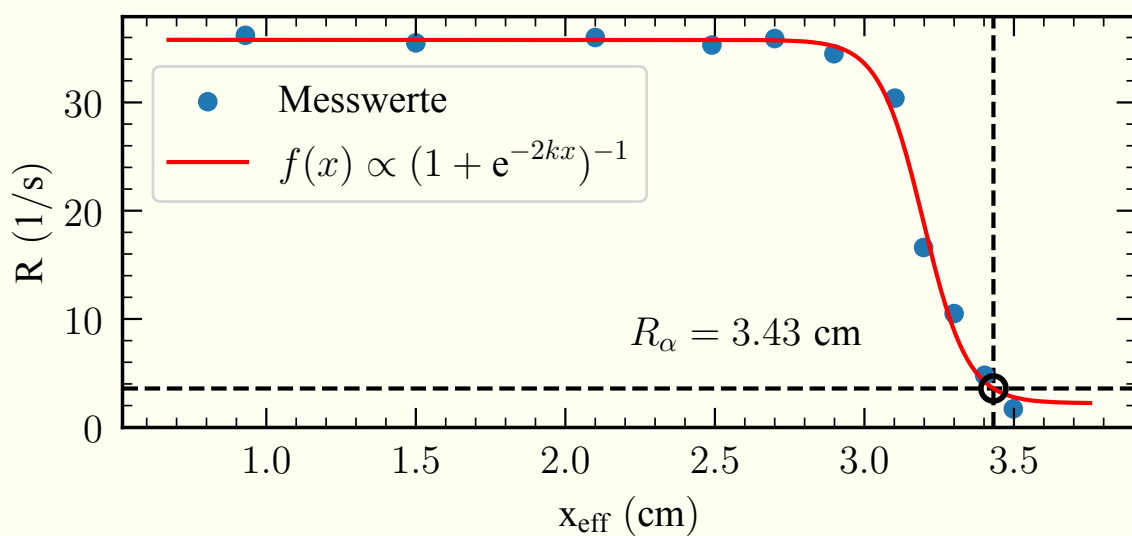
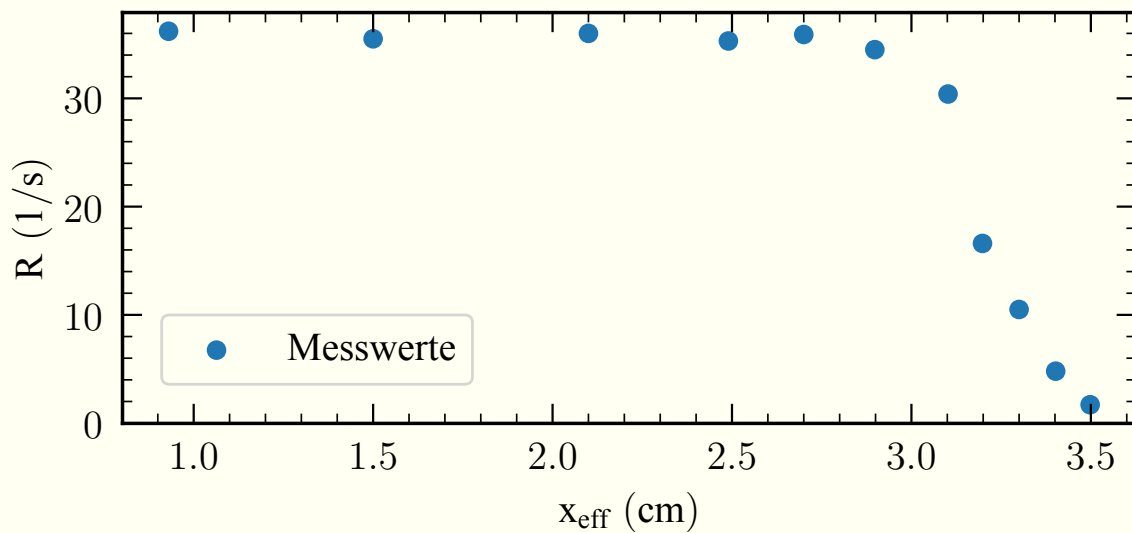


Reichweite von Alpha-Strahlung

p	0.155	0.25	0.35	0.415	0.45	0.483	0.517	0.533	0.55	0.567	0.583
R	36.2	35.5	36.0	35.3	35.9	34.5	30.4	16.6	10.5	4.8	1.7

a) $x_0 = 6 \text{ cm}$; $x = px_0$

p	0.155	0.25	0.35	0.415	0.45	0.483	0.517	0.533	0.55	0.567	0.583
R	36.2	35.5	36.0	35.3	35.9	34.5	30.4	16.6	10.5	4.8	1.7
x	0.93	1.5	2.1	2.49	2.7	2.9	3.1	3.2	3.3	3.4	3.5

