Auswertung

January 5, 2024

[1]:

```python
import os
import numpy as np
import pandas as pd
import seaborn as sns

from io import BytesIO
from matplotlib import pyplot as plt
from scipy.stats import linregress
```

[2]:

```python
sns.set_theme(context='paper', style="whitegrid", color_codes=True)

plt.rcParams["axes.titlesize"] = 13 # default: 9
plt.rcParams["axes.labelsize"] = 13 # default: 9
plt.rcParams["legend.fontsize"] = 11 # default: 8.8
plt.rcParams["legend.title_fontsize"] = 11 # default: 8.8
plt.rcParams["xtick.labelsize"] = 11 # default: 8.8
plt.rcParams["ytick.labelsize"] = 11 # default: 8.8
```

0.1 Methods

[3]:

```python
x_column = r'$z_0\ [\AA]$'
y_column = r'$\ln(I(z_0))\ [\ln(\mathrm{A})]$'
```

[4]:

```python
def read_vert_file(path) -> pd.DataFrame:
    """
    Read a *.VERT file from the given path.

    1. Read the file and create a list of lines, which are seperated by \r\n
    2. Extract the Title field
    3. Extract the data: Starting 2 lines after a line named "DATA"
    4. Convert data into DataFrame
    """
    # read
    with open(path, 'rb') as io:
        txt = io.read()
    txt = txt.split(b'\r\n')

    # extract title
    for line in txt:
        if line.startswith(b'Titel'):
            title = line.split(b'=')[1]
            break

    # extract data
    for index, line in enumerate(txt):
        if b'\nDATA' in line:
            data = txt[index+2:] # data start 2 lines after the found line
            break

    # convert to df
    with BytesIO(b'\n'.join(data)) as io:
        df = pd.read_csv(io, sep='\t', index_col=0, header=None)

    df.attrs['title'] = os.path.basename(path)
    df = df.drop(columns=4)
    df = df.rename(columns={
        1: 'U [V]',
        2: x_column,
        3: '$I(z_0)$'
    })
    df[y_column] = np.log(df['$I(z_0)$'])

    return df
```

[5]:

```
def plot(data, title=None, filename=None):
    data = data.copy()
    img = sns.relplot(
        data=data,
        x=x_column,
        y=y_column
    )
    if title is not None:
        plt.title(title)
    else:
        plt.title(data.attrs['title'])
    if filename is not None:
        img.figure.savefig(filename, bbox_inches='tight')
```

[6]:

```
def read_files(folder):
    data = {}
    for dirpath, dirnames, filenames in os.walk(folder):
        for f in filenames:
            filename = f"{dirpath}/{f}"
            print('read file: ', filename)
            df = read_vert_file(filename)
            data[df.attrs['title']] = df
    return data
```

[7]:
```
def regression(df):
    result = linregress(
        x=df[x_column],
        y=df[y_column]
    )
    print(f"$m = {round(result.slope*1000, 2)} \\pm {round(result.stderr*1000,␣
 ↪2)}$")

    x_values = np.linspace(df[x_column].min(), df[x_column].max())
    fig = plt.errorbar(
        x_values,
        result.slope * x_values + result.intercept,
        yerr=np.abs(result.stderr * x_values + result.intercept_stderr)
    )

    return result.slope*1000, result.stderr*1000
```

