Refractive Index in Air

Initialization

In[36]:=
```
Needs["Controls`LinearControl`"]
```

In[37]:=
```
$TextStyle = {FontFamily → "Helvetica", FontSize → 13};
```

In[38]:=
```
plotopt = Sequence @@ {GridLines → Automatic, Frame → True,
    FrameStyle → Thickness[0.0025], BaseStyle → {FontSize → 12}};
```

In[39]:=
```
plotoptn[n_Integer?(# > 0 ∧ # < 6 &)] := Sequence @@
   {GridLines → Automatic, Frame → True, FrameStyle → Thickness[0.0025], PlotStyle →
     Take[{Purple, Brown, Darker[Green], Blue, Red}, -n], BaseStyle → {FontSize → 12}};
plotoptn[n_Integer?(# ≤ 0 ∨ # ≥ 6 &)] := plotopt
```

In[41]:=
```
mylegend[labels_List, pos_:Right] :=
 {Placed[LineLegend[labels, LabelStyle → {FontSize → 11}, LegendMargins → 2,
    LegendFunction → (Framed[#, Background → White] &)], pos]}
```

Refractive Index

Data

Condition: 15°C and 1013.25 mbar
https://refractiveindex.info/?shelf=other&book=air&page=Ciddor

In[24]:=
```
nair532T15 = 1.00027821
nair1064T15 = 1.00027398
```

Out[24]=
```
1.00028
```

Out[25]=
```
1.00027
```

Condition: 25°C and 1013.25 mbar
https://emtoolbox.nist.gov/Wavelength/Ciddor.asp

In[26]:=
```
nair532 = 1.000268288
nair1064 = 1.000264189
```

Out[26]=
```
1.00027
```

Out[27]=
```
1.00026
```

Equations

In[30]:=
```
ϕ = (nair532 - nair1064) 2 π / λ l /. {λ → 1064*^-9, l → 0.01}
% 180 / π
```

Out[30]=
```
0.242056
```

Out[31]=
```
13.8688
```

In[13]:=
```
n[p_, t_] := δn p / p0 (t0 + 25) / (t0 + t) /. {t0 → 273.15, p0 → 1013.25}
```

In[34]:=
```
180 / π 2 π / λ l n[1013.25, 25] /. {λ → 1064*^-9, l → 0.01, δn → nair532 - nair1064}
```

