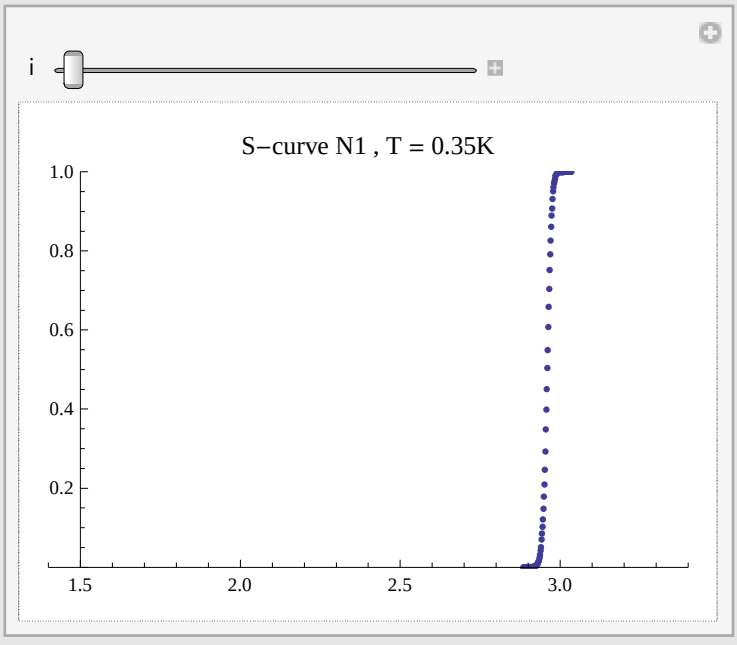
In[1]:=
```
Remove["Global`*"]
```

In[2]:=
```
Needs["PlotLegends`"]
mK = N[10^-3];
inputpath = "D:\\temp\\";
```

In[5]:=
```
(*Loading set of Scurves for
 different temperatures for calibration*)
temperatures = Table[temp, {temp, 350 mK, 900 mK, 10 mK}];
files = Table[fileno, {fileno, 283, 393, 2}];
Print["Files: ", Length[files]]
Print["Temperatures: ", Length[temperatures]]
For[i = 1, i <= Length[files], i++,
  scurve[i] = Map[{#[[1]], N[#[[2]] / 10000]} &, Import[inputpath <>
       "S-curve" <> ToString[files[[i]]] <> ".txt", "Table"]];
 ];
tmin = Min[temperatures];
tmax = Max[temperatures];
```

```
Files: 56

Temperatures: 56
```

```
Manipulate[ListPlot[scurve[i], PlotRange → {{1.4, 3.4}, {0, 1}},
  PlotLabel -> "S-curve N" <> ToString[i] <> " , T = " <>
    ToString[N[temperatures[[i]]]] <> "K"], {i, 1, Length[files], 1}]
```



Part::partd : Part specification temperatures[[1]] is longer than depth of object. >>

ListPlot::lpn : scurve[1] is not a list of numbers or pairs of numbers. >>

Part::partd : Part specification temperatures[[1]] is longer than depth of object. >>

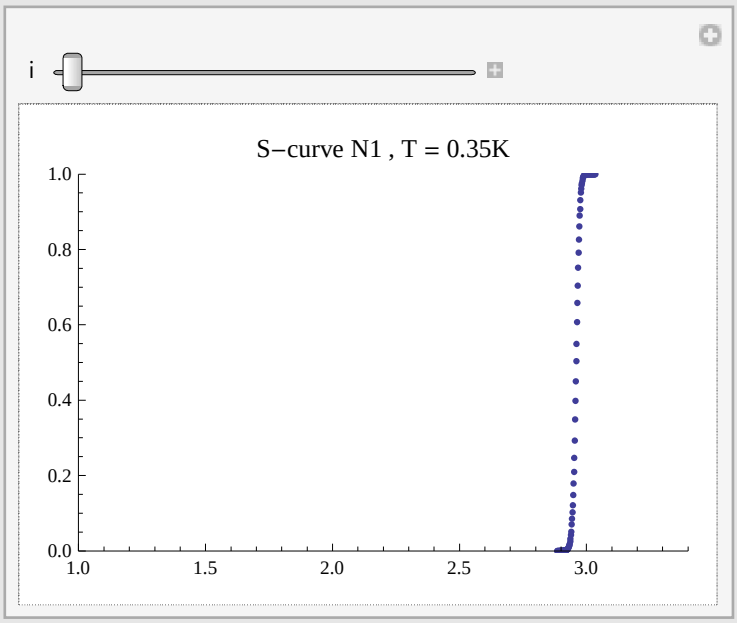
ListPlot::lpn : scurve[1] is not a list of numbers or pairs of numbers. >>

