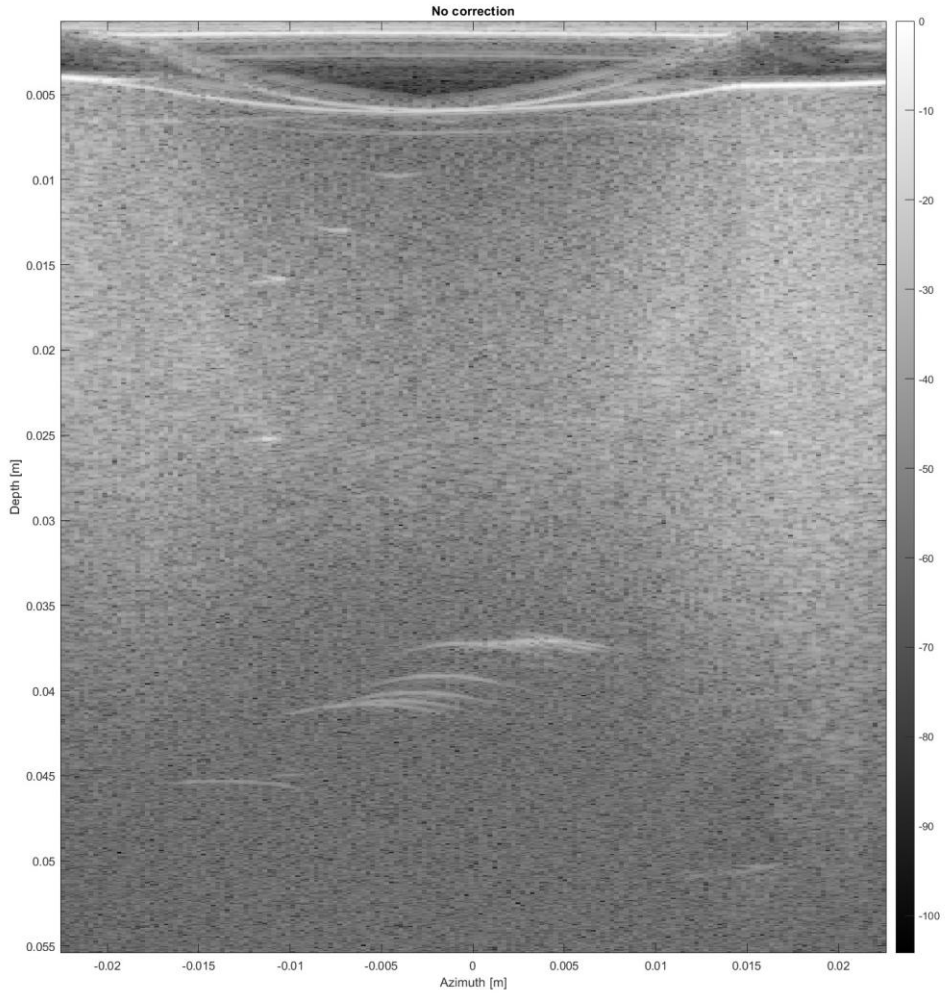
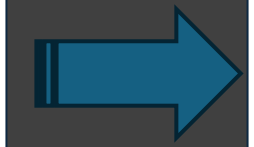
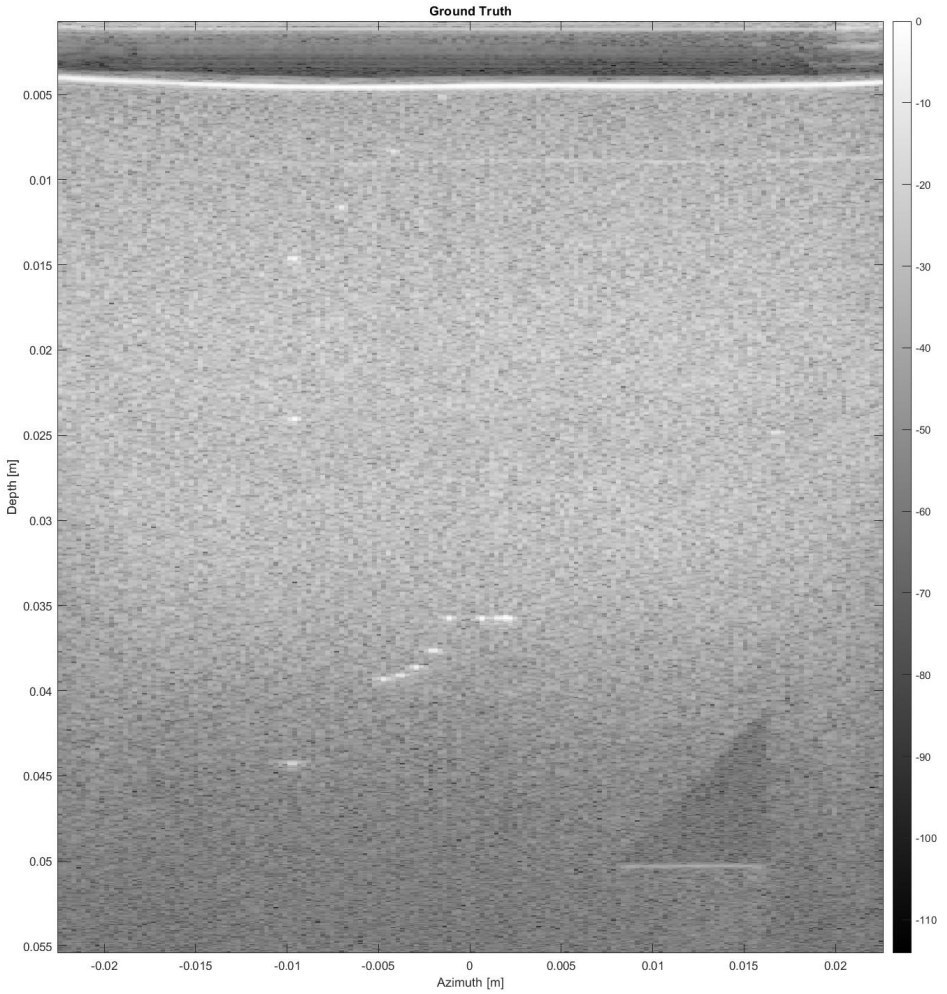
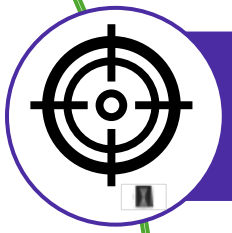
Ultraschallbilder


No correction
Depth [m]
0.005
0.01
0.015
0.02
0.025
0.03
0.035
0.04
0.045
0.05
0.055
Azimuth [m]
-0.02
-0.015
-0.01
-0.005
0
0.005
0.01
0.015
0.02
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100

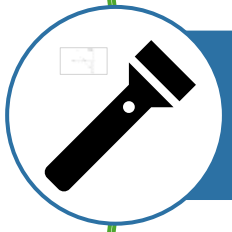



Ground Truth
Depth [m]
0.005
0.01
0.015
0.02
0.025
0.03
0.035
0.04
0.045
0.05
0.055
Azimuth [m]
-0.02
-0.015
-0.01
-0.005
0
0.005
0.01
0.015
0.02
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110

