Aperturantennen

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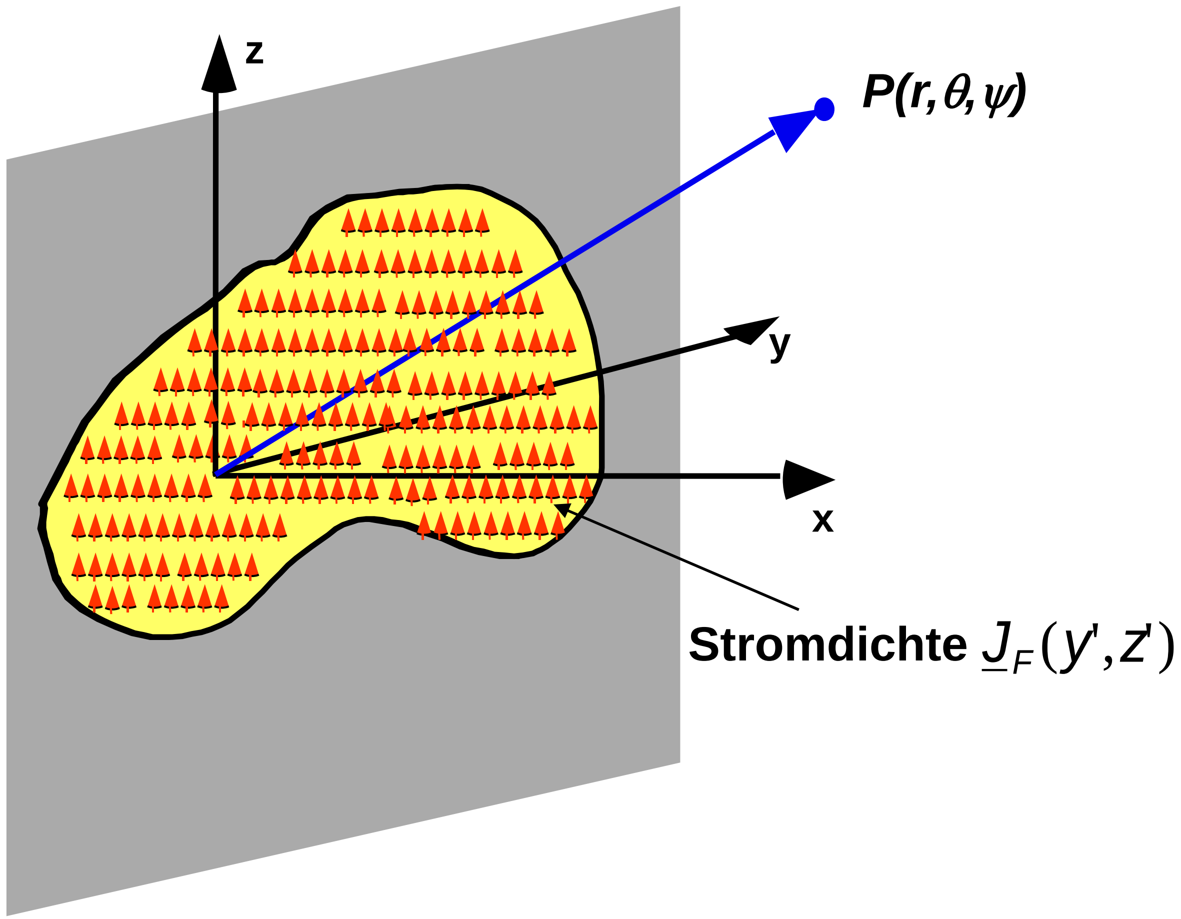
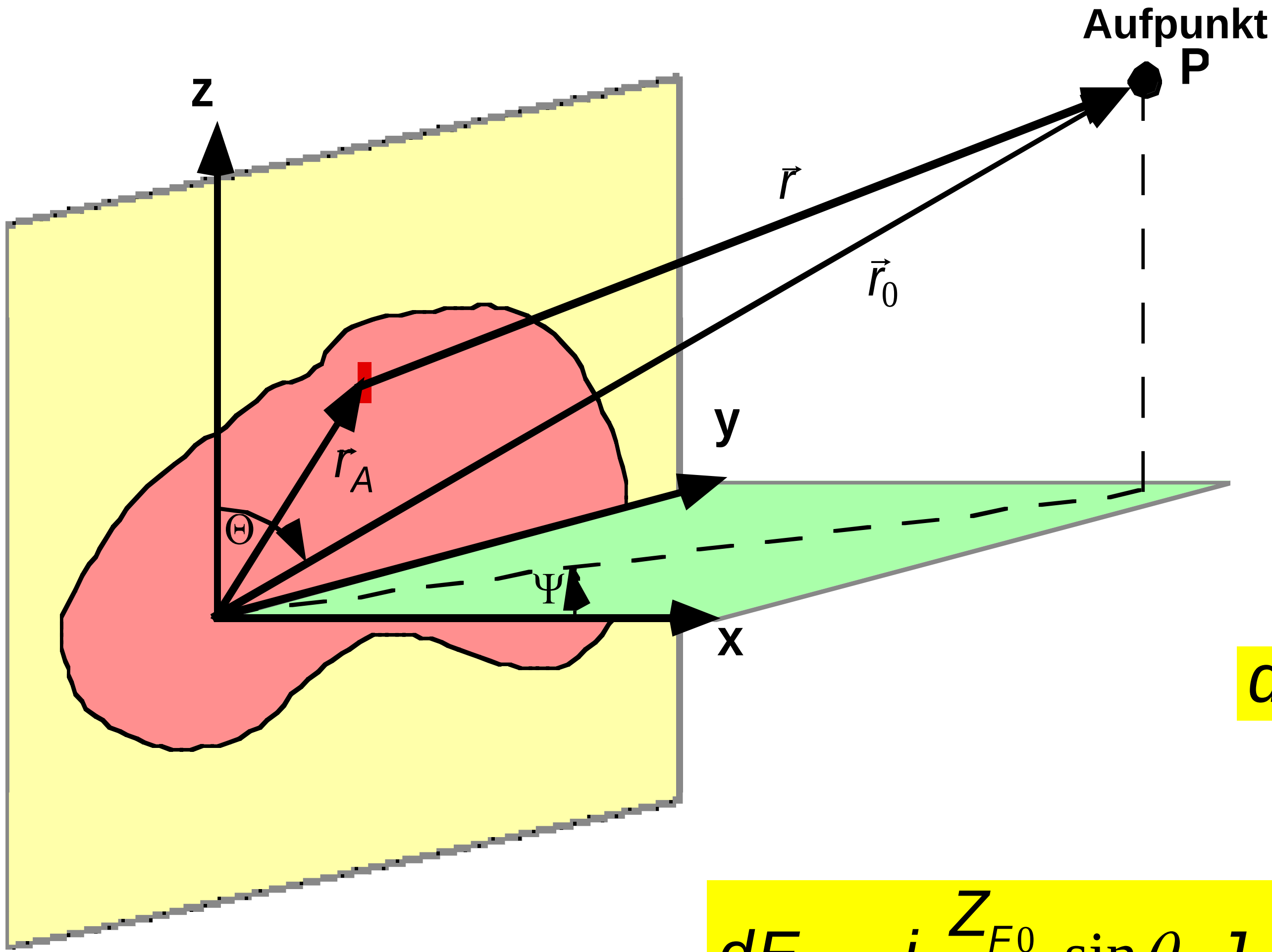
Definition Aperturantennen



