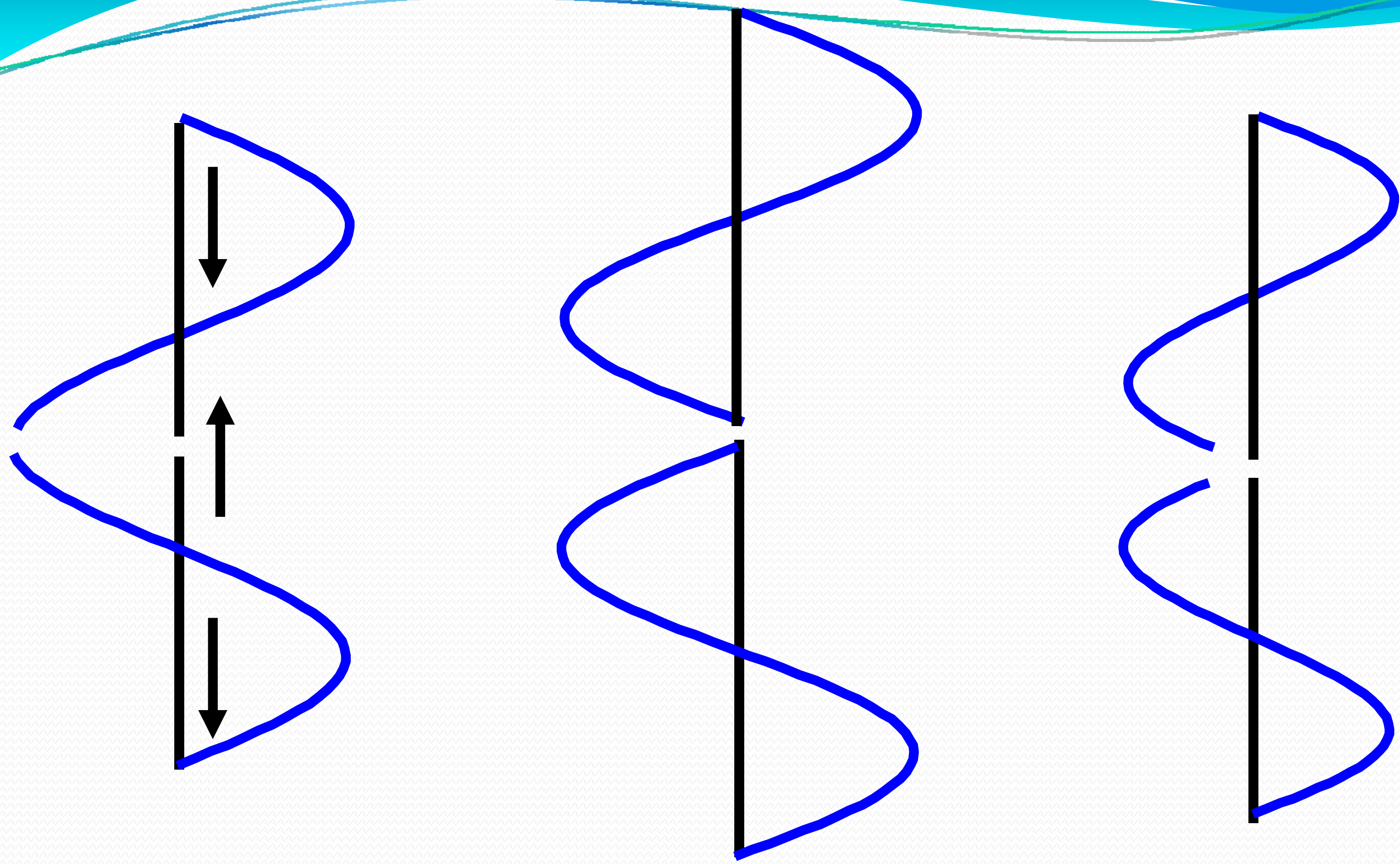
$$I(z') = \begin{cases} I_o \cdot \sin\left(k\left(\frac{l}{2} - z'\right)\right) \text{untuk } 0 \le z' \le \frac{l}{2} \\ I_o \cdot \sin\left(k\left(\frac{l}{2} + z'\right)\right) \text{untuk } -\frac{l}{2} \le z' \le 0 \end{cases}$$