1 A

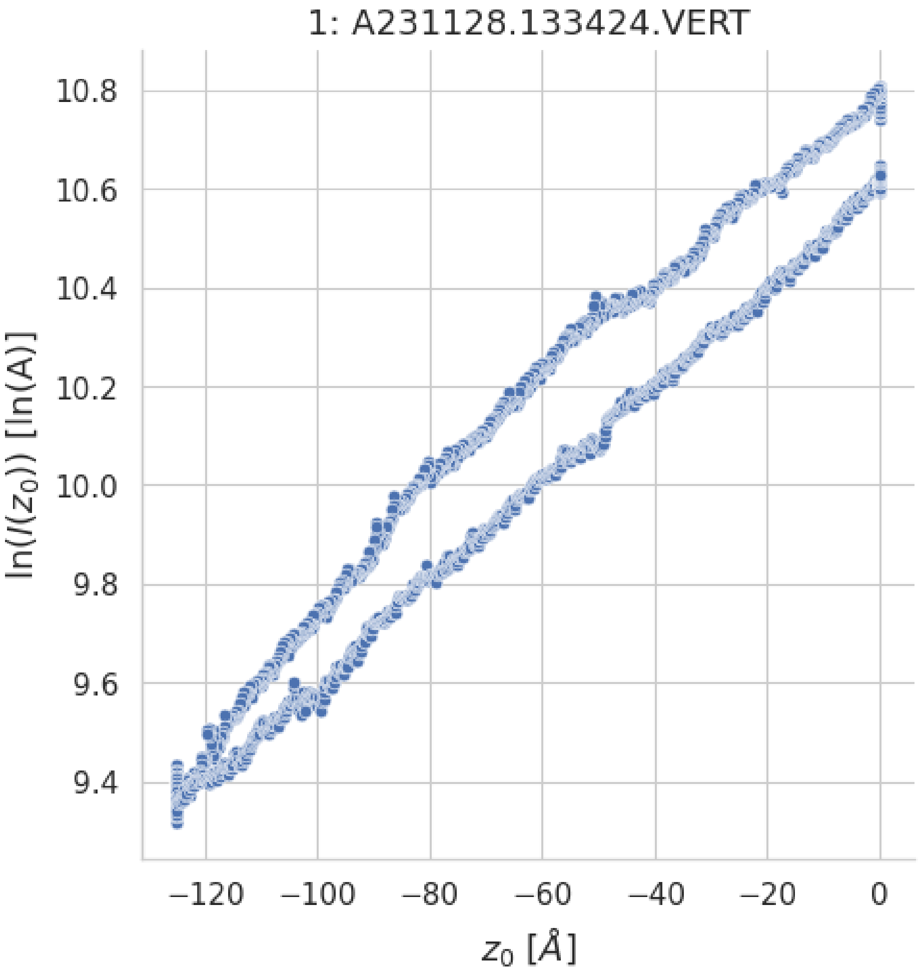
1.0.1 Messwerte

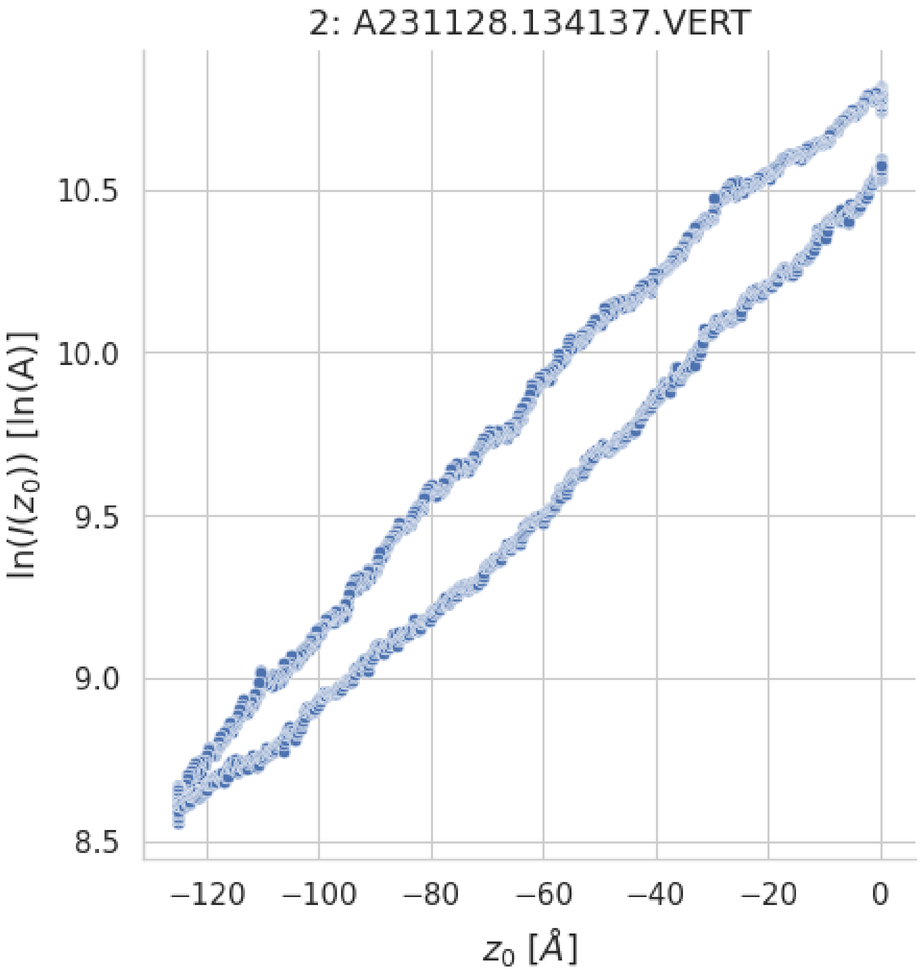
[8]:
```
data = read_files('a')
```

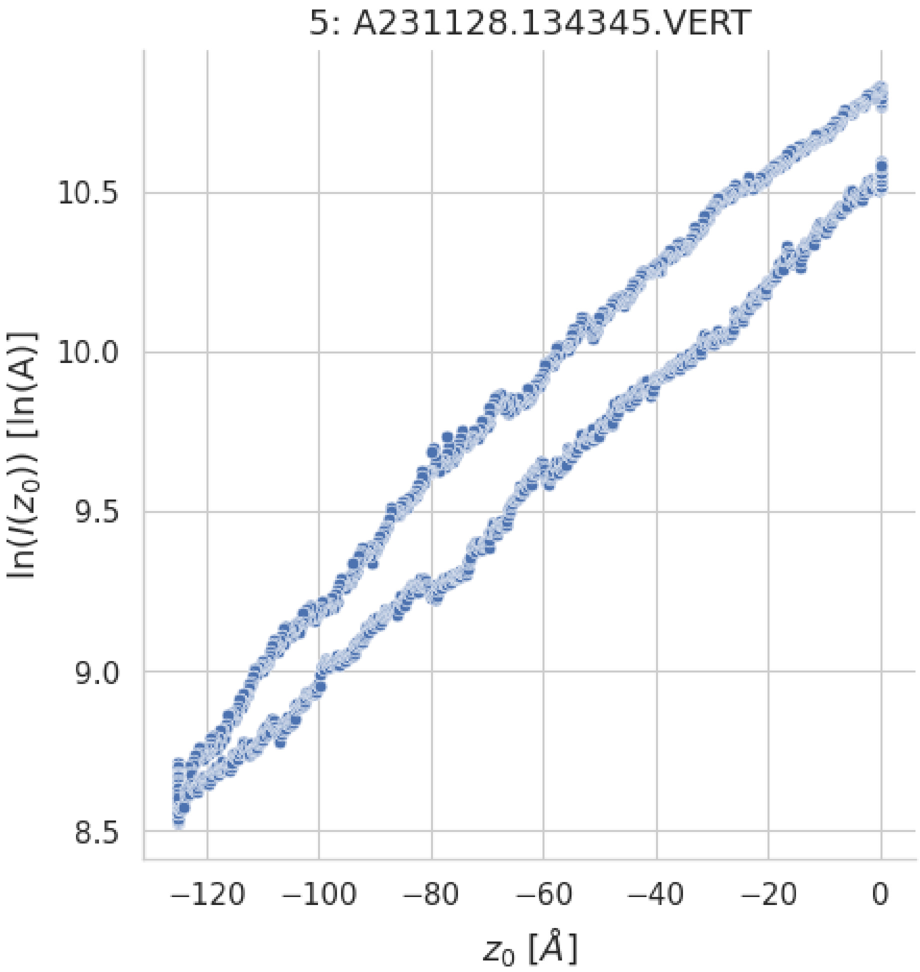
```
read file:  a/A231128.133315.VERT
read file:  a/A231128.133424.VERT
read file:  a/A231128.134137.VERT
read file:  a/A231128.134156.VERT
read file:  a/A231128.134230.VERT
read file:  a/A231128.134345.VERT
read file:  a/A231128.134401.VERT
read file:  a/A231128.134418.VERT
read file:  a/A231128.134446.VERT
```

