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Post-conversion research facilities

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POST-CONVERSION RESEARCH FACILITIES

The recent discussions of problems related to post-conversion machine operation have caused all of us to re-examine the experimental utilization of the AGS. The main problem in my judgement seems to be to find a way to have simultaneous, efficient operation of counter experiments and multiple pulsing bubble chambers on each machine pulse. As far as I can determine there is no fully satisfactory solution to the compatibility problem. The purpose of this note is to define a first-order mode of operating the AGS that appears to be compatible. I hesitate to write down these simple observations, but I suspect that they may help to clarify the compatability problem. Furthermore, it is hoped that this might serve as a point of departure for more sophisticated thoughts about AGS utilization.

I have been thinking about how to accommodate multiple pulsing bubble chambers with a slow spill for counter experiments. Because of the complicated beam equipment that is needed for bubble chamber beams, it makes sense to put such beams off targets located in external proton beams. In this manner the beams can be serviced without turning the accelerator off. At present, the only way that a satisfactory primary beam can be operated is by kicking at least one of the twelve bunches of circulating protons down such an external beam channel. This can be repeated for each pulse of the multiple-pulsing chambers at a loss of 1/12 of the initial circulating intensity each time.

The ejected protons will be used most efficiently if there is only <u>one</u> fast external proton beam. Each bunch of protons will follow after the one before until the total number allocated for bubble chamber use are ejected. Targets in this beam will then be illuminated the maximum number of times on each AGS pulse and consequently the bubble chambers that look at targets in this line will be able to expand the maximum number of time per AGS pulse. If there were two separate fast EPB lines, then the proton bunches that went down one channel would not be available to illuminate targets in the other beam line. This would lead to taking fewer pictures, and is, therefore, not desirable. Consequently, a single beam line with multiple target and chamber will potentially be more efficient.

Of course, it has to be demonstrated that the multiple targets, numerous secondary beams, and the several bubble chambers can be distributed satisfactorily along one such external proton beam. This is a detailed study that will have to be worked out with the bubble chamber group while they are defining the location of the 14-ft bubble chamber. Offhand, I believe that such a complex can be managed if the external beam exists from H10, while it may not be possible at I10.

There are drawbacks to such a concentration of facilities. The most important one is probably that some of the downstream bubble chamber may have to be turned off when upstream beams are repaired or re-arranged. In this case it is clearly advantageous to be able to have some of the beams decoupled from one another. I believe, however, that the potential benefits of higher efficiency outweigh the disadvantages of the concentration. This may not be so clear to others, and we should explore this concept with the bubble chamber group.

I would like to be specific now about a manner in which the AGS might be used. We have all recognized the difficulty of using the proton beam bunches if each one comes out at a different energy such as might happen if they are ejected during the accelerating part of the pulse. I would like to consider a mode of utilization where the particles are ejected at constant energy on the flat top. This would consist of accelerating all the protons to full energy, stopping the acceleration, but keeping the protons bunched for an additional 300 ms. During this time four bunches would be ejected, each 100 ms apart. After 300 ms the rf would be turned off, and the remaining protons spilled out in the slow external proton beams during almost 700 ms at the end of the flat top. A sketch of this mode is Fig. 1 attached.

This mode of utilization allocates 1/3 of the machine intensity to the bubble chamber program in nearly 1/3 of the flat top time. The counter program uses 2/3 of the intensity in 2/3 of the available flat top time. The instantaneous proton intensity in the slow EPB for counter experiments is the same as if the whole intensity were spilled out over the 1 second flat top.

Let us now look at how much of a gain this will bring over present day utilization of the machine. Assume for simplicity that the repetition period of the converted AGS is the same as now, namely 2/4 sec but with 1/2 sec rise, 1 sec flat top, 1/2 sec fall, and 0.4 sec rest before the next pulse. Then the bubble chambers could take 4 times the number of pictures that they take now. The counter program will have an intensity of $2/3 \times 10^{13}$ protons/pulse which is a factor of 4 larger than now, and in addition the spill time will be about 50% longer than at present. This implies that the improvement realized by the counter program will be 4 to 6 times better than now. It might be even better if the slow proton beam can be bifurcated, as suggested by A. Maschke.

This mode of utilization does not produce an intermediate length spill for chambers. Such a spill would be desirable in order to use switching magnets to stack the beam tracks in the bubble chamber or to switch-off the secondary beam when there are enough tracks in the chamber. However, present day rf separators continue to require the very fast spill. It would of course be desirable to have a slower spill for tuning purposes. Maybe such a spill might be set-up for the North Area every 10 AGS pulses or so when they are tuning without taking away too much from the counter program. It seemed to me to be more important to try to accommodate multiple pulsing chambers than to worry about spill length at the present time.

