INSTALLATION

First download the archive found on Moodle.

Then unzip its contents into the folder of your choice.

There are 3 options to use the program.

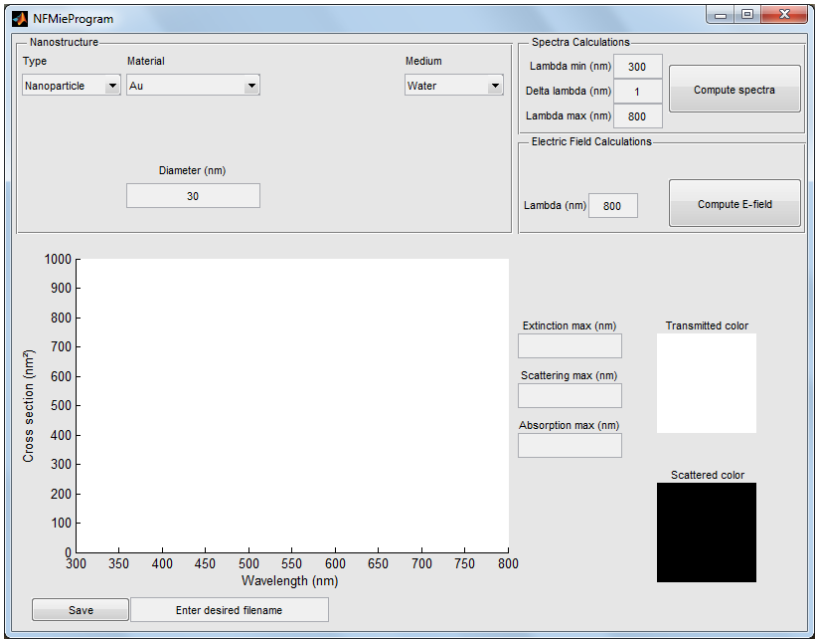
1- Users with MATLAB (Tested on R2015a, should work for newer versions, could have errors with older versions.)
   First start MATLAB. Change the current folder to the folder containing the file "NFMieProgram.m".
   In the MATLAB command window, type "NFMieProgram" and it should start.

2- Users without MATLAB with a 64 bits Windows OS.
   Your computer must have some of MATLAB's runtime files installed. They will be downloaded and installed at the same time as NFMieProgram is installed. For this, run the file "MyAppInstaller_web.exe". This will install on your computer the MATLAB components required to run the programme (without actually installing MATLAB on your computer). You can now run the program through its installed shortcut.

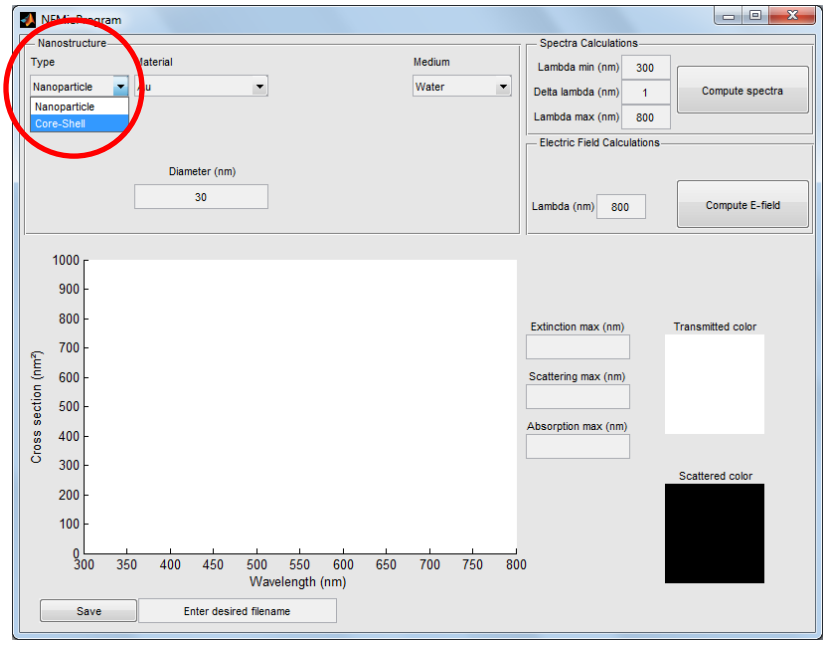
3- Users with MATLAB 2015a on a 64 bits Windows OS.
   If you happen to have this exact MATLAB version installed on your computer, you can simply run the "NFMieProgram.exe" file.