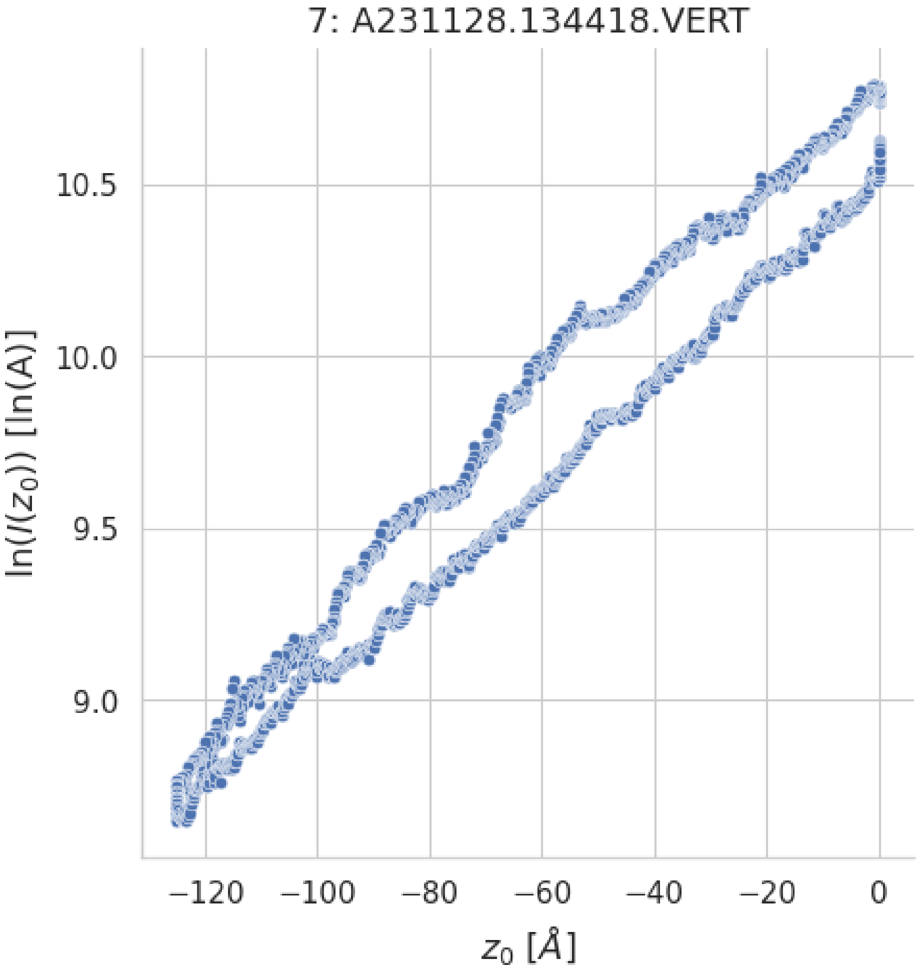
[9]:
```
# # Plotte alle Messungen
# for i, key in enumerate(data.keys()):
#     plot(data[key], title=f"{i}: {key}")
```

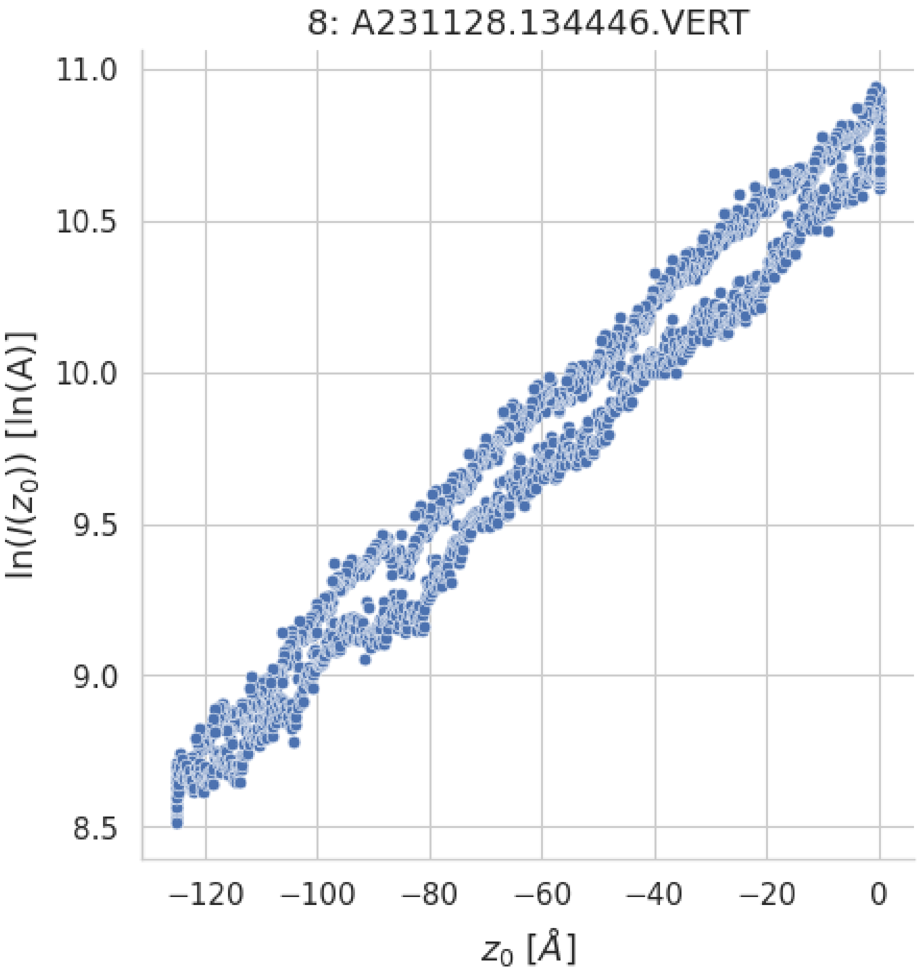
[10]:
```
# Plotte die 5 besten Messungen
selected_measurements_a = []
for i, key in enumerate(data.keys()):
    if i in (2, 5, 1, 7, 8):
        selected_measurements_a.append(data[key])
        plot(data[key], title=f"{i}: {key}")
```


