Brief Instructions For Silver Hammer

Overview
SilverHammer is an alpha version of a field mapping program for point charges. The fields are relativistically accurate. The fields are calculated from the Liénard-Wiechert potentials for point charged particles. Charges are entered in the "Charges" window. The region surrounded by the black border is the region that the graphs will map. Graphs are created in the "Graph" Window. Think of the two windows as two separate construction zones. The charge distribution is laid out in the "Charges" window, and the graphs of the fields are created and manipulated in the "Graph" window. In the graph window you can overlay graphs, compare graphs and order frames for a QuickTime movie.

All color graphs are drawn off-screen so the redrawing of the screen is extremely fast.

Color & Memory: The alpha version has the colors hard coded so that you cannot change them. Future versions will implement a color manager that will allow you assign colors to the graphs. The bitmaps are full 24-bit QuickDraw pix maps, and they require large amounts of memory. If you have Color QuickDraw installed in system 6.0.8 or have system 7 installed, you can greatly reduce the memory requirements by setting your monitor to black and white (1-bit graphics) in the monitors control panel. SilverHammer will then only generate bit-maps that are 1-bit deep. This saves both the RAM memory required to display the pictures and the disk space required by saved files.

A bug exists in some of the drawing routines (fieldlines) in which the picture is drawn all black if your monitor setting exceeds 256 colors.

The Charges Window

Coordinate System:
Distance is measured in screen pixels, so the speed of light is given in pixels per time click. The coordinate system follows the Macintosh convention: The origin is at the upper left corner of the black bordered region. x increases to the right and y increases down the screen.

The Black Border: The black border represents the graph region. When any graphs are produced in the graph window, they will graph the fields over the

region within the black border. Charged particles, however, are not constrained to the black region and may travel beyond the borders. When this happens, the graph region will automatically add a page to accommodate the new region. The default size of the black border region is one printed 8(1/2)" by 11" page.

Orientation of Page: The orientation of the page can be changed in the "Page Set-Up" choice under the "File Menu". The choice is portrait or landscape orientations.

Tool Palette: Along the left hand side is a palette of four tools, arrow, charge, velocity , and acceleration . The arrow tool is used to select, move, and edit charges. The charge tool is used to create charges by selecting the tool and then click-dragging to make the new charge. Click-dragging to the left will create a positive charge, while click-dragging to the left will create a negative charge. The sign of a charge is shown in the center as a small + or -.

The velocity and acceleration tools are used to assign a velocity or acceleration to a charge. This is done by clicking on the charge and then dragging the cursor to create the velocity (or acceleration) vector. Velocity vectors have solid black heads while acceleration vectors have hollow heads (see picture). In the alpha version, only constant accelerations may be used. Note that this will change. Constant accelerations are very unphysical in relativistic physics because it allows the particle to exceed the speed of light. A more physical approach is to specify the force which even under a constant force, will not allow the particle to exceed the speed of light.

Along the lower left side of the Charges window is the time scroll bar. By moving the scroll bar the user can look at the charge distribution at different points in time.

Double-clicking on a charge with the arrow tool will bring up the Charge Attributes dialog box. From this dialog box the user can set the position, size, sign, velocity, and acceleration for the selected charge. "Start Time" and "End Time" refer to the time period for the acceleration.

The Graphs Window

Choice of Field: Along the left hand side on the Graphs window are five tools, the arrow tool and four graph types (contour, density, field line, 3-D). With each graph type, simply choose the appropriate tool from the palette and then the field to be graphed from the "Fields" menu (see below) and then click-drag in the Graphs window to create the graph. Along the bottom of each graph are two symbols. The left symbol denotes the field drawn (E, V, B, A, or S). The right symbol gives the time of the graph.

Each graph type has a dialog box that can be reached by double-clicking on a graph with the arrow tool. The other tools in descending order are contour graph, density plot in which regions between the contours are filled with a pattern or color, field line plot, and a pseudo-height surface in which the magnitude of the field is plotted as the height over the map. When the density plot tool is used, the choice of patterns or color can be set in the "Preferences" dialog box in the "Edit" menu.

In Black and White there are a maximum of 33 patterns. In color there are only 21 color levels. Although the patterns will remain at a maximum of 33 in future releases, future versions will support more colors.

Preferences Dialog Box

The Preferences dialog box (located under the Edit menu) gives the user the ability to set origin defaults, contour info, map defaults, and the speed of light. If checked,

Use Patterns tells SilverHammer to draw the map using B & W patterns.

Numerical Accuracy is only used when dealing with accelerating charges. It refers to the accuracy of the time retarded values (in the picture above the accuracy is 1 in 100).

Scale Vectors is the scaling factor used in determining the velocity and acceleration values from a drawn vector. A scale of 10 means a vector 50 pixels long will have a magnitude of 5. For example, if the vector is a velocity vector and the arrow representing the velocity is 50 pixels long, then the value of the velocity is 5 pixels per time click. This scale factor allows you to have reasonable length vectors when either the velocity is very large or very small.

Quick Notes About 'Fields' Menu

Under the Fields menu are all of the fields the user can calculate & plot: electric field, electric potential, magnetic field, magnetic potential, Poynting vector. Also listed is "Use Acceleration Fields Only". When checked this command, will cause SilverHammer to only draw the components of the field due to acceleration for any field.

Questions, Problems, Bugs, etc.: Any questions, problems, or bugs can be sent to cole@physics.ucdavis.edu Please note that the interface is very crude and change. This is just the basic engine and it is still very much under development.