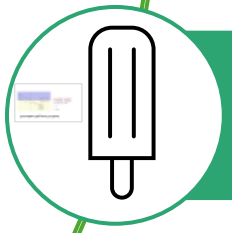
Theorie



Fokussieren



Life Ultraschall + Widerstand



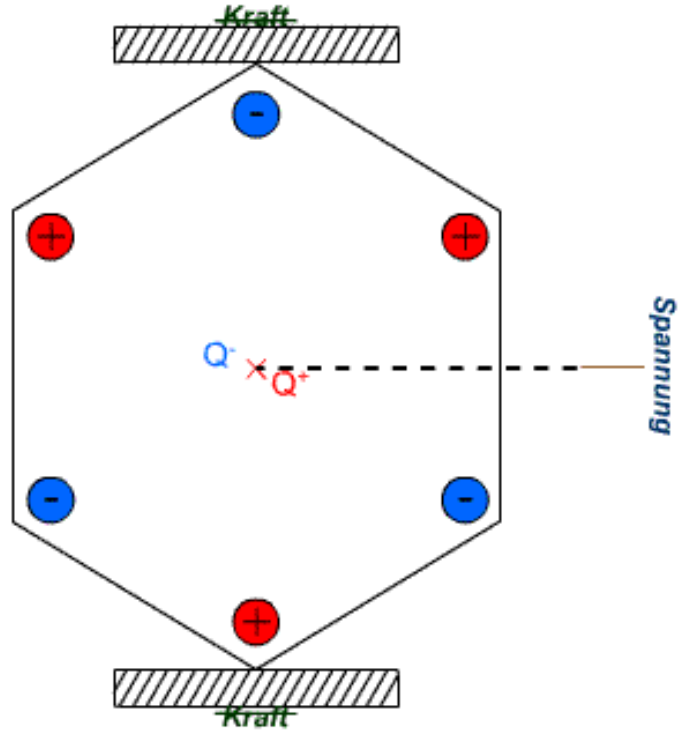
Snell‘sche Gesetz + Beispiel

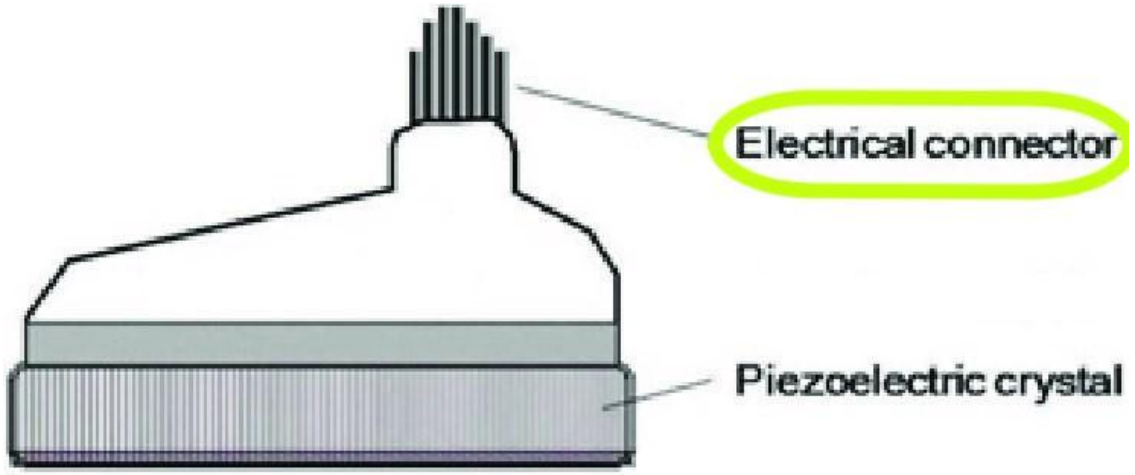
Bisection + Newton

Theorie

Aufbau

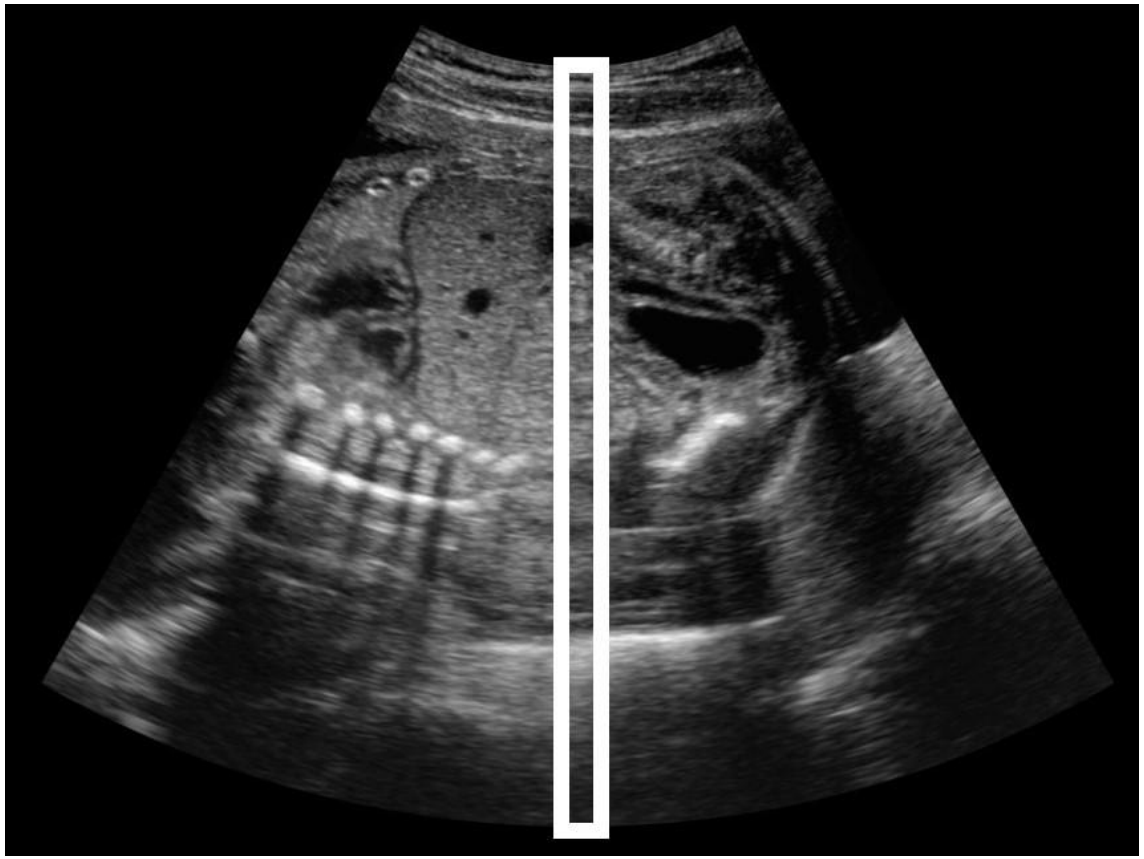
- 200 **Piezoelektrische Kristalle**
  - 5 pro mm
  - Ladung ungleich verteilt
  - Kristalle sind Bidirektional
- **Transducer-Abdeckung** → viele Schichten
- Viele Drähte

