

Tracking Particle Paths

NOVA Activity **The Elegant Universe**

Donald Glaser invented the bubble chamber in 1952. Inside the bubble chamber a superheated liquid, such as liquid hydrogen, is expanded just before particles are beamed through. The beamed particles—and some of the interactions they produce—ionize the atoms in the liquid, resulting in a series of bubbles along the trajectory of the particles. The bubbles make the tracks of the particles visible. The events are photographed. Once the events have occurred, the liquid is recompressed for the next particle burst. The following are some facts about how some tracks are formed:

- Only electrically charged particles leave trails. Protons, the particles beamed through the liquid in this example, are positively charged particles.
- Particles from outside the bubble chamber, such as cosmic rays, can also be recorded in the liquid.
- A magnetic field throughout the liquid in the chamber causes particle paths to bend. Particles with opposite charges produce paths that curve in opposite directions. In this representation, negatively charged particle trails curl left and positively charged particle trails curl right.
- The beamed particles all originated from the same direction and entered the liquid at the same speed.
- When a high-energy photon—which has no charge—interacts with a charged particle, the interaction can produce a pair of oppositely charged particles. This usually results in an electron-positron pair, a V-shaped trail in which each end of the V spins off in an opposite direction and spirals inward.
- Particles with less momentum, or those that have less mass, produce trails that curve more from the point at which they were produced. Particles with greater momentum, or those that are more massive, produce paths that curve less from the point of production. In the case of a particle pair, for example, a pair with greater momentum (or mass) will result in a longer, narrower V shape than a pair with less momentum (or mass).
- A photon that knocks an electron out of an atom creates a single track that bends to the left and spirals inward. This product is called a Compton electron.