USING THE PROGRAM

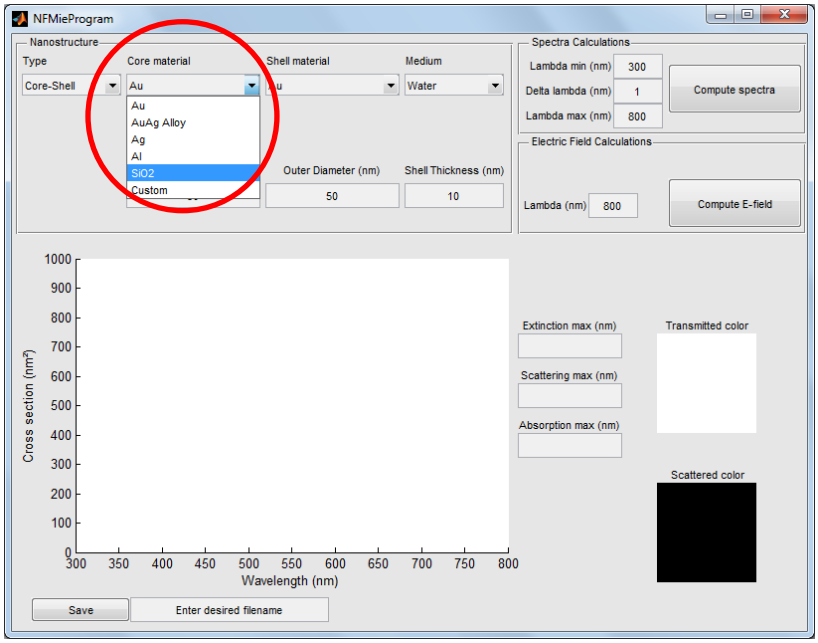
Once the program is started, this window appears:



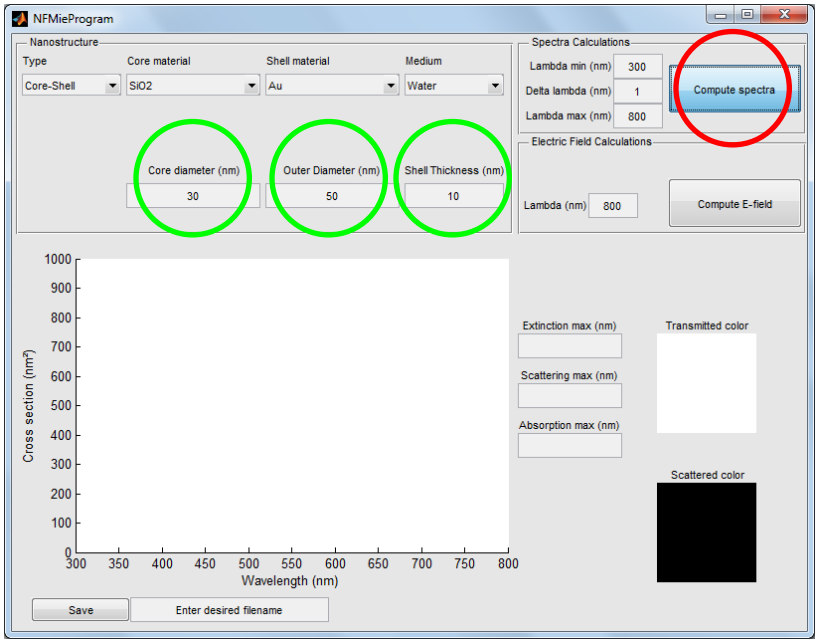
To start a calculation, first select the type of nanostructure (simple nanoparticle or core-shell structure) from the “Nanostructure Type” popup menu. In this example, “core-shell” is selected.



