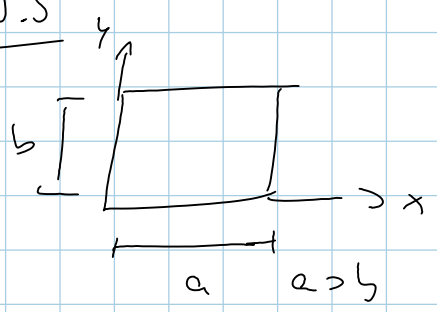
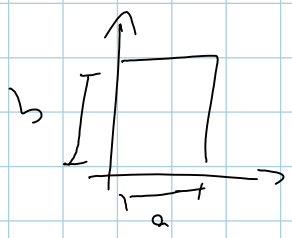
GGÜ 13

Dienstag, 12. Juli 2011
08:17

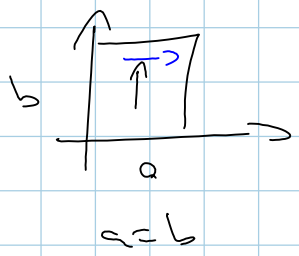
A.5



H_{10} ist Grundmode

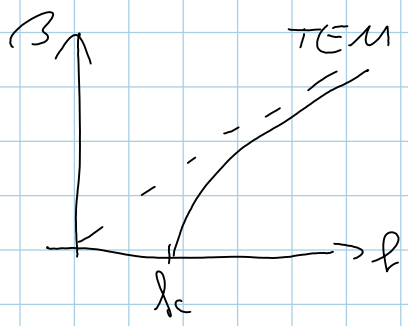


H_{on} Grundmode



H_{10}, H_{on} entartet, wenn Moden gleiche Ausbreitungsgeschw. haben ($f_{cn} = f_{c1}$)

E_y E_x



$$\beta = \frac{2\pi}{\lambda_H} = \frac{2\pi}{c_0}\sqrt{f^2 - f_c^2}$$

5.1.1)

1.) H_{10}

$$H_z \sim \cos\left(\pi\frac{x}{a}\right)\cdot 1$$

$$E_y \sim \sin\left(\pi\frac{x}{a}\right)\cdot 1$$

$$H_x \sim \sin\left(\pi\frac{x}{a}\right)\cdot 1$$

H_{mn}

$$H_z \sim \cos\left(m\pi\frac{x}{a}\right)\cos\left(n\pi\frac{y}{b}\right)$$

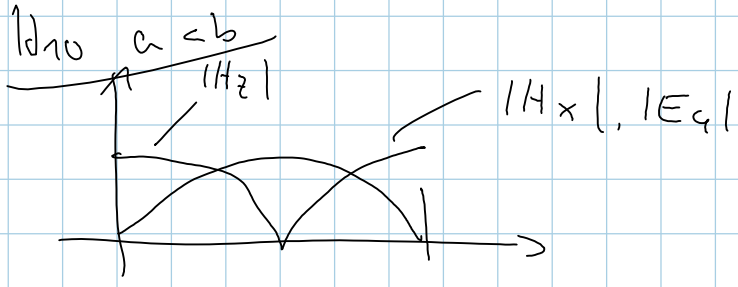
E_{mn}

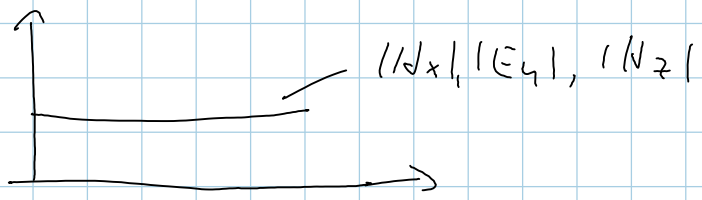
$$E_z \sim \sin\left(m\pi\frac{x}{a}\right)\sin\left(n\pi\frac{y}{b}\right)$$

$H_x \sim \sin\left(\pi \frac{x}{a}\right) \cdot 1$

$E_z \sim \sin\left(m\pi \frac{x}{a}\right) \sin\left(n\pi \frac{y}{a}\right)$

H_{10} $a < b$





H_{10} $a = b$ Feldbild s.o.