Flächenstrahler, Koordinatensystem



$$d\underline{I} = \underline{J}_F(y',z')\,dy'\,dz'$$

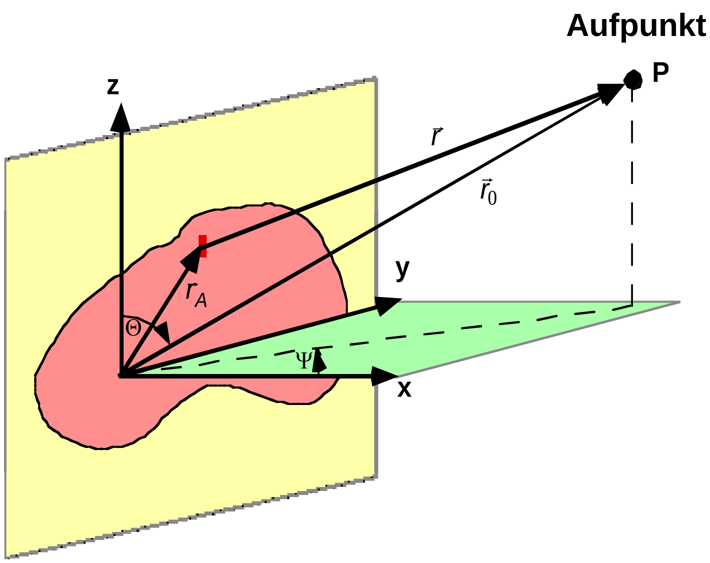
$$d\underline{E}_\theta = j\,\frac{Z_{F0}}{2r\lambda_0}\sin\theta\cdot\underline{J}_F(y',z')\cdot e^{-j\beta_0 r}\,dy'\,dz'$$

Flächenstrahler, Koordinatensystem

$$d\underline{E}_\theta = j\frac{Z_{F0}}{2r\lambda_0}\sin\theta\cdot\underline{J}_F(y',z')\cdot e^{-j\beta_0 r}dy'dz'$$

$$\underline{E}_\theta = \iint_A j\frac{Z_{F0}}{2r\lambda_0}\sin\theta\underline{J}_F(y',z')\cdot e^{-j\beta_0 r}dy'dz'$$

$$r = r_0 - \Delta r = r_0 - y'\sin\psi\sin\theta - z'\cos\theta$$

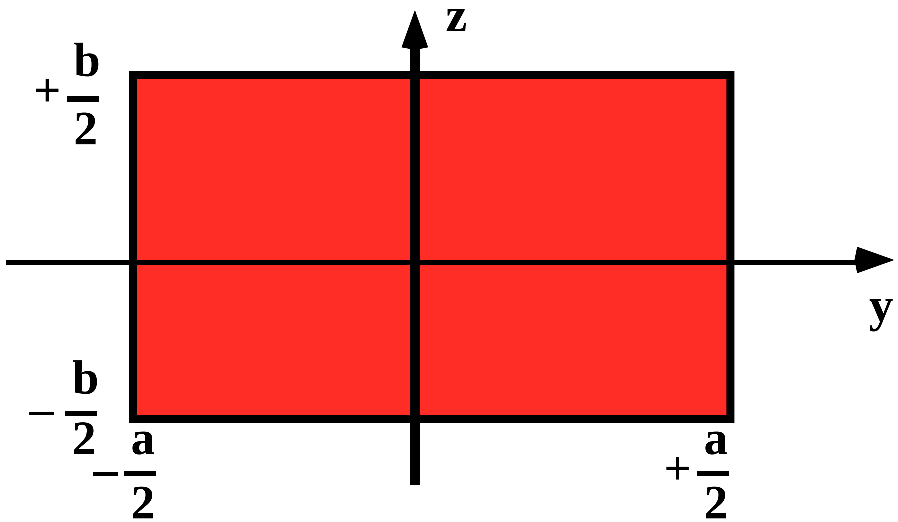


$$\underline{E}_{\theta S} = j\frac{Z_{F0}}{2r_0\lambda_0}e^{-j\beta_0 r_0}\underbrace{\sin\theta}_{F_E}\iint_A \underbrace{e^{j\beta_0(y'\sin\psi\sin\theta)}\underline{J}_F(y',z')}_{Horizontaldiagramm}\cdot e^{j\beta_0(z'\cos\theta)}dy'dz'$$

