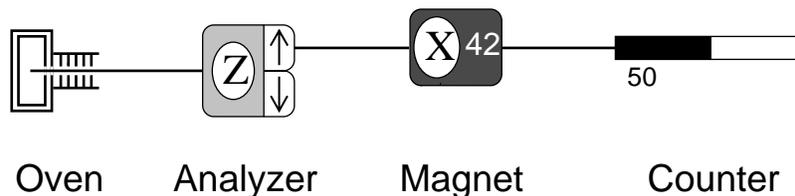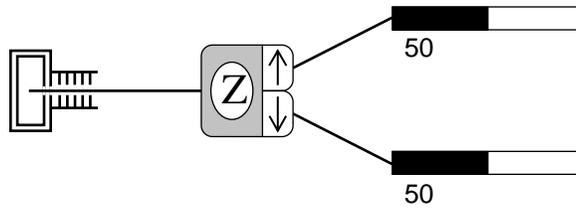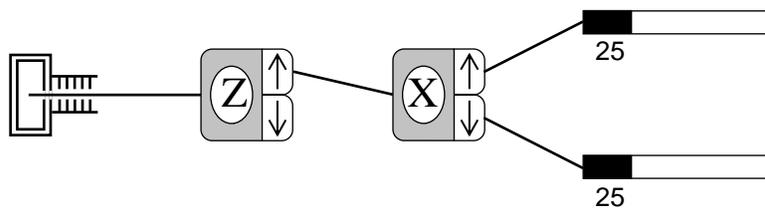# Notes for SPINS program

SPINS is an interactive computer program that simulates Stern-Gerlach experiments with spin 1/2 and spin 1 particles. The original Macintosh version was written by D. V. Schroeder (see Am. J. Phys. **61**, 798 (1993)). The Java version is very similar. In each case, an experiment consists of a few simple components that are controlled with menu and/or mouse commands.

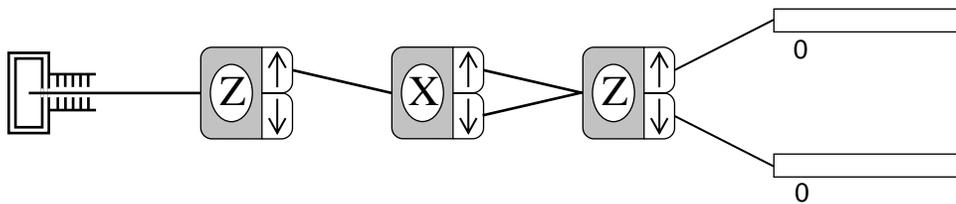Oven   Analyzer   Magnet   Counter

- The components can be moved using "click and drag" and can be connected by clicking on the output of one component (when the arrow appears) and dragging to the input of another. To disconnect components, just click on the output arrow.

- The multiple outputs of an analyzer can be combined at the input of the next component, which allows for making interferometers.

- Each analyzer and magnet can be aligned along the x, y, or z axes by clicking on the letter. There is also a general $\hat{\mathbf{n}}$ direction, which is determined by the polar angle θ and the azimuthal angle ϕ. The angles are set under the `Design` menu.

- The strength of the magnetic field can be increased by clicking on the number (0-99).

- Extra components can be added under the `Design` menu (or with keystrokes, *e.g.*, `ctrl-n` for a new analyzer).

- Commands under the `Control` menu allow you to start and stop the experiment, reset the counters, and run the experiment a given number of times (*i.e.*, number of atoms out of the oven). In `Watch` mode, a light source detects which output of the analyzer the atoms pass through, which is interesting to do in interferometer experiments.

- The `Initialize` menu allows you to choose the initial state of the atoms out of the oven. `Unknown` states represent specific state vectors, which we will determine as part of the course; `Random` means each atom has an equal probability of having any of the 2 or 3 possible spin projections available at the first analyzer. `User State` allows the user to enter the state vector components in a selectable basis; the program will properly normalize them.

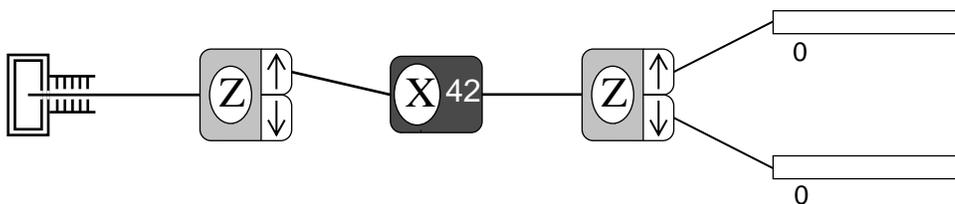- Some simple experiments are shown below.

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The simplest Stern-Gerlach experiment to measure the spin projection along the *z*-axis. This experiment is ready to go when the program starts up.

An experiment for successive measurement of spin projections.

An interference experiment with spin 1/2 particles.

An experiment to study spin 1/2 particles in a magnetic field.

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