H_{01} $H_z \sim 1 \cdot \cos\left(\pi \frac{y}{b}\right)$

$E_x \sim 1 \cdot \sin\left(\pi \cdot \frac{y}{b}\right)$

$H_y \sim 1 \cdot \sin\left(\pi \frac{y}{b}\right)$

5.1.2) $\frac{a}{b} = 2{,}25$

$H_{10}, H_{20}, H_{01}, \underbrace{H_{11}, E_{11}}_{\text{entartet}}$

$\frac{a}{b} = 1$

$\underbrace{H_{01}, H_{10}}_{\text{entartet}}$ $\underbrace{H_{11}\ E_{11}}_{\text{entartet}}$

$$f_c = \frac{c_0}{2}\sqrt{\left(\frac{m}{a}\right)^2 + \left(\frac{n}{b}\right)^2} \overset{a=b}{=} \frac{c_0}{2a}\sqrt{m^2+n^2}$$

$$f_c = \frac{c_0}{2}\sqrt{\left(\frac{m}{a}\right)^2 + \left(\frac{n}{b}\right)^2} = \frac{c_0}{2a}\sqrt{m^2 + n^2}$$

5.1.3) + verstärker
+ höhere Leistungen
- teurer
- Bauteile schlecht integrierbar

5.1.4) $f = 18{,}25\ GHz \qquad \frac{a}{b} = 2{,}25 \qquad a = ?\,cm$

Mode	f_c / GHz	λ_H / cm
H_{10}	7,5	1,93
H_{20}	15	3,52
H_{01}	16,875	8,39
H_{11}, E_{11}	$f > 18{,}47$	↯

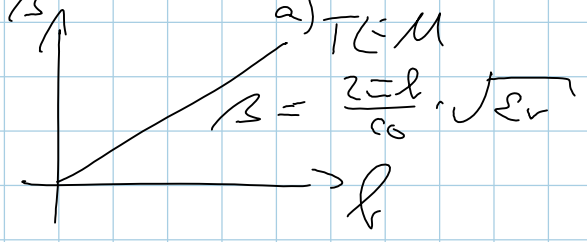
$\lambda_0 = 1{,}64\,cm$

nicht ausbreitungsfähig

$f \simeq f_c \rightarrow \lambda_H \rightarrow \infty$

$f \rightarrow \infty \rightarrow \lambda_H \rightarrow \lambda_0$

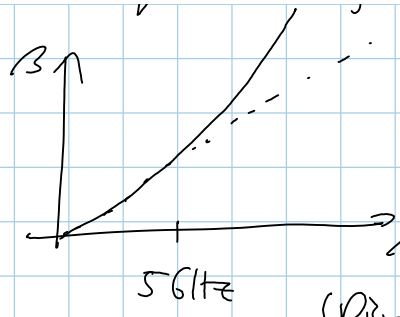
5.1.5)



b) Streifenleitung

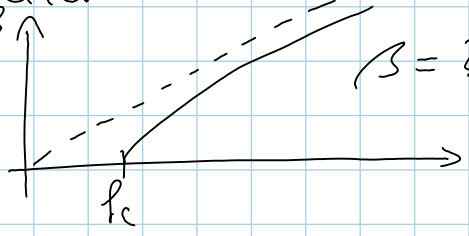
β

$\beta = \frac{2\pi f}{c_0} \cdot \sqrt{\varepsilon_r}$



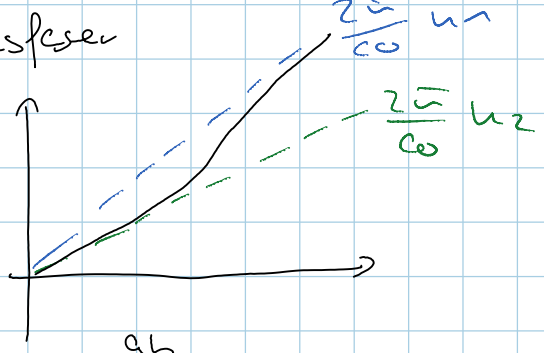
$$\beta = \frac{2\pi f}{c_0}\sqrt{\varepsilon_{rell}}$$