Vertikaldiagramm

- $A_w \rightarrow ab$ für Rechteck mit $a>>\lambda_0$ und $b>>\lambda_0$

Die rechteckige Aperturantenne

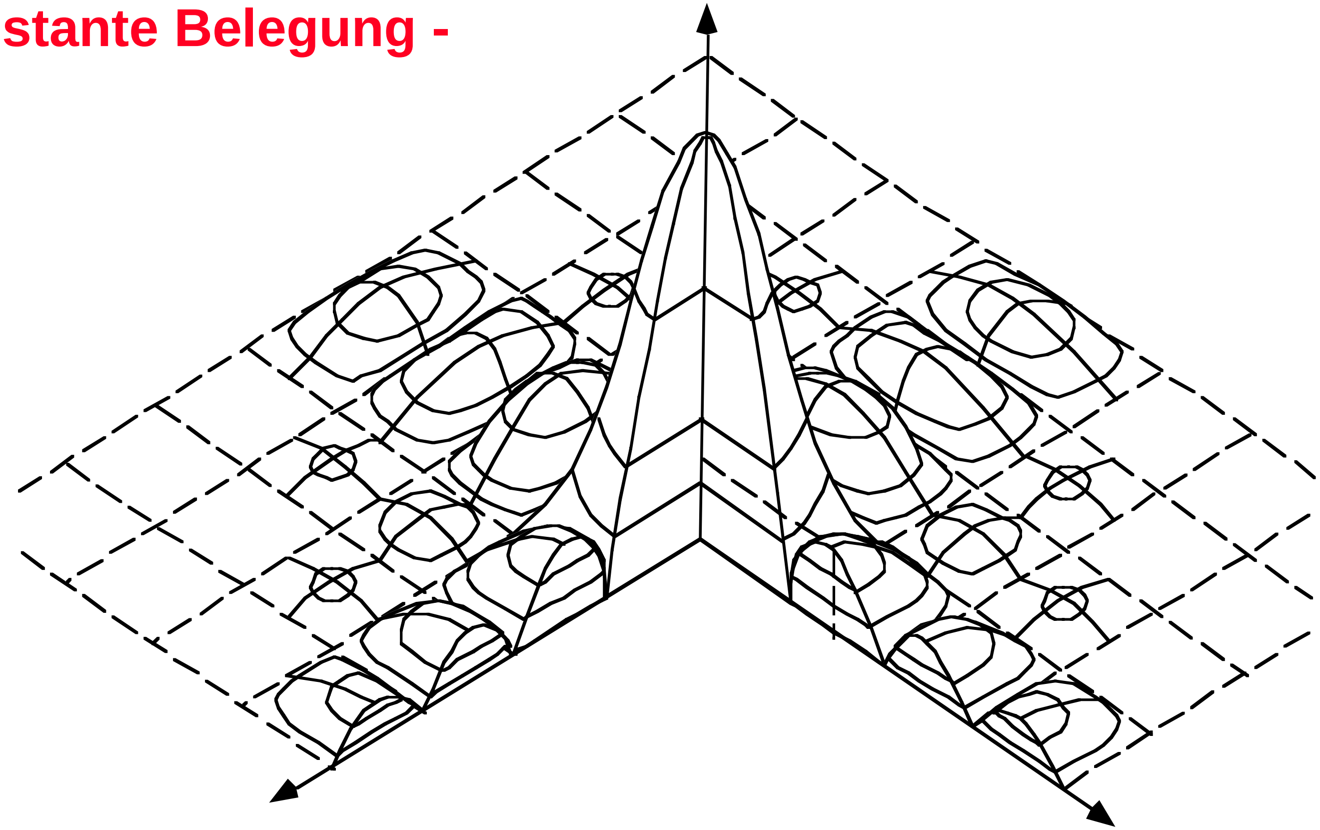


$$\underline{E}_{\theta S} = j\frac{Z_{F0}J_{F0}}{2r_0\lambda_0} e^{-j\beta_0 r_0}\sin\theta \int\limits_{y'=-\frac{a}{2}}^{y'=+\frac{a}{2}} e^{j\beta_0 y'\sin\psi\sin\theta}\,dy' \cdot \int\limits_{z'=-\frac{b}{2}}^{z'=+\frac{b}{2}} e^{j\beta_0 z'\cos\theta}\,dz'$$

$$\underline{E}_{\theta S} = j\frac{Z_{F0}J_{F0}}{2r_0\lambda_0} e^{-j\beta_0 r_0}\sin\theta\, ab \cdot \frac{\sin\left(\frac{\pi a}{\lambda_0}\sin\psi\sin\theta\right)}{\frac{\pi a}{\lambda_0}\sin\psi\sin\theta} \cdot \frac{\sin\left(\frac{\pi b}{\lambda_0}\cos\theta\right)}{\frac{\pi b}{\lambda_0}\cos\theta} = K\sin\theta \cdot \underbrace{\frac{\sin\zeta_a}{\zeta_a} \cdot \frac{\sin\zeta_b}{\zeta_b}}_{=F_{Gr}}$$

Charakteristik einer quadratischen Aperturantenne

- konstante Belegung -



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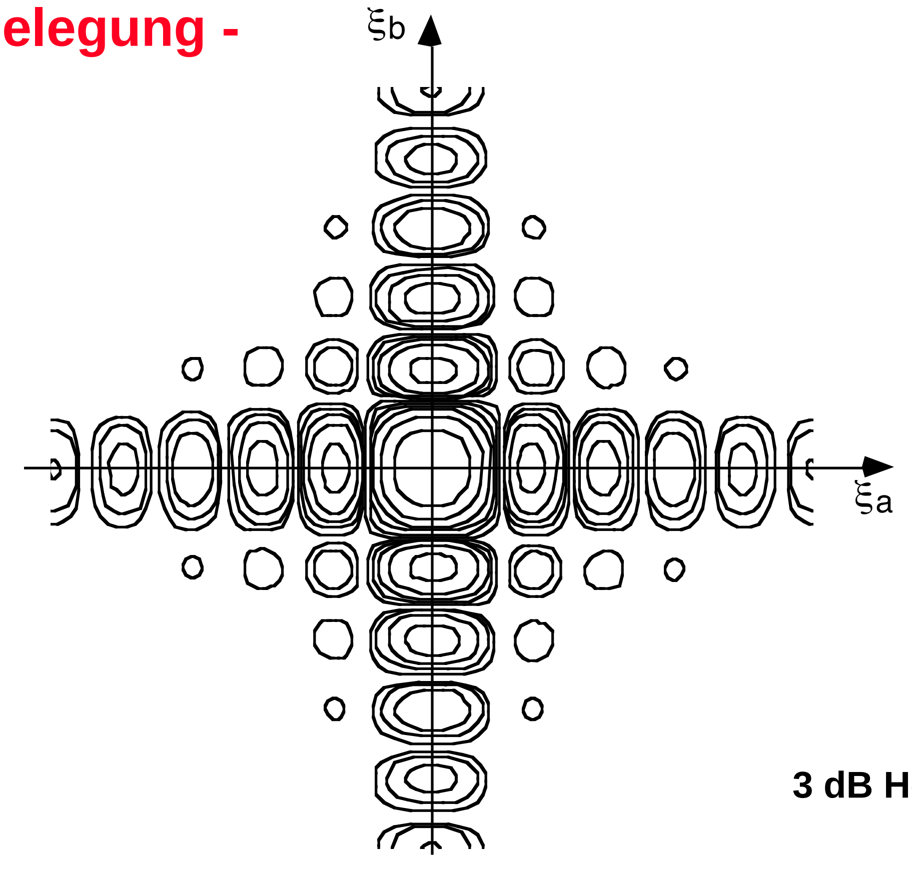
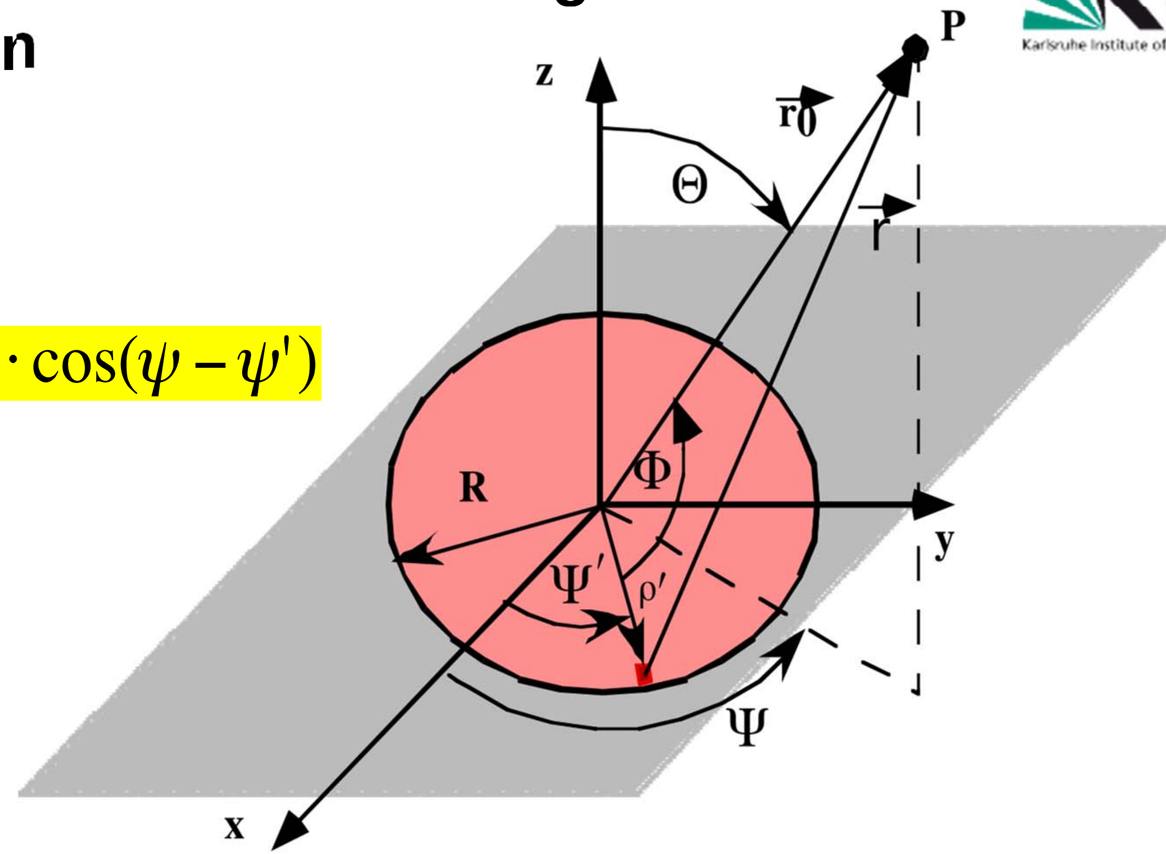
Charakteristik einer quadratischen Aperturantenne