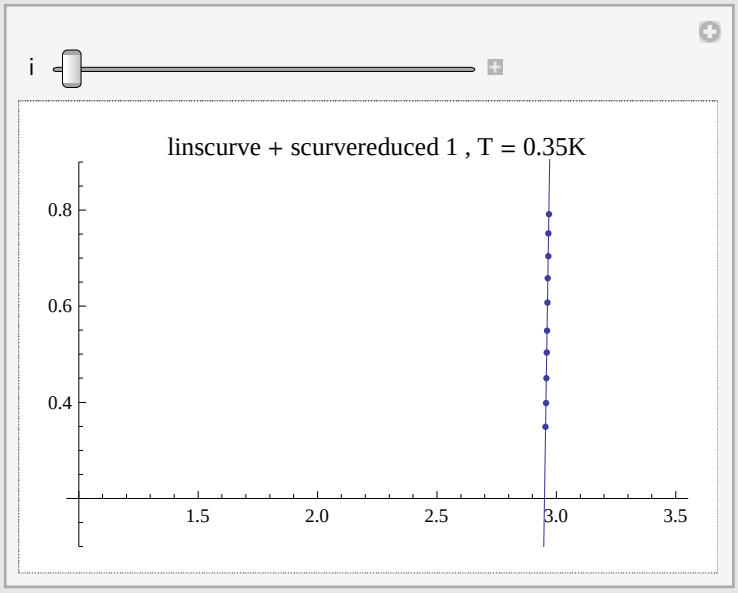
In[12]:=
```
(*Scurves processing*)
calib = {};
calib1 = {};
slopeScurve = {};

(*Select Scurve part from 0.3 to 0.8, and do linear fit of it*)
For[i = 1, i <= Length[files], i++,
 scurvereduced[i] = Select[scurve[i], #[[2]] < 0.8 && #[[2]] > 0.3 &];
 lmfscurve[i] = LinearModelFit[scurvereduced[i], {1, x}, x];
 (*Variable with all-in-one fitting results*)

 (*Make calibration curve - current at P=0.5 vs temperature (T)
   (using real data and using linear fit for comparison). Make
   scurve slope vs temperature curve *)
 scurveUnique = DeleteDuplicates[Map[{#[[2]], #[[1]]} &, scurve[i]],
   #1[[1]] == #2[[1]] &];
 scurveUnique1 = LinearModelFit[scurveUnique, {1, x}, x];
 points =
  {{Interpolation[scurveUnique, 0.5, InterpolationOrder → 1], 0.5},
   {Interpolation[scurveUnique, 0.1, InterpolationOrder → 1], 0.1},
   {Interpolation[scurveUnique, 0.9, InterpolationOrder → 1], 0.9}};
 position = points[[1, 1]];
 position1 = scurveUnique1[0.5];
 AppendTo[calib, {temperatures[[i]], position}];
 AppendTo[calib1, {temperatures[[i]], position1}];
 AppendTo[slopeScurve,
  {temperatures[[i]], Part[lmfscurve[i]["BestFitParameters"], 2]}];
]
(*Fitting of slope vs T curve *)
fitslopeScurve = LinearModelFit[slopeScurve, {x, x^2}, x]
```

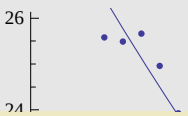
Out[16]=
$$\text{FittedModel}\left[\,71.5925 - 138.081\,x + 80.5622\,x^2\,\right]$$

