DRAFT MAKING TRACKS I: CLOUD CHAMBER DRAFT

STUDENT GUIDE

Right now, you are being bombarded by cosmic ray muons and neutrinos which, fortunately, do not interact with matter much, so they pass right through you and do no harm. Do you see them? C'mon, squint. Now? Of course not.

Physicists "see" atomic and subatomic particles with detectors, devices designed to interact with particles and produce some evidence of their existence and behavior. A good place to start to learn about detectors is the CERN "Seeing the Invisible" site at https://bit.ly/370Gn2P. We'll wait.

Back? Good. It turns out that one of the earliest and simplest particle detectors – which maybe you just read a bit about – is the *cloud chamber*. A cloud chamber contains a super-saturated vapor. When an energetic charged particle passes through, some of that vapor turns to liquid and the passing particle leaves a track, similar to the trail left by an airplace at high altitude.

What is the research question?

- Is it possible to distinguish one particle type from another by how the behave in the cloud chamber?

What tools do we need for our analysis?

If you are in class, then you might build a cloud chamber or inspect one that is already built. Your teacher will provide the materials, If that is not available or you are learning from home, you might instead use a video to see how one is made and works. The video we recommend is in the CERN "How to make your own cloud chamber" page at https://bit.ly/2z03yxI. You will then observe a cloud chamber in operation in small groups. Again, if it is not available, we have some recommendations:

- Diffusion cloud chamber, https://bit.ly/2UbMxrI
- CERN cloud chamber, https://bit.ly/2MG5zCJ
- BNL/SB QuarkNet 2007, https://bit.ly/2zQ8HZT.

What will we do?

You will work in teams of 3 to 5 students. Each team will have 10-15 min to work with a cloud chamber or a video of a cloud chamber in operation. Each team should look for 4 different types of particle track based on how you categorize them. Are they long? Short? Thick? Thin? In a straight line, a curve, or something else? Use the Team Report sheet to record your observations. Don't worry if you end up with more or less than four types: a lot depends on the visible categories and, since *you* are making the categories, your answers are right.

What are our claims? What is our evidence?

How many particle track types did you observe? On what are the categories based?