

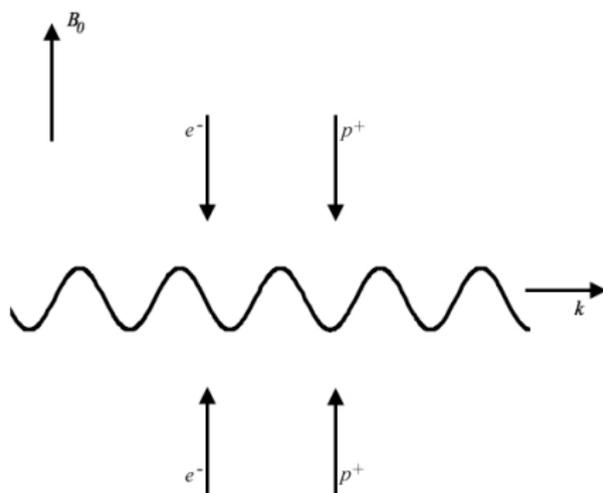
# Die Filamentierungsinstabilität in magnetisierten Plasmen

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Phasenraumdichte:

$$f^0(p_{\perp}, p_{\parallel}) = \frac{\delta(p_{\perp})}{2\pi p_{\perp}} [N_1 \delta(p_{\parallel} - \Gamma_1 m_+ U_1) + N_1 \delta(p_{\parallel} - \Gamma_1 m_- U_1) + N_2 \delta(p_{\parallel} + \Gamma_2 m_+ U_2) + N_2 \delta(p_{\parallel} + \Gamma_2 m_- U_2)]$$

mit  $\Gamma_i = [1 - (\frac{U_i}{c})^2]^{-1/2}$ .

Maxwell-Operator:

$$\Lambda_{ij} = \begin{pmatrix} \Psi_{11} & \Psi_{12} & \Psi_{13} \\ -\Psi_{12} & \Psi_{11} - \left(\frac{kc}{\sigma}\right)^2 & \Psi_{23} \\ \Psi_{13} & -\Psi_{23} & \Psi_{33} - \left(\frac{kc}{\sigma}\right)^2 \end{pmatrix}$$

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Lösungen von  $\det(\Lambda_{ij}) = 0$

$$\Leftrightarrow M(f) = A(\Omega^2, \sigma^2)f^2 + B(\Omega^2, \sigma^2)f + C(\Omega^2, \sigma^2) = 0$$

mit  $f = \left(\frac{kc}{\sigma}\right)^2$  und  $C > 0$

Für  $\sigma^2 \ll \chi^2 \Omega^2 / \Gamma_n^2$ :

$$A = 1 + \frac{(1 + \chi)\omega_{p1}^2 \Gamma_1}{\Omega^2 \chi} \left(1 - \frac{\beta_1}{\beta_2}\right) (1 + \beta_1 \beta_2) + \frac{(1 + \chi)^2 \omega_{p1}^4 \Gamma_1^2}{\Omega^4 \chi^2} \beta_1 \beta_2 \left(1 - \frac{\beta_1}{\beta_2}\right)^2$$

$$\chi = m_- / m_+, \omega_{p1} = \sqrt{4\pi e^2 N_1 / m_-}, \beta_n = U_n / c.$$

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Wegen  $A < 0$ :

$$\Omega^2 < \Omega_A^2 = \frac{1 + \chi}{\chi} \omega_{p1}^2 \Gamma_1 \beta_1 (\beta_1 - \beta_2)$$

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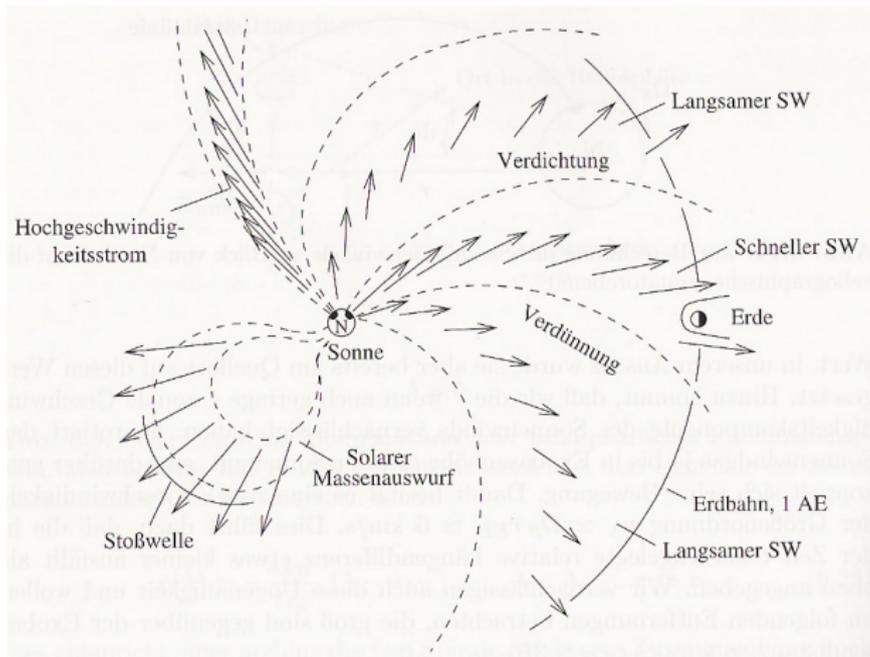
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Kritische Magnetfeldstärke:

$$B_0 < B_{max} = \frac{m_- c}{e} \Omega_A = \frac{m_- c}{e} \sqrt{\frac{1 + \chi}{\chi} \omega_{p1}^2 \Gamma_1 \beta_1 (\beta_1 - \beta_2)}.$$

## Nichtrelativistische Strömungsgeschwindigkeiten:





- ▶ **Schneller Strom:**  $u_1 = 600 \frac{\text{km}}{\text{s}}$ ,  $N_1 = 10 \text{ cm}^{-3}$ .
- ▶ **Langsamer Strom:**  $u_2 = 300 \frac{\text{km}}{\text{s}}$ ,  $N_2 = 20 \text{ cm}^{-3}$ .

$$B_{max} = 3.6 \cdot 10^{-4} \text{ G}$$

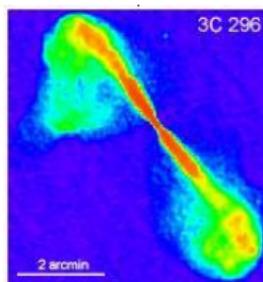
$$\sigma_{max} \approx 0.3 \text{ s}^{-1}$$

$$\tau_{min} \approx 3 \text{ s}$$



# AGN-Klassifikation nach Röntgenemission

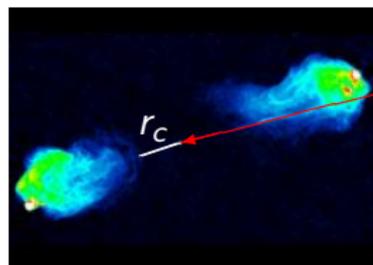
FRI



Kleine Abstände zwischen Hot Spots

$$B_0 < B_{max}$$

FRII



Große Abstände zwischen Hot Spots

$$B_0 > B_{max}$$