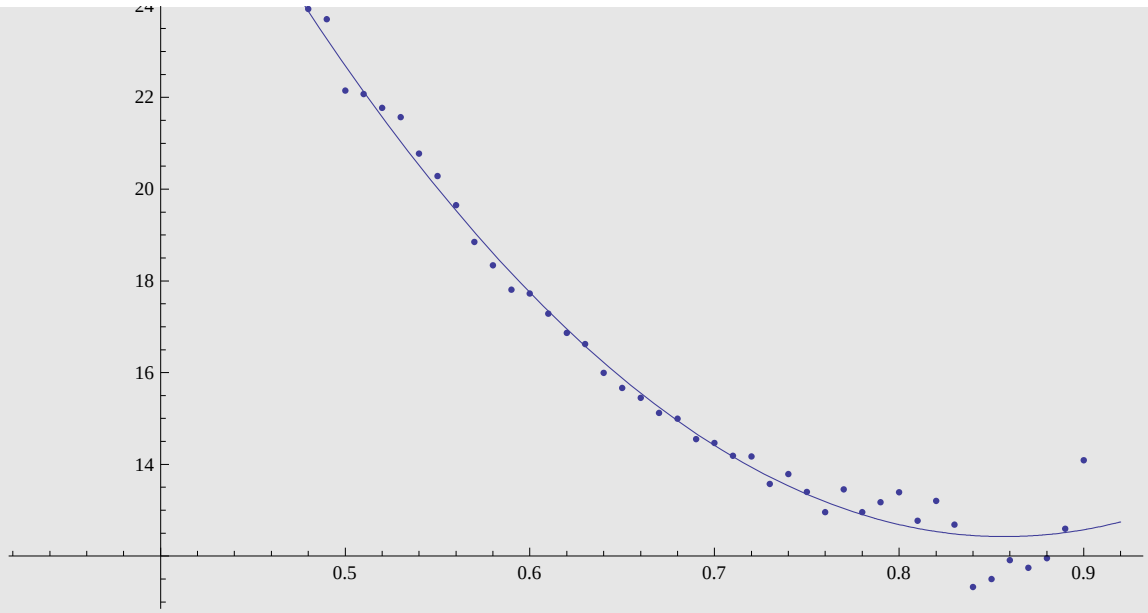
In[17]:=
```
Row[{Manipulate[ListPlot[scurve[i], PlotRange → {{1.0, 3.4}, {0, 1}},
    PlotLabel -> "S-curve N" <> ToString[i] <> " , T = " <>
      ToString[N[temperatures[[i]]]] <> "K"], {i, 1, Length[files], 1}],
  Manipulate[Show[ListPlot[scurvereduced[i]],
    Plot[Normal[lmfscurve[i]], {x, 1, 3.5}], PlotRange → {0.1, 0.9},
    PlotLabel -> "linscurve + scurvereduced " <> ToString[i] <>
      " , T = " <> ToString[N[temperatures[[i]]]] <> "K"],
   {i, 1, Length[files], 1}], Show[ListPlot[slopeScurve],
   Plot[fitslopeScurve[x], {x, tmin - 0.02, tmax + 0.02}]]}]
```