$$l = \frac{\lambda}{2}$$



$$l = \lambda$$

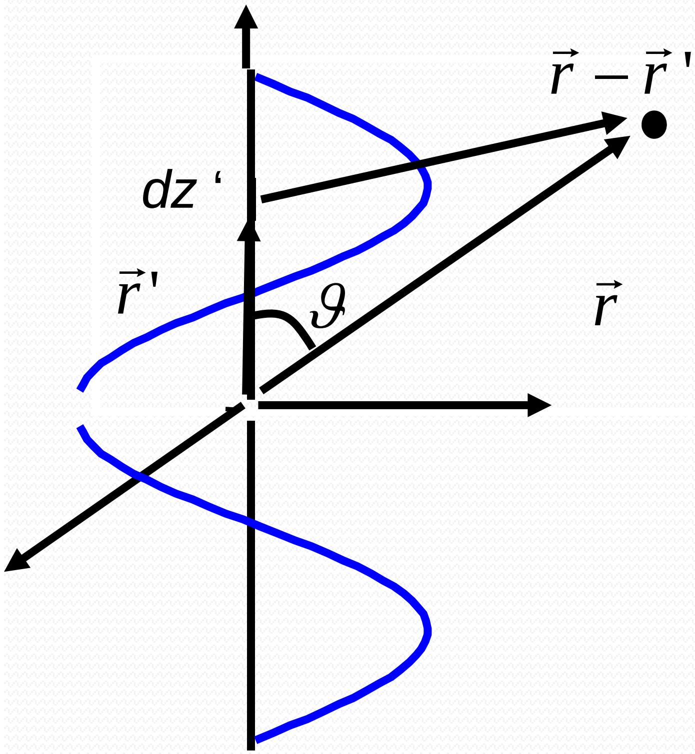


$$l = \frac{3\lambda}{2}$$

$$l = 2\lambda$$

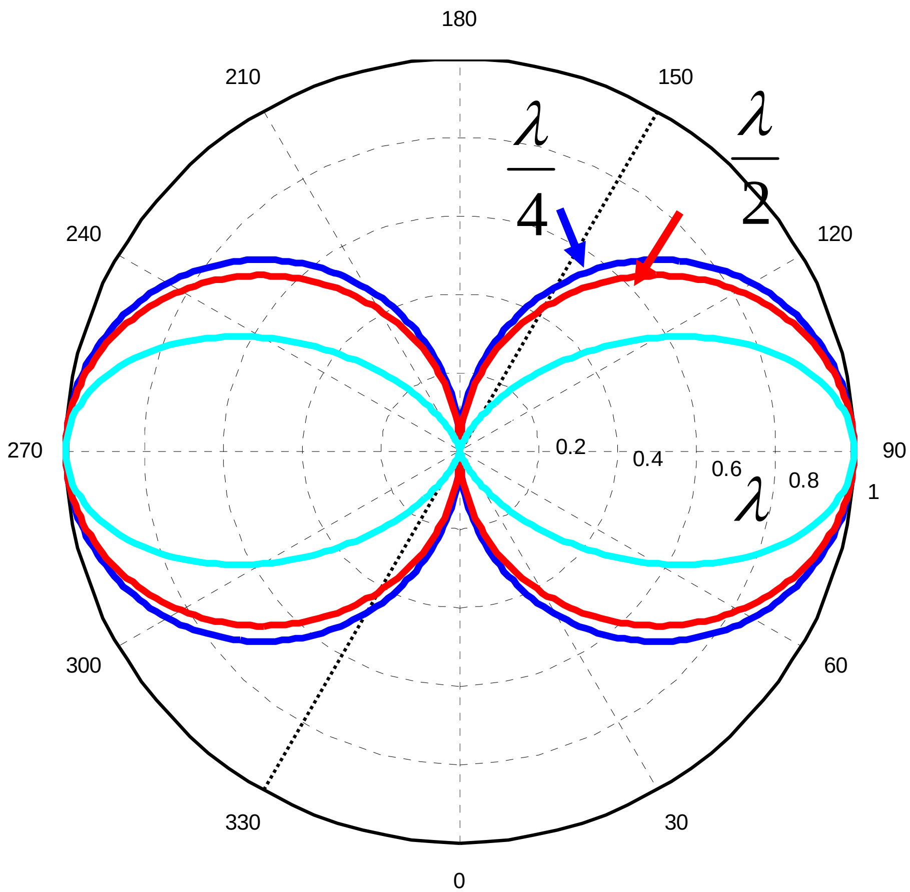
$$\frac{3\lambda}{2} < l < 2\lambda$$

$$\vec{A}(\vec{r}) = \frac{\mu}{4\pi}\int_L \frac{I(\vec{r}\,')\cdot\vec{a}_l(\vec{r}\,')\,e^{-jk|\vec{r}-\vec{r}\,'|}}{|\vec{r}-\vec{r}\,'|}\,dl'$$

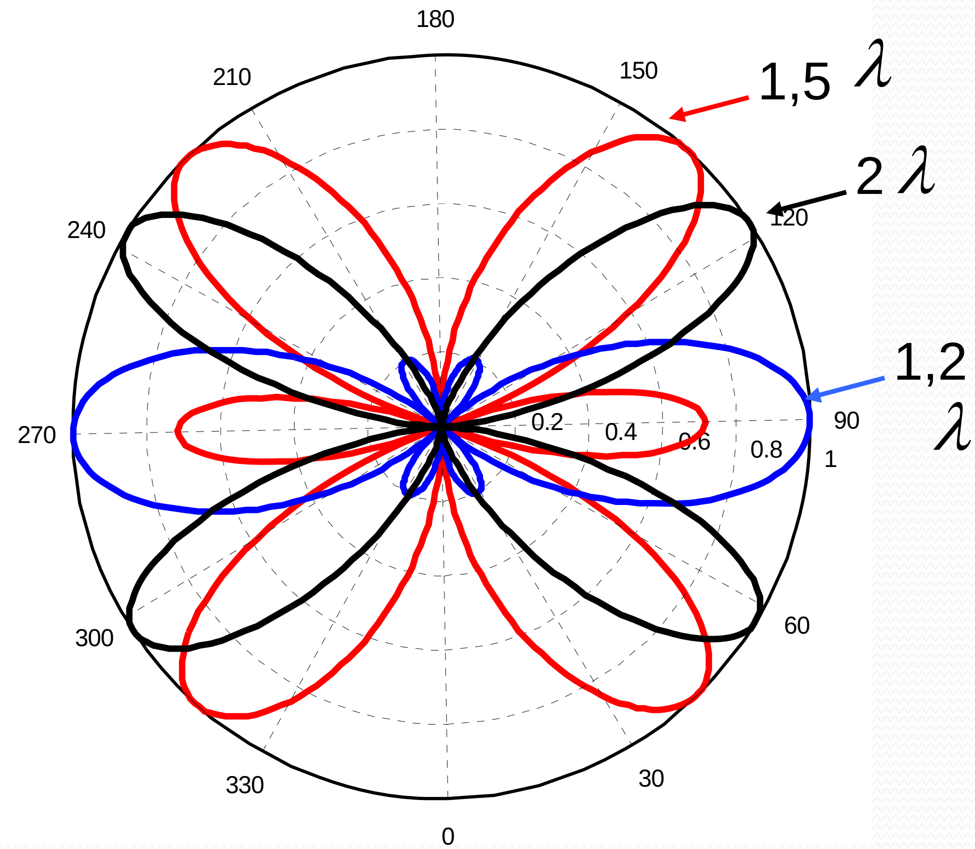


$$H_\varphi = j\frac{I_o}{2\pi}\frac{e^{-jkr}}{r}\left[\frac{\cos\left(\pi\frac{l}{\lambda}\cos\vartheta\right)-\cos\left(\pi\frac{l}{\lambda}\right)}{\sin\vartheta}\right]$$

