In[308]:=

```
(**refractive index data for Ag and Au**)

Off[General::spell1];

Off[SetDelayed::write];


dataAg = {{.64, .24 - i * 14.08},
   {.77, .15 - i * 11.85},
   {.89, .13 - i * 10.1},
   {1.02, .09 - i * 8.828},
   {1.14, .04 - i * 7.795},
   {1.26, .04 - i * 6.992},
   {1.39, .04 - i * 6.312},
   {1.51, .04 - i * 5.727},
   {1.64, .03 - i * 5.242},
   {1.76, .04 - i * 4.838},
   {1.88, .05 - i * 4.483},
   {2.01, .06 - i * 4.152},
   {2.13, .05 - i * 3.858},
   {2.26, .06 - i * 3.586},
   {2.38, .05 - i * 3.324},
   {2.50, .05 - i * 3.093},
   {2.63, .05 - i * 2.869},
   {2.75, .04 - i * 2.657},
   {2.88, .04 - i * 2.462},
   {3.00, .05 - i * 2.275},
   {3.12, .05 - i * 2.070},
   {3.25, .05 - i * 1.864},
   {3.37, .07 - i * 1.657},
   {3.50, .10 - i * 1.419},
   {3.62, .14 - i * 1.142},
   {3.74, .17 - i * 0.829},
   {3.87, .81 - i * 0.392},
   {3.99, 1.13 - i * 0.616},
   {4.12, 1.34 - i * 0.964},
   {4.24, 1.39 - i * 1.161},
   {4.36, 1.41 - i * 1.264},
   {4.49, 1.41 - i * 1.331},
```

```
    {4.61, 1.38 - i * 1.372},
    {4.74, 1.35 - i * 1.387},
    {4.86, 1.33 - i * 1.393},
    {4.98, 1.31 - i * 1.389},
    {5.11, 1.30 - i * 1.378}};

Ag1 = Table[{Evaluate[dataAg[[i, 1]]], Evaluate[Re[dataAg[[i, 2]]]]}, {i, 1, 37}];
Interpolation[Ag1, InterpolationOrder → 2];
Ag2 = Table[{Evaluate[dataAg[[i, 1]]], Evaluate[Im[dataAg[[i, 2]]]]}, {i, 1, 37}];
Interpolation[Ag2, InterpolationOrder → 2];
nAg[ω_] := Interpolation[Ag1][ω] + i * Interpolation[Ag2][ω];

data = {{.64, .92 - i * 13.78},
    {.77, .56 - i * 11.21},
    {.89, .43 - i * 9.519},
    {1.02, .35 - i * 8.145},
    {1.14, .27 - i * 7.150},
    {1.26, .22 - i * 6.350},
    {1.39, .17 - i * 5.663},
    {1.51, .16 - i * 5.083},
    {1.64, .14 - i * 4.542},
    {1.76, .13 - i * 4.103},
    {1.88, .14 - i * 3.697},
    {2.01, .21 - i * 3.272},
    {2.13, .29 - i * 2.863},
    {2.26, .43 - i * 2.455},
    {2.38, .62 - i * 2.081},
    {2.50, 1.04 - i * 1.833},
    {2.63, 1.31 - i * 1.849},
    {2.75, 1.38 - i * 1.914},
    {2.88, 1.45 - i * 1.948},
    {3.00, 1.46 - i * 1.958},
    {3.12, 1.47 - i * 1.952},
    {3.25, 1.46 - i * 1.933},
    {3.37, 1.48 - i * 1.895},
    {3.50, 1.50 - i * 1.866},
    {3.62, 1.48 - i * 1.871},
    {3.74, 1.48 - i * 1.883},
    {3.87, 1.54 - i * 1.898},
    {3.99, 1.53 - i * 1.893},
```

```
    {4.12, 1.53 - i * 1.889},
    {4.24, 1.49 - i * 1.878},
    {4.36, 1.47 - i * 1.869},
    {4.49, 1.43 - i * 1.847},
    {4.61, 1.38 - i * 1.803},
    {4.74, 1.35 - i * 1.749},
    {4.86, 1.33 - i * 1.688},
    {4.98, 1.33 - i * 1.631},
    {5.11, 1.32 - i * 1.577},
    {5.23, 1.32 - i * 1.536},
    {5.36, 1.30 - i * 1.497},
    {5.48, 1.32 - i * 1.460},
    {5.60, 1.31 - i * 1.427},
    {5.73, 1.30 - i * 1.387},
    {5.85, 1.30 - i * 1.350},
    {5.98, 1.30 - i * 1.304},
    {6.10, 1.30 - i * 1.277},
    {6.22, 1.33 - i * 1.251},
    {6.35, 1.34 - i * 1.266},
    {6.47, 1.32 - i * 1.203},
    {6.60, 1.28 - i * 1.188}};

Au1 = Table[{Evaluate[data[[i, 1]]], Evaluate[Re[data[[i, 2]]]]}, {i, 1, 49}];
Interpolation[Au1, InterpolationOrder → 2];
Au2 = Table[{Evaluate[data[[i, 1]]], Evaluate[Im[data[[i, 2]]]]}, {i, 1, 49}];
Interpolation[Au2, InterpolationOrder → 2];
nAu[ω_] := Interpolation[Au1][ω] + i * Interpolation[Au2][ω];

(**Functions needed to calculate the an and bn coefficients in Mie theory,
the coefficients and expressions fro the extinction and scattering efficiencies,
nmax is the maximum number of terms in the expansion**)
```