Out[17]=


i
S−curve N1 , T = 0.35K
1.0
0.8
0.6
0.4
0.2
0.0
1.0
1.5
2.0
2.5
3.0


i
linscurve + scurvereduced 1 , T = 0.35K
0.8
0.6
0.4
1.5
2.0
2.5
3.0
3.5


26
24



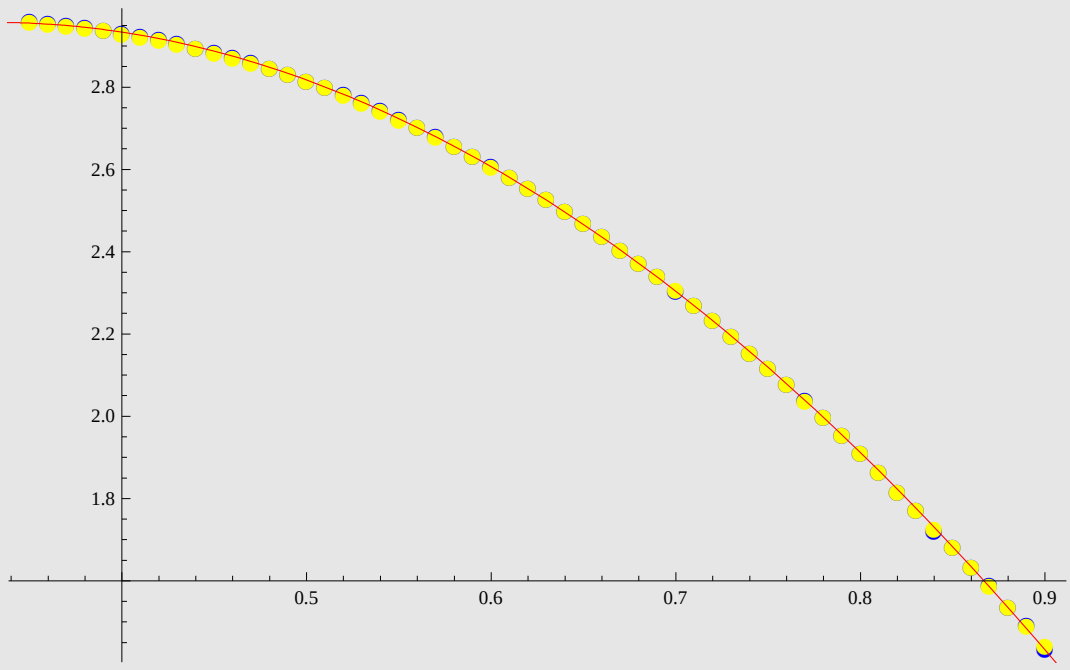
In[18]:=

```
(*3 types of of calibration curve -
 raw calibration (from raw scurves) - calib,
calibration from linearly fited scurves - calib1,
and fit of raw calibration - lmfcalib *)
lmfcalib = LinearModelFit[calib, {x, x^2, x^3}, x]
Show[ListPlot[calib, PlotStyle → {Blue},
  PlotMarkers → {Automatic, Medium}], ListPlot[calib1,
  PlotStyle → {Yellow}, PlotMarkers → {Automatic, Medium}],
 Plot[Normal[lmfcalib], {x, tmin - 0.02, tmax + 0.02}, PlotStyle → {Red}]]
```

Out[18]=

$$\text{FittedModel}\left[\, 2.40173 + 3.41095\,x - 5.37467\,x^2 + 0.431247\,x^3 \,\right]$$

Out[19]=



In[20]:=
```
(*Differentiating of each type calibration curve *)
Print["Derivative of interpolated data points:"]
difintercalib = Derivative[1][Interpolation[calib]]
difintercalib1 = Derivative[1][Interpolation[calib1]]
Print["Derivative of LinModFit result:"]
diflmfcalib = Derivative[1][lmfcalib]
Print["Comparison of derivatives of interpolation and LinModFit:"]
Plot[{diflmfcalib[x], difintercalib[x], difintercalib1[x]},
 {x, tmin, tmax},
 PlotLegend → {"D of fitting", "D of pts", "D of pts from Sfit"},
 PlotStyle → {Thick}]
```

Derivative of interpolated data points:

Out[21]=
```
InterpolatingFunction[{{0.35, 0.9}}, <>]
```

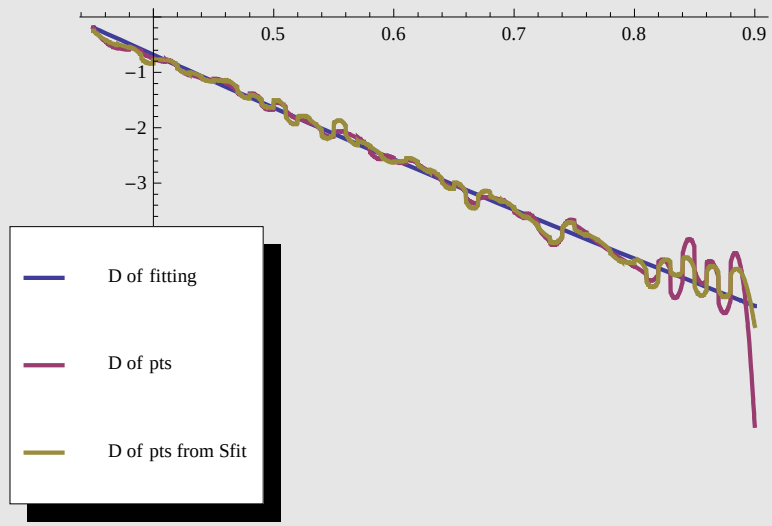
Out[22]=
```
InterpolatingFunction[{{0.35, 0.9}}, <>]
```