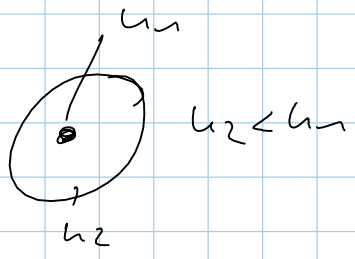
c) Hohlleiter (Dispersion)



$$\beta = \frac{2\pi}{c_0}\sqrt{f^2 - f_c^2}$$

d) Glasfaser





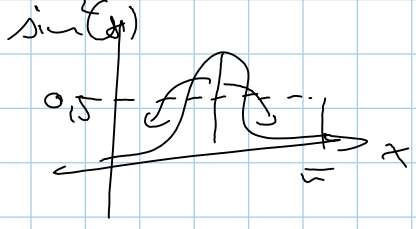
5.1.6

$$P = \int_0^a \int_0^b \frac{1}{2} \mathrm{Re}\{\underline{E} \times \underline{H}^*\}\, dy\, dx$$

$$= \int_0^a \int_0^b \frac{1}{2} \mathrm{Re}\{\underline{E}_y \cdot \underline{H}_x^*\}\, dy\, dx$$

$$H_x = \frac{\underline{E}_y}{Z_F} \qquad Z_F^H = \frac{Z_0}{\sqrt{f^2 - f_c^2}}$$

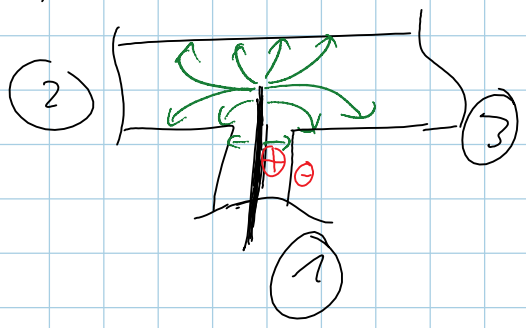
$$P = \frac{1}{2 Z_F^{H_{10}}} \int_0^a \int_0^b |\underline{E}_y|^2\, dy\, dx$$

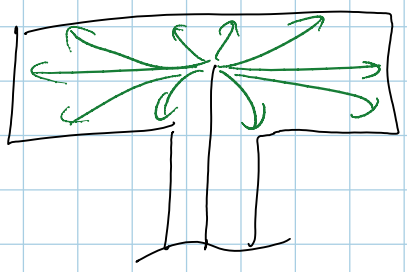


$$= \frac{|\underline{E}_{y,max}|^2}{2 Z_F^{H_{10}}} \int_0^a \int_0^b \sin^2\left(\pi \frac{x}{a}\right) dy\, dx$$

$$= \frac{|\underline{E}_{y,max}|^2}{2 Z_F^{H_{10}}} \cdot \frac{a}{2} \cdot b$$

5.2.1)



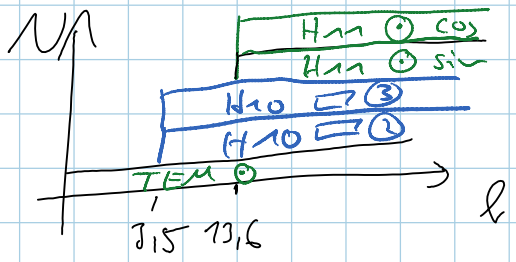


5.2.2) ① TEM

② H_{10}

③ H_{10}

Σ 3 Typen



TEM $f_c = 0$ TEM

$f_c = 13,0666\,\text{Hz}$ H_{11}

□-HL

$f_c = 7,5\,\text{GHz}$ (H_{10})

$f_c = 15\,GHz$ (H_{20})

$f_c = 16{,}88\,GHz$ (H_{01})

$f_c = 18{,}47\,GHz$ (H_{11}, E_{11})

5.2.3)

