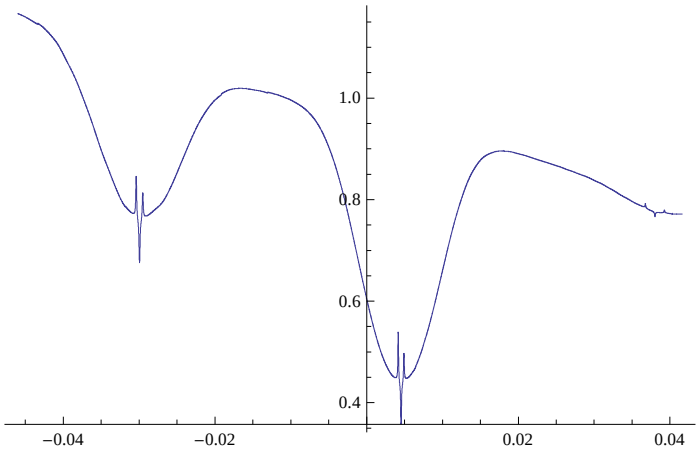
```
SetDirectory["E:\\Utz\\Physik4\\Übungen"]
```

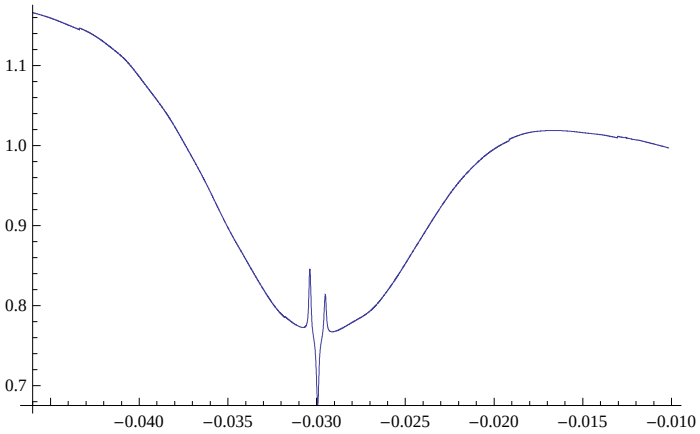
```
E:\Utz\Physik4\Übungen
```

```
data = Import["satspectroscopy.dat", "Table", "FieldSeparators" → ";"];
```

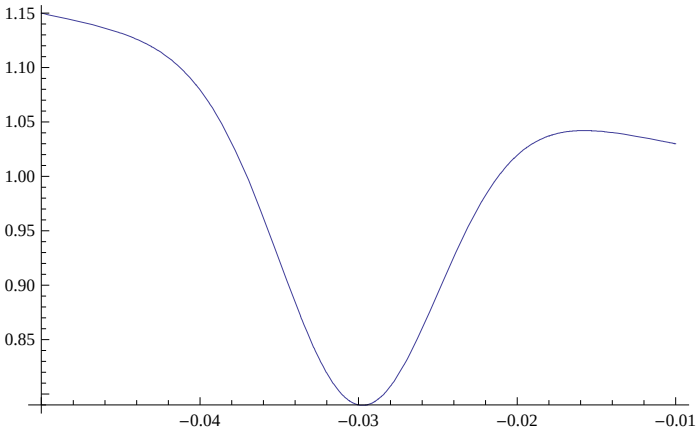
```
ListPlot[data, Joined → True]
```



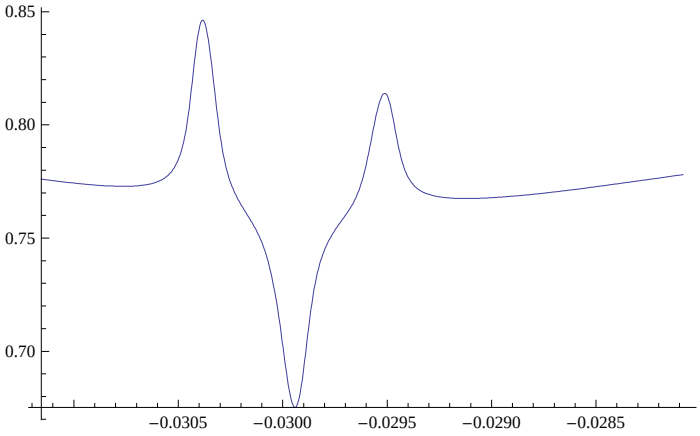

```
plot1 = ListPlot[data[[1 ;; 7000]], Joined → True]
```




```
Plot[c + lin * x - a * E^(-(x - x0)^2 / (2 * sig^2)) /.
  {c → 1., lin -> -3., a -> .3, x0 -> -.03, sig -> 0.005}, {x, -.05, -.01}]
```



```
ListPlot[data[[2900 ;; 3500]], Joined → True, PlotRange → All]
```




```
erg01 =
 NonlinearModelFit[data[[1 ;; 7000]], c + lin * x - a * E^(-(x - x0)^2 / (2 * sig^2)),
  {{c, 1.}, {lin, -3.}, {a, .3}, {x0, -.03}, {sig, 0.005}}, x]
```

FittedModel[$0.951915 - 0.335767\, e^{-17514.7\,(\ll 21 \gg + x)^2} - 4.8279\, x$]

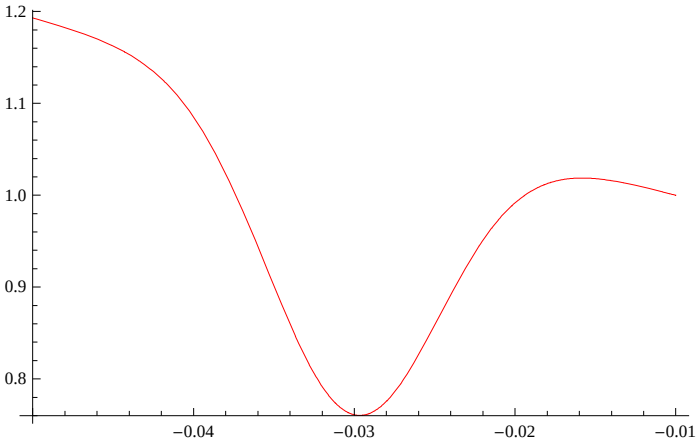
```
erg01["ANOVATable"]
```

	DF	SS	MS
Model	5	6580.34	1316.07
Error	6995	0.451437	0.0000645372
Uncorrected Total	7000	6580.79	
Corrected Total	6999	99.897	

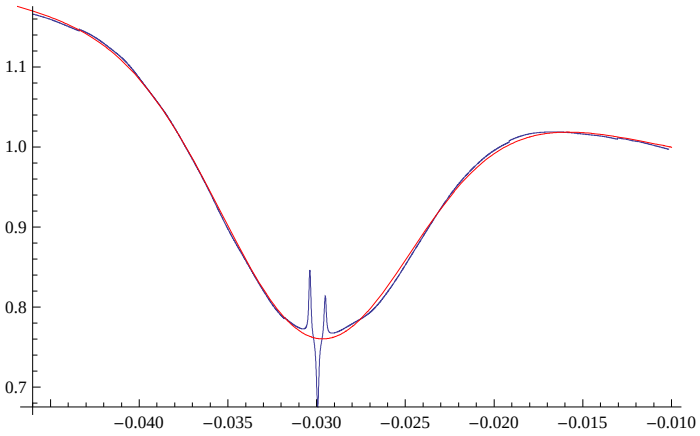
```
erg01["ParameterTable"]
```

	Estimate	Standard Error	t-Statistic	P-Value
c	0.951915	0.000327378	2907.7	$2.19364513513 \times 10^{-10784}$
lin	−4.8279	0.0117552	−410.705	$5.9405204764 \times 10^{-4899}$
a	0.335767	0.000281684	1192.	$1.30918923094 \times 10^{-8081}$
x0	−0.0300738	5.03067×10^{-6}	−5978.08	$6.0083409262 \times 10^{-12973}$
sig	0.00534298	6.4152×10^{-6}	832.863	$2.99095003033 \times 10^{-7000}$

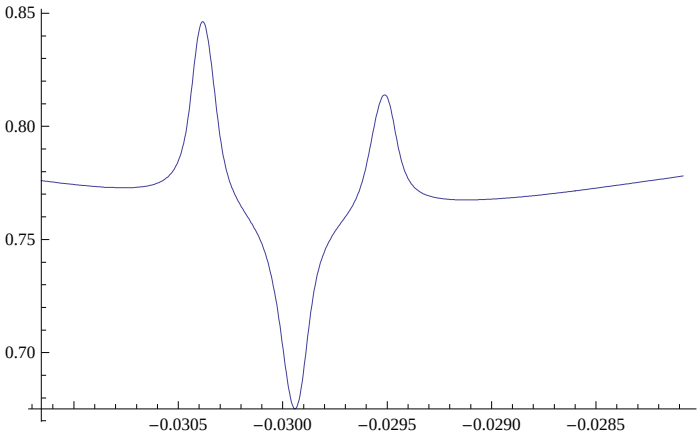
```
plot2 = Plot[Evaluate[erg01["BestFit"]],
  {x, -.05, -.01}, PlotStyle -> RGBColor[1, 0, 0]]
```



```
Show[plot1, plot2]
```