$$\psi[n\_, x\_] := \sqrt{\frac{\pi x}{2}}\ \text{BesselJ}[n + 1/2, x];$$

$$d\psi[n\_, x\_] := \sqrt{\frac{\pi x}{2}}\ \left(\left(\frac{n + 1/2}{x}\right) \text{BesselJ}[n + 1/2, x] - \text{BesselJ}[n + 3/2, x] + \frac{\text{BesselJ}[n + 1/2, x]}{2 x}\right);$$

```
ξ[n_, x_] := Sqrt[π x / 2] (BesselJ[n + 1 / 2, x] - ⅈ * BesselY[n + 1 / 2, x]);
```

$$\text{d}\xi[\text{n\_}, \text{x\_}] := \sqrt{\frac{\pi x}{2}} \left(\left(\frac{n + 1/2}{x} \right) \text{BesselJ}[n + 1/2, x] - \text{BesselJ}[n + 3/2, x] + \frac{\text{BesselJ}[n + 1/2, x]}{2 x} - i * \left(\left(\frac{n + 1/2}{x} \right) \text{BesselY}[n + 1/2, x] - \text{BesselY}[n + 3/2, x] + \frac{\text{BesselY}[n + 1/2, x]}{2 x} \right) \right)$$

$$\text{an}[\text{n\_}, \text{x\_}, \text{m\_}] := \frac{\text{d}\psi[n, m * x] * \psi[n, x] - m * \psi[n, m * x] * \text{d}\psi[n, x]}{\text{d}\psi[n, m * x] * \xi[n, x] - m * \psi[n, m * x] * \text{d}\xi[n, x]};$$

$$\text{bn}[\text{n\_}, \text{x\_}, \text{m\_}] := \frac{m * \text{d}\psi[n, m * x] * \psi[n, x] - \psi[n, m * x] * \text{d}\psi[n, x]}{m * \text{d}\psi[n, m * x] * \xi[n, x] - \psi[n, m * x] * \text{d}\xi[n, x]};$$

$n_{max} = 10;$

$$Q_{sca}[\text{x\_}, \text{m\_}] := \frac{2}{x^2} \sum_{i=1}^{n_{max}} \left((2 i + 1) * \left(\text{Abs}[\text{an}[i, x, m]]^2 + \text{Abs}[\text{bn}[i, x, m]]^2 \right) \right);$$

$$Q_{ext}[\text{x\_}, \text{m\_}] := \frac{2}{x^2} \sum_{i=1}^{n_{max}} \left((2 i + 1) * \left(\text{Re}[\text{an}[i, x, m]] + \text{Re}[\text{bn}[i, x, m]] \right) \right);$$