Koax: $\alpha_R = \frac{R'}{2 Z_L}$

$R' = \frac{1}{\pi \kappa \delta} \left(\frac{1}{D} + \frac{1}{d} \right)$

$\delta = \frac{1}{\sqrt{\pi \kappa \mu_0 f}}$

$\alpha_R = 0{,}0264 \frac{Np}{m} \hat{=} 0{,}2298 \frac{dB}{m}$

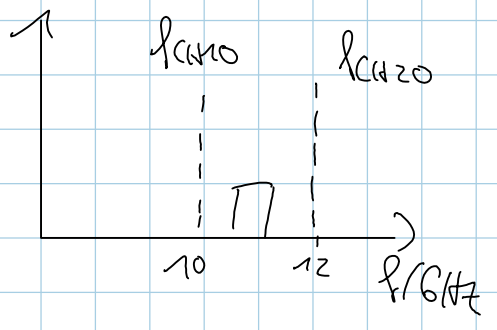
$\alpha_{H10} = 0{,}1525 \frac{dB}{m}$

5.3 1) $f_{cH10} < f_{min}$ $\quad \frac{c_0}{2a} < 10\,GHz$

$\Rightarrow a > \frac{c_0}{2 \cdot 10\,GHz} = 1{,}5\,cm$

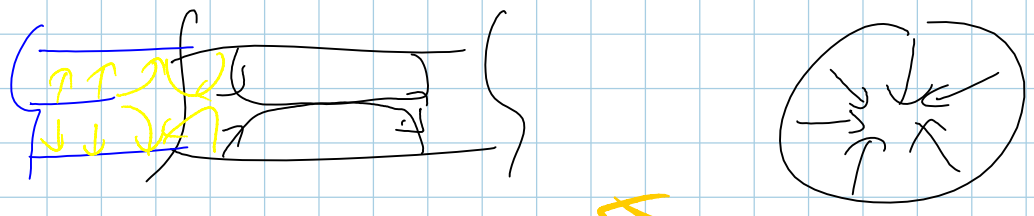
$f_{cH20} > f_{max}$ $\quad \frac{c_0}{a} > 12\,GHz$

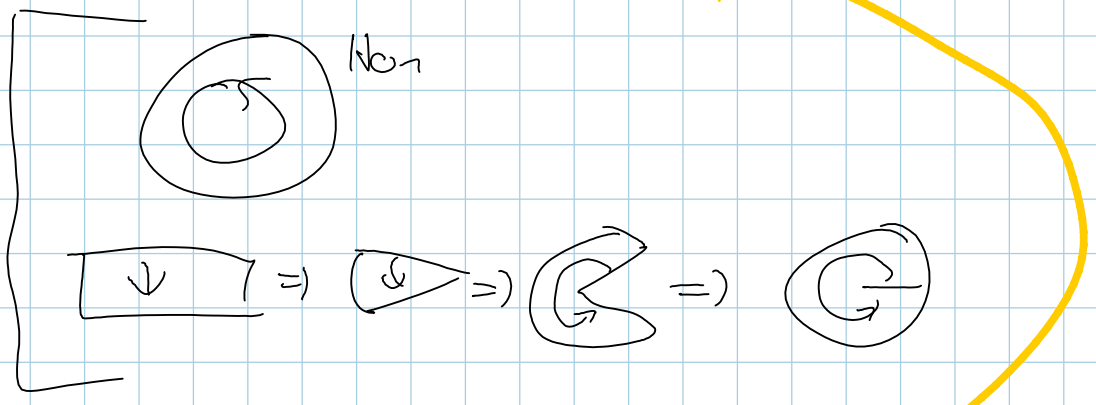
$\rightarrow a < \frac{c_0}{12\,GHz} = 2{,}5\,cm$



5.3.2) H_{01}, wegen $m=1$ ist eine φ-Abh. der Feldstärkekomponenten gegeben

5.3.3) E_{01}, wegen $m=0$ keine φ-Abh!