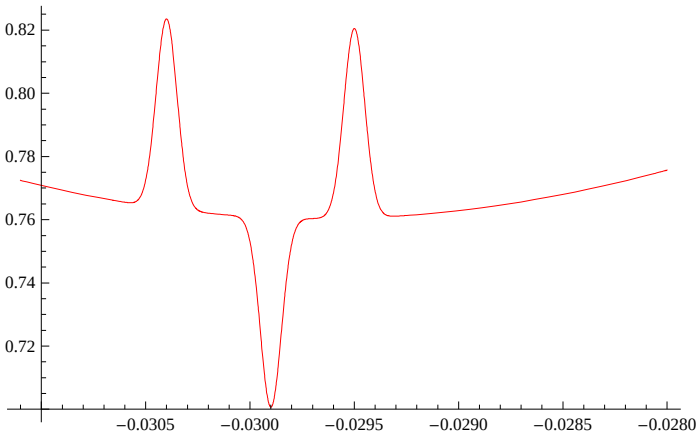

```
plot3 = ListPlot[data[[2900 ;; 3500]], Joined → True, PlotRange → All]
```



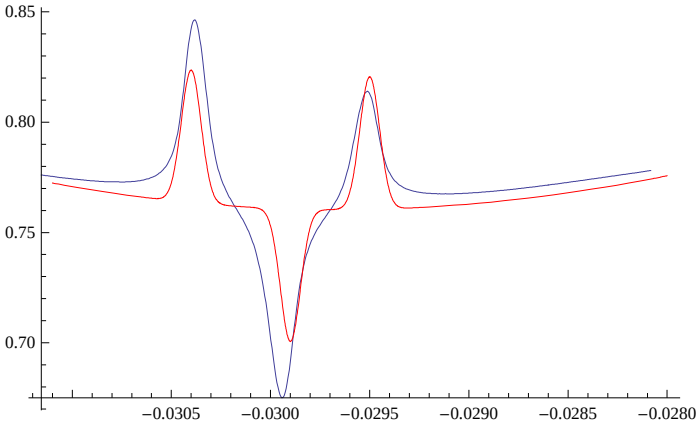

```
Apply[Rule, erg01["ParameterTable"][[1, 1, 2 ;; -1, 1 ;; 2]], {1}]
```

```
{c → 0.951915, lin → -4.8279, a → 0.335767, x0 → -0.0300738, sig → 0.00534298}
```

```
plot4 = Plot[Evaluate[
    c + lin * x - a * E^(-(x - x0)^2 / (2 * sig^2)) + a1 * E^(-(x - x01)^2 / (2 * sig1^2)) -
      a2 * E^(-(x - x02)^2 / (2 * sig2^2)) + a3 * E^(-(x - x03)^2 / (2 * sig3^2)) /.
     Join[Apply[Rule, erg01["ParameterTable"][[1, 1, 2 ;; -1, 1 ;; 2]], {1}],
      {a1 -> .06, x01 -> -.0304, sig1 -> 0.00005, a2 -> .06, x02 -> -.0299,
       sig2 -> 0.00005, a3 -> .06, x03 -> -.0295, sig3 -> 0.00005}]],
  {x, -.0311, -.028}, PlotStyle -> RGBColor[1, 0, 0], PlotRange → All]
```



```
Show[plot3, plot4]
```




```
fitfun =
 c + lin * x - a * E^(-(x - x0)^2 / (2 * sig^2)) + a1 * E^(-(x - x01)^2 / (2 * sig1^2)) -
  a2 * E^(-(x - x02)^2 / (2 * sig2^2)) + a3 * E^(-(x - x03)^2 / (2 * sig3^2))
```

$$c - a\, e^{-\frac{(x-x0)^2}{2\,sig^2}} + a1\, e^{-\frac{(x-x01)^2}{2\,sig1^2}} - a2\, e^{-\frac{(x-x02)^2}{2\,sig2^2}} + a3\, e^{-\frac{(x-x03)^2}{2\,sig3^2}} + lin\, x$$

```
fitpar = Apply[{#1, #2} &,
  Join[Apply[Rule, erg01["ParameterTable"][[1, 1, 2 ;; -1, 1 ;; 2]], {1}],
   {a1 -> .06, x01 -> -.0304, sig1 -> 0.00005, a2 -> .06, x02 -> -.0299,
    sig2 -> 0.00005, a3 -> .06, x03 -> -.0295, sig3 -> 0.00005}], {1}]
```

```
{{c, 0.951915}, {lin, -4.8279}, {a, 0.335767}, {x0, -0.0300738},
 {sig, 0.00534298}, {a1, 0.06}, {x01, -0.0304}, {sig1, 0.00005}, {a2, 0.06},
 {x02, -0.0299}, {sig2, 0.00005}, {a3, 0.06}, {x03, -0.0295}, {sig3, 0.00005}}
```

```
erg02 = NonlinearModelFit[data[[1 ;; 7000]], fitfun, fitpar, x]
```

```
FittedModel[
```

$$0.951783 + 0.0513255\, e^{-8.41775\times10^{7}\,(\ll20\gg+x)^2} - 0.0805501\, e^{\ll1\gg} - \ll19\gg e^{\ll1\gg} + 0.0789245\, e^{-1.0184\times10^{8}\,\ll1\gg^2} - 4.82185\, x$$

```
]
```

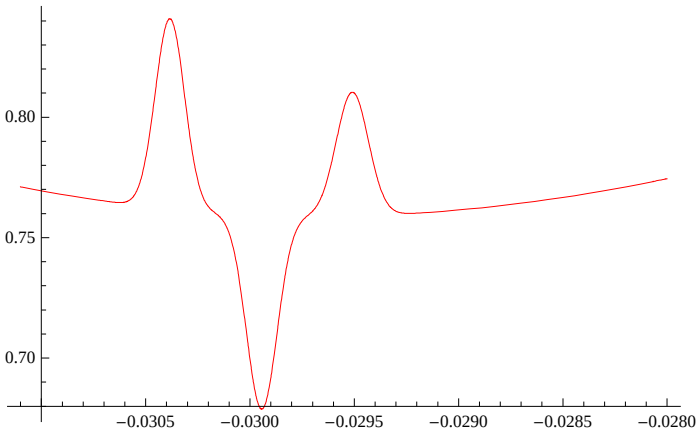
```
erg02["ANOVATable"]
```

	DF	SS	MS
Model	14	6580.73	470.052
Error	6986	0.0682181	9.76498×10^{-6}
Uncorrected Total	7000	6580.79	
Corrected Total	6999	99.897	

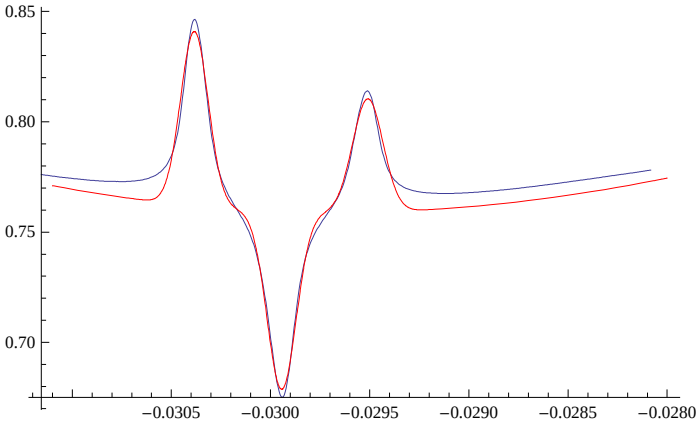
```
erg02["ParameterTable"]
```

	Estimate	Standard Error	t-Statistic	P-Value
c	0.951783	0.000127152	7485.38	$2.6409893368\times10^{-13640}$
lin	−4.82185	0.00456551	−1056.15	$4.5797680816\times10^{-7708}$
a	0.336925	0.000114745	2936.29	$3.9578855643\times10^{-10802}$
x0	−0.0300727	1.94441×10^{-6}	−15466.2	$6.0603053246\times10^{-15842}$
sig	0.00532214	2.56227×10^{-6}	2077.12	$4.2527903813\times10^{-9753}$
a1	0.0789245	0.000780521	101.118	$2.15063230876\times10^{-1370}$
x01	−0.0303839	7.96633×10^{-7}	−38140.4	$2.00764687488\times10^{-18580}$
sig1	0.000070069	8.0665×10^{-7}	86.8641	$1.18935972656\times10^{-1113}$
a2	0.0805501	0.00076401	105.431	$5.8563703033\times10^{-1447}$
x02	−0.029944	7.9792×10^{-7}	−37527.5	$2.8477403787\times10^{-18531}$
sig2	0.0000732125	8.08174×10^{-7}	90.59	$3.6926142706\times10^{-1181}$
a3	0.0513255	0.000744712	68.9199	$1.73689075097\times10^{-789}$
x03	−0.0295094	1.28481×10^{-6}	−22967.9	$1.13972691235\times10^{-17041}$
sig3	0.0000770703	1.30243×10^{-6}	59.1741	$7.7619886370\times10^{-619}$

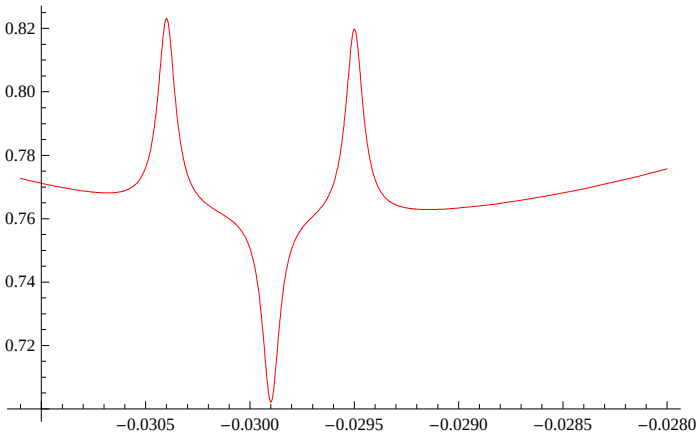
```
plot5 = Plot[Evaluate[erg02["BestFit"]],
  {x, -.0311, -.028}, PlotStyle -> RGBColor[1, 0, 0], PlotRange → All]
```