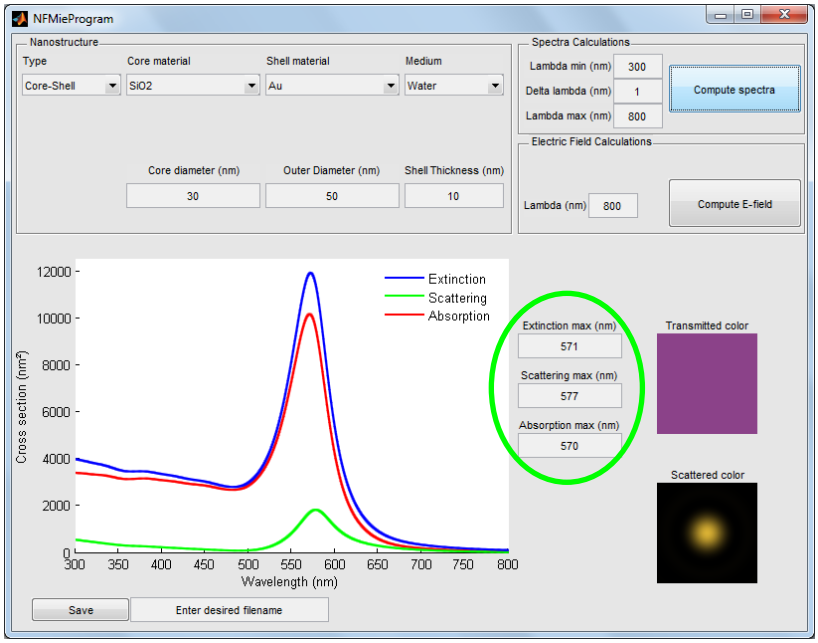
Then select the materials for the core and the shell. In this example SiO_2 was selected for the core material and the shell material is gold.



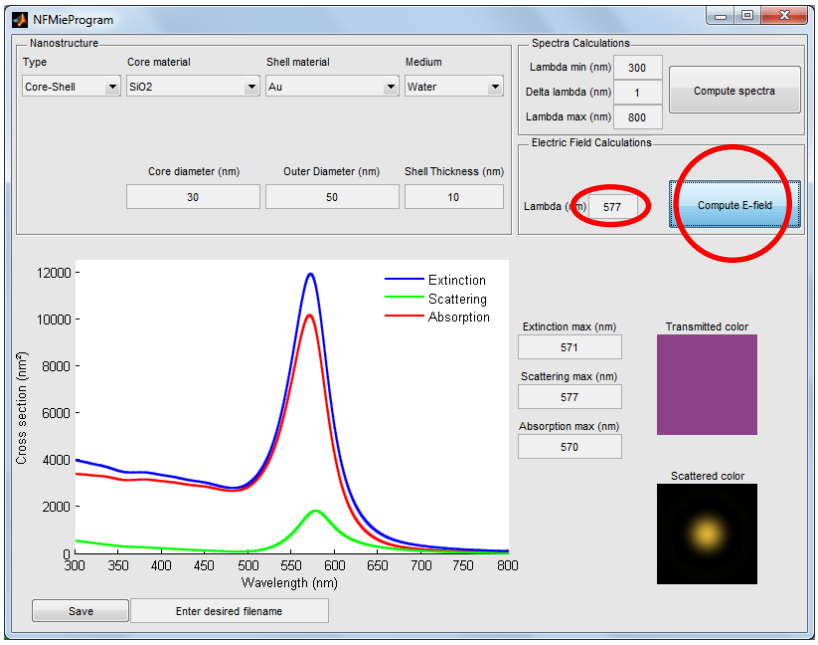
The dimensions of the core-shell structure can be set using these three boxes. The core diameter must be set. Then, the user can choose to set the outer diameter of the structure OR the thickness of the shell. By changing one of those attributes, the other is automatically set to the appropriate value. Once the values are correctly set, press “Compute Spectra” to start the calculation.