$$E_\vartheta = Z_o\cdot H_\varphi$$

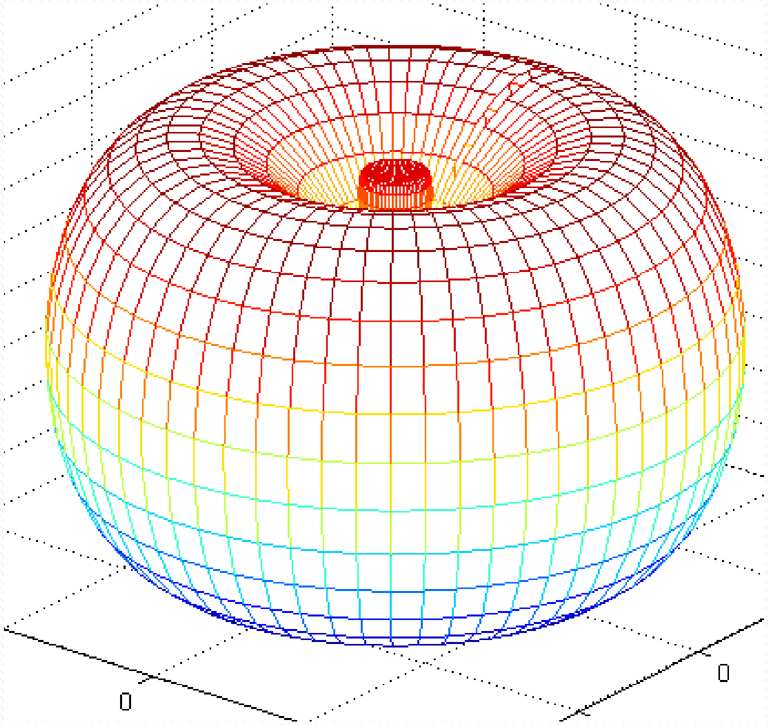


180
210
150
240
120
270
90
300
60
330
30
0
0.2
0.4
0.6
0.8
1
λ/4
λ/2
λ

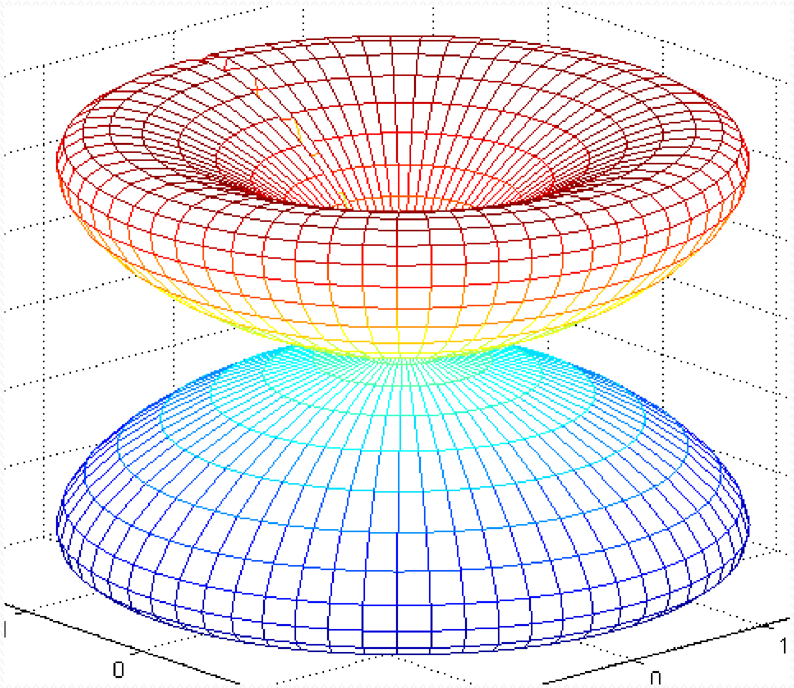


180
210
150
240
120
270
90
300
60
330
30
0
0.2
0.4
0.6
0.8
1
1,5 λ
2 λ
1,2 λ

$l = 1{,}2\lambda$



$l = 2\lambda$



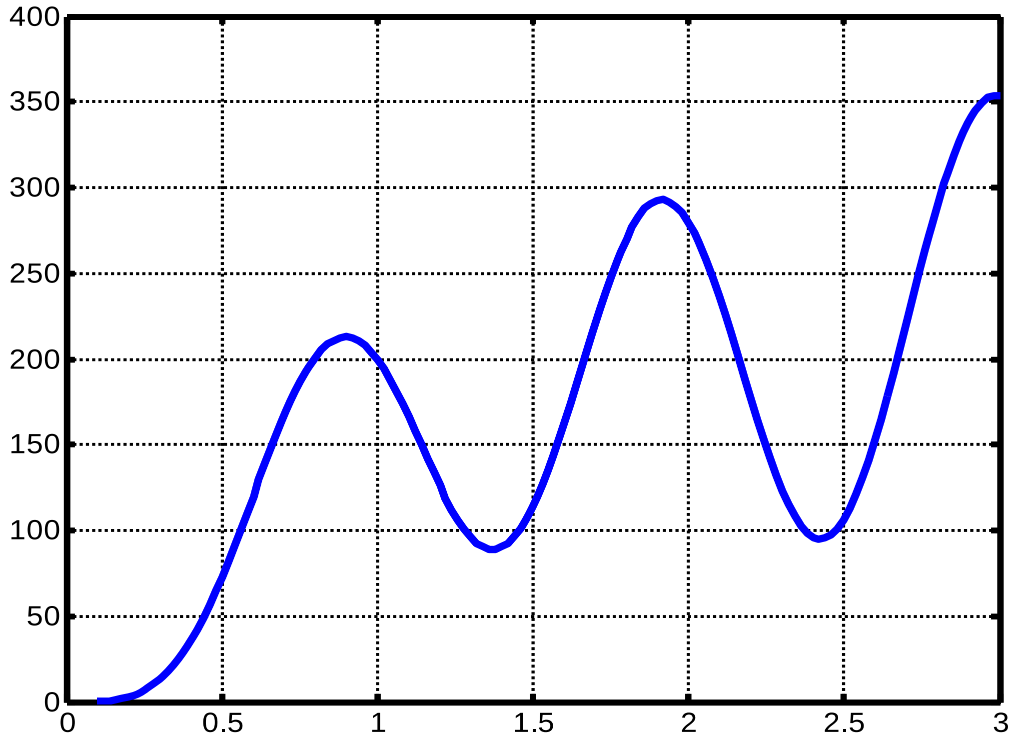
Half – Power Beam Width

Panjang dipol (dalam λ)	hpbw
0,01	90^o
0,25	87^o
0,5	78^o
0,75	64^o
1,0	47,8^o
1,2	35,5^o (terbentuk side lobe)

Resistansi Radiasi

$$R_{rad} = \frac{2P}{I_o^{\;2}} = \frac{1}{2\pi} Z_o \int_0^{\pi} \frac{1}{\sin\vartheta} \left[\cos\left(\pi \frac{l}{\lambda} \cos\vartheta\right) - \cos\left(\pi \frac{l}{\lambda}\right) \right]^2 d\vartheta$$

Resistansi radiasi (Ω)