1: A231128.133424.VERT
ln(I(z0)) [ln(A)]
10.8
10.6
10.4
10.2
10.0
9.8
9.6
9.4
−120
−100
−80
−60
−40
−20
0
z0 [Å]


2: A231128.134137.VERT
ln(I(z0)) [ln(A)]
10.5
10.0
9.5
9.0
8.5
−120
−100
−80
−60
−40
−20
0
z0 [Å]


5: A231128.134345.VERT
$\ln(I(z_0))$ [$\ln(A)$]
10.5
10.0
9.5
9.0
8.5
−120
−100
−80
−60
−40
−20
0
z_0 [$\AA$]


7: A231128.134418.VERT
ln(I(z0)) [ln(A)]
10.5
10.0
9.5
9.0
−120
−100
−80
−60
−40
−20
0
z0 [Å]

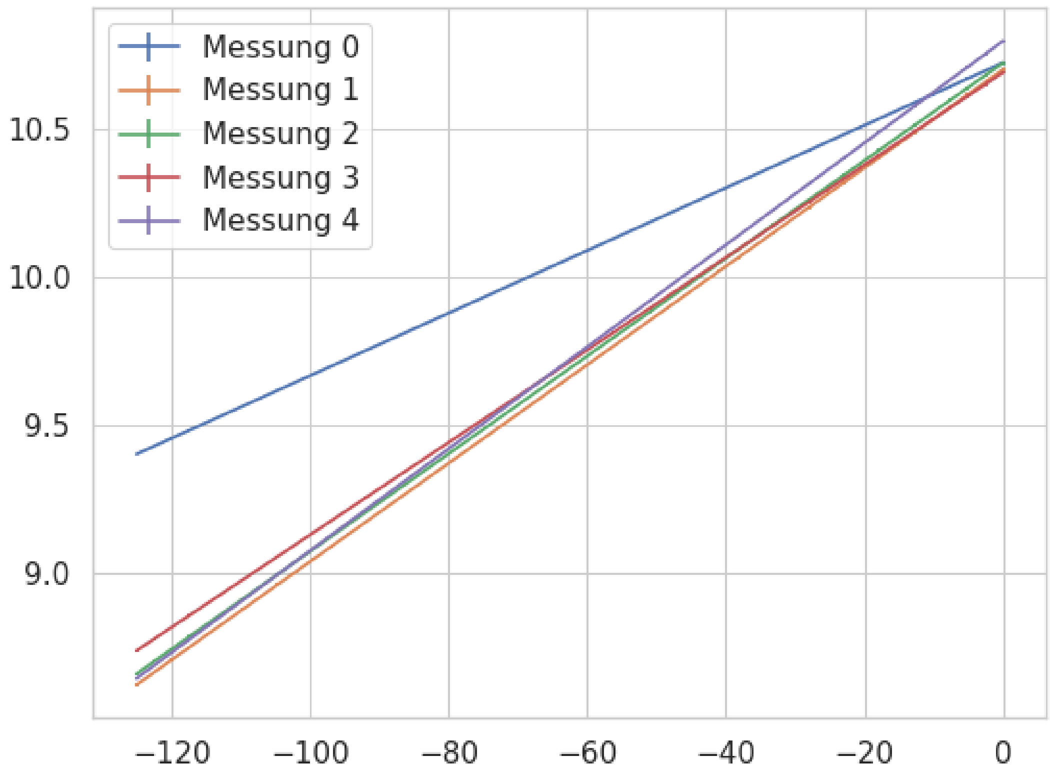


1.0.2 Regression

```
[11]: for df in selected_measurements_a:
          regression(df)
      plt.legend([ f"Messung {i}" for i in range(5)])
```

```
$m = 10.55 \pm 0.05$
$m = 16.58 \pm 0.08$
$m = 16.46 \pm 0.08$
$m = 15.58 \pm 0.07$
$m = 17.18 \pm 0.05$
```

```
[11]: <matplotlib.legend.Legend at 0x7f4cbdeaf470>
```



