

What are cosmic rays?:

Cosmic rays are high energy particles that rain down from space, they come from a wide variety of sources from supernova to supermassive blackhole accretion disks, and some are still unexplained. However, whatever their source these particles rain down on us at extreme fractions of the speed of light, when they inevitably collide with particles in the atmosphere they shed their energy in showers of energetic particles, which themselves may cause smaller showers. All this means we are living in a storm of high energy particles from space zipping around us at near the speed of light, a cloud chamber allows us a brief peek at these interstellar travelers as they shoot through the chamber.

How does a cloud chamber work?:

The cloud is formed from alcohol vapor which is evaporated out of the hot end of the chamber, the cold air from the cold air then rapidly cools it back below its evaporation point. This means the air is saturated with alcohol vapor cool enough that it will condense back into liquid at its first opportunity, our cosmic rays will provide such an opportunity. When a charged particle such as an electron or positron hurtles through the cloud it will repel or attract nearby electrons ripping them off their atoms, the result is a trail of ions left behind which will attract nearby alcohol particles and cause them to condense around it. This means we can see a wake of condensing alcohol behind the cosmic rays when they pass through.

Why alcohol?:

You don't have to use alcohol, in fact the first cloud chamber ever built used water! That said, alcohol is much easier. Ideally for a cloud chamber you want a liquid that you can easily supersaturate the air with, water will rapidly condensate onto the walls and even form droplets in air with itself so your cloud will be very hard to maintain and your walls will cloud. Indeed the first cloud chamber did not solve this problem, they merely got around it by rapidly expanding the chamber (and thus cooling the gas) giving them a very brief viewing before the cloud vanished and the walls clouded. On the other hand since alcohol is a nonpolar molecule it won't condense on the walls or form droplets easily, instead it will just hang in the air until disturbed. Since we want long viewing times, alcohol is ideal.