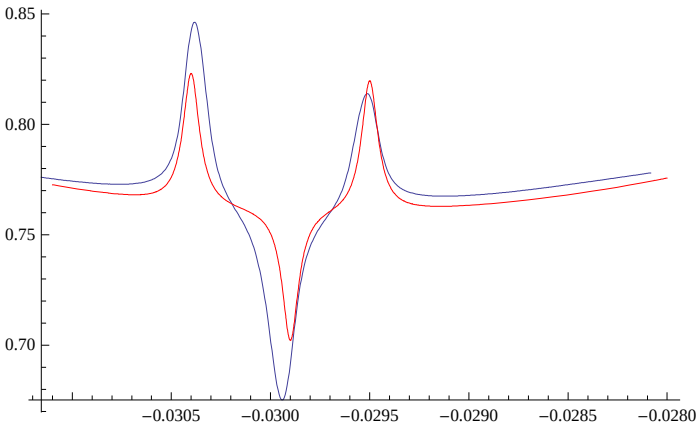

```
Show[plot3, plot5]
```



```
plot4 = Plot[Evaluate[
    c + lin * x - a * E^(-(x - x0)^2 / (2 * sig^2)) + a1 * 1 / (1 + ((x - x01) / gam1)^2) -
      a2 * 1 / (1 + ((x - x02) / gam2)^2) + a3 * 1 / (1 + ((x - x03) / gam3)^2) /.
     Join[Apply[Rule, erg01["ParameterTable"][[1, 1, 2 ;; -1, 1 ;; 2]], {1}],
      {a1 -> .06, x01 -> -.0304, gam1 -> 0.00005, a2 -> .06, x02 -> -.0299,
       gam2 -> 0.00005, a3 -> .06, x03 -> -.0295, gam3 -> 0.00005}]],
  {x, -.0311, -.028}, PlotStyle -> RGBColor[1, 0, 0], PlotRange → All]
```




```
Show[plot3, plot4]
```




```
fitfun1 =
 c + lin * x - a * E^(-(x - x0)^2 / (2 * sig^2)) + a1 * 1 / (1 + ((x - x01) / gam1)^2) -
  a2 * 1 / (1 + ((x - x02) / gam2)^2) + a3 * 1 / (1 + ((x - x03) / gam3)^2)
```

$$c - a\, e^{-\frac{(x-x0)^2}{2\,sig^2}} + lin\, x + \frac{a1}{1+\frac{(x-x01)^2}{gam1^2}} - \frac{a2}{1+\frac{(x-x02)^2}{gam2^2}} + \frac{a3}{1+\frac{(x-x03)^2}{gam3^2}}$$

```
fitpar1 = Apply[{#1, #2} &, Join[Apply[Rule,
     Apply[Rule, erg01["ParameterTable"][[1, 1, 2 ;; -1, 1 ;; 2]], {1}], {1}],
    {a1 -> .06, x01 -> -.0304, gam1 -> 0.00005, a2 -> .06, x02 -> -.0299,
     gam2 -> 0.00005, a3 -> .06, x03 -> -.0295, gam3 -> 0.00005}], {1}]
```

```
{{c, 0.951915}, {lin, -4.8279}, {a, 0.335767}, {x0, -0.0300738},
 {sig, 0.00534298}, {a1, 0.06}, {x01, -0.0304}, {gam1, 0.00005}, {a2, 0.06},
 {x02, -0.0299}, {gam2, 0.00005}, {a3, 0.06}, {x03, -0.0295}, {gam3, 0.00005}}
```

```
erg03 = NonlinearModelFit[data[[1 ;; 7000]], fitfun1, fitpar1, x]
```

```
FittedModel[
```

$$0.951711 - 0.337761\, e^{-17747.5\,(\ll 1\gg)^2} - \ll 18\gg x + \frac{\ll 20\gg}{\ll 1\gg} - \frac{0.0901945}{1 + 1.54382\times 10^{8}\ \ll 1\gg} + \frac{0.0868686}{1 + 1.64593\times 10^{8}\,(\ll 21\gg + x)^2}$$

```
]
```

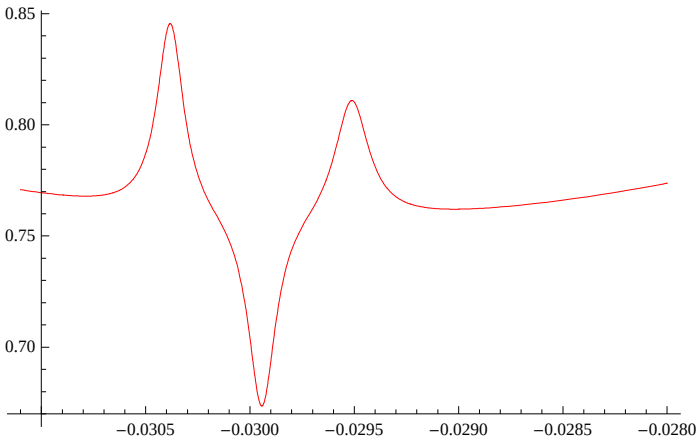
```
erg03["ANOVATable"]
```

	DF	SS	MS
Model	14	6580.74	470.053
Error	6986	0.0582558	8.33894×10^{-6}
Uncorrected Total	7000	6580.79	
Corrected Total	6999	99.897	

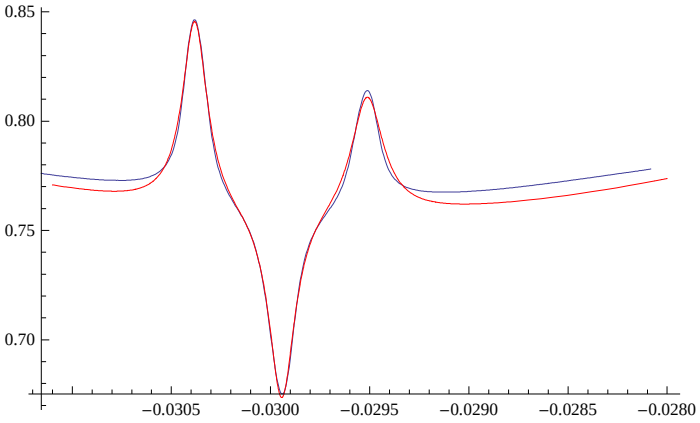
```
erg03["ParameterTable"]
```

	Estimate	Standard Error	t-Statistic	P-Value
c	0.951711	0.000117392	8107.12	$2.3306639693\times 10^{-13882}$
lin	−4.81695	0.00421536	−1142.71	$1.05698743687\times 10^{-7945}$
a	0.337761	0.00011046	3057.77	$4.9950131404\times 10^{-10925}$
x0	−0.030071	1.79068×10^{-6}	−16793.1	$1.17441476648\times 10^{-16091}$
sig	0.00530783	2.4146×10^{-6}	2198.23	$9.1730092186\times 10^{-9925}$
a1	0.0868686	0.000837674	103.702	$2.3559529909\times 10^{-1416}$
x01	−0.0303821	7.54252×10^{-7}	−40281.1	$4.2262508527\times 10^{-18746}$
gam1	0.0000779461	1.14548×10^{-6}	68.0467	$6.0388070404\times 10^{-774}$
a2	0.0901945	0.000827327	109.019	$4.0252340307\times 10^{-1510}$
x02	−0.0299434	7.45577×10^{-7}	−40161.4	$4.5068907414\times 10^{-18737}$
gam2	0.0000804826	1.18836×10^{-6}	67.7259	$3.0279955128\times 10^{-768}$
a3	0.055282	0.000742177	74.4863	$2.4844559448\times 10^{-889}$
x03	−0.0295127	1.35241×10^{-6}	−21822.3	$1.93267867597\times 10^{-16886}$
gam3	0.0000997251	2.10804×10^{-6}	47.3071	$5.2563084468\times 10^{-424}$

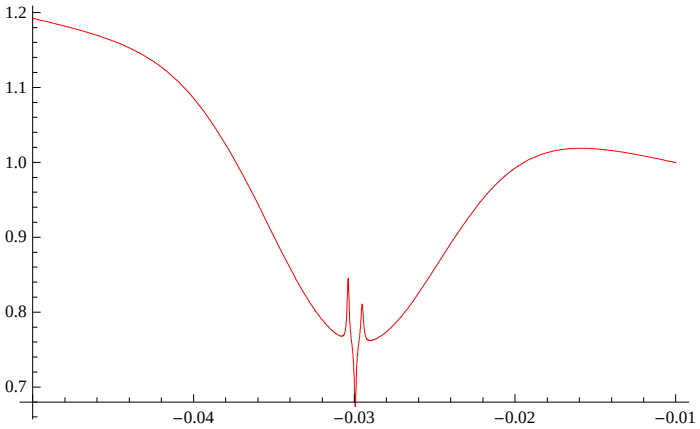
```
plot5 = Plot[Evaluate[erg03["BestFit"]],
  {x, -.0311, -.028}, PlotStyle -> RGBColor[1, 0, 0], PlotRange → All]
```