- konstante Belegung -



3 dB Höhenlinien

Koordinatensystem für kreisförmige Aperturantennen



$$\Delta r = r_0 - r = \rho' \cdot \sin\theta \cdot \cos(\psi - \psi')$$

$$E_\theta = -j \frac{Z_{F0}}{2\lambda_0} \cos\theta \cos\psi \frac{e^{-j\beta_0 r_0}}{r_0} J_{F0} \underbrace{\int_0^{2\pi} \int_0^{R} e^{j\beta_0 \rho' \sin\theta \cos(\psi - \psi')} \rho' \, d\rho' \, d\psi'}_{= F_{Gr}}$$

Zusammenfassung Aperturantennen

Rechteckige Apertur

$$C_{Gr} = \left|\frac{\sin(\zeta_a)}{\zeta_a}\right| \cdot \left|\frac{\sin(\zeta_b)}{\zeta_b}\right|$$

$$\zeta_a = \frac{\pi a}{\lambda_0}\sin\psi\sin\theta \qquad \zeta_b = \frac{\pi b}{\lambda_0}\cos\theta$$

$$G_i = ab\frac{4\pi}{\lambda_0^2} \qquad A_w = ab \qquad \text{für } a,b >> \lambda_0$$

Kreisförmige Apertur

$$C_{Gr} = \left|\frac{2J_1(\zeta)}{\zeta}\right|$$

$$\zeta = \frac{2\pi R}{\lambda_0}\sin\theta$$

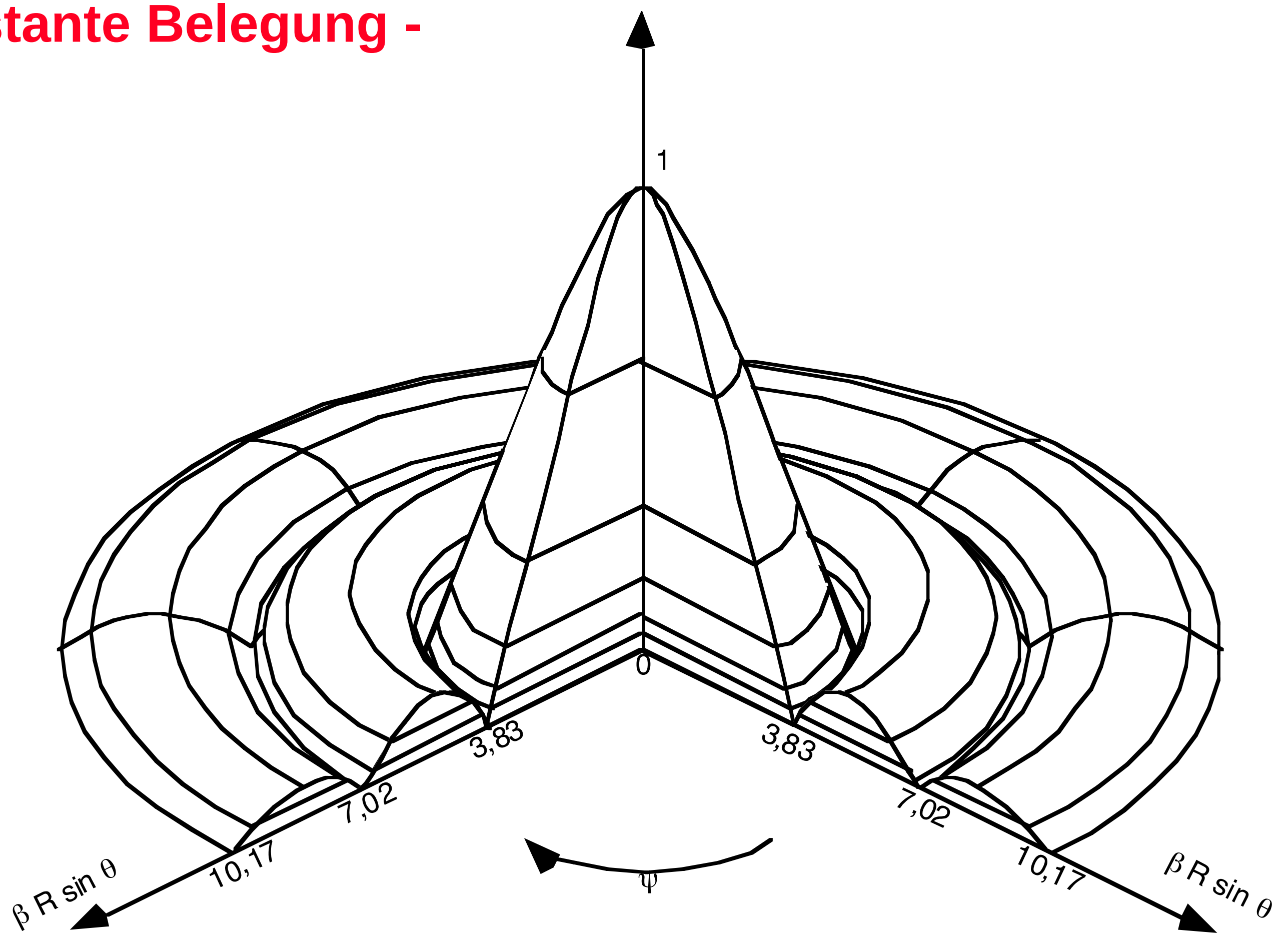
$$G_i = R^2\frac{4\pi^2}{\lambda_0^2} \qquad A_w = \pi R^2 \qquad \text{für } R >> \lambda_0$$

$$G_i = \frac{4\pi}{\int\limits_{\psi=0}^{2\pi}\int\limits_{\theta=0}^{\pi} C^2(\theta,\psi)\sin\theta\, d\theta\, d\psi}$$