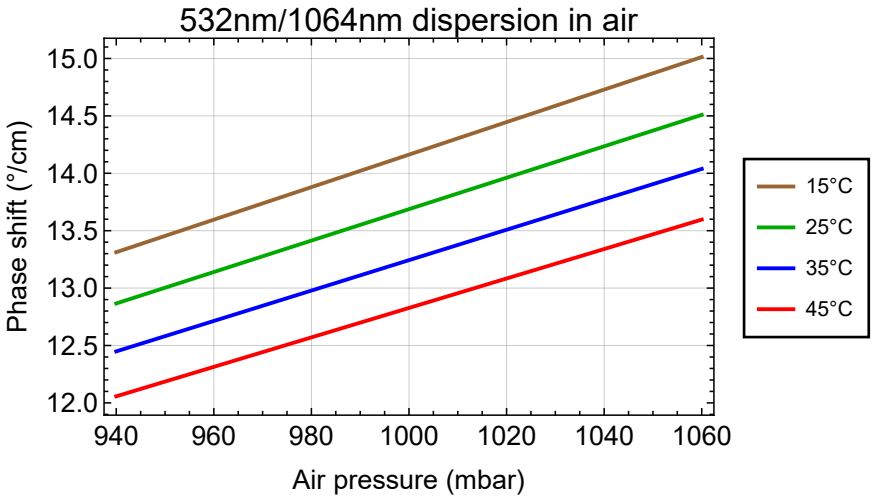
Out[34]=
```
13.8688
```

Plots

Refractive Index

In[162]:=

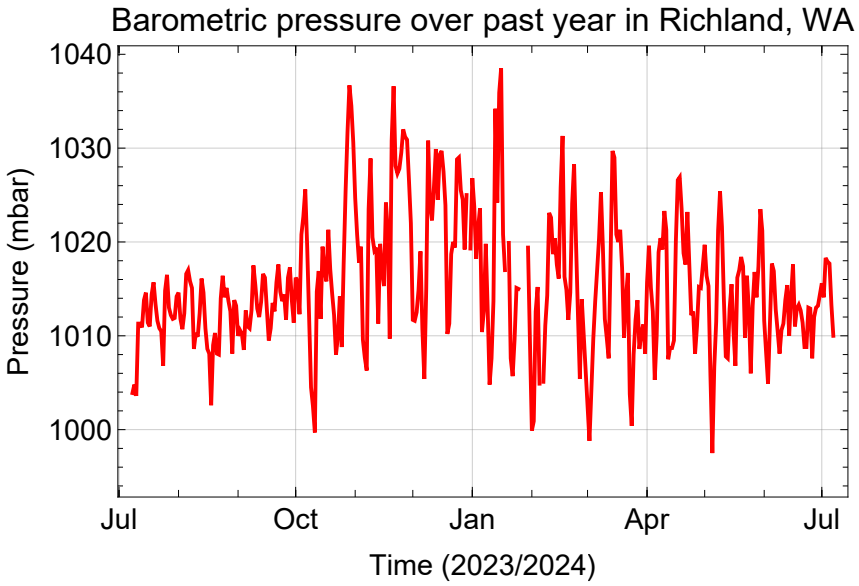
```
Plot[Evaluate[180/π 2 π/λ l {n[p, 15], n[p, 25], n[p, 35], n[p, 45]} /.
   {λ → 1064*^-9, l → 0.01, δn → nair532 - nair1064}], {p, 940, 1060},
 FrameStyle → Thickness[0.0025], FrameStyle → Directive[Black, 12],
 BaseStyle → {FontSize → 12, FontColor → Black},
 LabelStyle → {FontSize → 14, FontColor → Black},
 PlotLabel → "532nm/1064nm dispersion in air",
 FrameLabel → {"Air pressure (mbar)", "Phase shift (°/cm)"}, Evaluate[plotoptn[4]],
 ImageSize → 380, PlotLegends → mylegend[{"15°C", "25°C", "35°C", "45°C"}]]
```



Barometric Pressure

In[151]:=

```
DateListPlot[WeatherData[{"Richland", "Washington", "UnitedStates"},
  "Pressure", {{2023, 7, 8}, {2024, 7, 7}, "Day"}],
 PlotLabel → "Barometric pressure over past year in Richland, WA",
 FrameLabel → {"Time (2023/2024)", "Pressure (mbar)"},
 BaseStyle → {FontSize → 12, FontColor → Black},
 LabelStyle → {FontSize → 14, FontColor → Black},
 FrameStyle → Directive[Black, 15], Joined → True, plotoptn[1], ImageSize → 444]
```

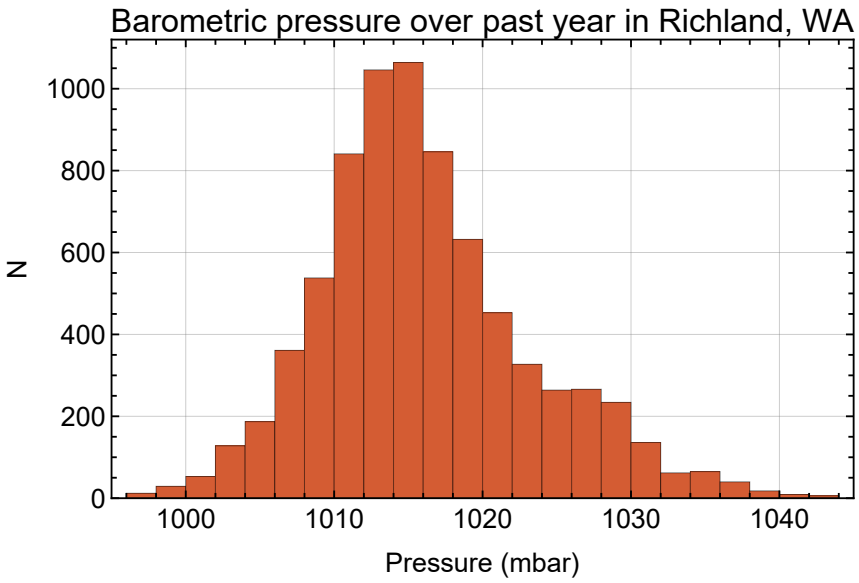


In[106]:=

```
pdata = WeatherData[{"Richland", "Washington", "UnitedStates"},
   "Pressure", {{2023, 7, 8}, {2024, 7, 7}, All}];
```