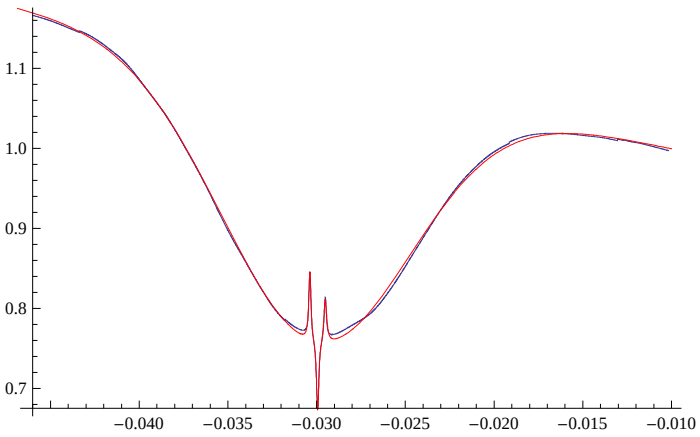
```
Show[plot3, plot5]
```




```
plot6 = Plot[Evaluate[erg03["BestFit"]],
  {x, -.05, -.01}, PlotStyle -> RGBColor[1, 0, 0], PlotRange → All]
```




```
Show[plot1, plot6]
```




```
fitfun2 = c + lin * (x - x0) + quad * (x - x0)^2 + a1 / (1 + ((x - x01) / gam1)^2) -
  a2 / (1 + ((x - x02) / gam2)^2) + a3 / (1 + ((x - x03) / gam3)^2)
```

$$c + lin\ (x - x0) + quad\ (x - x0)^2 + \frac{a1}{1 + \frac{(x-x01)^2}{gam1^2}} - \frac{a2}{1 + \frac{(x-x02)^2}{gam2^2}} + \frac{a3}{1 + \frac{(x-x03)^2}{gam3^2}}$$

```
fitfun2a = fitfun2 /. x0 → -.03;
```

```
fitpar2 = Join[{{c, .8}, {lin, -3.}, {quad, 300.}}, Apply[{#1, #2} &,
    {a1 -> .06, x01 -> -.0304, gam1 -> 0.00005, a2 -> .06, x02 -> -.0299,
     gam2 -> 0.00005, a3 -> .06, x03 -> -.0295, gam3 -> 0.00005}, {1}]]
```

```
{{c, 0.8}, {lin, -3.}, {quad, 300.}, {a1, 0.06},
 {x01, -0.0304}, {gam1, 0.00005}, {a2, 0.06}, {x02, -0.0299},
 {gam2, 0.00005}, {a3, 0.06}, {x03, -0.0295}, {gam3, 0.00005}}
```

```
erg04 = NonlinearModelFit[data[[2900 ;; 3500]], fitfun2a, fitpar2, x]
```

```
FittedModel[
```

$$0.765017 - 3.32496\,(0.03 + x) + 5522.47\,\ll 1\gg^2 + \frac{\ll 20\gg}{\ll 1\gg} - \frac{0.093248}{1 + 1.30621\times 10^8\,\ll 1\gg^2} + \frac{0.0850375}{1 + 2.33092\times 10^8\,(\ll 21\gg + x)^2}$$

```
]
```

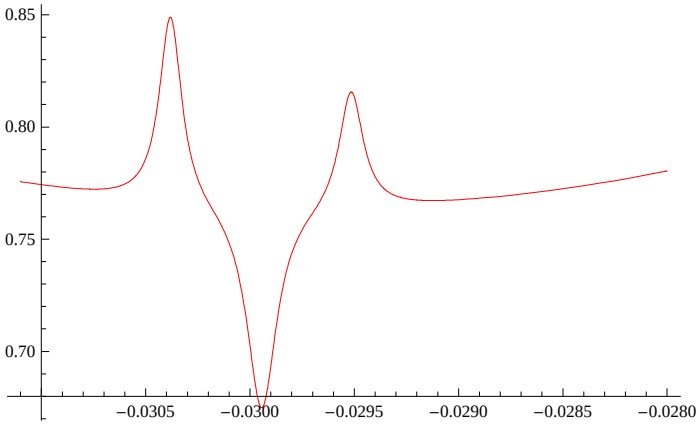
```
erg04["ANOVATable"]
```

	DF	SS	MS
Model	12	356.892	29.741
Error	589	0.000447056	7.59008×10^{-7}
Uncorrected Total	601	356.892	
Corrected Total	600	0.3938	

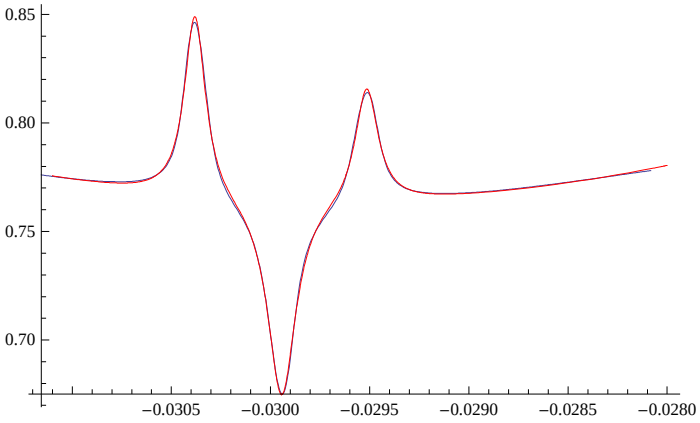
```
erg04["ParameterTable"]
```

	Estimate	Standard Error	t-Statistic	P-Value
c	0.765017	0.000113487	6741.	$1.568361578988\times 10^{-1441}$
lin	−3.32496	0.0654654	−50.7896	2.26632×10^{-217}
quad	5522.47	77.0489	71.6749	4.42023×10^{-293}
a1	0.0850375	0.000278326	305.532	$6.52236574554\times 10^{-651}$
x01	−0.0303812	2.13146×10^{-7}	−142537.	$4.488875162073\times 10^{-2222}$
gam1	0.0000654992	3.52916×10^{-7}	185.594	$9.24733550877\times 10^{-525}$
a2	0.093248	0.000248396	375.4	$2.545168610952\times 10^{-703}$
x02	−0.029944	2.26088×10^{-7}	−132444.	$2.748405003455\times 10^{-2203}$
gam2	0.000087497	3.85611×10^{-7}	226.905	$1.867164988942\times 10^{-575}$
a3	0.0541482	0.000269176	201.163	$4.793118243045\times 10^{-545}$
x03	−0.0295155	3.48625×10^{-7}	−84662.6	$8.04098570434\times 10^{-2089}$
gam3	0.0000708483	6.06036×10^{-7}	116.905	$9.44913505729\times 10^{-410}$

```
plot7 = Plot[Evaluate[erg04["BestFit"]],
  {x, -.0311, -.028}, PlotStyle -> RGBColor[1, 0, 0], PlotRange → All]
```

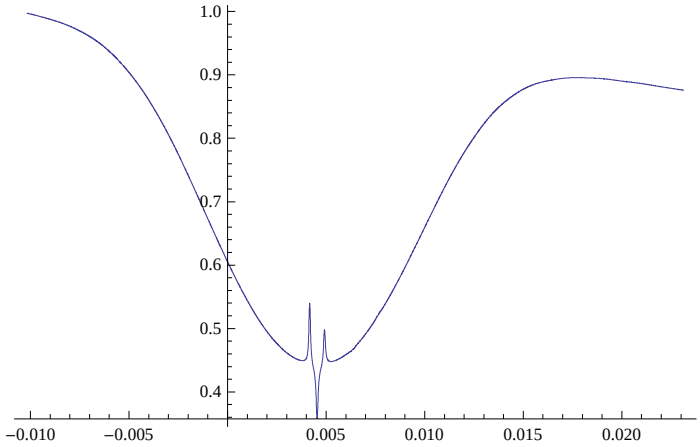


```
Show[plot3, plot7]
```

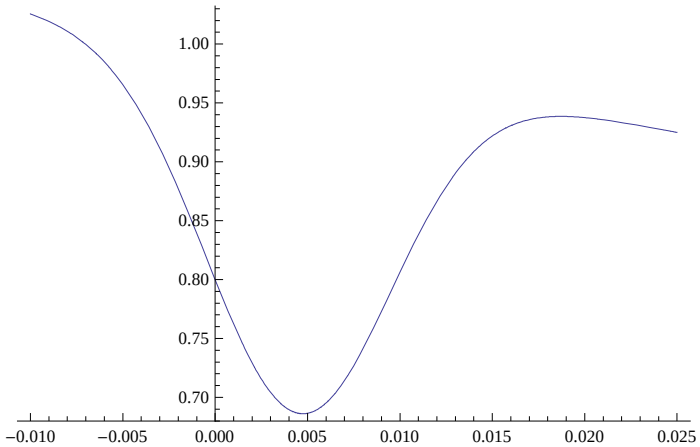



```
(* D2 *)
```

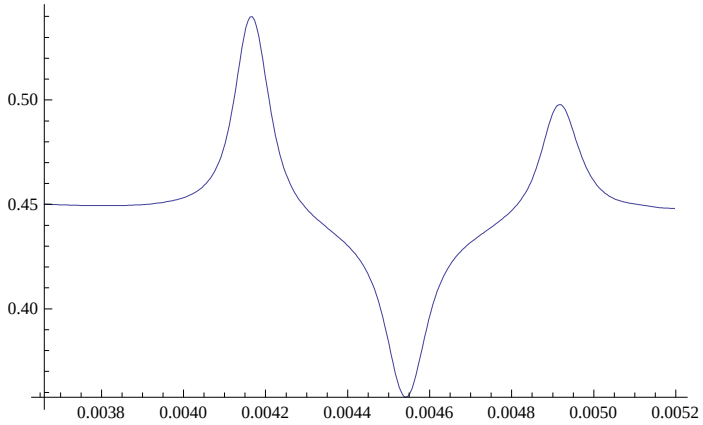
```
plot11 = ListPlot[data[[7000 ;; 13 500]], Joined → True]
```




```
Plot[c + lin * x - a * E^(-(x - x0)^2 / (2 * sig^2)) /.
  {c → 1., lin -> -3., a -> .3, x0 -> .0045, sig -> 0.005}, {x, -.01, .025}]
```



```
ListPlot[data[[9700 ;; 10 000]], Joined → True, PlotRange → All]
```




```
erg011 = NonlinearModelFit[data[[7000 ;; 13 500]],
  c + lin * x - a * E^(-(x - x0)^2 / (2 * sig^2)),
  {{c, 1.}, {lin, -3.}, {a, .3}, {x0, .0045}, {sig, 0.005}}, x]
```