2 B

2.0.1 Messwerte

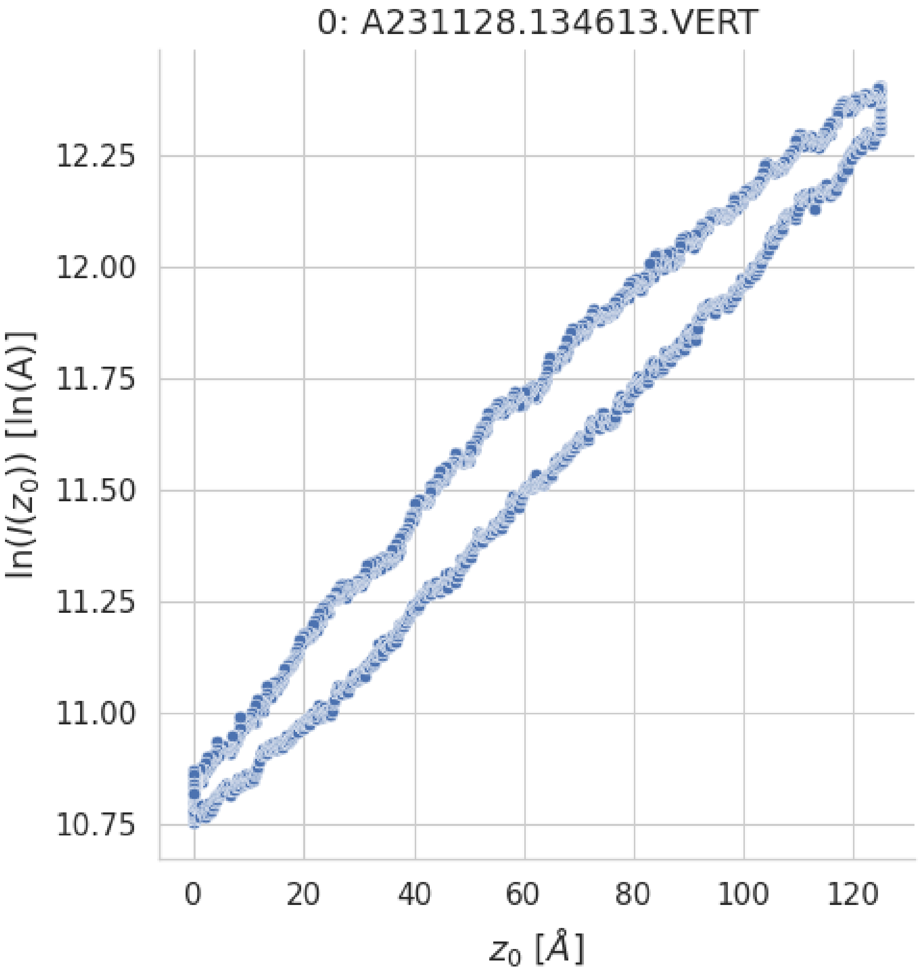
[12]:
```
data = read_files('b')
```

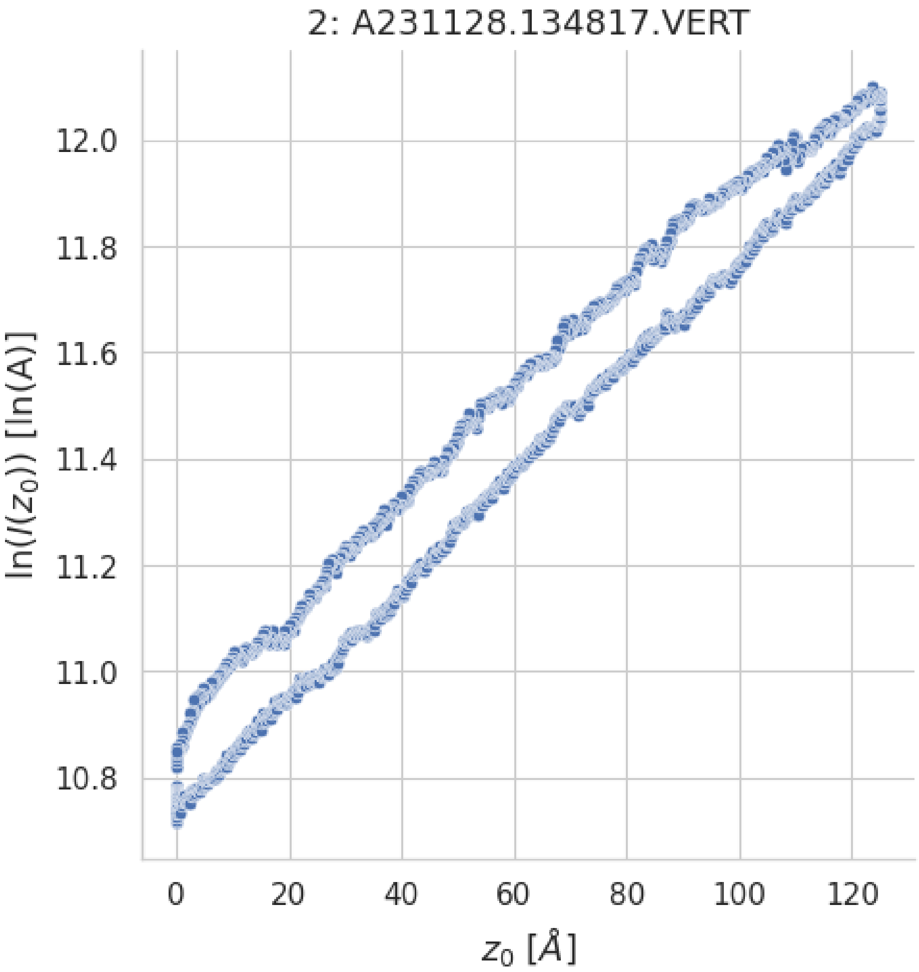
```
read file:  b/A231128.134613.VERT
read file:  b/A231128.134739.VERT
read file:  b/A231128.134817.VERT
read file:  b/A231128.134842.VERT
read file:  b/A231128.134923.VERT
read file:  b/A231128.134937.VERT
read file:  b/A231128.134951.VERT
read file:  b/A231128.135005.VERT
read file:  b/A231128.135041.VERT
```