Derivative of LinModFit result:

Out[24]=
```
3.41095 - 10.7493 #1 + 1.29374 #1^2 &
```

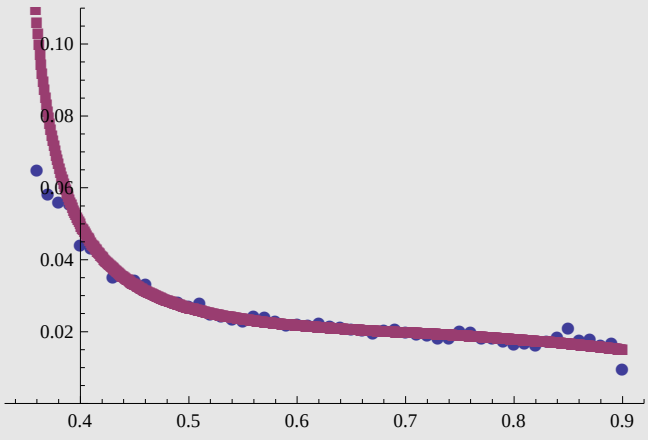
Comparison of derivatives of interpolation and LinModFit:

Out[26]=



In[27]:=
```
(* Finding dT/dP coefficient *)

(*raw data - by points*)
coefraw = {};
For[i = 1, i ≤ Length[files], i++,
 slope = Part[lmfscurve[i]["BestFitParameters"], 2];
 a = -1 / (slope * difintercalib[temperatures[[i]]]);
 AppendTo[coefraw, {temperatures[[i]], a}];
]

(*ratio1={}; (*smooth - fitted data, by init temperature step*)
For[i=1,i≤Length[files],i=i+2,
 slope=fitslopeScurve[temperatures[[i]]];
 a=-1/(slope*diflmfcalib[temperatures[[i]]]);
 AppendTo[ratio1,{temperatures[[i]],a}];
]*)

(*fitted data, by arbitrary temperature step*)
coeffit = {};
For[i = tmin, i ≤ tmax, i = i + 1 mK,
 slope = fitslopeScurve[i];
 a = -1 / (slope * diflmfcalib[i]);
 AppendTo[coeffit, {i, a}];
]

ListPlot[{coefraw, coeffit},
 PlotRange → {{tmin - 0.02, tmax + 0.02}, {0, 0.11}},
 PlotMarkers → {Automatic, Small}]
```

Out[31]=



```
Export[inputpath <> "dTdP(T) from " <> ToString[Min[files]] <>
   "-" <> ToString[Max[files]] <> " raw.dat", coefraw];
Export[inputpath <> "dTdP(T) from " <> ToString[Min[files]] <>
   "-" <> ToString[Max[files]] <> " fitted.dat", coeffit];
Export[inputpath <> "slopeScurve " <> ToString[Min[files]] <>
   "-" <> ToString[Max[files]] <> ".dat", slopeScurve];
Export[inputpath <> "fitslopeScurve " <> ToString[Min[files]] <>
   "-" <> ToString[Max[files]] <> ".dat", Normal[fitslopeScurve]];
Export[inputpath <> "calib " <> ToString[Min[files]] <>
   "-" <> ToString[Max[files]] <> ".dat", calib];
Export[inputpath <> "lmfcalib " <> ToString[Min[files]] <>
   "-" <> ToString[Max[files]] <> ".dat", Normal[lmfcalib]];
```