In[347]:=

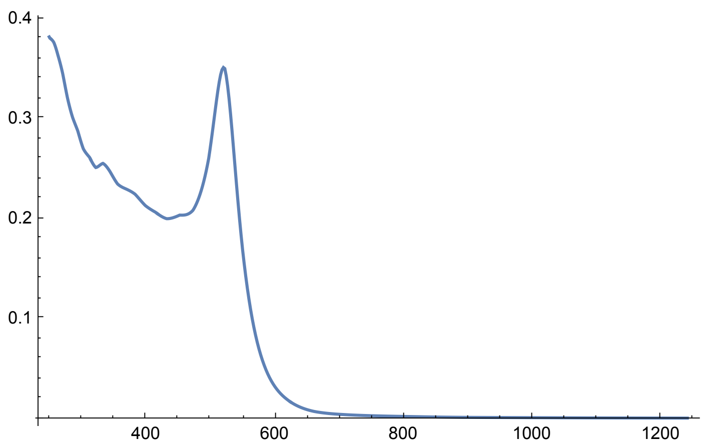
```
(**routine for calculating spectra, output is efficiency versus wavelength,
a is the radius of the particle and n_med the refractive index of the medium**)
Clear[a, λ, ω];
a = 3.5;
n_med = 1.25;
x[ω_] := 2 * π * a * n_med * 8065.5 * ω / 10^7;
λ[ω_] := 10^7 / (8065.5 * ω);

tab1 = Table[{λ[ω], Evaluate[Q_ext[x[ω], nAu[ω] / n_med]]}, {ω, 1, 5, .01}];
tab2 = Table[{λ[ω], Evaluate[Q_sca[x[ω], nAu[ω] / n_med]]}, {ω, 1, 5, .01}];
```

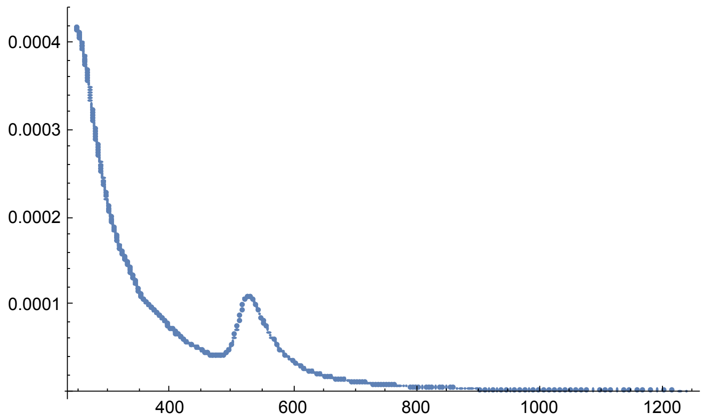
In[354]:=

```
gp1 = ListLinePlot[tab1, PlotRange → All]
gp2 = ListPlot[tab2, PlotRange → All]
Show[gp1, gp2]
```

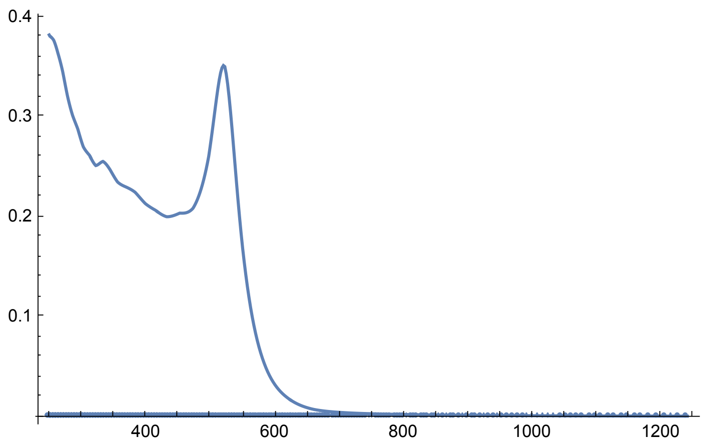
Out[354]=



Out[355]=



Out[356]=



```
(**rotuine for calculating the "radar cross-section" which is efficiency versus size (x = (2π a n_med)/λ),
n_sp is the refractive index of a sphere**)

n_sp = 1.33;
n_med = 1.;

tab3 = Table[{x, Evaluate[Q_sca[x, n_sp / n_med]]}, {x, 1, 50, .1}];
(**tab4=Table[{x,Evaluate[Q_ext[x,n_sp/n_med]]},{x,1,50,.5}];**)
```

```
ListLinePlot[Log10[tab3], PlotRange → All]
ListLinePlot[tab3, PlotRange → All]
```