FittedModel[$0.972501 - 0.522335\, e^{-20347.1\,(-\ll 21 \gg + x)^2} - 3.7242\, x$]

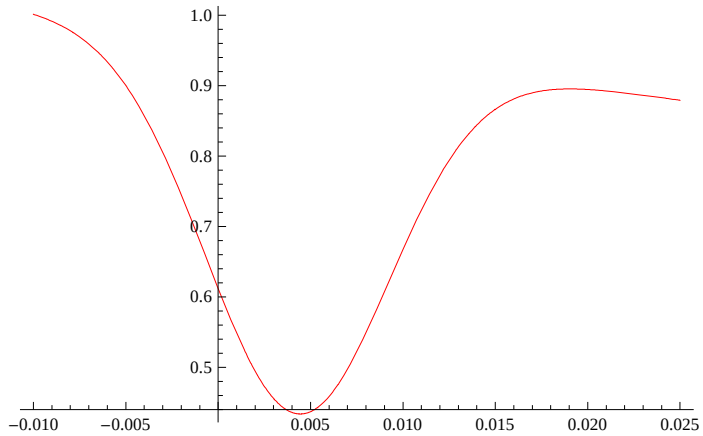
```
erg011["ANOVATable"]
```

	DF	SS	MS
Model	5	3903.19	780.638
Error	6496	0.608076	0.0000936077
Uncorrected Total	6501	3903.8	
Corrected Total	6500	210.333	

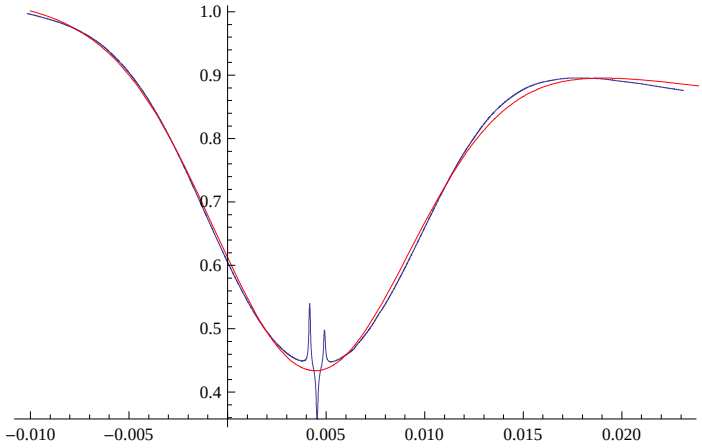
```
erg011["ParameterTable"]
```

	Estimate	Standard Error	t-Statistic	P-Value
c	0.972501	0.000330408	2943.33	$6.7723168970 \times 10^{-10154}$
lin	−3.7242	0.016316	−228.254	$2.8889118409 \times 10^{-3105}$
a	0.522335	0.000357372	1461.6	$2.8690350220 \times 10^{-8182}$
x0	0.00427117	3.77919×10^{-6}	1130.18	$1.15867355383 \times 10^{-7459}$
sig	0.00495716	4.85523×10^{-6}	1021.	$1.23208070173 \times 10^{-7174}$

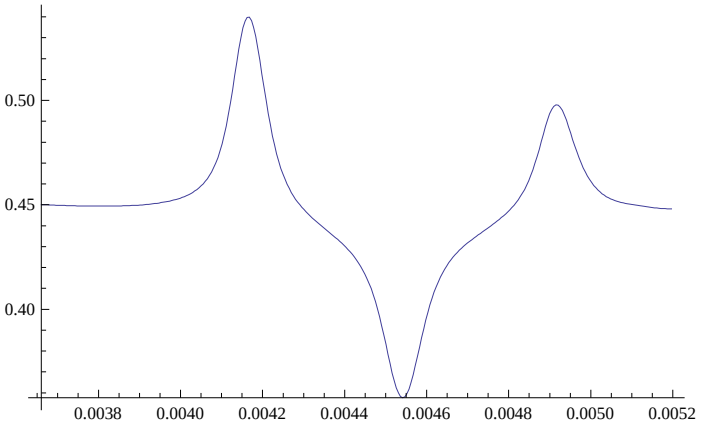
```
plot21 = Plot[Evaluate[erg011["BestFit"]],
  {x, -.01, .025}, PlotStyle -> RGBColor[1, 0, 0]]
```



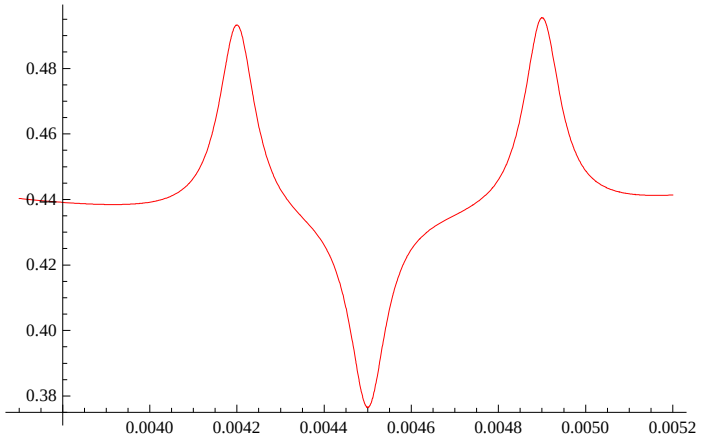
```
Show[plot11, plot21]
```



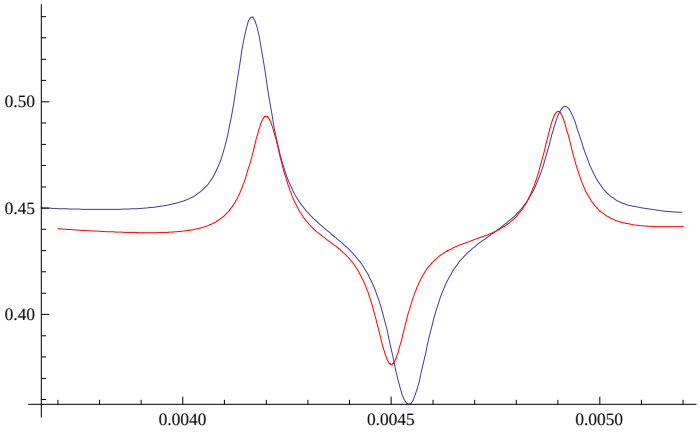

```
plot31 = ListPlot[data[[9700 ;; 10 000]], Joined → True, PlotRange → All]
```




```
plot41 = Plot[Evaluate[
    c + lin * x - a * E^(-(x - x0)^2 / (2 * sig^2)) + a1 * 1 / (1 + ((x - x01) / gam1)^2) -
      a2 * 1 / (1 + ((x - x02) / gam2)^2) + a3 * 1 / (1 + ((x - x03) / gam3)^2) /.
     Join[Apply[Rule, erg011["ParameterTable"][[1, 1, 2 ;; -1, 1 ;; 2]], {1}],
      {a1 -> .06, x01 -> .0042, gam1 -> 0.00005, a2 -> .06, x02 -> .0045,
       gam2 -> 0.00005, a3 -> .06, x03 -> .0049, gam3 -> 0.00005}]],
  {x, .0037, .0052}, PlotStyle -> RGBColor[1, 0, 0], PlotRange → All]
```



```
Show[plot31, plot41]
```




```
fitpar11 = Apply[{#1, #2} &,
  Join[Apply[Rule, erg011["ParameterTable"][[1, 1, 2 ;; -1, 1 ;; 2]]], {1}],
   {a1 -> .06, x01 → .0042, gam1 -> 0.00005, a2 -> .06, x02 → .0045,
    gam2 -> 0.00005, a3 -> .06, x03 → .0049, gam3 -> 0.00005}], {1}]
```

```
{{c, 0.972501}, {lin, -3.7242}, {a, 0.522335}, {x0, 0.00427117},
 {sig, 0.00495716}, {a1, 0.06}, {x01, 0.0042}, {gam1, 0.00005}, {a2, 0.06},
 {x02, 0.0045}, {gam2, 0.00005}, {a3, 0.06}, {x03, 0.0049}, {gam3, 0.00005}}
```

```
erg031 = NonlinearModelFit[data[[7000 ;; 13500]], fitfun1, fitpar11, x]
```

```
FittedModel[
```

$$0.971233 - 0.52619\, e^{-20695.1\,(-\ll 21\gg + x)^2} + \frac{\ll 20\gg}{1 + \ll 21\gg\, \ll 1\gg^2} - \frac{\ll 19\gg}{1 + \ll 1\gg} + \frac{0.100812}{1 + 1.69623\times 10^8\,(\ll 1\gg)^2} - 3.69065\, x$$

```
]
```

