

The Cloud Chamber as a Field Diagnostic Tool

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FROM: A. Clark

SUBJECT: The Cloud Chamber as a Field Diagnostic Tool

I. Pros and Cons

Off hand, a cloud chamber sounds like a most unlikely detector for field use.

1. It has never been so used before and almost no one uses such a detector even in the laboratory any more.
2. It has very poor time resolution (about 0.1 sec.) so late backgrounds can be very bad.
3. Since it is so different, a whole new body of field and laboratory know-how must be developed. One cannot borrow from existing field techniques: fluors, P.D.'s, oscilloscopes, etc.
4. Its use requires a L.O.S. pipe to the surface, a scatterer and a further horizontal L.O.S. pipe and about ten feet of earth protection for the equipment from sky shine backgrounds.

However, a cloud chamber is so completely different from other field techniques that it can provide a much more independent check on the other experiments which generally share some systematic errors. The cloud chamber is really quite a simple device, flexible as to pressure, gas and geometry. Each complete electron track, photo electron or Compton knock-on electron, is identified and measured and understood in detail so that one has high confidence that one understands the physics of the phenomena and the detector.

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Backgrounds are easily identified and accounted for: they are not bothersome. Knock-on protons from neutrons and high energy electrons from gamma rays make very different tracks in the chamber and cause trouble only if there are so many as to confuse the rest of the picture.

An obvious drawback is the difficulty in getting good statistics. Many tracks must be analyzed to obtain much accuracy. Actually, this is not a great difficulty, and it is worth while belaboring this point:

Good statistics are not really necessary: 10% answers are much sought after and rarely obtained in the field. So, 100 tracks provide a statistic; and analyzing 100 tracks takes less than a man week of effort. Actually, a 20% number is about all one can expect from field experiments. Furthermore, the source is commonly not known to 10% and is probably not reproducible either. In addition, the effects one is interested in are in even much worse shape as far as being quantitative; a piece of material with an incipient crack is much more vulnerable and much more likely to spall. So the vulnerability of a particular R/V is unknown since it has a large number of pieces, any one of which may have an incipient crack. And, finally if one talks of the enemy's materials one must be still less quantitative because of lack of knowledge of his R/V's.

Another comment on the general pros and cons. One must be very careful not to introduce a subjective bias into the measurements. However, if one reads and accounts for essentially every track in the cloud chamber it is difficult to have much bias left.

II. History

The history of cloud chambers is older than the century. The history on nuclear shots is about one year old. Just one year ago, we obtained our first track in a resurrected chamber from Berkeley. A year ago last June, Montgomery Johnson suggested using a much attenuated beam so that one could look at individual quantum events. Paul Ebert suggested a cloud chamber. We looked into the possibilities and started work last fall. Ref: COL 66-440

III. Midi Mist

The cloud chamber experiment on Midi Mist was designed to check our theories, calculations, the experimental gear, and the people. A check out of the personnel was as important as anything. Actually, we did unbelievably well; we got actual data. Not only did we verify that the x-rays other people were measuring are the same as those seen in cloud chambers 30 and 40 years ago, but we got fairly quantitative results!! Ref: COL 67-101 Cloud Chamber Calculations and Qualitative Comments. Pre-Op for Midi Mist.

COL 67-315 Midi Mist Cloud Chamber Direct Flux Measurements

We quote a derived flux number for Midi Mist with a 25% error. This error will become smaller when we understand our energy calibration better.

IV. Hupmobile

We are in the process of working out an experiment to be fielded on Hupmobile. We will use 12 cloud chambers and expect to measure 100 to 200 tracks in each chamber and thus get flux and spectrum numbers from about 10 to 100 Kev.

AFC:jb

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