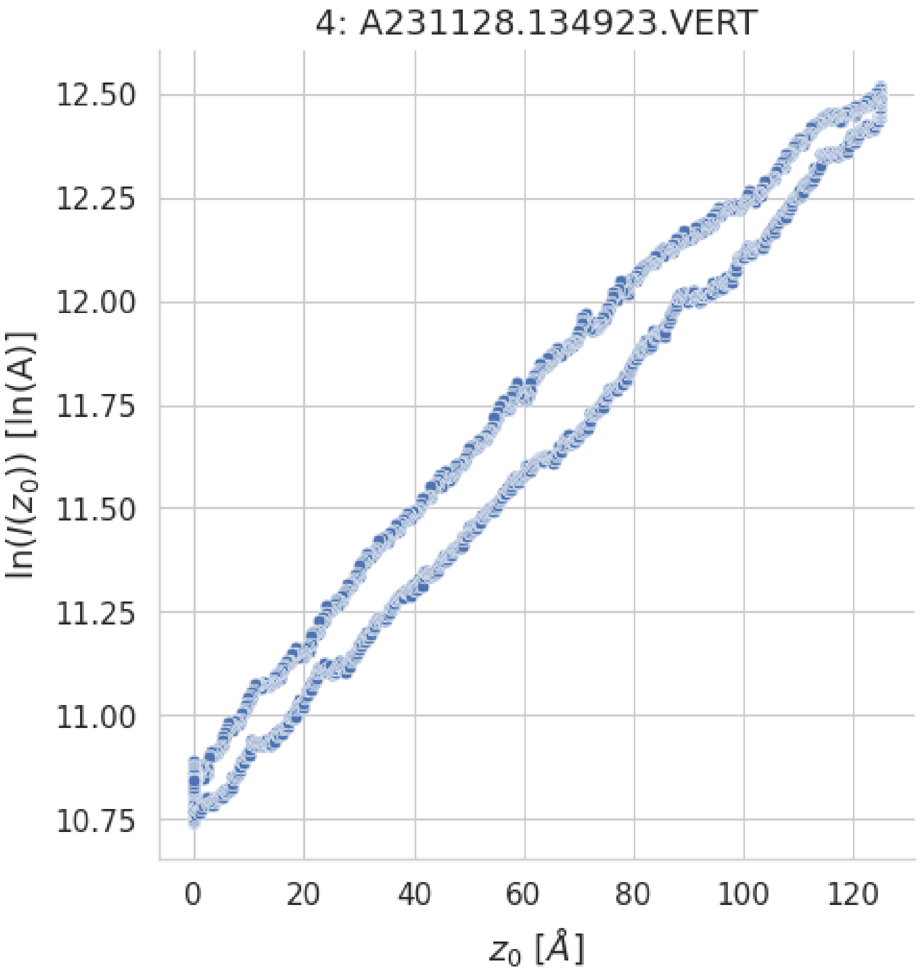
[13]:
```
# # Plotte alle Messungen
# for i, key in enumerate(data.keys()):
#     plot(data[key], title=f"{i}: {key}")
```

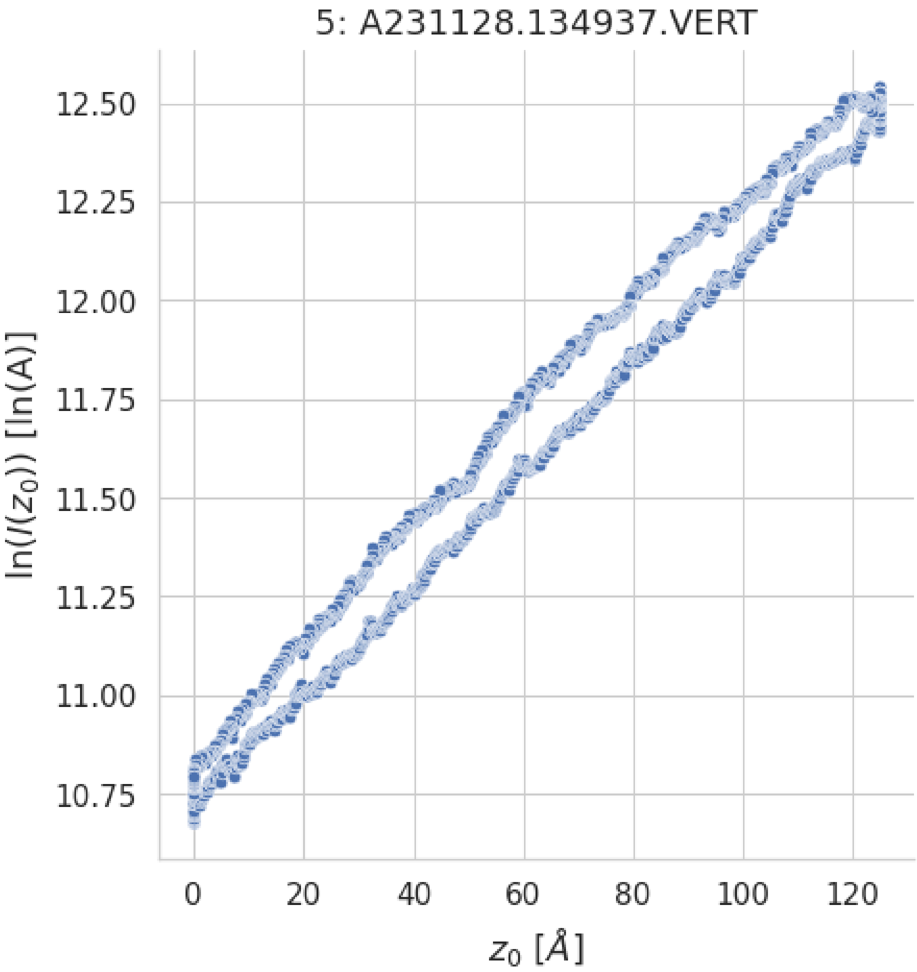
[14]:
```
# Plotte die 5 besten Messungen
selected_measurements_b = []
```

