CrystalWave Examples

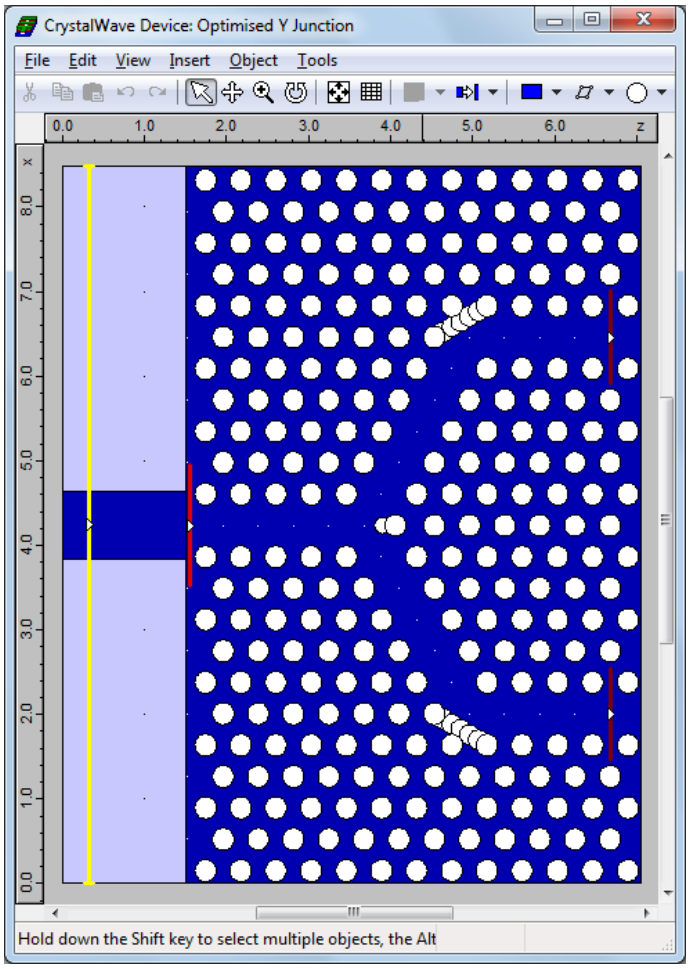
Modelling a Y Junction
in a Photonic Crystal

PCYJunction.prj

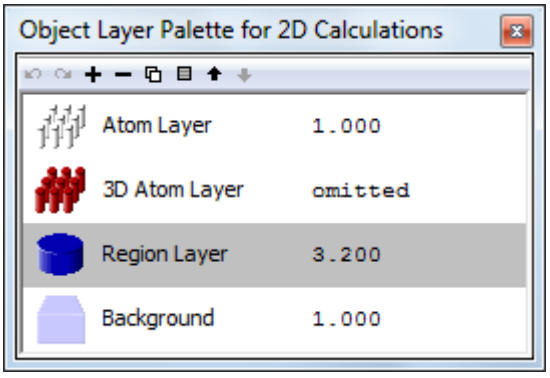
Modelling a Y Junction in a Photonic Crystal with Crystalwave

➢ Open the project PCYJunction.prj in CrystalWave and double-click on "Optimised Y Junction".

The CrystalWave Device will open. The structure is a photonic crystal in which a line defect has been created, creating a guiding region in the form of a Y junction. The lattice period is set to 0.4284um and the hole diameter to 0.25969um. Note that individual off-lattice atoms have been added to the structure to optimise the transmission.



➢ Go to the menu and select /View/Object Layer Palette for 2D calculations.



This palette tells you how the structure is defined for 2D calculations. In this case the dark blue areas have a refractive index of 3.2 whilst the white holes and the pale blue background have a refractive index of 1.

The yellow line is a mode excitor from which the fundamental TE mode of the bus waveguide will be launched as a temporal pulse, centred on a wavelength of 1.55um. The red lines are sensors, which will monitor the field during the calculation.

We will now run a 2D FDTD calculation on this structure.

- Go to the menu and select /Tools/Calculator/FDTD Calculator…

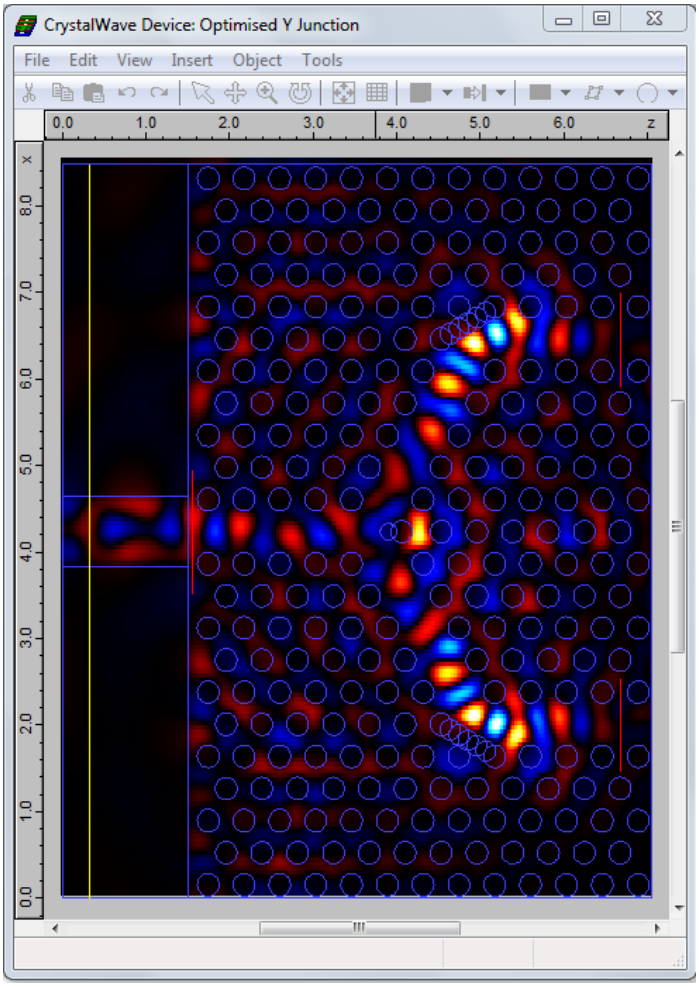
Notice that GridType has been set to "Match Lattice". This allows the FDTD Engine to use a grid that matches the crystal lattice, speeding up calculations significantly.

