

Quantum Well

This program draws the wave functions for an electron in either a single or a double potential well. The depth and width of the well can be adjusted, as can the width of the middle barrier in the case of a double well. Once a well is chosen, the energy levels can be calculated, and the waves can be displayed.

Changing the Well

The size of the well can be changed by moving the mouse pointer to the item to be adjusted and pressing and holding down the mouse button. If you move the mouse while holding the button, an outline of the well will appear to show the new size of the well. Additionally, the size will be displayed in the bottom left corner of the screen. Releasing the mouse button will redraw the well at its new size.

You can choose between a single or a double well by choosing the corresponding selection from the 'Well' menu. A check mark indicates the current setting.

The size can also be changed by choosing 'Size' under the 'well' menu. When 'Size' is selected, a dialog box is opened, allowing you to enter new values. The depth of the well is measured in electron volts. The width of the well and of the middle barrier is measured in angstroms. Click on OK to use the newly entered values, or click on 'Cancel' to keep the original settings.

Finding the Energy Levels

Once a well size is set, the energy levels can be found by selecting 'Calculate Wave' from the 'Wave' menu. While calculating the levels for a single well should be quick, the double well requires finding the zeros of a very large equation. This may take a while for some sizes of well. If it starts taking too long, it can be stopped by holding down the *command* key and pressing "." . This will usually result in some energy levels not being found.

As levels are found, the title of the 'Level' menu will indicate the number of levels that have been found so far. When all the levels are found, the lowest level will be displayed. The values of the energy levels can be found by looking at the items in the 'Level' menu. The items consist of the level number and its energy in electron volts. In order to display other levels, select them from the 'level' menu. Levels that are already displayed can also be hidden by selecting them. A check mark beside a level indicates that it is currently being displayed. To display only one level, hold down the *option* key while selecting a level. Any other displayed levels will be hidden.

You can choose to display either the wave functions corresponding to the levels, or a line indicating the value of the energy level. If 'Show levels' is selected from the 'View' Menu, the lines are shown. If 'Show waves' is selected, the wave functions are shown. Both can be shown at the same time.

Changing the View

You can adjust what part of the well is shown on the screen. There are two parts to this --

scaling and panning.

Scaling is controlled by menu items in the 'view' menu. 'Squeeze' reduces the scaling by a factor of two, making more of the well fit on the screen at one time. 'Stretch' increases the scaling factor by two, making the portion seen on the screen appear larger. The well can be squeezed or stretched either horizontally or vertically by choosing the relevant subitem from the menu.

Also, 'Fit to Screen' causes the scaling to be adjusted so that the well fits nicely on the screen. If you make a major change to the size of the well, 'Fit to Screen' sets the scaling to something appropriate for the new values.

The Screen is panned by holding down the *option* key and then holding down the mouse button while moving the mouse. This will cause a well outline to be dragged around the screen, showing its new position.

The Centre commands in the 'view' menu also cause panning. 'Centre around Partition' pans the screen so that the partition is centred on the screen. If the partition is too wide, the wells may not be visible on the screen. This can be fixed by either choosing 'Fit to screen' or by using 'Centre around left well' or 'Centre around right well.' These cause the screen to be panned to bring the selected well to the centre of the screen.

Other Little Things

You can end the program by choosing 'Quit' from the 'File' menu.

The 'Edit' Menu contains two items. 'Copy' copies the values for all the currently displayed waves to the clipboard. This can then be pasted into Cricket Graph or a similar program.

Undo restores the well to the settings that were in effect before the most recent adjustment, in case you accidentally change something.

There is one more item in the 'View' Menu. 'Resolution' allows you to set how carefully waves are drawn. At low resolution, every third point is calculated. At medium, every second. At high resolution, every point is calculated. The higher the resolution, the longer it will take to draw the waves. Low resolution should be adequate for most waves.