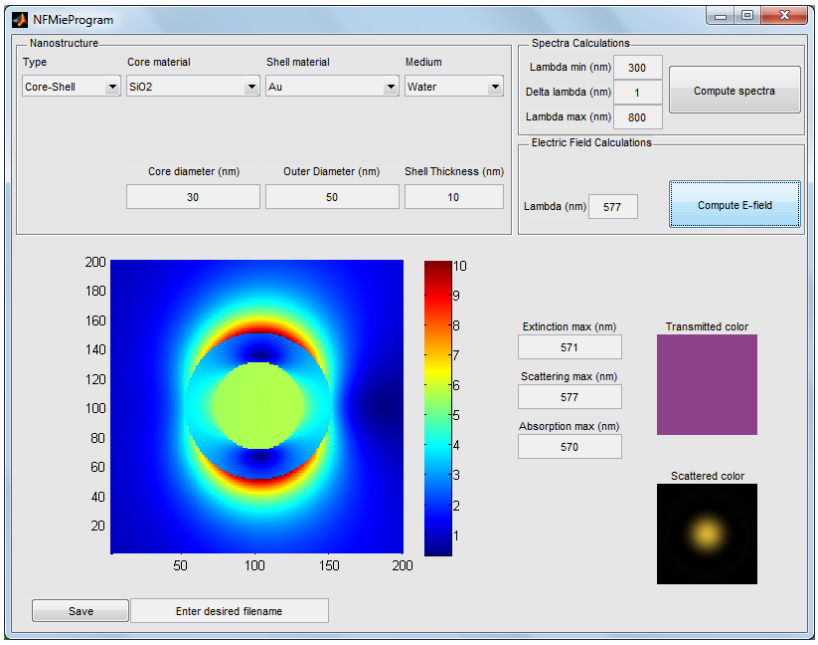
After a few seconds, the following spectra should appear. Note that the program indicates the position of the maxima of the Extinction, Scattering and Absorption spectra.



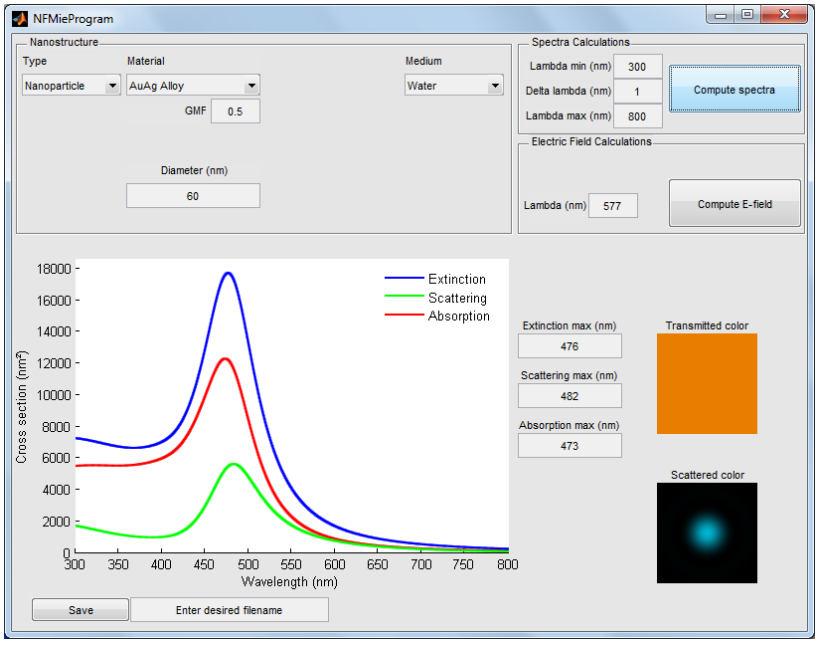
It is possible to compute the amplitude of the electric field around and inside the nanostructure. First specify the wavelength at which you want to view the field distribution then press “Compute E-field”.



