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## Dust Modeling Function

$$\text{dust}[x_, t_, dn_, b_] := \left( \frac{dn}{x^4} \frac{1}{E^{\frac{1.4388 \cdot 10^4}{t \cdot x}} - 1} \right) * x^b$$

```
Manipulate[Plot[dust[x, t, dn, b], {x, 0, 7}], {{t, 1300}, 1, 3000, 1},  
  {{dn, 2.2 * 10^-9}, 0, 1 * 10^-8, 1 * 10^-10}, {{b, .3}, 0, 1, .01}]
```

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## Import Data

```
listTarget = Import["Replace this with the path to the target data"];  
listTargetPrism = Import["Replace this with the path to the prism data"];  
listStandard = Import["Replace this with the path to the standard star data"];  
  
ListLogLogPlot[{listTarget, listStandard, listTargetPrism},  
  PlotStyle -> {Red, Blue, Green}, PlotRange -> All,  
  PlotLegends -> {"Target", "Standard", "Prism"}]
```

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## Create the standard model

Smooth the standard data

```
sdata = Drop[listStandard, {1, Length[listStandard], 2}];  
sdata = Drop[sdata, {1, Length[sdata], 2}];  
sdata = Drop[sdata, {1, Length[sdata], 2}];  
sdata = Drop[sdata, {1, Length[sdata], 2}];  
Length[sdata]  
sdata = MovingAverage[sdata, 20];  
ListLogLogPlot[{listStandard, sdata}, PlotStyle -> {Blue, Red},  
  PlotLegends -> {"Standard", "Smoothed Standard"}]
```

Create the interpolating

```
Clear[standardFunction]  
standardFunction = Interpolation[sdata]  
xmin = standardFunction["Domain"][[1, 1]];  
xmax = standardFunction["Domain"][[1, 2]];  
sfPlot = LogLogPlot[standardFunction[x], {x, xmin, xmax},  
  PlotStyle -> {Thick, Green}, PlotLegends -> {"Standard Function"}];  
Show[ListLogLogPlot[{listStandard, sdata}, PlotStyle -> {Blue, Red},  
  PlotLegends -> {"Standard", "Smoothed Standard"}], sfPlot]
```

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## Create the target model

Smooth the target data

```

tdata = Drop[listTarget, {1, Length[listTarget], 2}];
tdata = Drop[tdata, {1, Length[tdata], 2}];
tdata = Drop[tdata, {1, Length[tdata], 2}];
tdata = Drop[tdata, {1, Length[tdata], 2}];
Length[tdata]
tdata = MovingAverage[tdata, 30];
p1 = ListLogLogPlot[{listTarget, tdata},
  PlotStyle → {Blue, Red}, PlotLegends → {"Target", "Smoothed Target"}]

```

Create the interpolating function

```

Clear[targetFunction]
targetFunction = Interpolation[tdata]
xminT = targetFunction["Domain"][[1, 1]];
xmaxT = targetFunction["Domain"][[1, 2]];
tfPlot = LogLogPlot[targetFunction[x], {x, xminT, xmaxT},
  PlotStyle → {Thick, Green}, PlotLegends → {"Target Function"}];
Show[ListLogLogPlot[{listTarget, tdata}, PlotStyle → {Blue, Red},
  PlotLegends → {"Target", "Smoothed Target"}], tfPlot]

```

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## Scale the target data

Scale the target data to the prism data

```

tScaleModel[s_, x_] := targetFunction[x] * s;

Manipulate[
  Show[LogLogPlot[tScaleModel[s, x],
    {x, xminT, xmaxT}, PlotStyle → Blue, PlotLegends → {"Target"}],
    ListLogLogPlot[listTargetPrism, PlotStyle → Green, PlotLegends → {"Prism"}]],
  {{s, 1.0}, .5, 2.0)]

targetScale = 1.058`

```

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## Create the function to fit

```

model[x_, t_, dn_, b_, sn_] := (standardFunction[x] * sn) + dust[x, t, dn, b];
model[1, 1300, 2.2 * 10-9, .3, .15] // N (*Test*)

Manipulate[
  plot1 = LogLogPlot[model[x, t, dn, b, sn], {x, xmin, xmax},
    PlotStyle → {Red, Thick}, PlotRange → All, PlotLegends → {"Model"}];
  plot2 = ListLogLogPlot[listTarget * targetScale, PlotStyle → Blue,
    PlotRange → All, PlotLegends → {"Target"}];
  Show[plot2, plot1, PlotRange → All],
  {{t, 1300}, 1, 2000, 1}, {{dn, 2.2 * 10-9}, 0, 1.0 * 10-8, 0.1 * 10-10},
  {{b, .37}, 0, 2, .01}, {{sn, .158}, 0, 2, .001}]

```

## Trim data to keep in range. Without constraints

```

dropAmount = 40;
data = Drop[Drop[tdata * targetScale, dropAmount], -dropAmount];

fit = NonlinearModelFit[data, model[x, t, dn, b, sn],
  {{t, 1836}, {dn, 4.0 * 10^-10}, {b, 0.66`}, {sn, 0.152`}}, x]

plot1 =
  LogLogPlot[model[x, t, dn, b, sn] /. fit["BestFitParameters"], {x, xmin, xmax},
    PlotStyle → {Red, Thick}, PlotRange → All, PlotLegends → {"Model"}];
plot2 = ListLogLogPlot[listTarget * targetScale, PlotStyle → Blue,
  PlotRange → All, PlotLegends → {"Target"}];
plot3 = ListLogLogPlot[tdata * targetScale, PlotStyle → Green,
  PlotRange → All, PlotLegends → {"Smoothed Target"}];
Show[plot2, plot3, plot1, PlotRange → All]

fit["ParameterTable"]

```