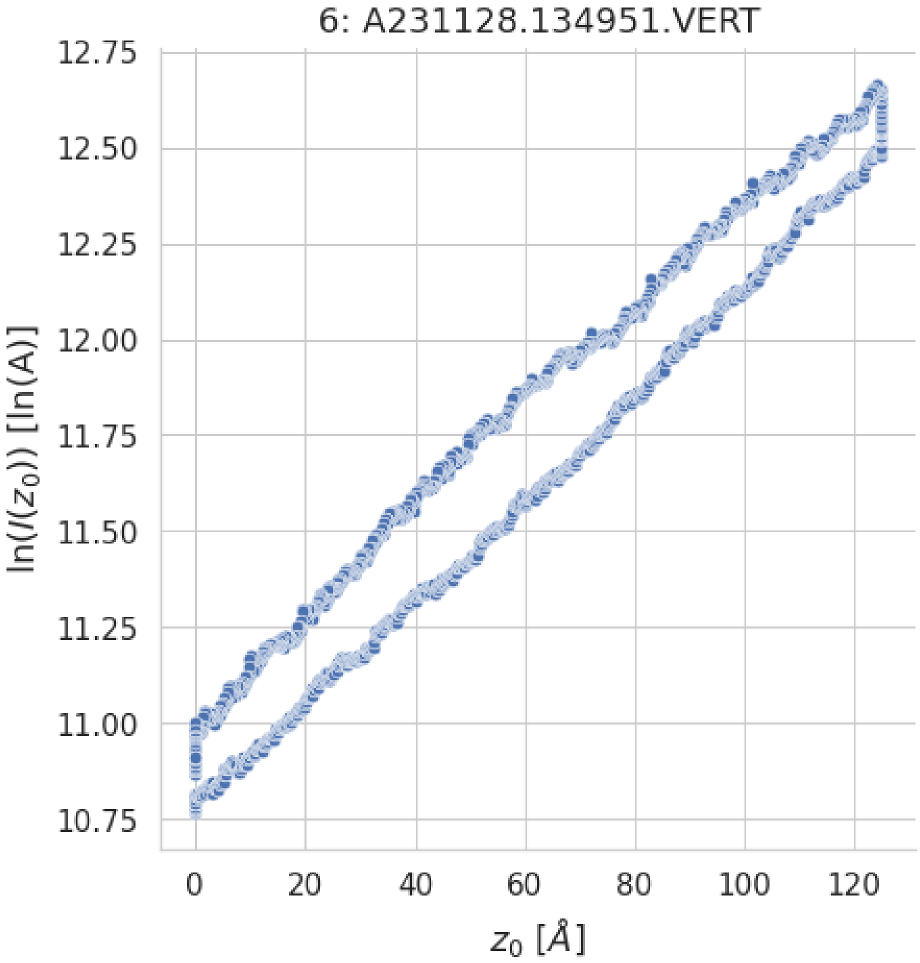
```
for i, key in enumerate(data.keys()):
    if i in (2, 4, 5, 6, 0):
        selected_measurements_b.append(data[key])
        plot(data[key], title=f"{i}: {key}")
```




2: A231128.134817.VERT
ln(I(z_0)) [ln(A)]
12.0
11.8
11.6
11.4
11.2
11.0
10.8
0
20
40
60
80
100
120
z_0 [Å]


4: A231128.134923.VERT
12.50
12.25
12.00
11.75
11.50
11.25
11.00
10.75
$\ln(I(z_0))$ [ln(A)]
0
20
40
60
80
100
120
z_0 [$\AA$]


5: A231128.134937.VERT
ln(I(z_0)) [ln(A)]
12.50
12.25
12.00
11.75
11.50
11.25
11.00
10.75
0
20
40
60
80
100
120
z_0 [Å]