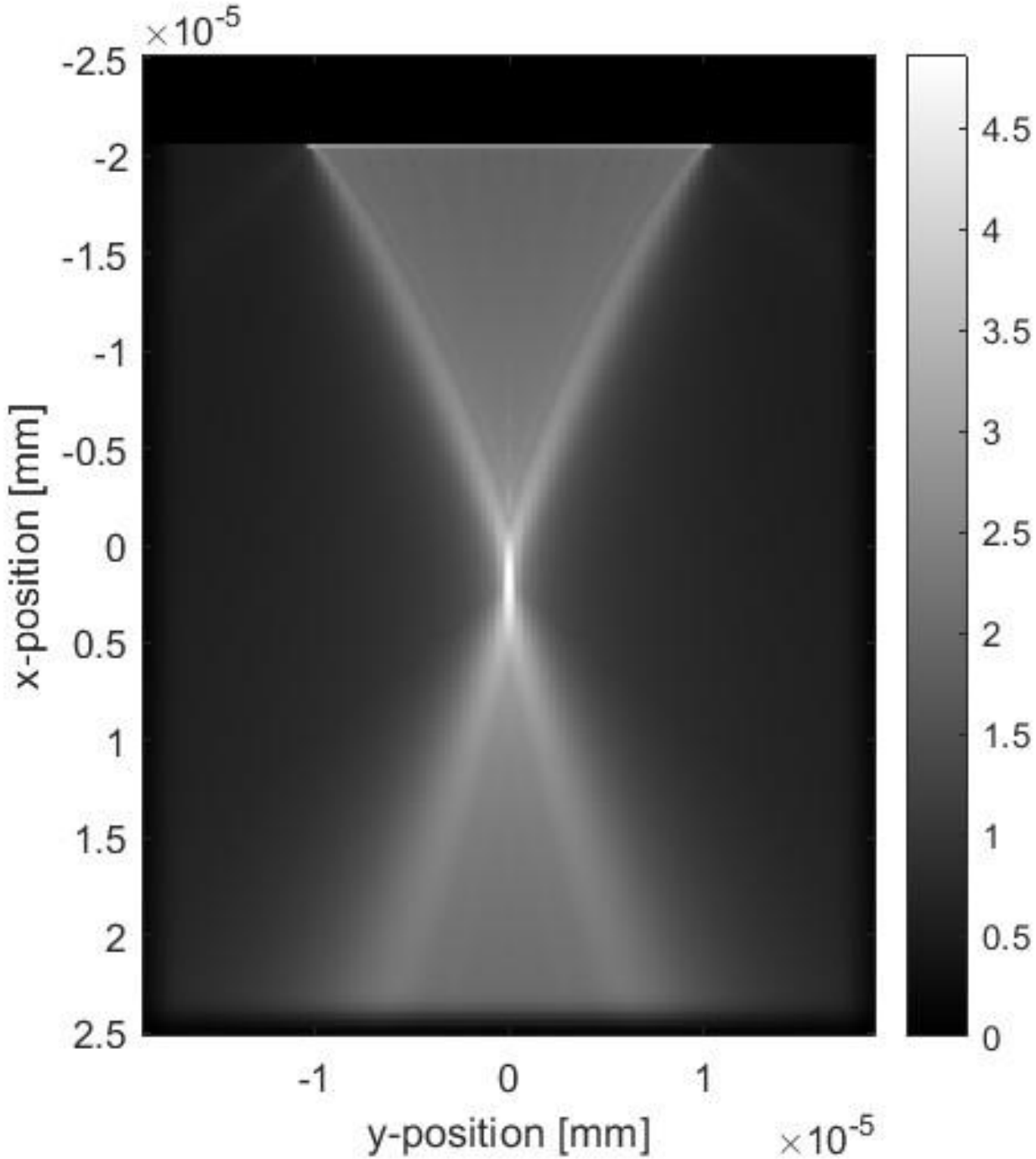


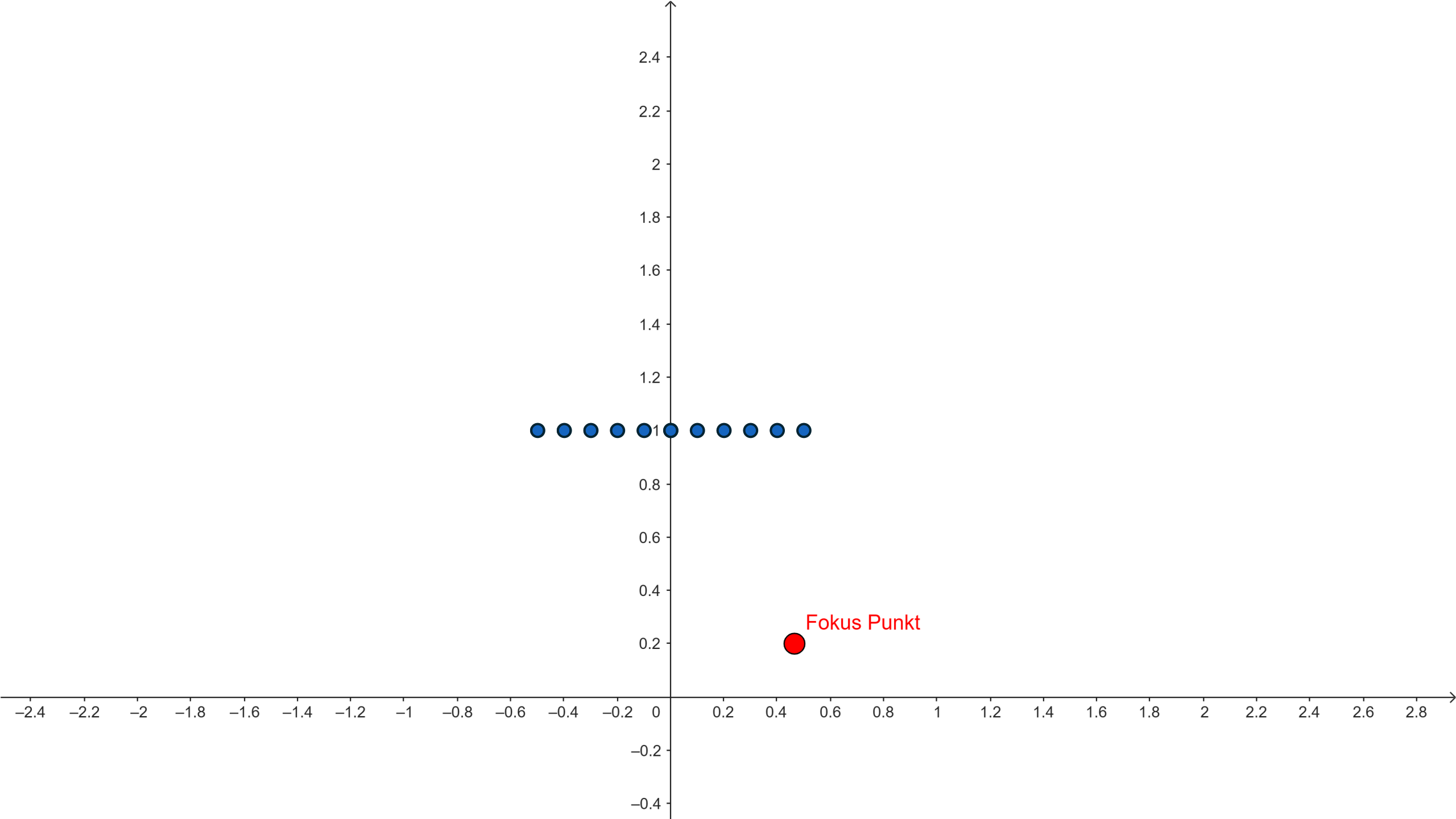


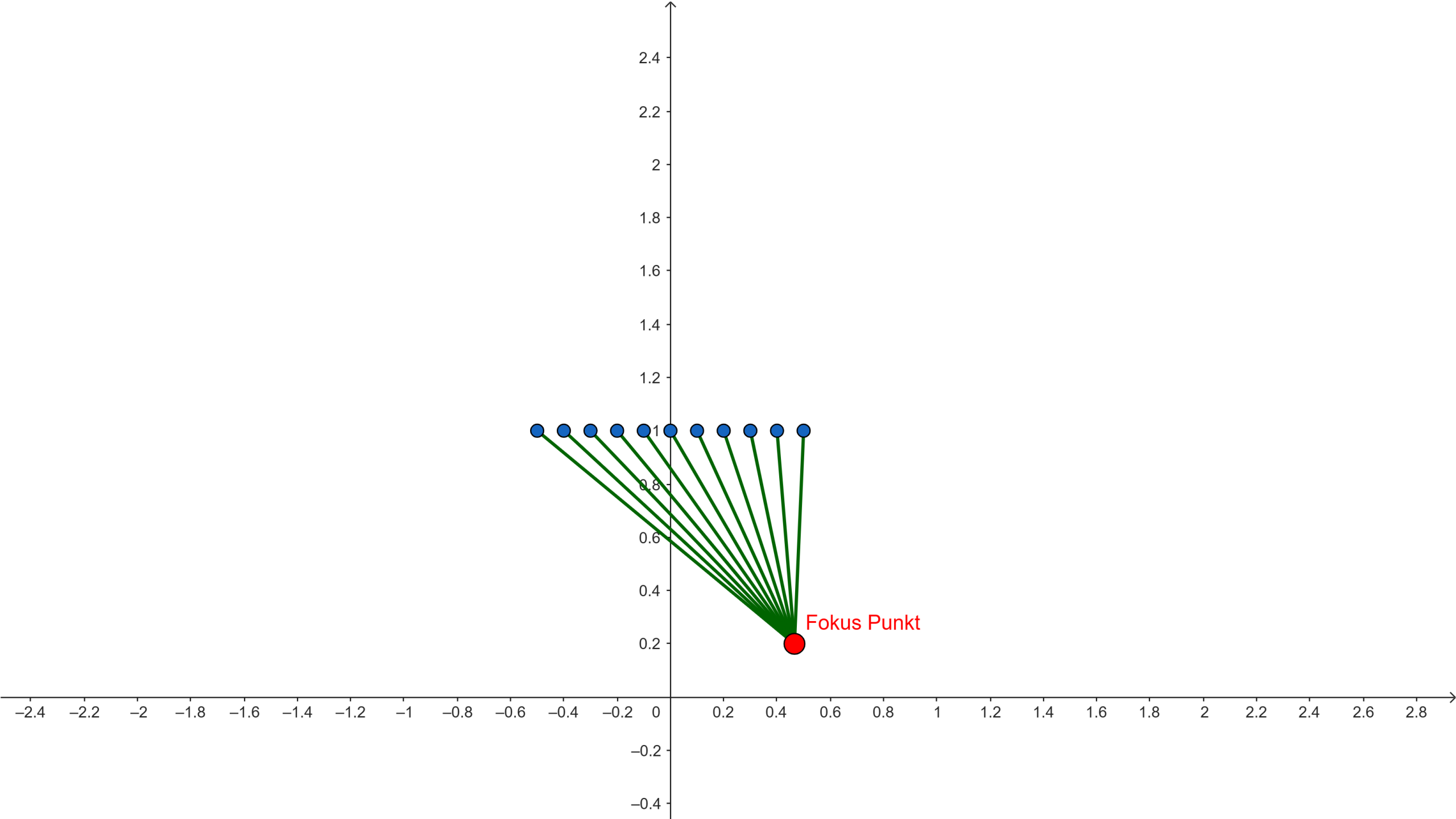
Entstehung

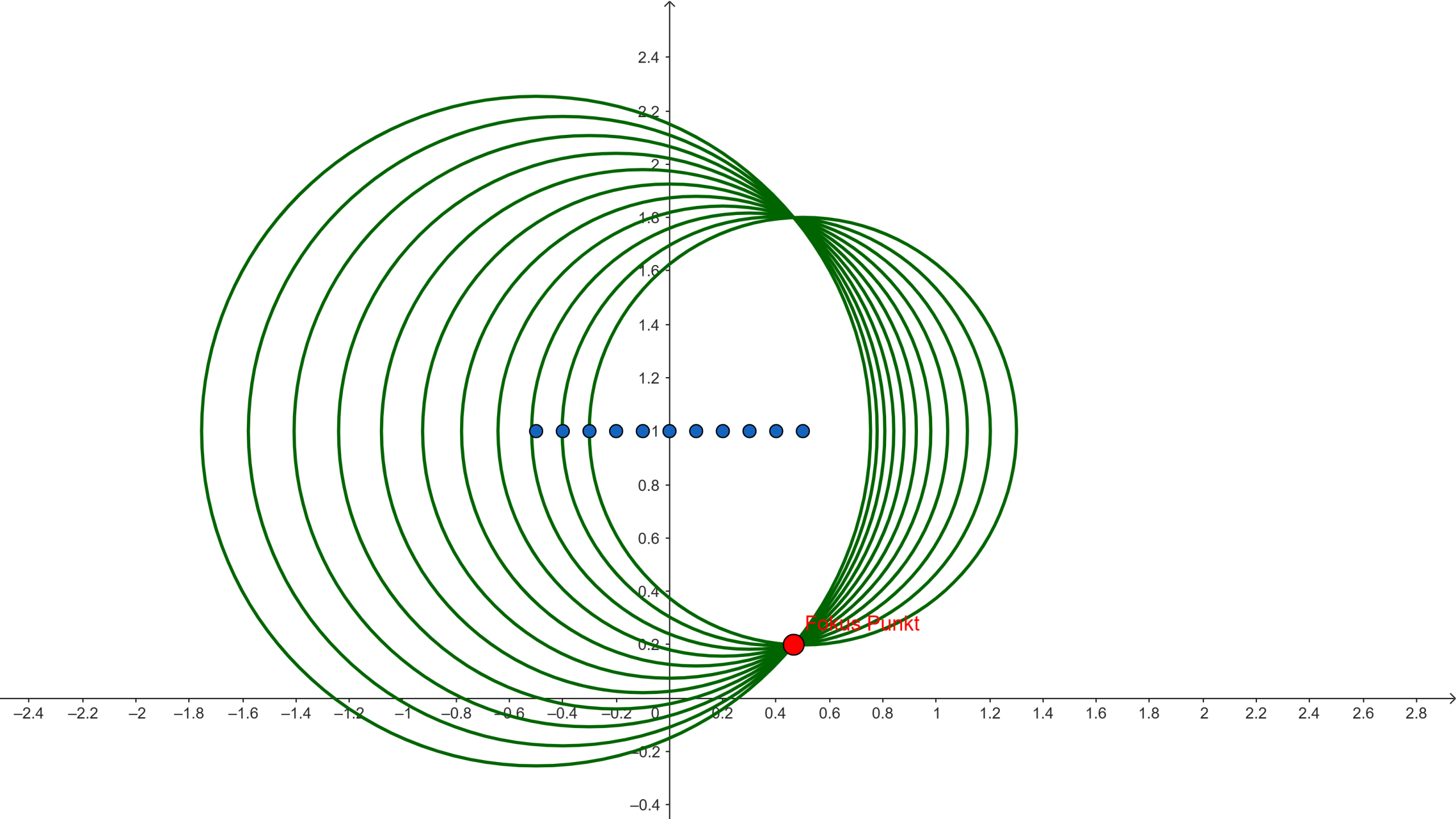
- Bild in **Streifen** unterteilt
  - Pro Streifen ein **Fokuspunkt**
- Kristalle senden **kreisförmige Schallwellen** aus
- Wellen werden **reflektiert**
- Kristalle **empfangen** reflektierte Wellen
- Schallwellen werden zum Teil wieder zurückreflektiert

