Homework #10: Bubble Chambers

1. Figure 1 shows a bubble chamber photograph. According to the authors, it shows a beam of K^- mesons streaming through the chamber. In this image, they claim to have found the following interactions and decays (in no particular order):

$$\Lambda^0 \to p + \pi^-, \tag{1}$$

$$K^0 \to \pi^+ + \pi^-, \tag{2}$$

$$\Omega^- \to \Lambda^0 + K^-, \tag{3}$$

$$K^- + p \to \Omega^- + K^+ + K^0, \tag{4}$$

and

$$K^- \to \pi^- + \pi^0. \tag{5}$$

Re-draw this digram yourself. Omit all irrelevent tracks from your drawing. Identify which tracks in the diagram belong to the particles listed in the above interactions (and draw in any unseen tracks as dotted lines). Identify where each interaction listed above occured in the diagram. Explain the logic behind your decisions. In particular, explain how you can be sure there's an Ω^- in here.

2. Figure 2 shows a bubble chamber photograph. A K^- particle enters the figure from the bottom. When all is said and done, at the end of the fireworks, there are $3\pi^-$, $2\pi^+$, an e^+, an e^-, and a p^+. Can you reason in from the beginning and the end to figure out what happened in the middle? Two aspects of the invisible tracks may not be clear from the figure. First, there is a tiny gap between the first vertex and the fork the goes off to the right. Second, there are actually four invisible tracks in this image: in addition to the gap mentioned above, a vertical track from the first vertex goes up to the middle of the image and then splits into two invisible tracks! One of these goes left (very, very short) and then splits into the two *very curvy* tracks you can see in the middle, and the other goes up (and slightly right) until it splits into the two tracks you can see as well that go up to the top edge of the figure.

Tell the story of what happened in this picture, and write down the five decays and/or collisions as equations. Draw your own version of the figure (with the invisible tracks as dotted lines) and identify all 14 of the particles present here. Explain the logic and applications of the conservation laws (including strangeness number!) clearly. Make sure your decays don't violate the DoP rule.

If you don't have five interactions and 14 particles, you've missed something.