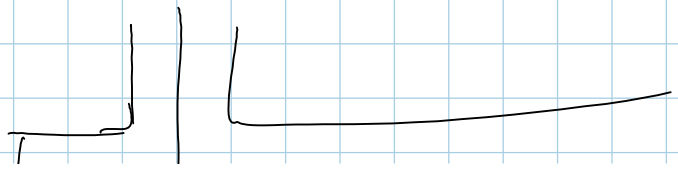
5.3.4) J_{a_1} ist anregbar

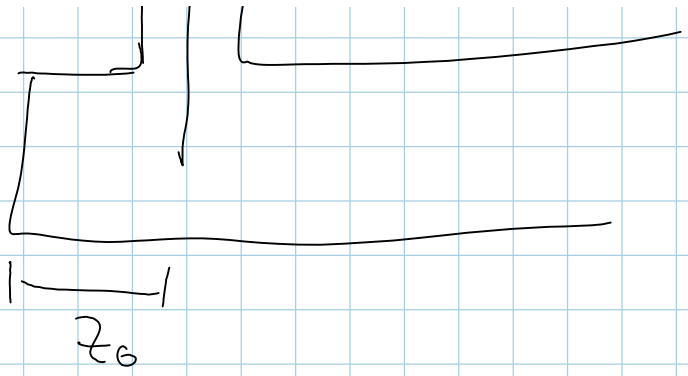
5.3.5) $f_{CE10} < f_{min}$ $\quad f_{CE10} = \frac{c_0}{2\pi R} \cdot 1{,}8412 \cdot 1{,}106$

$f_{CH21} > f_{max}$ $\quad f_{CH21} = \frac{c_0}{2\pi R} \cdot \underbrace{1{,}842 \cdot 1{,}6588}_{n_{21}}$

$$1{,}148 \leq \frac{R}{c_m} \leq 1{,}215$$

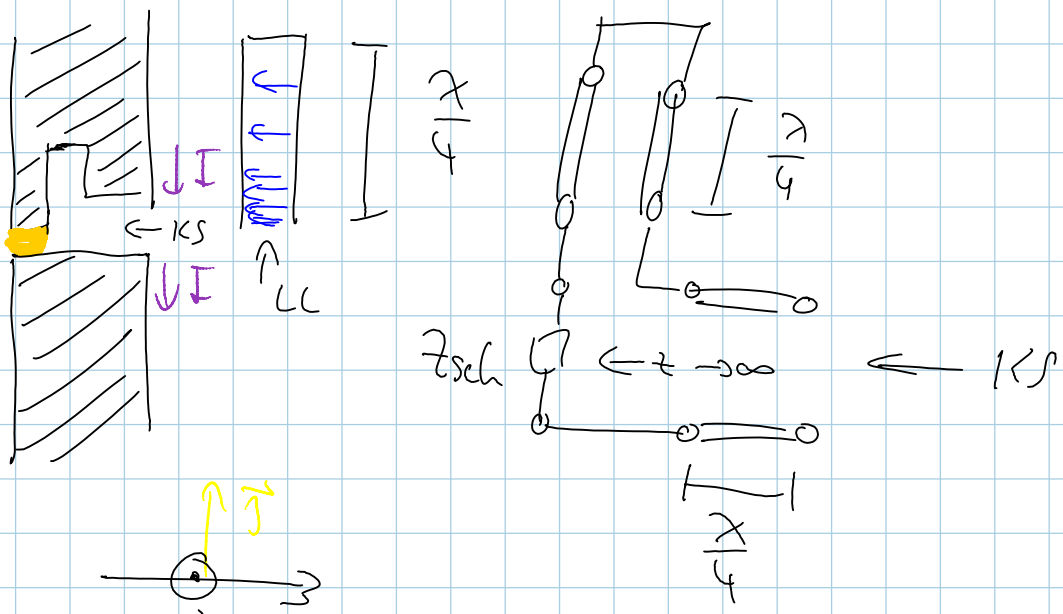
5.3.6)





$$Z_0 = \frac{\lambda_N}{4}$$

5.3.7)



5.3.8)

Hörsaalfragestunde Mo - Mi 29.8. - 31.8.

9:00 - 12:00

FT

Hilfsmittel: Folien, Mitschriften, KEINE Übungunterlagen/Lösungen der Übungen