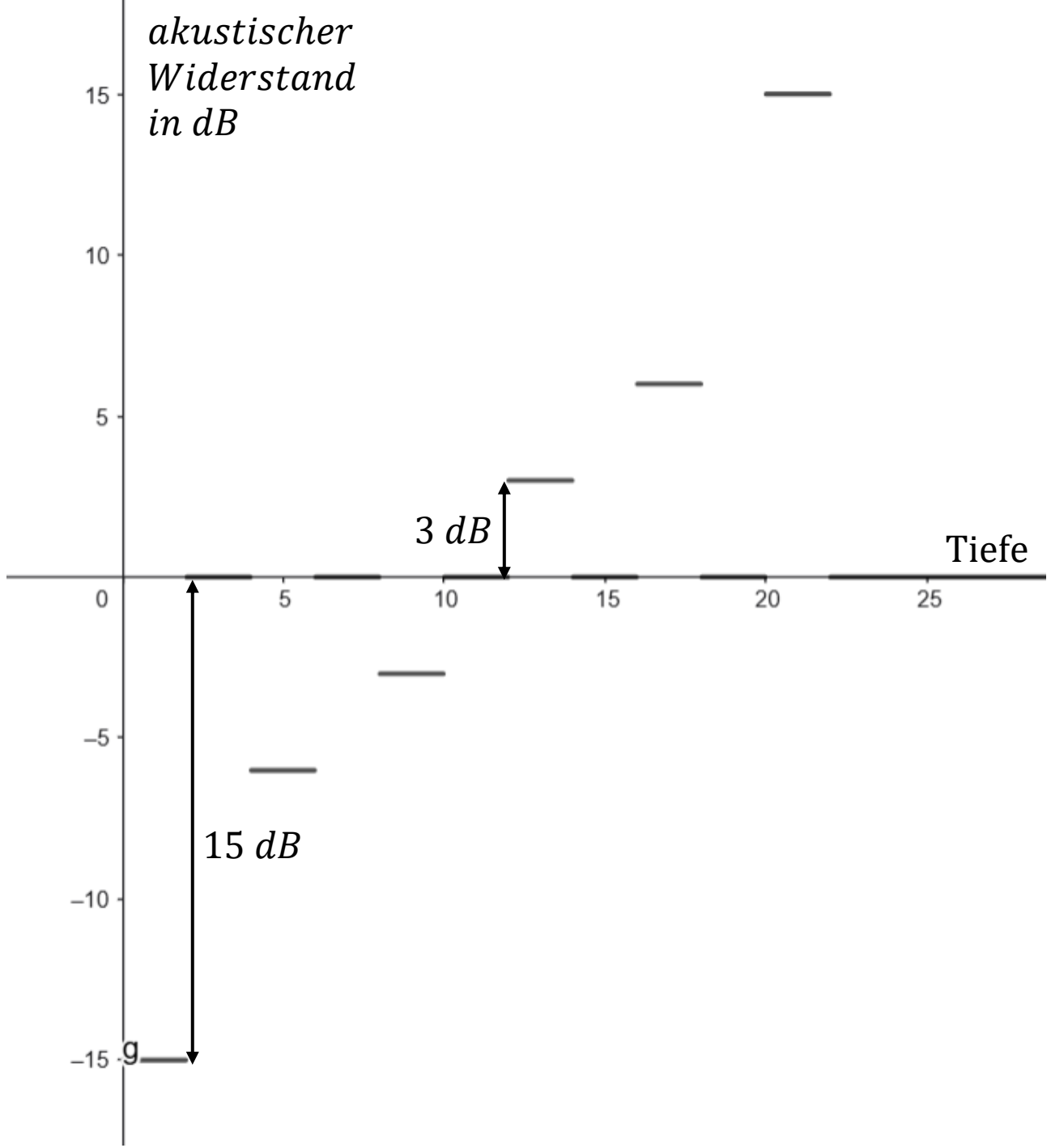



×10^-5
-2.5
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2
2.5
x-position [mm]
-1
0
1
y-position [mm]
×10^-5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0