In[150]:=

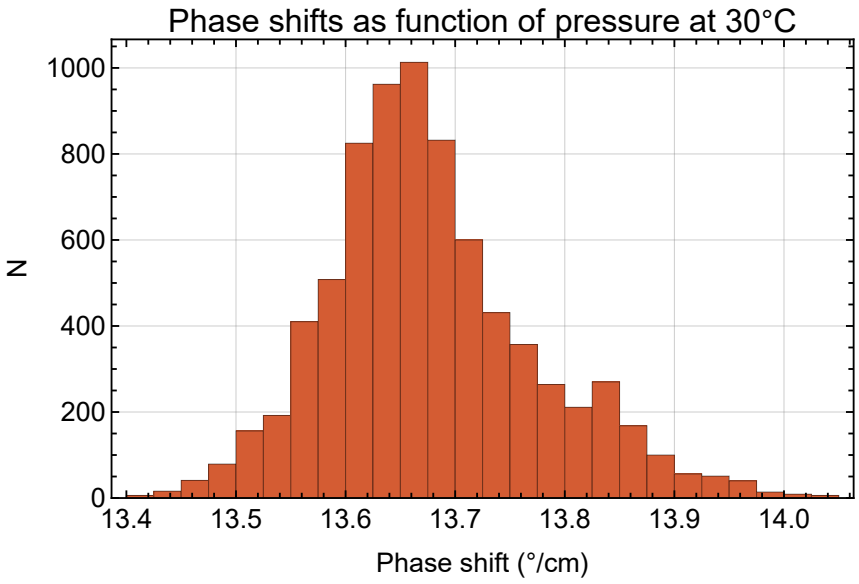
```
Histogram[pdata, Frame → True, GridLines → Automatic, Frame → True,
 FrameStyle → Thickness[0.0025], FrameStyle → Directive[Black, 12],
 BaseStyle → {FontSize → 12, FontColor → Black},
 LabelStyle → {FontSize → 14, FontColor → Black},
 FrameStyle → Directive[Black, 15],
 PlotLabel → "Barometric pressure over past year in Richland, WA",
 FrameLabel → {"Pressure (mbar)", "N"}, PlotTheme → {"Scientific", "VibrantColor"},
 ImageSize → 444]
```



Histogram of Phase Shifts

In[155]:=

```
Histogram[Evaluate[
  180/π 2 π/λ l (n[#, 30] & /@ rawdata) /. {λ → 1064*^-9, l → 0.01, δn → nair532 - nair1064}],
 {0.025}, Frame → True, GridLines → Automatic,
 FrameStyle → Thickness[0.0025], FrameStyle → Directive[Black, 12],
 BaseStyle → {FontSize → 12, FontColor → Black},
 LabelStyle → {FontSize → 14, FontColor → Black},
 PlotLabel → "Phase shifts as function of pressure at 30°C",
 FrameLabel → {"Phase shift (°/cm)", "N"},
 PlotTheme → {"Scientific", "VibrantColor"}, ImageSize → 444]
```



In[163]:=

```
Histogram[Evaluate[
  4 180/π 2 π/λ l (n[#, 30] & /@ rawdata) /. {λ → 1064*^-9, l → 0.01, δn → nair532 - nair1064}],
 {0.1}, Frame → True, GridLines → Automatic, FrameStyle → Thickness[0.0025],
 BaseStyle → {FontSize → 12}, FrameStyle → Thickness[0.0025],
 FrameStyle → Directive[Black, 12], BaseStyle → {FontSize → 12, FontColor → Black},
 LabelStyle → {FontSize → 14, FontColor → Black},
 PlotLabel → "Phase shifts as function of pressure at 30°C",
 FrameLabel → {"Phase shift over 4 cm (°)", "N"},
 PlotTheme → {"Scientific", "VibrantColor"}, ImageSize → 444]
```