Also, notice that GridSpacing is set to 0.026775. To ensure that the grid matches the periodicity of the lattice the GridSpacing should be a fraction of the lattice period. Here it is 1/16th.

- If you are working on a computer with multiple CPU cores, go to the "SMP" or "Cluster/SMP" tab. Make sure that "SMP (No cluster)" is selected in the drop-down menu and select your computer in the list, then click on the "+" button until it is disabled to add enable as many CPU cores as available for the calculation.
- Before starting the calculation, go to the "Controls" tab.

CrystalWave allows you to plot the field and intensity evolving in the time domain during the calculation.

- Select "Show Hy every 256 steps".
- Click on **Calculate** to launch the FDTD calculation. The Hy field profile will be plotted every 256 steps, allowing you to see the pulse moving within the guiding region.



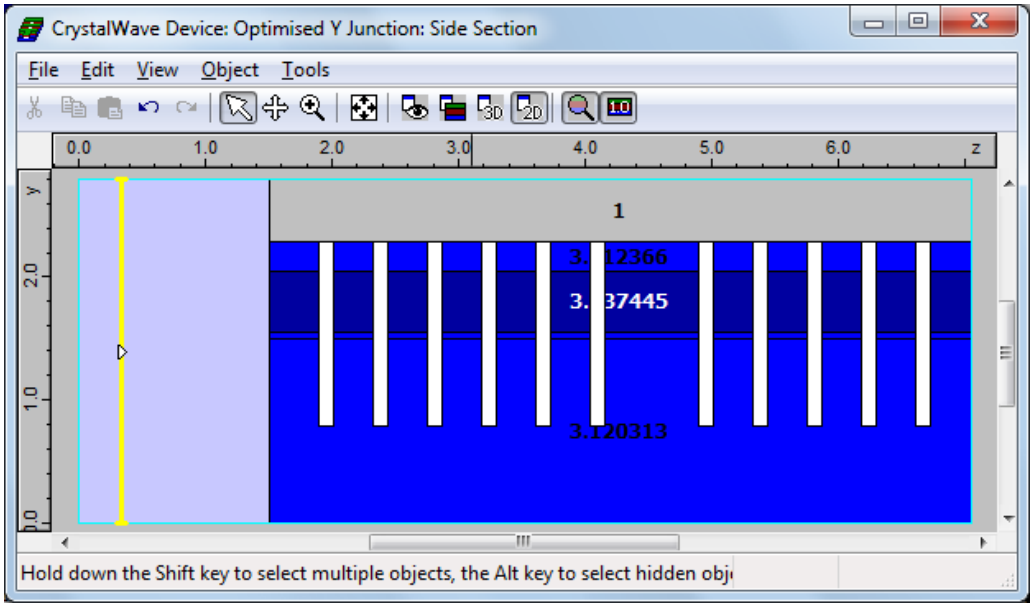
During the calculation you can select other field components or the intensity, adjust the brightness and the plotting rate. If you want to speed up the calculation you can set the plotting rate to "none". From this panel you can also easily record videos of your FDTD calculation.

- Once the calculation is complete, click on **Close**.
- In the CrystalWave Device, go to the menu /Tools/Sensor/Calculate Flux …
- Select the "positive flux for "Upper Sensor" or "Lower Sensor" relative to the positive flux for "Reference" at 1.55um and click **Calculate**.

You should find coupling coefficients between 40 and 50%. By re-running the FDTD calculation with a lower grid spacing you should find that the two values converge.

- To repeat this simulation in 3D simply open the FDTD Calulator again, set NumDimension to "3D" and click **Calculate**. This may take between fourty minutes and a couple of hours depending on the specifics of your PC.

You can see how the structure is defined in 3D by double-clicking on the white lines on the device. This will display a cross-section at the position of the line. Note that you can move the lines across the device to inspect the cross-section at different positions. To view the layers and the materials, go to the menu View/Preview and then View/Materials.


CrystalWave Device: Optimised Y Junction: Side Section
File Edit View Object Tools
0.0 1.0 2.0 3.0 4.0 5.0 6.0 z
y
2.0
1.0
0.0
1
3.12366
3.37445
3.120313
Hold down the Shift key to select multiple objects, the Alt key to select hidden obj