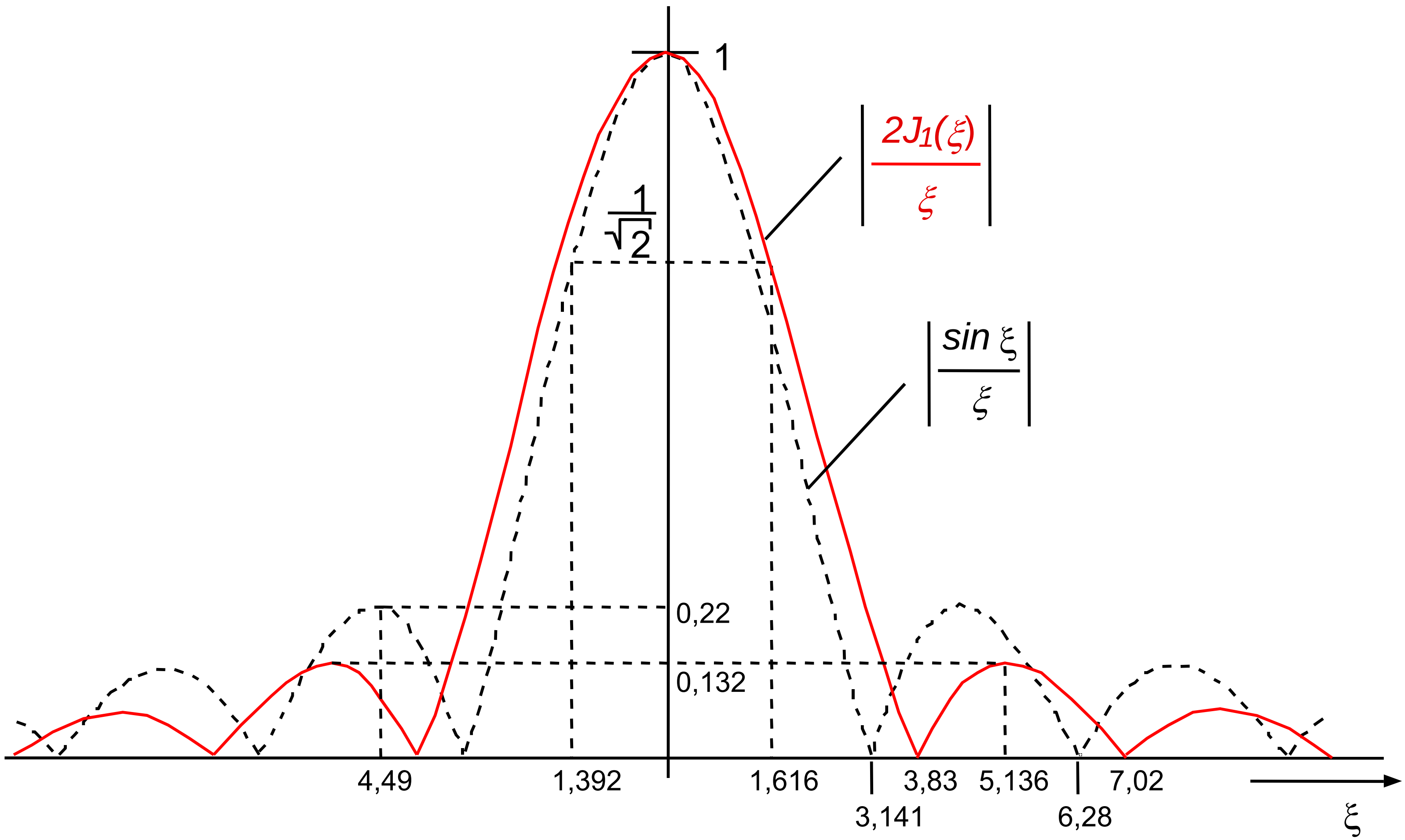
Bessel-Integral erster Ordnung: $J_1(\zeta) = \int\limits_{\tau=0}^{2\pi} e^{j(\zeta\cos\tau-\tau)}\, d\tau$