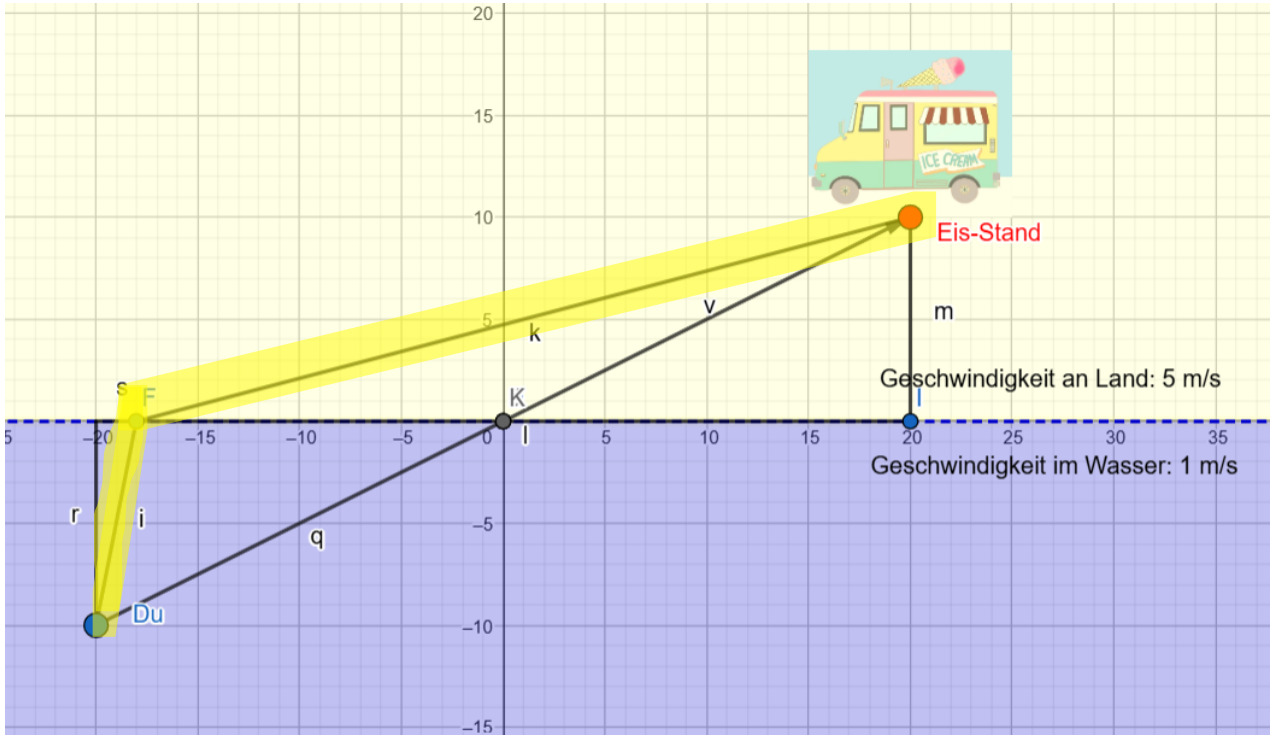

2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
−0.2
−0.4
−2.4
−2.2
−2
−1.8
−1.6
−1.4
−1.2
−1
−0.8
−0.6
−0.4
−0.2
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
2.2
2.4
2.6
2.8
Fokus Punkt


2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
–0.2
–0.4
–2.4
–2.2
–2
–1.8
–1.6
–1.4
–1.2
–1
–0.8
–0.6
–0.4
–0.2
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
2.2
2.4
2.6
2.8
Fokus Punkt


Fokus Punkt


akustischer
Widerstand
in dB
15
10
5
0
−5
−10
−15
5
10
15
20
25
3 dB
15 dB
Tiefe
g

Schnellster Weg zum Eis-Stand



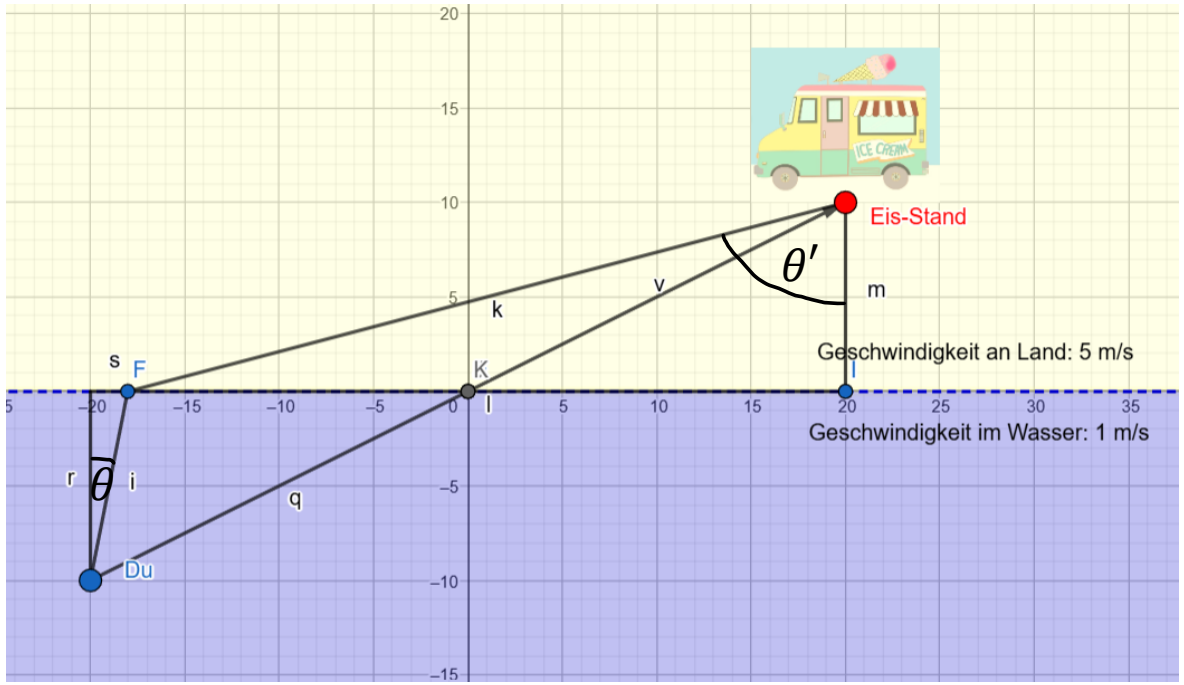
$$F = (x, 0)$$

$$t = \frac{s}{c}$$

$\binom{x}{0} - \binom{-20}{0} = \binom{x+20}{0}$ → x+20

$$t(x) = \frac{\sqrt{10^2 + (x+20)^2}}{1 (= c_{Wasser})} + \frac{\sqrt{10^2 + (20-x)^2}}{5 (= c_{Land})}$$