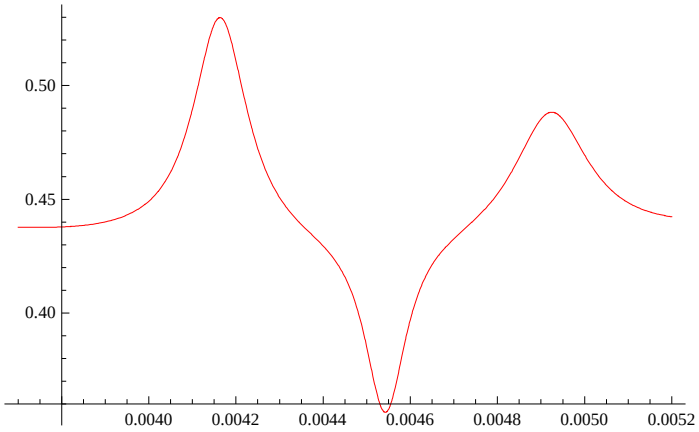
```
erg031["ANOVATable"]
```

	DF	SS	MS
Model	14	3903.57	278.827
Error	6487	0.224777	0.0000346504
Uncorrected Total	6501	3903.8	
Corrected Total	6500	210.333	

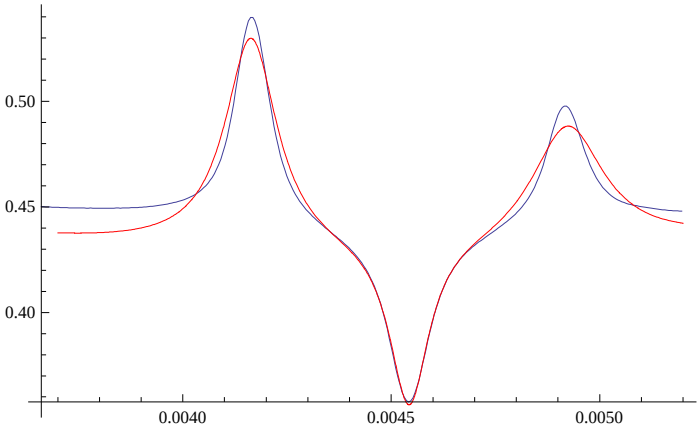
```
erg031["ParameterTable"]
```

	Estimate	Standard Error	t-Statistic	P-Value
c	0.971233	0.000200894	4834.55	$3.55316333432\times 10^{-11539}$
lin	−3.69065	0.00989446	−373.001	$3.10433978676\times 10^{-4385}$
a	0.52619	0.000236261	2227.16	$4.5175390888\times 10^{-9357}$
x0	0.00427832	2.27364×10^{-6}	1881.7	$5.8551463078\times 10^{-8883}$
sig	0.00491531	3.08295×10^{-6}	1594.35	$3.9980736783\times 10^{-8417}$
a1	0.100812	0.00172208	58.5406	$5.7248860333\times 10^{-600}$
x01	0.00416371	1.31533×10^{-6}	3165.52	$1.14977409909\times 10^{-10346}$
gam1	0.0000767817	2.00025×10^{-6}	38.3861	1.06487×10^{-290}
a2	0.0808464	0.00198521	40.7243	$4.4636212558\times 10^{-323}$
x02	0.00454277	1.43128×10^{-6}	3173.92	$4.0208110075\times 10^{-10354}$
gam2	0.0000577925	2.25385×10^{-6}	25.6417	3.31733×10^{-138}
a3	0.0577078	0.00147279	39.1825	1.35163×10^{-301}
x03	0.00492298	2.72819×10^{-6}	1804.49	$3.9197814047\times 10^{-8765}$
gam3	0.000105683	4.29097×10^{-6}	24.6292	4.05094×10^{-128}

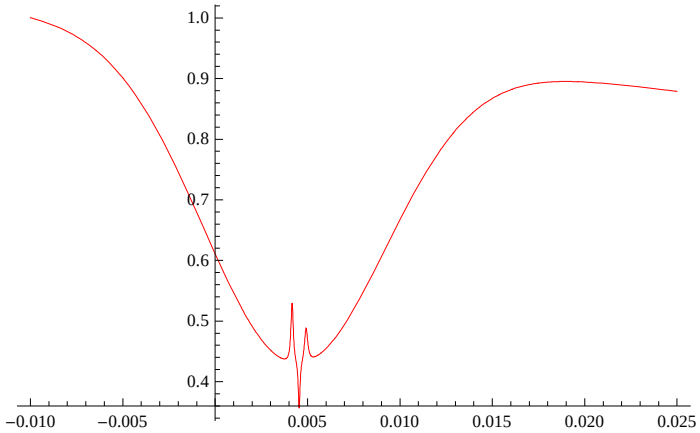
```
plot51 = Plot[Evaluate[erg031["BestFit"]],
  {x, .0037, .0052}, PlotStyle -> RGBColor[1, 0, 0], PlotRange → All]
```



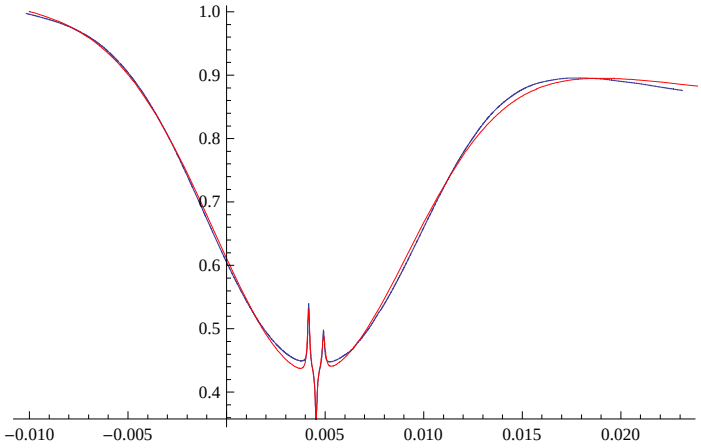

```
Show[plot31, plot51]
```




```
plot61 = Plot[Evaluate[erg031["BestFit"]],
  {x, -.01, .025}, PlotStyle -> RGBColor[1, 0, 0], PlotRange → All]
```



```
Show[plot11, plot61]
```




```
fitfun2b = fitfun2 /. x0 → .0045;
```

```
fitpar21 = Join[{{c, .45}, {lin, -3.}, {quad, 300.}},
  Apply[{#1, #2} &, {a1 -> .06, x01 → .0042, gam1 -> 0.00005, a2 -> .06,
    x02 → .0045, gam2 -> 0.00005, a3 -> .06, x03 → .0049, gam3 -> 0.00005}, {1}]]
```

```
{{c, 0.45}, {lin, -3.}, {quad, 300.}, {a1, 0.06},
 {x01, 0.0042}, {gam1, 0.00005}, {a2, 0.06}, {x02, 0.0045},
 {gam2, 0.00005}, {a3, 0.06}, {x03, 0.0049}, {gam3, 0.00005}}
```

```
erg041 = NonlinearModelFit[data[[9700 ;; 10000]], fitfun2b, fitpar21, x]
```

$$\text{FittedModel}\left[0.4396+\frac{0.058297}{1+3.07042\times10^{8}\,(-\ll21\gg+x)^{2}}-\frac{0.085034}{1+\ll22\gg\,\ll1\gg^{2}}+\frac{\ll20\gg}{1\,\ll1\gg\,\ll1\gg}-0.570393\,(-0.0045+x)+15967.1\,(-0.0045+x)^{2}\right]$$

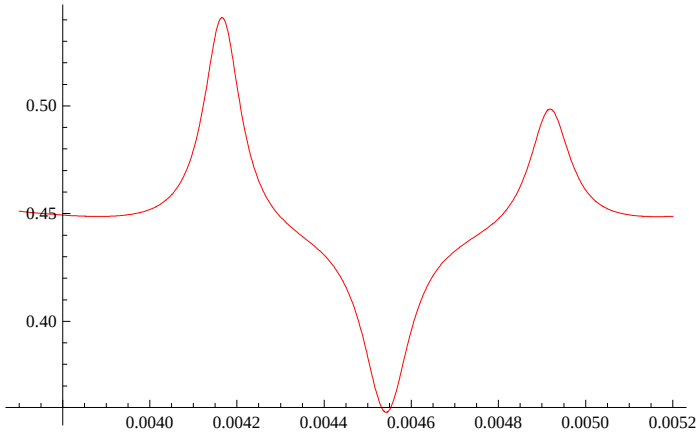
```
erg041["ANOVATable"]
```

	DF	SS	MS
Model	12	60.9448	5.07873
Error	289	0.000174776	6.04762×10^{-7}
Uncorrected Total	301	60.945	
Corrected Total	300	0.32752	

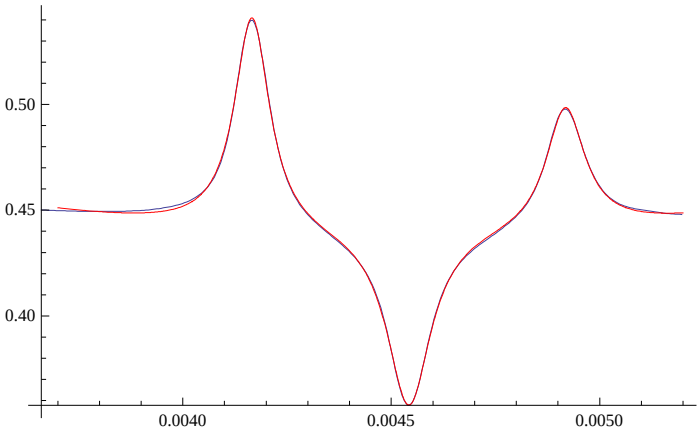
```
erg041["ParameterTable"]
```

	Estimate	Standard Error	t-Statistic	P-Value
c	0.4396	0.000242426	1813.33	$3.674587744836476\times10^{-588}$
lin	−0.570393	0.161843	−3.52435	0.000493356
quad	15967.1	499.415	31.9717	6.63514×10^{-97}
a1	0.101484	0.000293131	346.206	$1.788537251484563\times10^{-380}$
x01	0.00416601	1.41933×10^{-7}	29351.9	$1.329803139640560\times10^{-937}$
gam1	0.0000517527	2.85143×10^{-7}	181.498	8.14377×10^{-300}
a2	0.085034	0.00028513	298.229	$8.373144420650812\times10^{-362}$
x02	0.00454228	1.88983×10^{-7}	24035.4	$1.602714342954158\times10^{-912}$
gam2	0.0000644295	4.25853×10^{-7}	151.295	3.28664×10^{-277}
a3	0.058297	0.000280948	207.501	$1.712116327126986\times10^{-316}$
x03	0.00491771	2.65291×10^{-7}	18537.1	$6.411612517156382\times10^{-880}$
gam3	0.0000570691	5.26031×10^{-7}	108.49	3.35859×10^{-236}

```
plot71 = Plot[Evaluate[erg041["BestFit"]],
  {x, .0037, .0052}, PlotStyle -> RGBColor[1, 0, 0], PlotRange → All]
```