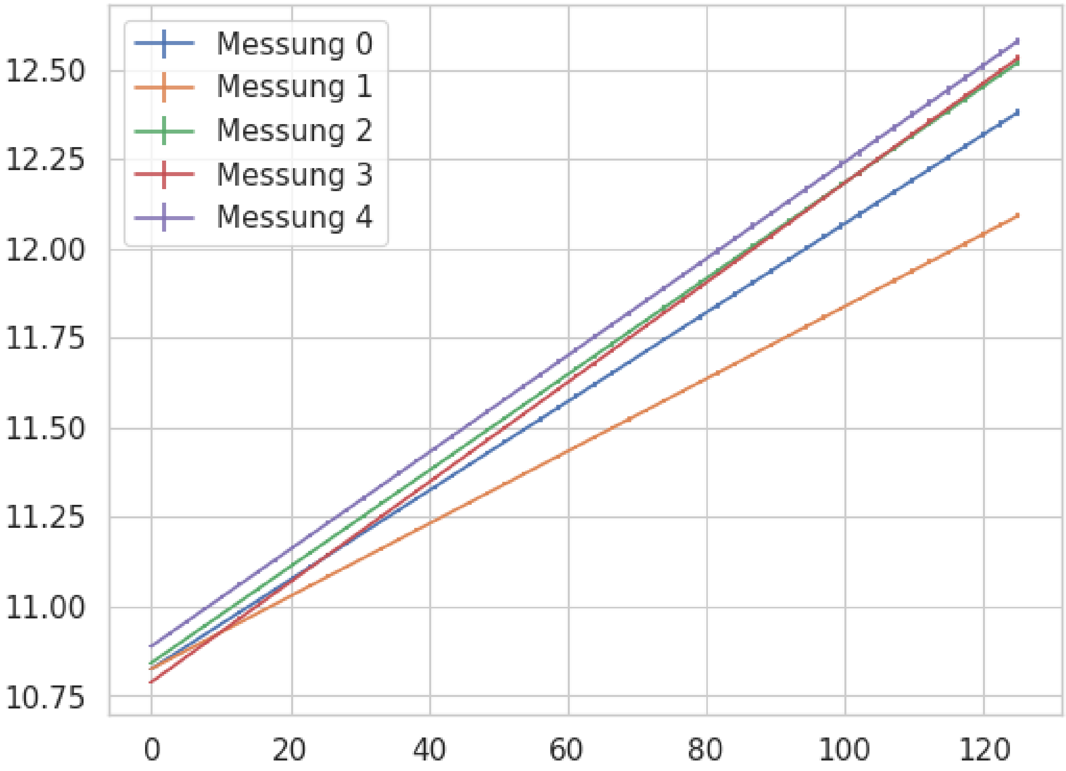
2.0.2 Regression

[15]:
```
# plotte alle Regressionen
# for df in selected_measurements_a:
#     plot_regression(df)
```

[16]:
```
for df in selected_measurements_b:
    regression(df)
plt.legend([ f"Messung {i}" for i in range(5)])
```

```
$m = 12.44 \pm 0.05$
$m = 10.12 \pm 0.04$
$m = 13.42 \pm 0.04$
$m = 13.94 \pm 0.04$
$m = 13.53 \pm 0.06$
```

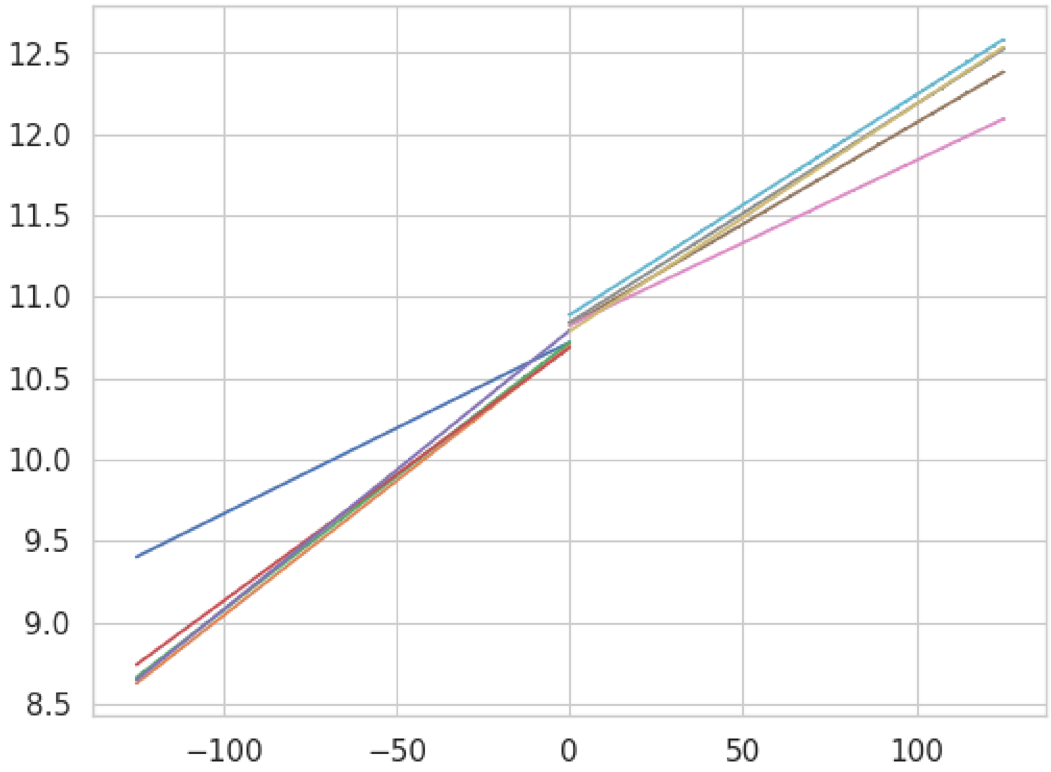
[16]:
```
<matplotlib.legend.Legend at 0x7f4cbdf83c80>
```



3 A und B

[17]:
```
ms = []
errs = []
for df in selected_measurements_a + selected_measurements_b:
    m, err = regression(df)
    ms.append(m)
    errs.append(err)
```

```
$m = 10.55 \pm 0.05$
$m = 16.58 \pm 0.08$
$m = 16.46 \pm 0.08$
$m = 15.58 \pm 0.07$
$m = 17.18 \pm 0.05$
$m = 12.44 \pm 0.05$
$m = 10.12 \pm 0.04$
$m = 13.42 \pm 0.04$
$m = 13.94 \pm 0.04$
$m = 13.53 \pm 0.06$
```



```
[18]: for i in range(10):
          phi = (1000*ms[i])**2/1e6
          err_phi = (1000*errs[i])**2/1e6
          print(f'| ${round(ms[i], 3)} \\pm {round(errs[i], 3)}$ | ${round(phi, 3)}␣
       ↪\\pm {round(err_phi, 3)}$ |')
```

```
| $10.549 \pm 0.049$ | $111.29 \pm 0.002$ |
| $16.579 \pm 0.079$ | $274.872 \pm 0.006$ |
| $16.464 \pm 0.078$ | $271.057 \pm 0.006$ |
| $15.579 \pm 0.065$ | $242.699 \pm 0.004$ |
| $17.176 \pm 0.054$ | $295.018 \pm 0.003$ |
| $12.439 \pm 0.048$ | $154.737 \pm 0.002$ |
| $10.123 \pm 0.038$ | $102.478 \pm 0.001$ |
| $13.417 \pm 0.043$ | $180.009 \pm 0.002$ |
| $13.945 \pm 0.038$ | $194.458 \pm 0.001$ |
| $13.526 \pm 0.057$ | $182.949 \pm 0.003$ |
```