Herleitung Snell‘sches Gesetz

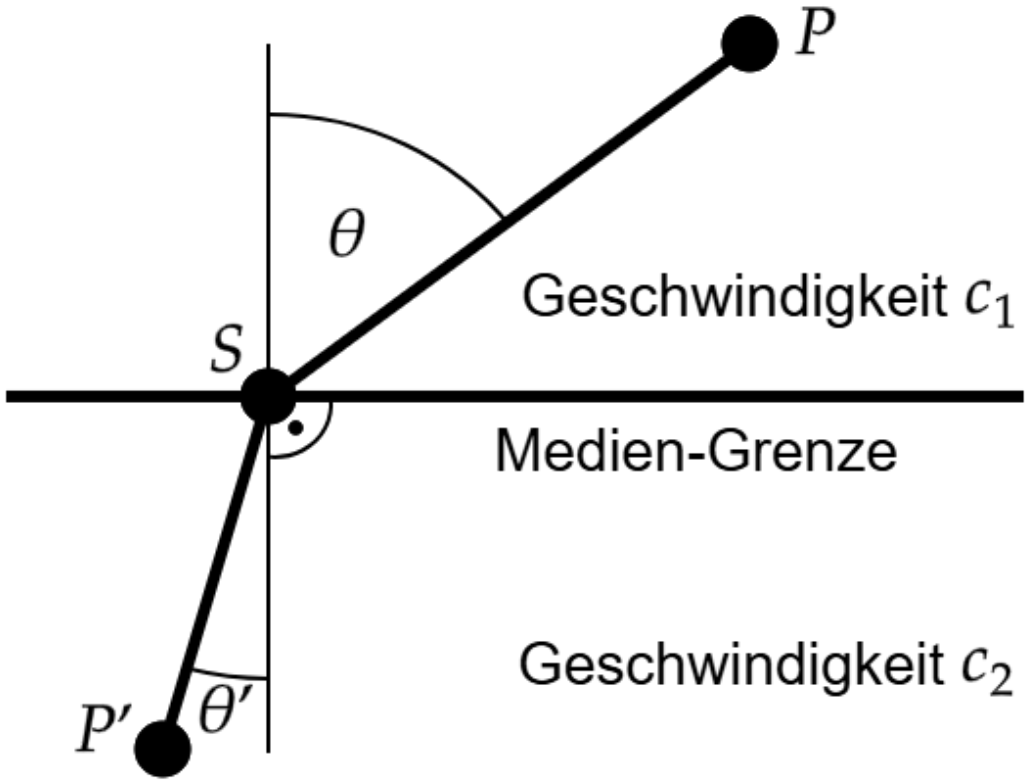


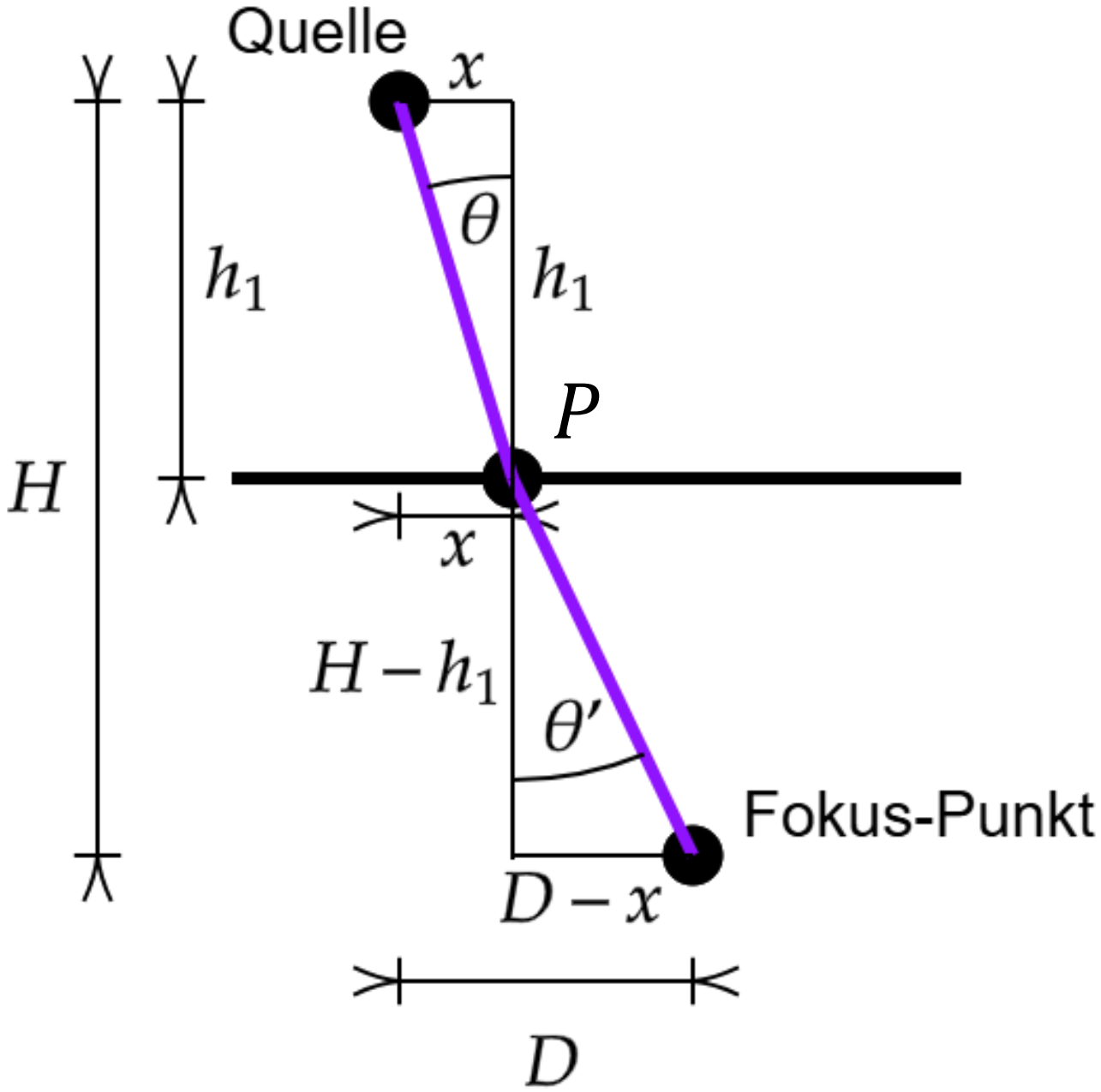
- $t'(x) = \frac{x+20}{\sqrt[2]{10^2+(x+20)^2} * c_1} - \frac{20-x}{\sqrt[2]{10^2+(20-x)^2} * c_2}$

- $\frac{x+20}{\sqrt[2]{10^2+(x+20)^2}} = \sin(\theta)$
- $\frac{20-x}{\sqrt[2]{10^2+(20-x)^2} * c_2} = \sin(\theta')$
- $t'(x) = 0$

Snell‘sches Gesetz

- **Schnellesten Weg**
- $\frac{1}{c_1} * \sin(\theta) = \frac{1}{c_2} * \sin(\theta')$





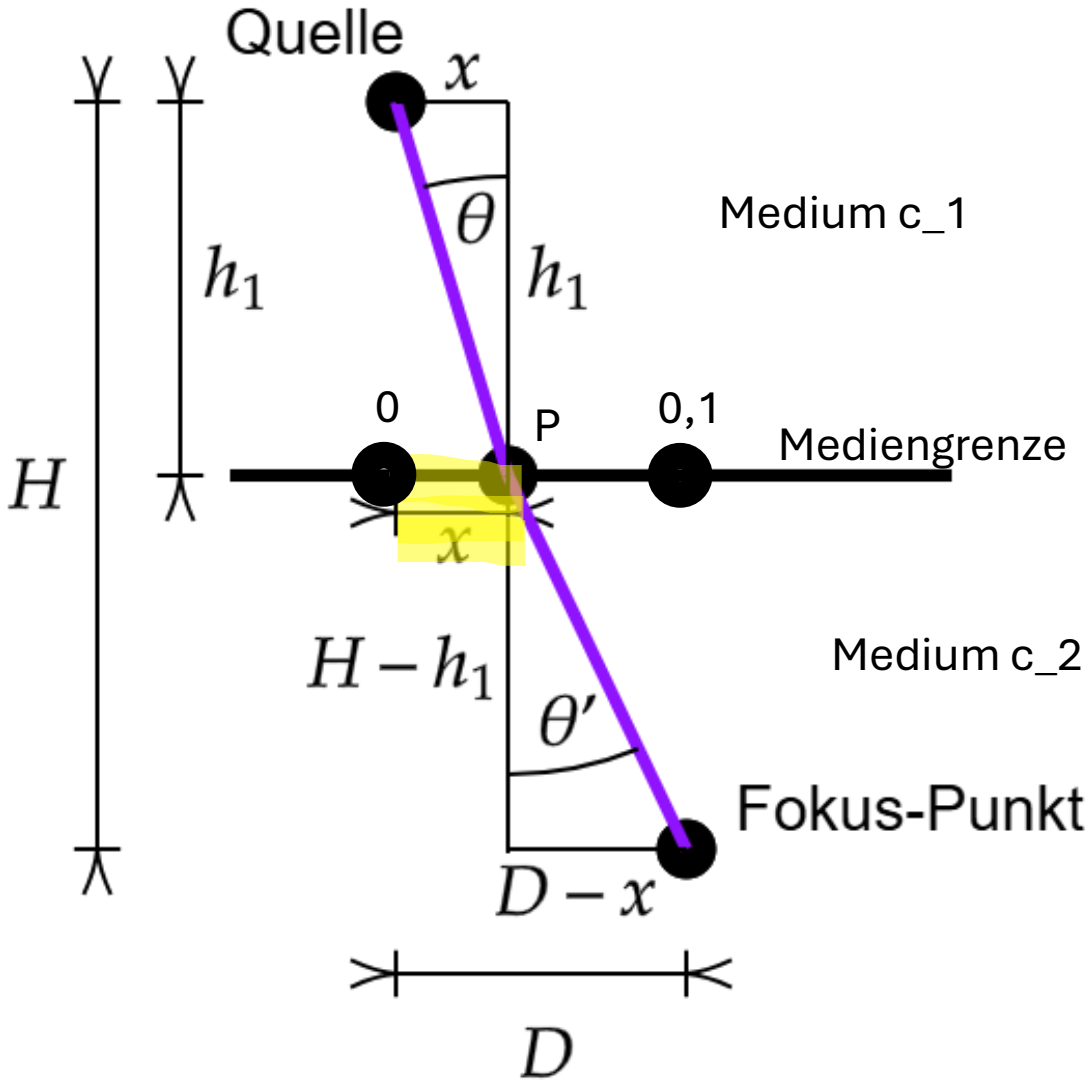
$$\frac{1}{c_1} * \sin\theta = \frac{1}{c_2} * \sin\theta'$$