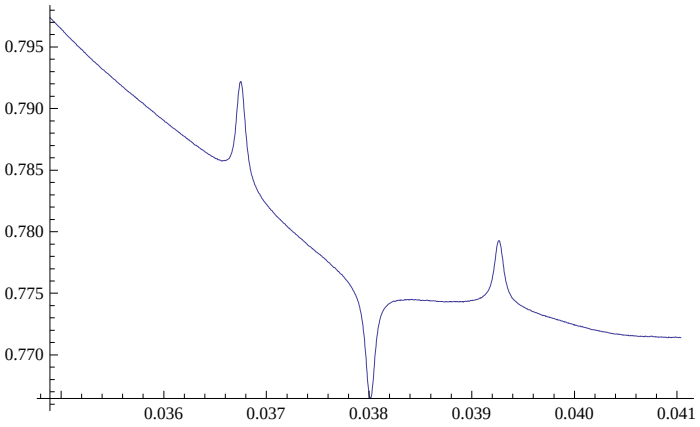



```
Show[plot31, plot71]
```




```
(* D2 6-Li *)
```

```
plot32 = ListPlot[data[[15 800 ;; 17 000]], Joined → True, PlotRange → All]
```




```
fitfun2c = fitfun2 /. x0 → .038;
```

```
fitpar22 = Join[{{c, .77}, {lin, -3.}, {quad, 300.}},
  Apply[{#1, #2} &, {a1 -> .006, x01 → .0368, gam1 -> 0.00005, a2 -> .006,
    x02 → .038, gam2 -> 0.00005, a3 -> .006, x03 → .0393, gam3 -> 0.00005}, {1}]]
```

```
{{c, 0.77}, {lin, -3.}, {quad, 300.}, {a1, 0.006},
 {x01, 0.0368}, {gam1, 0.00005}, {a2, 0.006}, {x02, 0.038},
 {gam2, 0.00005}, {a3, 0.006}, {x03, 0.0393}, {gam3, 0.00005}}
```

```
erg042 = NonlinearModelFit[data[[15800 ;; 17000]], fitfun2c, fitpar22, x]
```

```
FittedModel[
```

$$0.776861+\frac{0.00548107}{1+9.14116\times10^{7}\,(-\ll20\gg+x)^{2}}-\frac{0.00942845}{1+\ll22\gg\,\ll1\gg^{2}}+\frac{\ll21\gg}{1+\ll1\gg}-4.1578\,(-0.038+x)+835.514\,(-0.038+x)^{2}$$

```
]
```

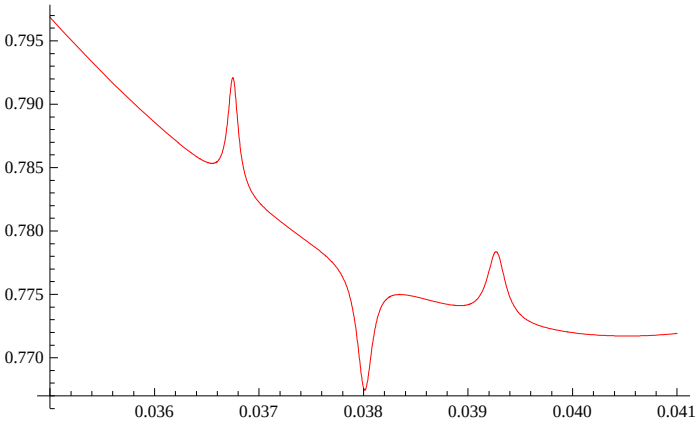
```
erg042["ANOVATable"]
```

	DF	SS	MS
Model	12	730.337	60.8614
Error	1189	0.00022395	1.88352×10^{-7}
Uncorrected Total	1201	730.338	
Corrected Total	1200	0.0794266	

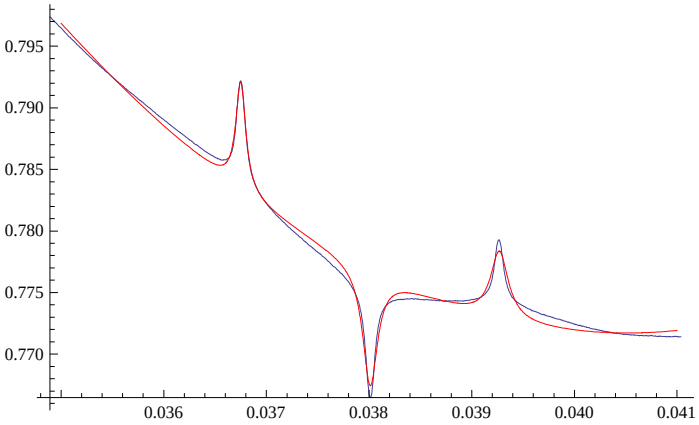
```
erg042["ParameterTable"]
```

	Estimate	Standard Error	t-Statistic	P-Value
c	0.776861	0.0000303429	25602.8	$1.278079358866\times10^{-3415}$
lin	−4.1578	0.00766965	−542.111	$4.87239247178\times10^{-1426}$
quad	835.514	5.5637	150.172	$2.186656269431\times10^{-775}$
a1	0.00876333	0.000143645	61.007	$1.687821256682\times10^{-368}$
x01	0.03675	9.76164×10^{-7}	37647.3	$1.027724250863\times10^{-3614}$
gam1	0.0000595662	1.49261×10^{-6}	39.9074	1.11548×10^{-221}
a2	0.00942845	0.000117985	79.9126	$2.009918195547\times10^{-480}$
x02	0.0380103	1.10677×10^{-6}	34343.6	$2.74814822814\times10^{-3567}$
gam2	0.0000886429	1.79799×10^{-6}	49.3013	1.05052×10^{-289}
a3	0.00548107	0.000108615	50.4634	7.54161×10^{-298}
x03	0.0392696	2.07044×10^{-6}	18966.8	$1.059207414922\times10^{-3260}$
gam3	0.000104592	3.30984×10^{-6}	31.6004	1.31944×10^{-159}

```
plot72 = Plot[Evaluate[erg042["BestFit"]],
  {x, .035, .041}, PlotStyle -> RGBColor[1, 0, 0], PlotRange → All]
```



```
Show[plot32, plot72]
```




```
erg04["ParameterTable"] (* D1 6-Li*)
```

	Estimate	Standard Error	t-Statistic	P-Value
c	0.765017	0.000113487	6741.	$1.568361578988\times10^{-1441}$
lin	−3.32496	0.0654654	−50.7896	2.26632×10^{-217}
quad	5522.47	77.0489	71.6749	4.42023×10^{-293}
a1	0.0850375	0.000278326	305.532	$6.52236574554\times10^{-651}$
x01	−0.0303812	2.13146×10^{-7}	−142537.	$4.488875162073\times10^{-2222}$
gam1	0.0000654992	3.52916×10^{-7}	185.594	$9.24733550877\times10^{-525}$
a2	0.093248	0.000248396	375.4	$2.545168610952\times10^{-703}$
x02	−0.029944	2.26088×10^{-7}	−132444.	$2.748405003455\times10^{-2203}$
gam2	0.000087497	3.85611×10^{-7}	226.905	$1.867164988942\times10^{-575}$
a3	0.0541482	0.000269176	201.163	$4.793118243045\times10^{-545}$
x03	−0.0295155	3.48625×10^{-7}	−84662.6	$8.04098570434\times10^{-2089}$
gam3	0.0000708483	6.06036×10^{-7}	116.905	$9.44913505729\times10^{-410}$

```
erg041["ParameterTable"](* D2 6-Li*)
```

	Estimate	Standard Error	t-Statistic	P-Value
c	0.4396	0.000242426	1813.33	$3.674587744836476\times10^{-588}$
lin	−0.570393	0.161843	−3.52435	0.000493356
quad	15967.1	499.415	31.9717	6.63514×10^{-97}
a1	0.101484	0.000293131	346.206	$1.788537251484563\times10^{-380}$
x01	0.00416601	1.41933×10^{-7}	29351.9	$1.329803139640560\times10^{-937}$
gam1	0.0000517527	2.85143×10^{-7}	181.498	8.14377×10^{-300}
a2	0.085034	0.00028513	298.229	$8.373144420650812\times10^{-362}$
x02	0.00454228	1.88983×10^{-7}	24035.4	$1.602714342954158\times10^{-912}$
gam2	0.0000644295	4.25853×10^{-7}	151.295	3.28664×10^{-277}
a3	0.058297	0.000280948	207.501	$1.712116327126986\times10^{-316}$
x03	0.00491771	2.65291×10^{-7}	18537.1	$6.411612517156382\times10^{-880}$
gam3	0.0000570691	5.26031×10^{-7}	108.49	3.35859×10^{-236}

```
erg042["ParameterTable"](* D2 7-Li*)
```