I have not considered the use of internal targets in the present memo. I assume that internal targets will continue to be used while the external beam facilities are being developed, but that the research program will eventually use external beams almost entirely. Of course, the F20, G10 and I10 areas stand ready to be used for experiments if a satisfactory method of efficient internal targeting and external beam ejection can be developed, and secondary beam equipment can be accommodated within the accelerator housing. For clarity, however, I have tried to focus my attention on external beam operation which will dominate the AGS utilization in the years ahead.

This simple example of machine utilization seems to contain significant improvements and advantages for all. With only one fast external beam, and one slow external beam--operating in sequence on each machine pulse, accelerator operation is simplified. The beams emerge at constant energy, separated in time as is appropriate for multiple pulsing bubble chambers. Each chamber should be able to take four times the present number of pictures, and yet the majority of protons and spill time is available to the counter program.

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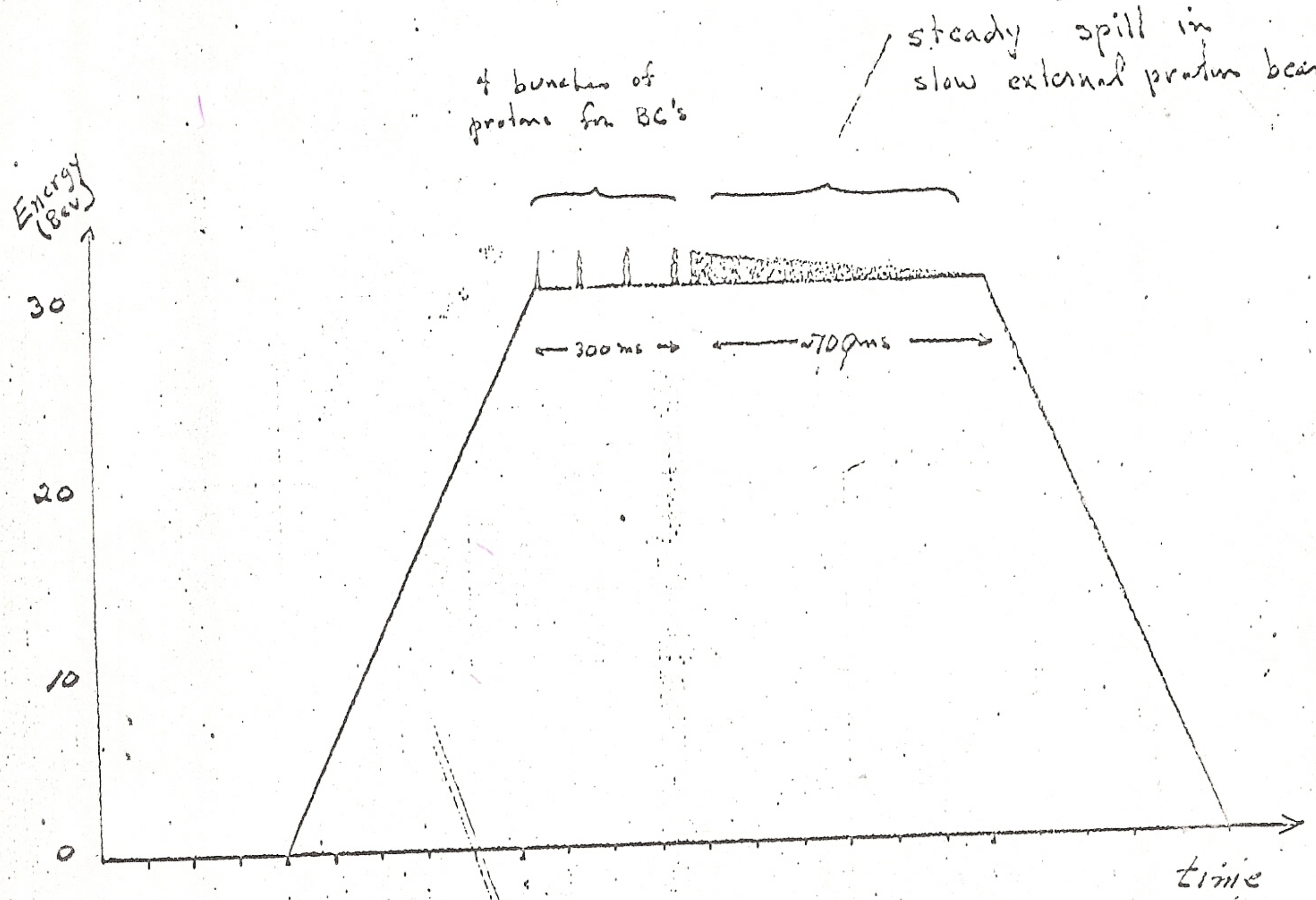

Fig 1.