Charakteristik einer runden Aperturantenne

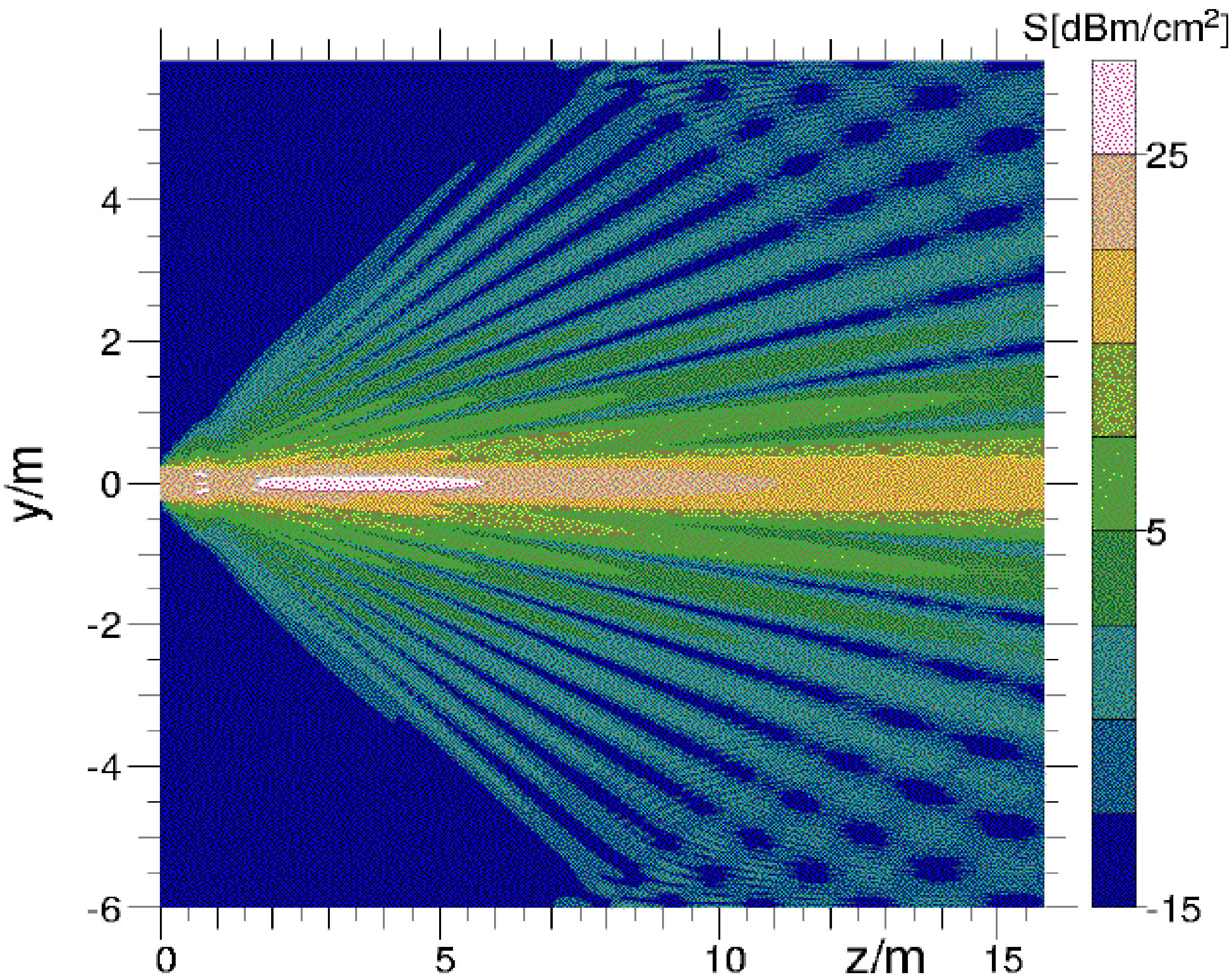
- konstante Belegung -



Spaltfunktionen bei Rechteckiger und Runder Belegung

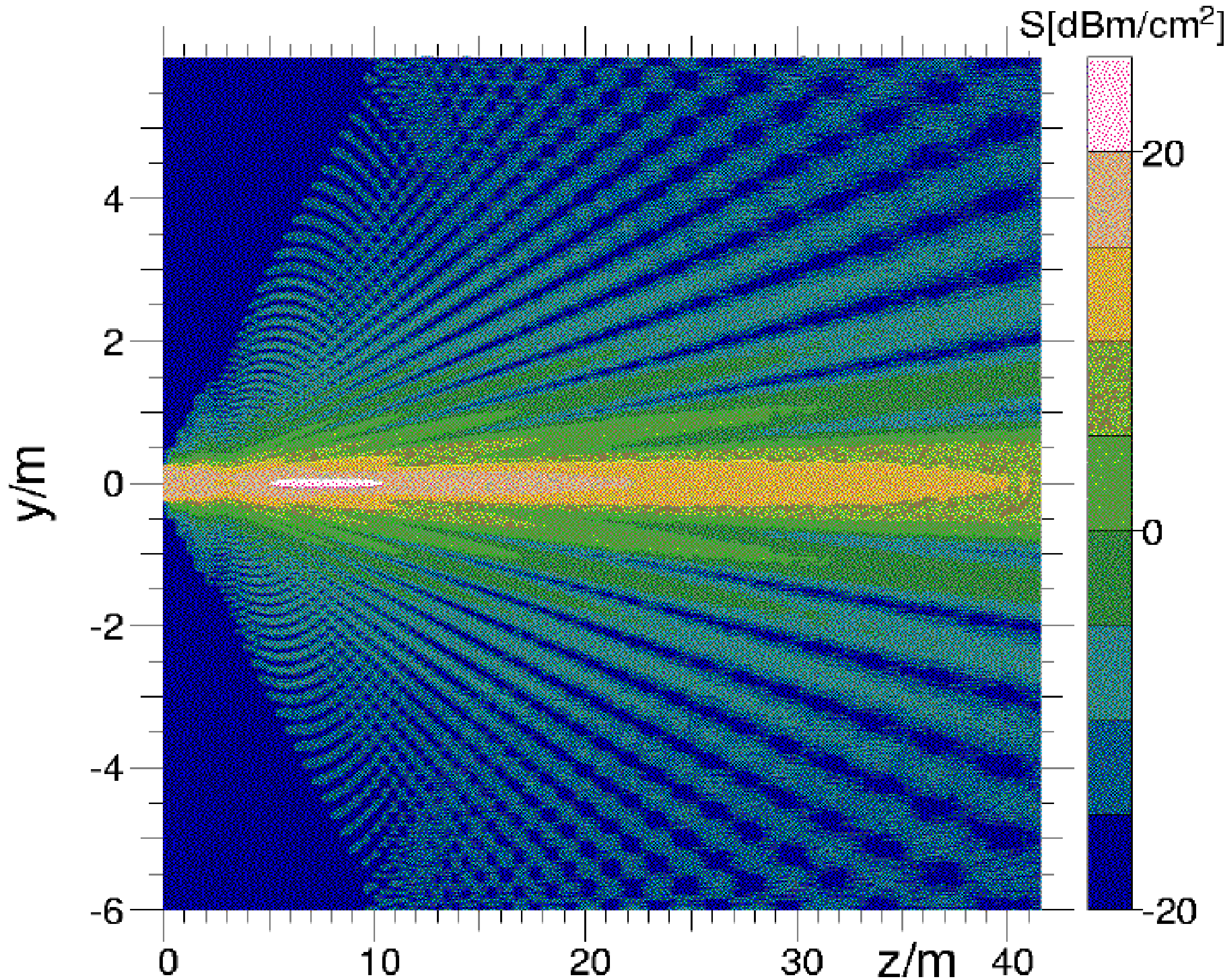


Nahfeld Quadratische Apertur Antenne



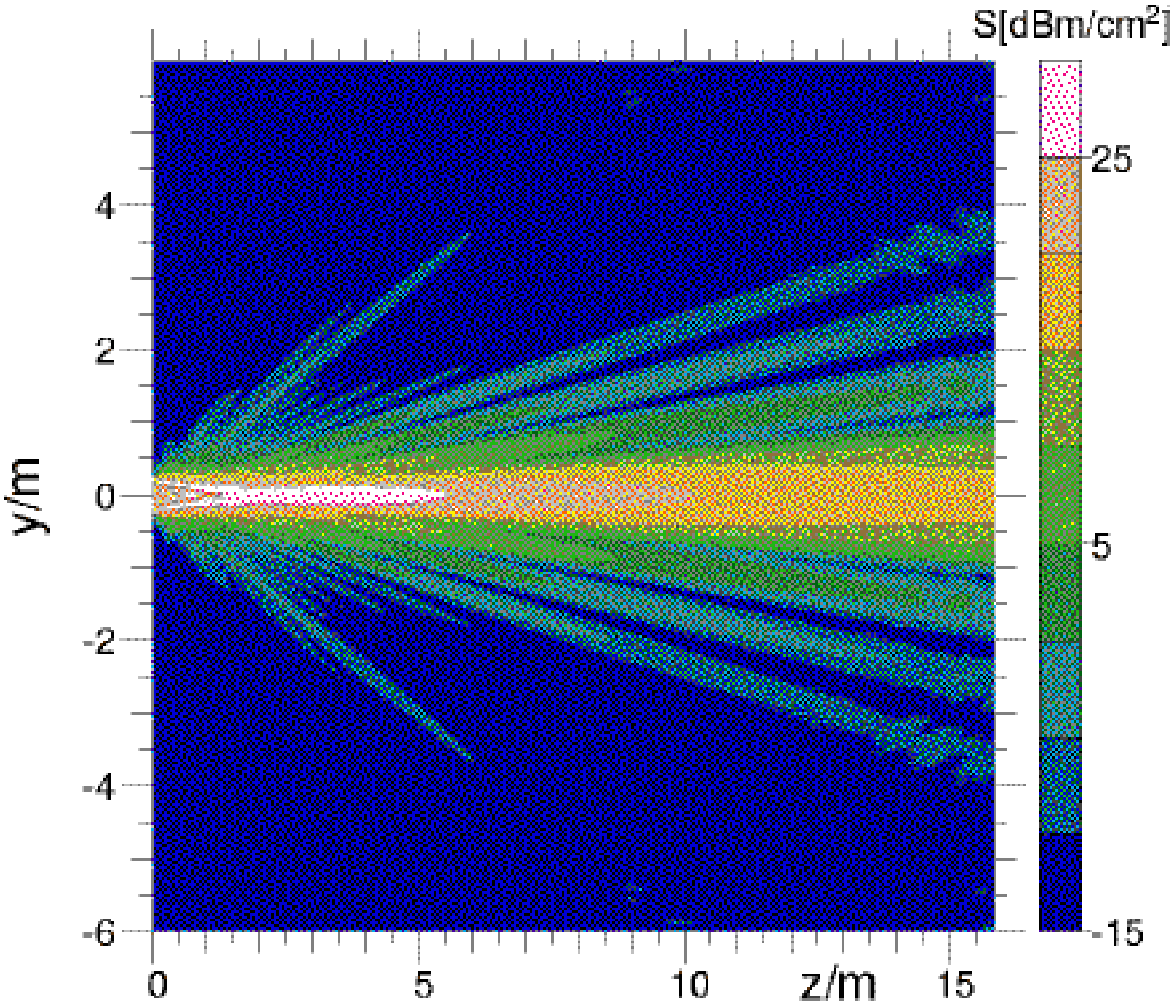
Größe:	**50 cm x 50 cm**
Belegung:	**homogen**
Sendeleistung:	**50 W**
Frequenz:	**10 GHz**
$2D^2/\lambda$:	**16,6 m**