$$\Downarrow$$

$$f(x) = ax^4 + bx^3 + cx^2 + dx + e$$

$$Lösung: f(x) = 0$$

Ziel: x finden

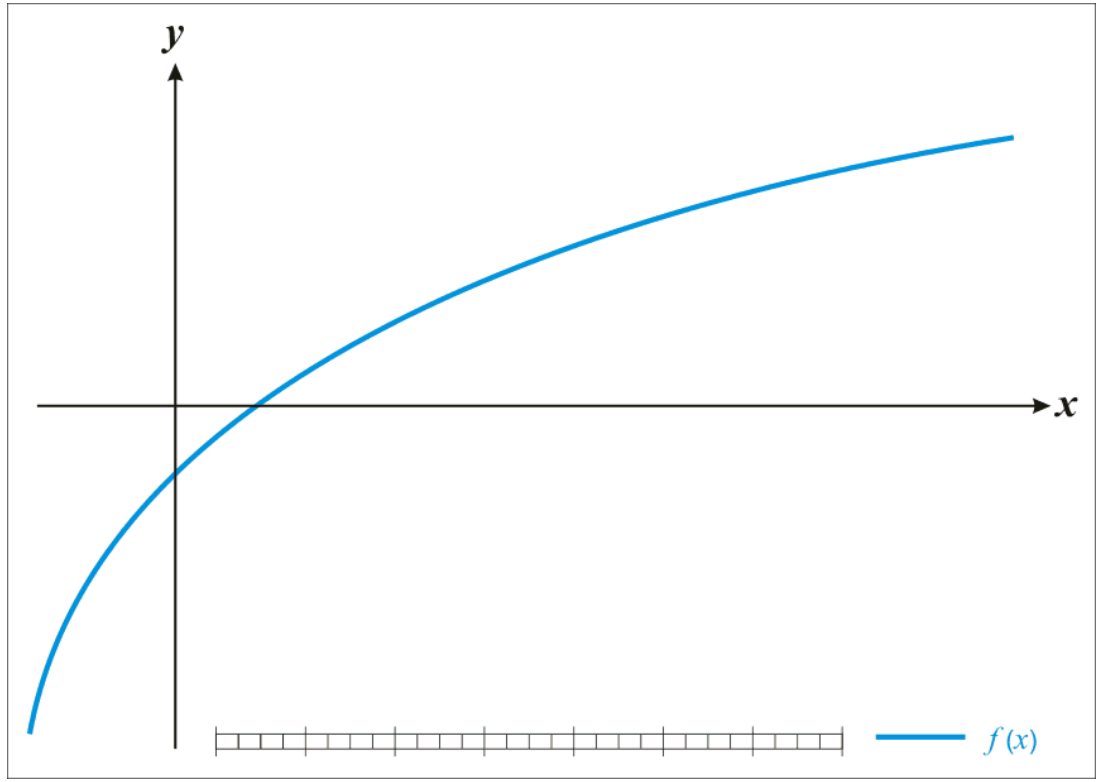


- Durch x kann der Punkt P bestimmt werden (Snellius)

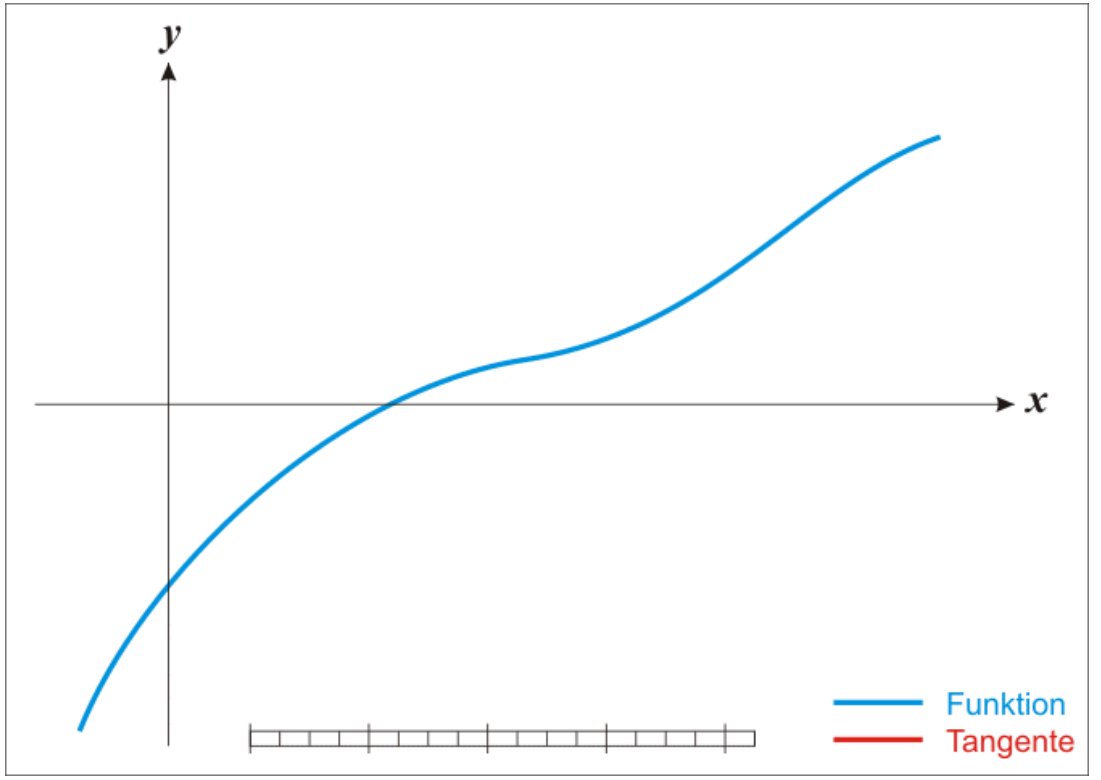
- **Zwischenwertgesetz:**

„Bei einer stetigen Funktion mit f(0)>0 und f(0.1)<0 gibt es sicher eine Nullstelle im Intervall (0;0.1)“

Bisektionsverfahren



Newton-Verfahren



Danke für eure Aufmerksamkeit