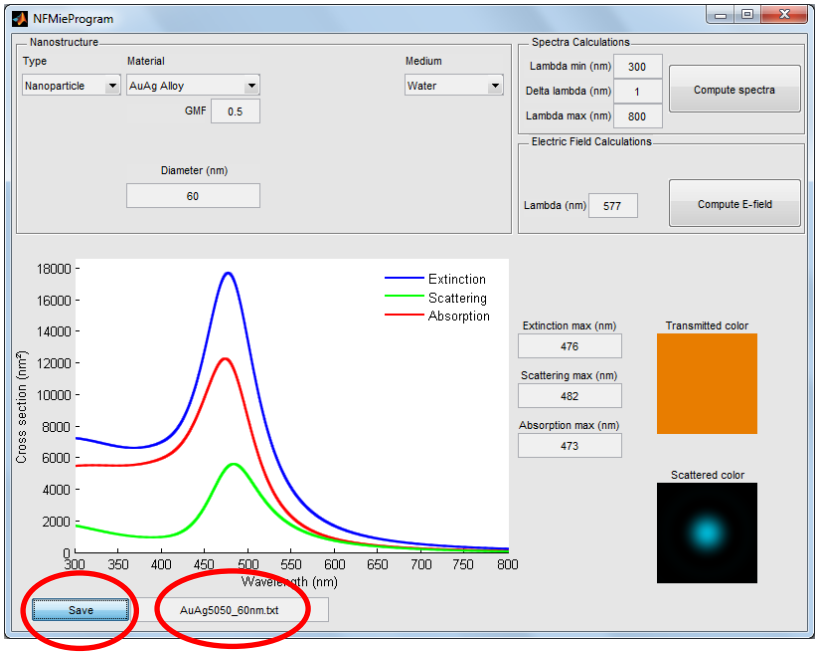
After a few seconds, the electric-field distribution appears. Note that we assume a plane-wave incident field with an amplitude of 1. Therefore, the values in the field distribution are equal to the field amplification.



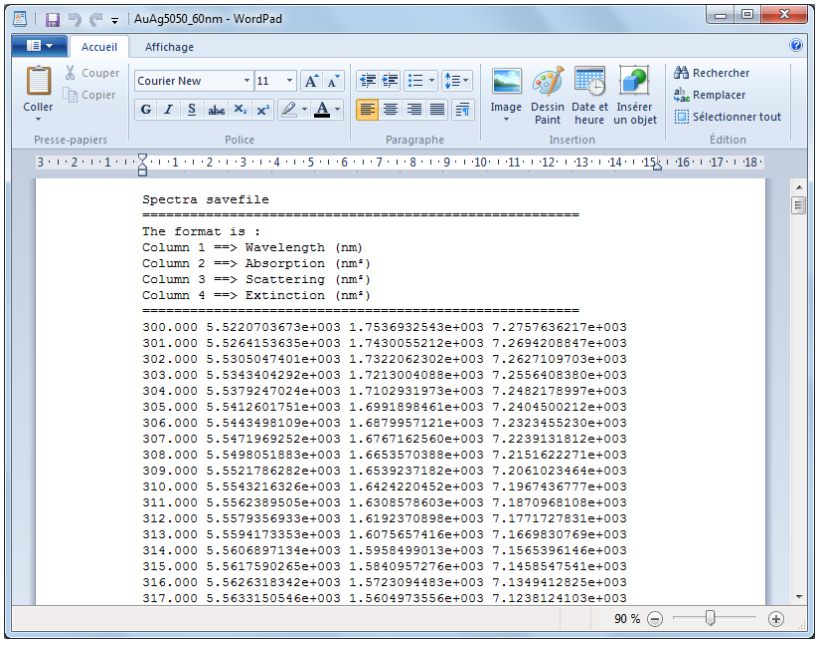
The materials popup menus contain the option for a gold-silver alloy. When selected, the alloy composition must be specified. It is specified as GMF (Gold Molar Fraction) with a value that must be in the interval between 0 (pure silver) and 1 (pure gold).