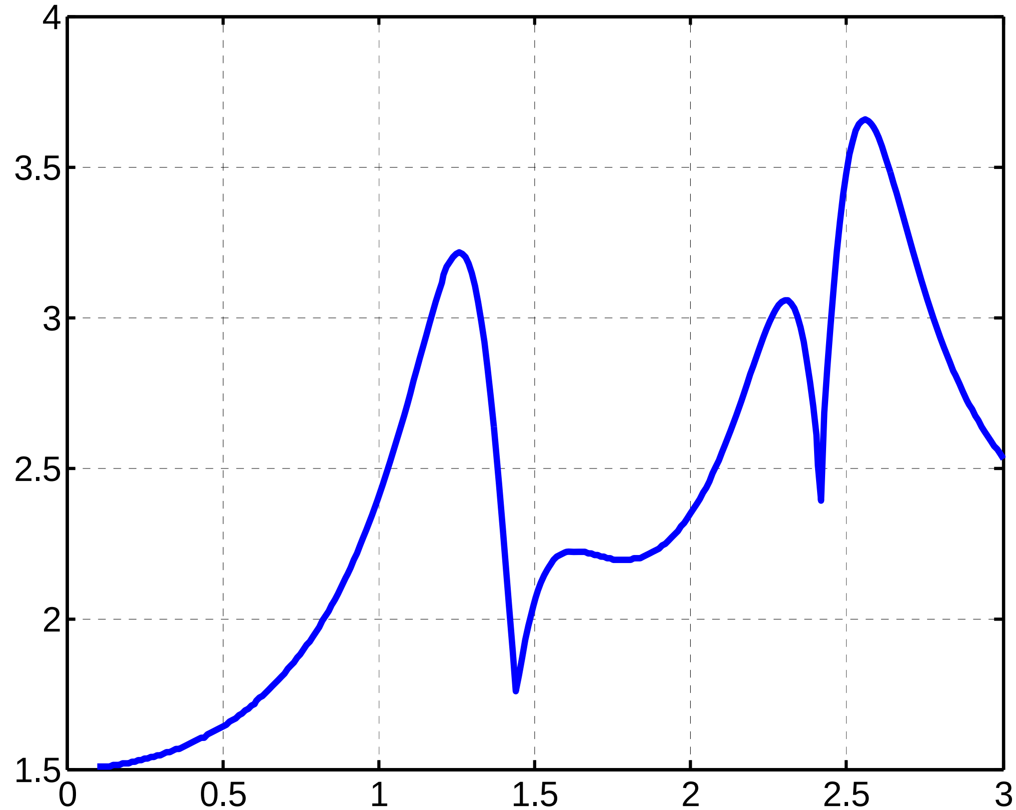


Panjang antena dalam (λ)

Direktivitas Antenna

$$D_o = 2\left[\frac{\cos\left(\pi\frac{l}{\lambda}\cos\vartheta\right)-\cos\left(\pi\frac{l}{\lambda}\right)}{\sin\vartheta}\right]^2 \Bigg/ \int_0^{\pi}\frac{1}{\sin\vartheta}\left[\cos\left(\pi\frac{l}{\lambda}\cos\vartheta\right)-\cos\left(\pi\frac{l}{\lambda}\right)\right]^2 d\vartheta$$

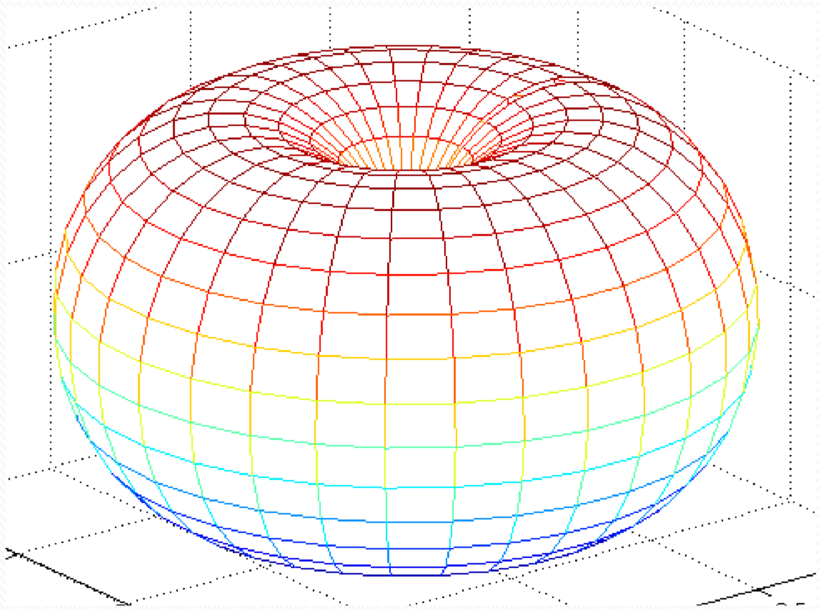
direktivitas



Dipol Setengah Gelombang (Dipol λ/2)

$$H_{\varphi} = j\frac{I_o}{2\pi}\frac{e^{-jkr}}{r}\frac{\cos\left(\frac{\pi}{2}\cos\vartheta\right)}{\sin\vartheta}$$

$$E_{\vartheta} = Z_o \cdot H_{\varphi}$$



Resistansi Radiasi

$$R_{rad} = \frac{2P}{I_o^{\,2}} = \frac{1}{2\pi} Z_o \int_0^{\pi} \frac{1}{\sin\vartheta} \cos^2\left(\frac{\pi}{2}\cos\vartheta\right) d\vartheta \approx 73\Omega$$

Direktivitas

$$D_o = \frac{2\left[\dfrac{\cos\left(\dfrac{\pi}{2}\cos\vartheta\right)}{\sin\vartheta}\right]^2\Bigg|_{\max}}{\displaystyle\int_0^{\pi} \frac{1}{\sin\vartheta}\cos^2\left(\frac{\pi}{2}\cos\vartheta\right) d\vartheta} = \frac{2}{0{,}8219} \approx 1{,}644$$