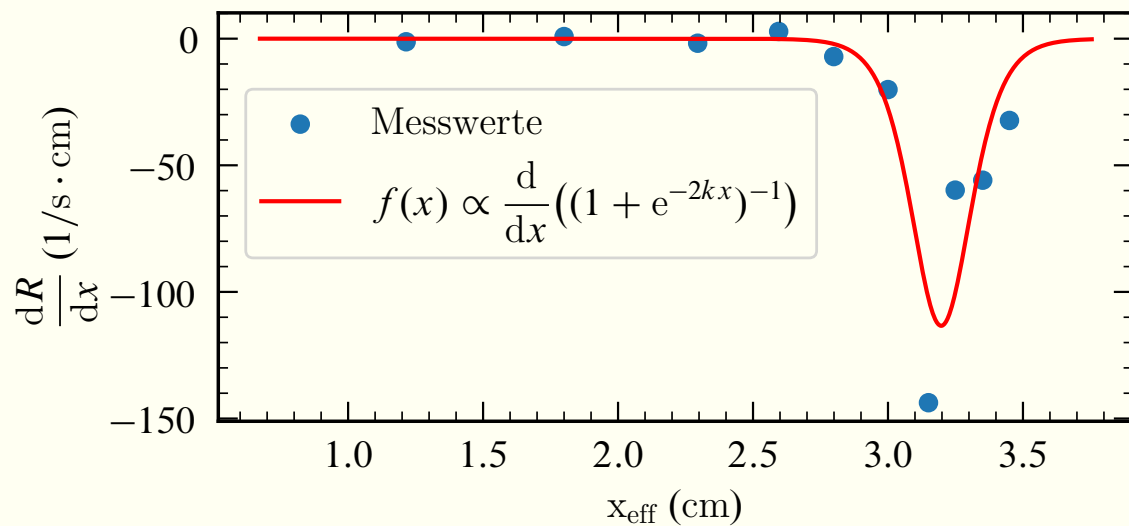


Fitfunktion als angepasste Heaviside Funktion [1] scheint recht gut zu passen.

$$f(R_\alpha) \stackrel{!}{=} \frac{f_{\max}}{10} \Rightarrow R_\alpha = 3.43 \text{ cm}$$

$$R_\alpha = 0.31 \left(\frac{E_{\text{kin}}}{1 \text{ MeV}} \right)^{3/2} \text{ cm} = 3.43 \text{ cm}$$

$$E_{\text{kin}} = \underline{\underline{4.97 \text{ MeV}}}$$



In blau numerisch differenzierte Werte (über $f'(x_n) = \frac{f(x_{n+1}) - f(x_n)}{x_{n+1} - x_n}$). In rot Ableitung der Fitfunktion aus c). Man erkennt sehr gut, dass bei ca. 3.2 cm ein starker Fall ist, was physikalisch bedeutet, dass bei dieser Entfernung die α -Teilchen ihre Energie deponieren.