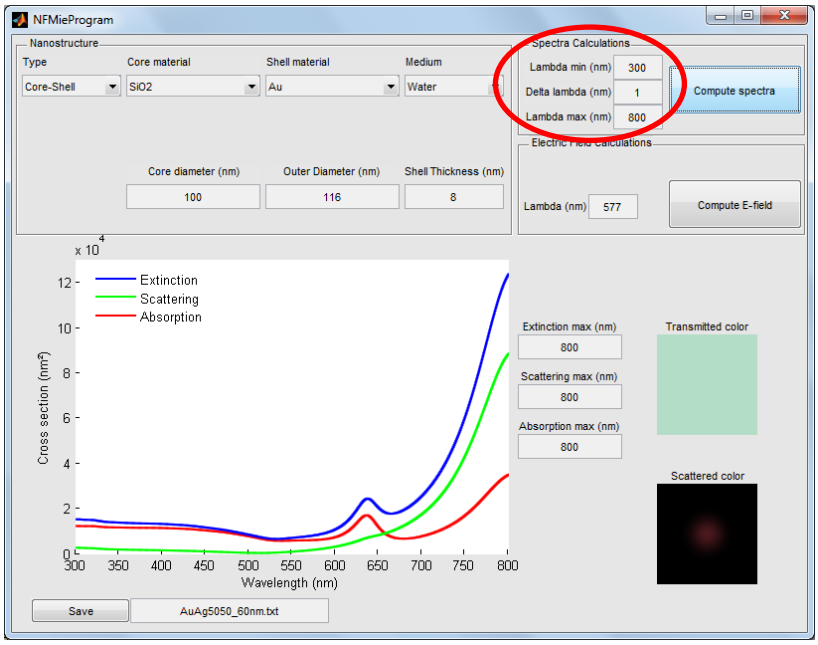
The calculated spectra can be saved as a textfile. The desired filename must first be typed in the corresponding box and then the “Save” button must be pressed.



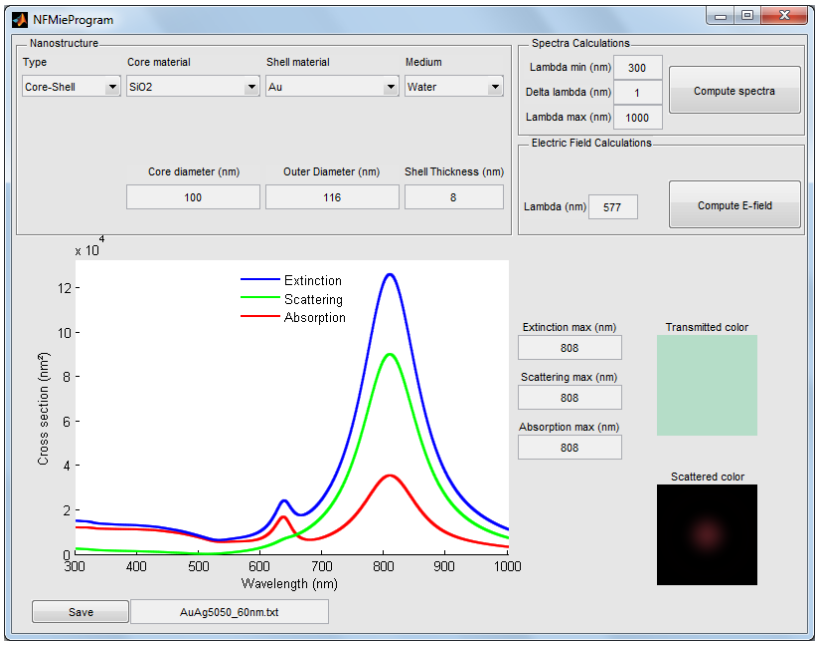
This is what the saved file looks like when opened in a text editor (WordPad, Notepad, Word…)