Nahfeld Quadratische Apertur Antenne



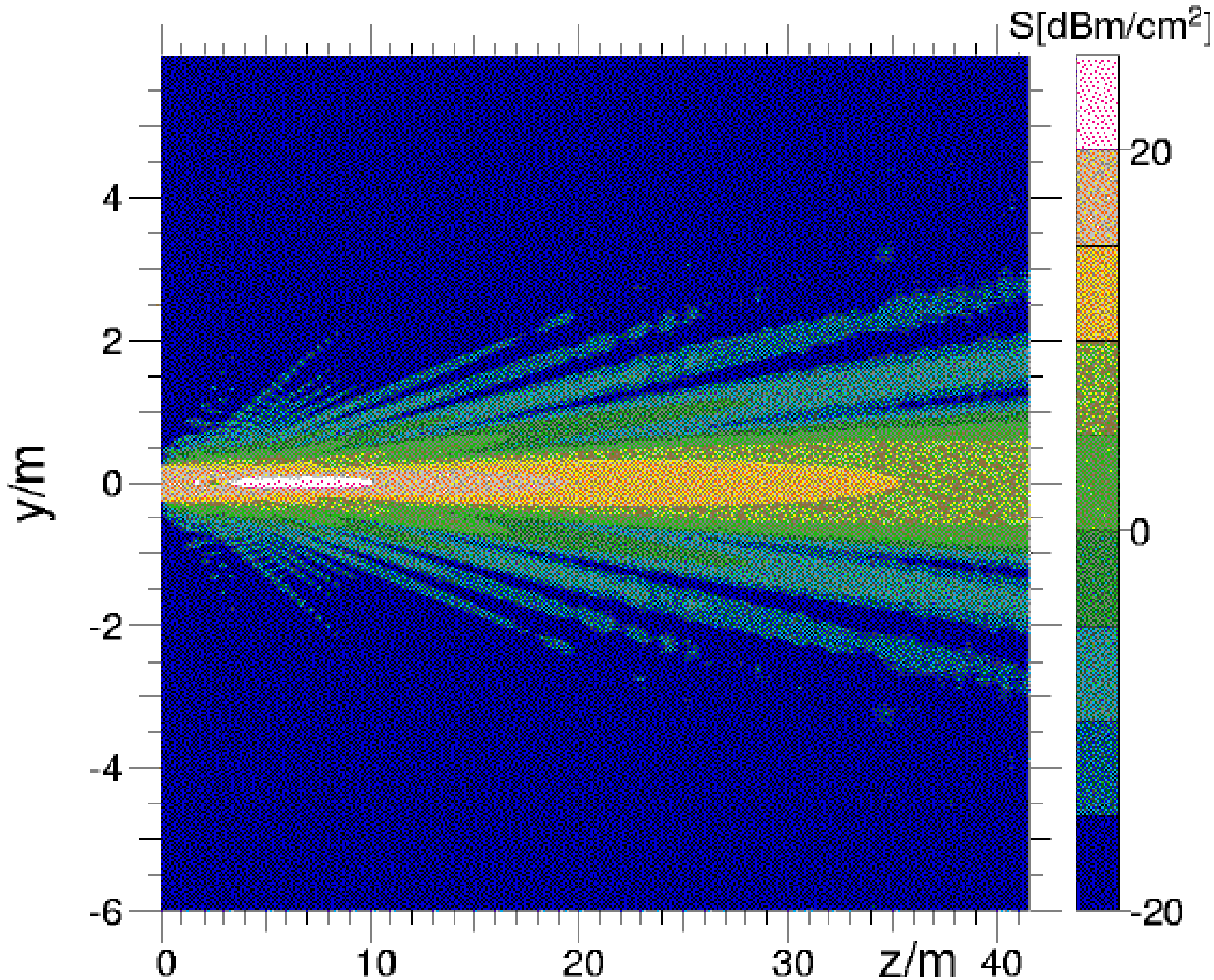
Größe:	**50 cm x 50 cm**
Belegung:	**homogen**
Sendeleistung:	**10 W**
Frequenz:	**24 GHz**
$2D^2/\lambda$:	**41,5 m**