3. Ford, P4.3, p. 88.

4. Ford, Q4.22, p. 86.

Due: Friday, November 13, 2:30 pm

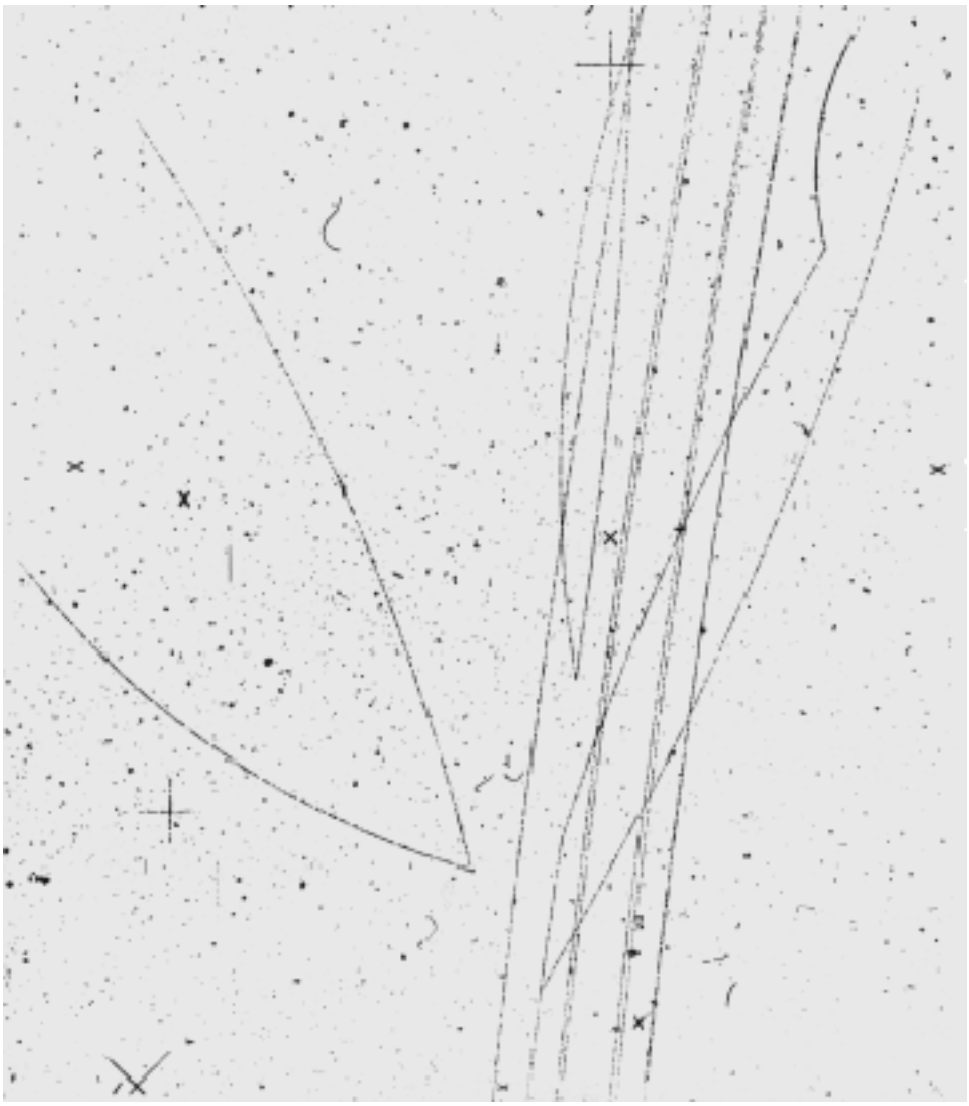

Figure 1: Bubble Chamber Photograph. Taken from G.G. Harigel, D.C. Colley, and D. C. Cundy, eds., Proceedings of the Conference on the Bubble Chamber and its Con tributions to Particle Physics, Geneva, Nucl. Phys. B (Proc. Suppl.) 36 (1994).

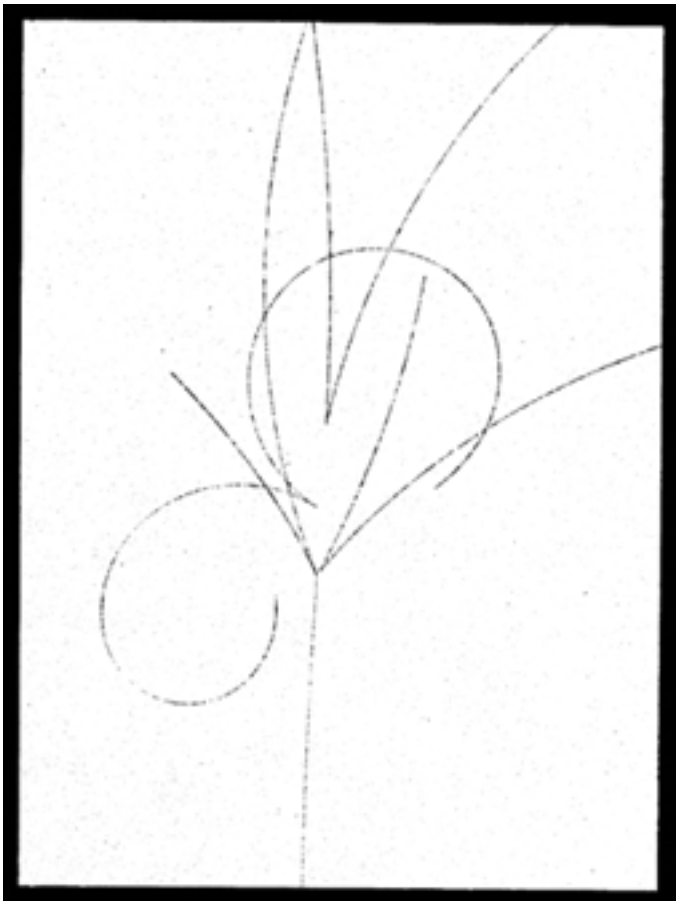

Figure 2: Bubble chamber image with K^- entering from the bottom.