	Estimate	Standard Error	t-Statistic	P-Value
c	0.776861	0.0000303429	25602.8	$1.278079358866\times10^{-3415}$
lin	−4.1578	0.00766965	−542.111	$4.87239247178\times10^{-1426}$
quad	835.514	5.5637	150.172	$2.186656269431\times10^{-775}$
a1	0.00876333	0.000143645	61.007	$1.687821256682\times10^{-368}$
x01	0.03675	9.76164×10^{-7}	37647.3	$1.027724250863\times10^{-3614}$
gam1	0.0000595662	1.49261×10^{-6}	39.9074	1.11548×10^{-221}
a2	0.00942845	0.000117985	79.9126	$2.009918195547\times10^{-480}$
x02	0.0380103	1.10677×10^{-6}	34343.6	$2.74814822814\times10^{-3567}$
gam2	0.0000886429	1.79799×10^{-6}	49.3013	1.05052×10^{-289}
a3	0.00548107	0.000108615	50.4634	7.54161×10^{-298}
x03	0.0392696	2.07044×10^{-6}	18966.8	$1.059207414922\times10^{-3260}$
gam3	0.000104592	3.30984×10^{-6}	31.6004	1.31944×10^{-159}

```
<< PhysicalConstants`;
```

General::obspkg: PhysicalConstants` is now obsolete. The legacy version being loaded may conflict with current Mathematica functionality. See the Compatibility Guide for updating information.

```
{nued1 = SpeedOfLight[[1]] / (670.99144 * 10^-9),
 nued2 = SpeedOfLight[[1]] / (670.97634 * 10^-9)}
```

$\{4.4679\times10^{14},\ 4.468\times10^{14}\}$

```
repl04 = Apply[Rule, erg04["ParameterTable"][[1, 1, 2 ;; -1, 1 ;; 2]], {1}]
```

{c → 0.765017, lin → −3.32496, quad → 5522.47, a1 → 0.0850375,
 x01 → −0.0303812, gam1 → 0.0000654992, a2 → 0.093248, x02 → −0.029944,
 gam2 → 0.000087497, a3 → 0.0541482, x03 → −0.0295155, gam3 → 0.0000708483}

```
repl041 = Apply[Rule, erg041["ParameterTable"][[1, 1, 2 ;; -1, 1 ;; 2]], {1}]
```

{c → 0.4396, lin → −0.570393, quad → 15967.1, a1 → 0.101484,
 x01 → 0.00416601, gam1 → 0.0000517527, a2 → 0.085034, x02 → 0.00454228,
 gam2 → 0.0000644295, a3 → 0.058297, x03 → 0.00491771, gam3 → 0.0000570691}

```
repl042 = Apply[Rule, erg042["ParameterTable"][[1, 1, 2 ;; -1, 1 ;; 2]], {1}]
```

{c → 0.776861, lin → −4.1578, quad → 835.514, a1 → 0.00876333,
 x01 → 0.03675, gam1 → 0.0000595662, a2 → 0.00942845, x02 → 0.0380103,
 gam2 → 0.0000886429, a3 → 0.00548107, x03 → 0.0392696, gam3 → 0.000104592}

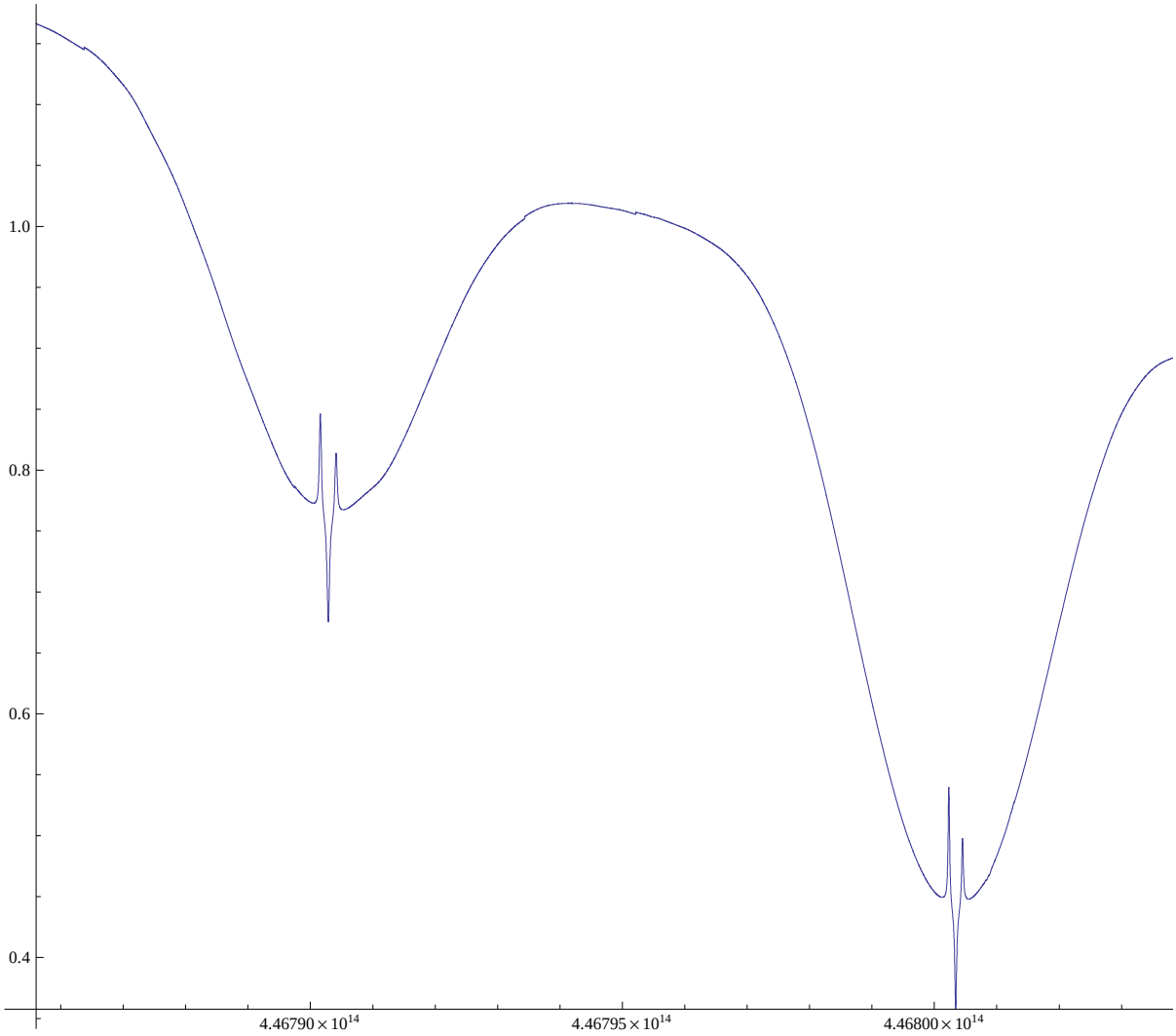
```
kfak = (nued2 - nued1) / ((x02 /. repl041) - (x02 /. repl04))
```

2.9156×10^{11}

```
koffset = nued2 - kfak * (x02 /. repl041)
```

4.46799×10^{14}

```
ListPlot[Apply[{#1 * kfak + koffset, #2} &, data, {1}], Joined → True]
```




```
(* Hyperfinesplitting 2S(1/2) D1 6-Li ; Literaturwert 228.2 MHz*)
kfak * ((x03 /. repl04) - (x01 /. repl04))
```

2.52391×10^{8}

```
(* Hyperfinesplitting 2S(1/2) D2 6-Li ; Literaturwert 228.2 MHz*)
kfak * ((x03 /. repl041) - (x01 /. repl041))
```

2.19166×10^{8}

```
(* Hyperfinesplitting 2S(1/2) D2 7-Li ; Literaturwert 803.53 MHz*)
kfak * ((x03 /. repl042) - (x01 /. repl042))
```

7.34617×10^{8}

```
c1 = SpeedOfLight[[1]]^2 * 6 *
  QuantityMagnitude[UnitConvert[Quantity[1., "AtomicMassUnit"], "Kilogram"]] /
   BoltzmannConstant[[1]]
```

6.48572×10^{13}

```
repl03 = Apply[Rule, erg03["ParameterTable"][[1, 1, 2 ;; -1, 1 ;; 2]], {1}]
```

```
{c → 0.951711, lin → -4.81695, a → 0.337761, x0 → -0.030071,
 sig → 0.00530783, a1 → 0.0868686, x01 → -0.0303821, gam1 → 0.0000779461,
 a2 → 0.0901945, x02 → -0.0299434, gam2 → 0.0000804826,
 a3 → 0.055282, x03 → -0.0295127, gam3 → 0.0000997251}
```

```
repl031 = Apply[Rule, erg031["ParameterTable"][[1, 1, 2 ;; -1, 1 ;; 2]], {1}]
```

```
{c → 0.971233, lin → -3.69065, a → 0.52619, x0 → 0.00427832,
 sig → 0.00491531, a1 → 0.100812, x01 → 0.00416371, gam1 → 0.0000767817,
 a2 → 0.0808464, x02 → 0.00454277, gam2 → 0.0000577925,
 a3 → 0.0577078, x03 → 0.00492298, gam3 → 0.000105683}
```

```
{sig /. repl03, sig /. repl031}
```

```
{0.00530783, 0.00491531}
```

```
(* Temperatur [°C] Dopplerverbreiterung D1 *)
(kfak * (sig /. repl03) / nued1 )^2 * c1 - 273.
```

```
505.107
```

```
(* Temperatur [°C] Dopplerverbreiterung D2 *)
(kfak * (sig /. repl031) / nued2 )^2 * c1 - 273.
```

```
394.249
```