Nahfeld Kreisförmiger Apertur Antenne



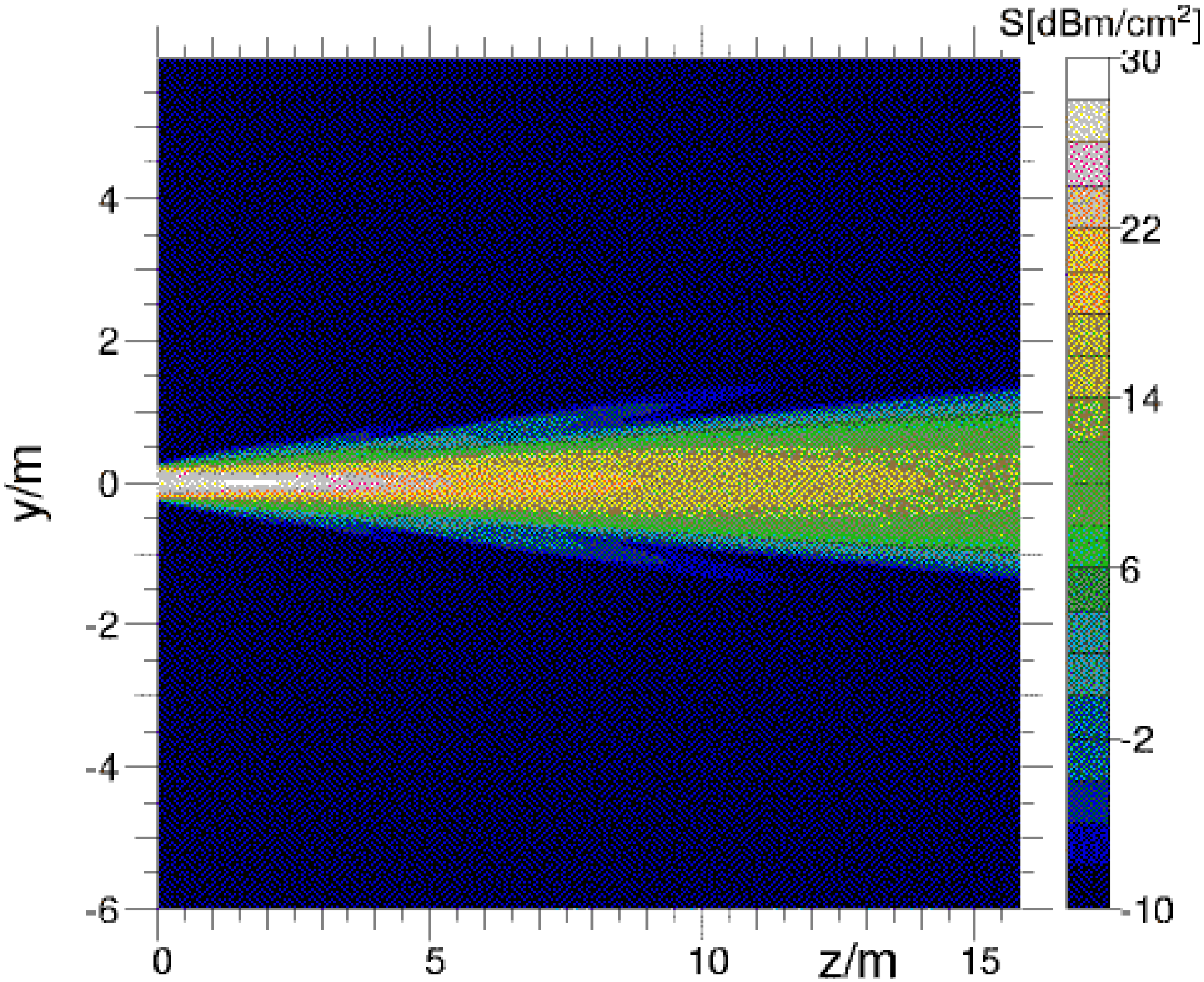
Größe:	**D = 50 cm**
Belegung:	**homogen**
Sendeleistung:	**50 W**
Frequenz:	**10 GHz**
$2D^2/\lambda$:	**16,6 m**

Nahfeld Kreisförmiger Apertur Antenne



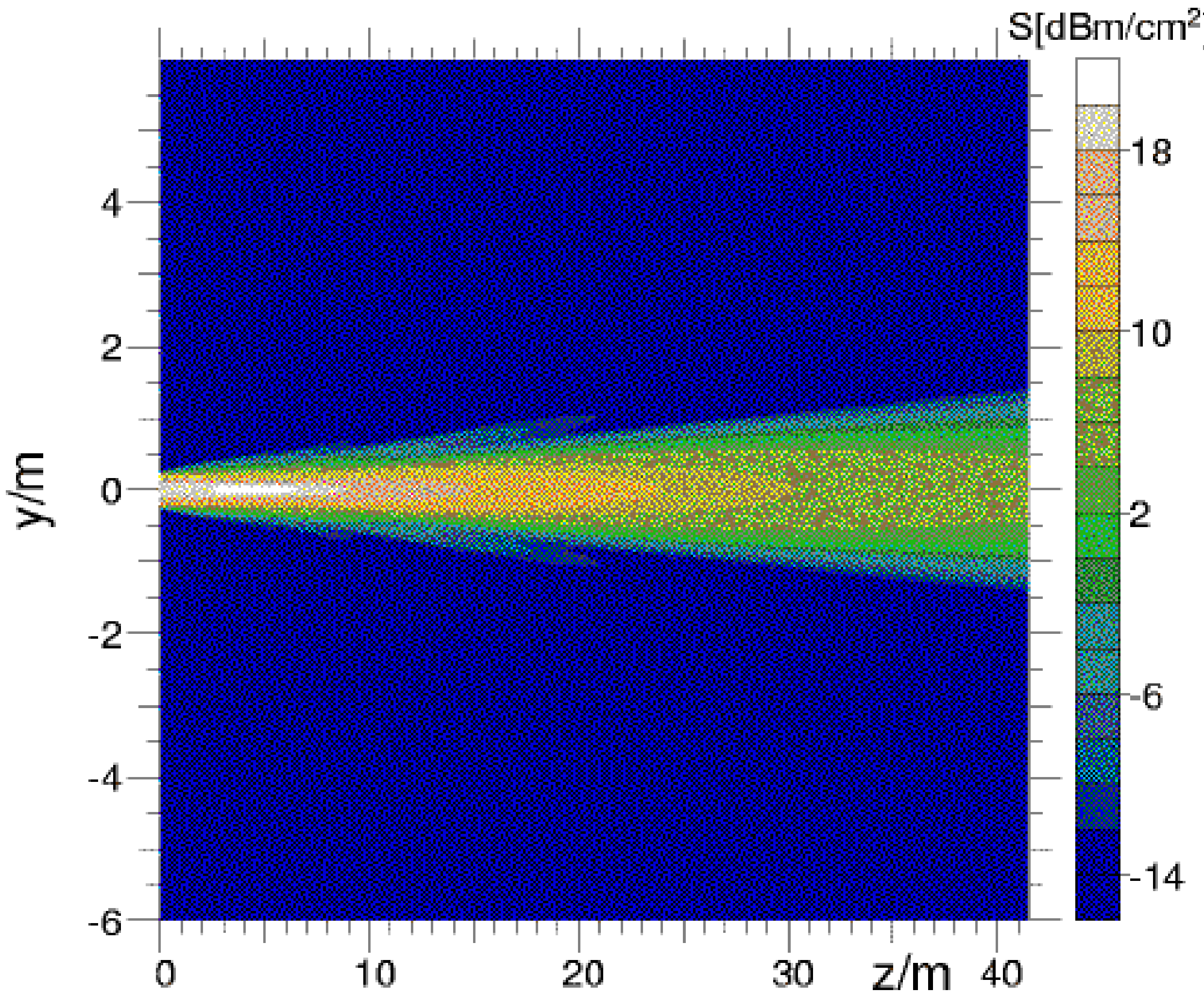
Größe:	**D = 50 cm**
Belegung:	**homogen**
Sendeleistung:	**10 W**
Frequenz:	**24 GHz**
$2D^2/\lambda$:	**41,5 m**

Nahfeld Kreisförmiger Apertur Antenne



Größe:	**D = 50 cm**
Belegung:	**quadratisch**
Sendeleistung:	**50 W**
Frequenz:	**10 GHz**
$2D^2/\lambda$:	**16,6 m**

Nahfeld Kreisförmiger Apertur Antenne



Größe: D = 50 cm
Belegung: quadratisch
Sendeleistung: 10 W
Frequenz: 24 GHz
$2D^2/\lambda$: 41,5 m