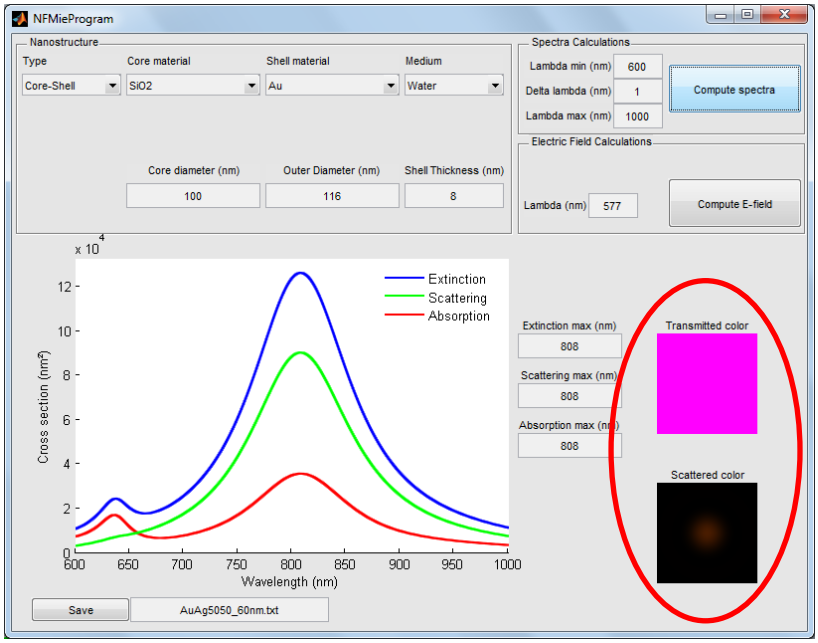
Depending on the nanostructure used, the plasmon peak may be out of the calculated wavelength range. If this happens, the wavelength range can be changed in order to have a complete view of the peak.



Here is the complete view of the peak after setting the maximum wavelength value at 1000 nm.



Note that the calculated transmitted and scattered colors will be wrong if the wavelength range does not cover the whole visible range (about 380 to 780 nm).



A note on the built in materials:

All the built in materials (Gold, Gold-Silver alloy, Silver, Aluminium, SiO_2 and Water) are based on the complex refractive indexes from tabulated values or from models from the literature.

1. Gold uses the tabulated values from Johnson & Christie (1972)
2. Gold-Silver alloy uses a model developed by Rioux *et al.* (2014)
3. Silver uses the tabulated values from Palik (1998)
4. Aluminium uses the tabulated values from McPeak *et al.* (2015)
5. SiO2 uses the dispersion formula by Malitson (1965)
6. Water uses the dispersion formula by Daimon *et al.* for a temperature of 20 °C (2007)

Most of these values can be found on the website http://refractiveindex.info/ along with many other tabulated values for the same materials and many other materials as well.

A note on the use of external files for other materials:

The file should be located in a folder named /IndexFiles/ which itself must be located in the same folder as NFMieProgram.p or NFMieProgram.exe (depending on which one you are using).

The structure of the file should be as follows:

- There should be no text header; the data starts at the first line
- Each line must contain only three numbers separated by space character; the wavelength (in nanometers), the real part of the refractive index at this wavelength (n) and the imaginary part of the refractive index (k)
- The program uses the convention $\eta = n + ik$ (rather than $\eta = n - ik$), so the values for k must be positive.

Here is an example of the content of such a file:

206.6 1.020 1.597
210.1 1.054 1.656
213.8 1.090 1.697
217.5 1.133 1.739
221.4 1.181 1.770
225.4 1.228 1.800
229.6 1.276 1.822
233.9 1.329 1.843
238.4 1.388 1.851
243.1 1.439 1.844
248.0 1.489 1.840

Where the first column contains the wavelengths, the second column contains n and the third column contains k.