Bethe-Bloch-Formel

```

T = 2 * u"GeV" | 2 GeV

d = 1 * u"cm" | 1 cm
ρ = 2.7 * u"g/cm^3" | 2.7 g cm^-3
Zal = 13 | 13
Aal = 26.98 * u"g/mol" | 26.98 g mol^-1

ma = 3727.4 * u"MeV/c^2" | 3727.4 MeV c^-2
mp = 938.3 * u"MeV/c^2" | 938.3 MeV c^-2
md = 1875.6 * u"MeV/c^2" | 1875.6 MeV c^-2

Za = 2 | 2
Zp = 1 | 1
Zd = 1 | 1

I(Z) = 16*Z^0.9 * u"eV"
gamma(m, T) = T/(m*c_0^2) + 1
beta(m, T) = sqrt(1 - 1/gamma(m, T)^2)

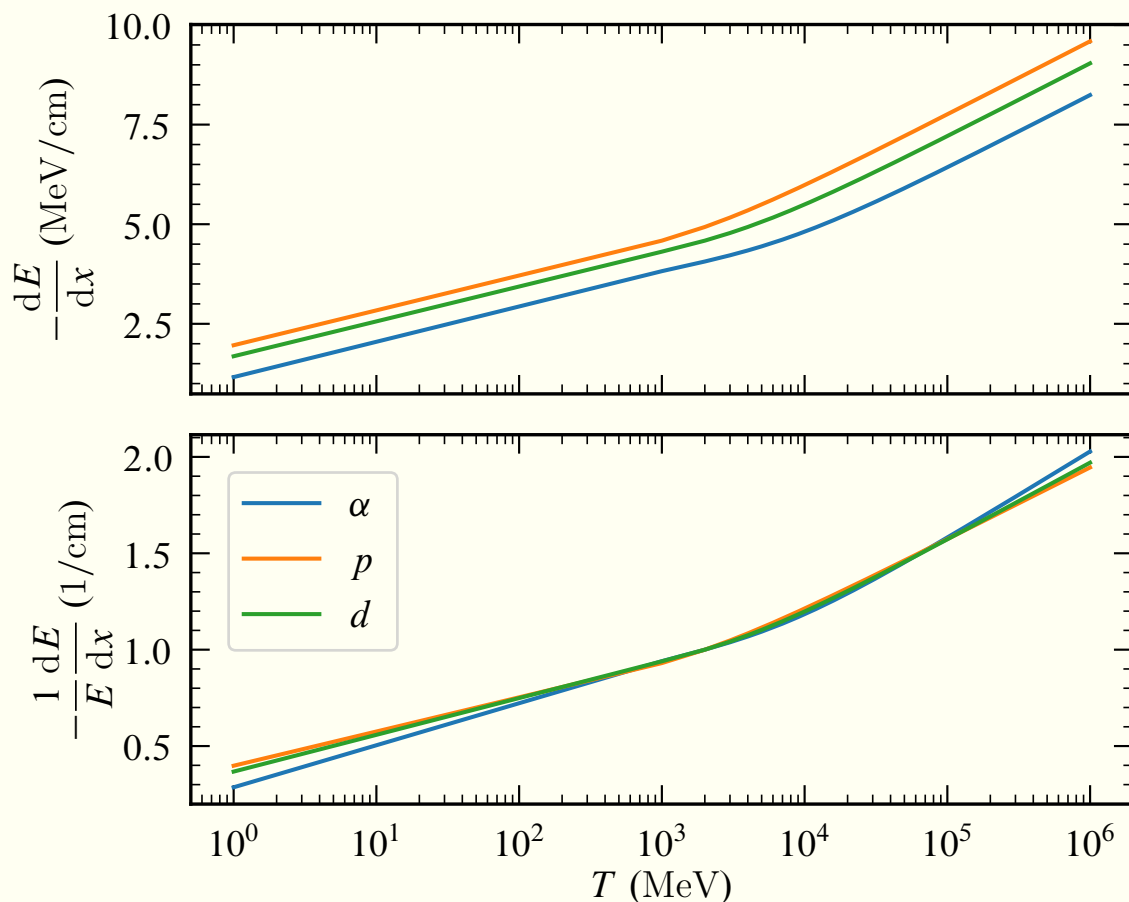
k = 1/(4π*ε_0)^2 * (4π*e^4/(m_e*c_0^2)) * N_A * ρ * Zal/Aal | 6.4005887402183545e-18 C^4 s^2 F^-2 kg^-1 cm^-3

dE(m, T, Z) = k * (log(2 * m_e * c_0^2 * beta(m, T)^2 * gamma(m, T)^2/I(Z)) - beta(m, T)^2)

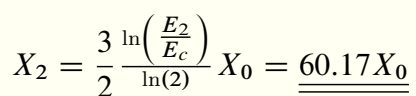
Eα = dE(ma, T, Za) * d |> u"MeV" | 4.063901453508626 MeV
Ep = dE(mp, T, Zp) * d |> u"MeV" | 4.93059955054809 MeV
Ed = dE(md, T, Zd) * d |> u"MeV" | 4.587616861209597 MeV

```

$$E_{\alpha} = 4.06 \text{ MeV}; \quad E_p = 4.93 \text{ MeV}; \quad E_d = 4.59 \text{ MeV}$$



Elektromagnetische Teilchenschauer



d) $H_0 = 8 \text{ km}; \quad X_E = \text{g/cm}^2; \quad X_0 = 37.8 \text{ g/cm}^2$

$$X_1 \stackrel{!}{=} X_E e^{-\frac{h}{H_0}}$$

$$\Rightarrow h = -\ln\left(\frac{X_1}{X_E}\right) H_0 = \underline{\underline{2.35 \text{ km}}}$$

$$X_2 \stackrel{!}{=} X_E e^{-\frac{h}{H_0}}$$

$$\Rightarrow h = -\ln\left(\frac{X_2}{X_E}\right) H_0 = \underline{\underline{-6.34 \text{ km}}}$$

e) $h = 575 \text{ m}$

$$X_{\max} = \frac{\ln\left(\frac{E_0}{E_c}\right)}{\ln(2)} X_0 \stackrel{!}{=} X_E e^{-\frac{h}{H_0}}$$

$$E = 2E_c \exp(2X_E/3X_0 \exp(-h/H_0)) = \underline{\underline{10.32 \text{ TeV}}}$$