BNL-105732-2014-TECH

EP&S No. 16;BNL-105732-2014-IR

Beam sharing compatiblity between internal and external targets at the AGS

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June 1968

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U.S. Department of Energy

USDOE Office of Science (SC)

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EP & S DIVISION TECHNICAL NOTE

No. 16

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June 26, 1968

BEAM SHARING COMPATIBILITY BETWEEN INTERNAL AND EXTERNAL TARGETS AT THE AGS

Set-ups for electronic experiments will exist on the AGS floor at both the internal and external target stations for some indefinite time into the future. The efficient utilization of the AGS complex involves some understanding of the possible and desirable modes of compatible running of the two targetting modes. This technical note is intended to stimulate discussion of these possibilities.

Conceptually, at least, compatibility can be achieved by:

1. Alternate use of the full beam for substantial blocks of time, e.g. 3 weeks internal/1week external targetting.
2. Pulse sharing by spilling N out of M pulses entirely on the internal target, M-N on the external target(s).
3. Sharing within a pulse by spilling part of the beam on one target for some part of the flat top, then spilling the rest on the other target.
   a. Spill down the SEB channel first, turn off the perturbation then spill the rest internally.
   b. Spill on the internal target first, turn on the perturbation, and spill the rest down the SEB channel.
4. Spilling simultaneously on the internal target and down the SEB channel.

Solution one,alternate blocks of time is the simplest from an operational viewpoint, and also is efficient in terms of protons delivered to the target. In general it is an inefficient use of equipment since at all times a substantial fraction of the AGS experimental equipment inventory is tied up, but not in use. If only testing is being done on one target station this is an unreasonable solution, since it gives prime user status to experiments in the testing phase. An additional inefficiency factor is introduced by the need to use some time at the beginning of each start-up at a given station in retuning and testing.

Solution two, N out of M pulses on a given station, is essentially the same solution as solution one, without most of the drawbacks of that solution. Under this mode low-priority use, such as testing, can go on in the SEB channel without having to let the experiments that are ready to run on the internal target stand idle for large blocks of time. The start-up time at each changeover is eliminated and you eliminate the situation of having a large fraction of the equipment inventory lying idle at all times.

Some of the drawbacks are that experiments may be rate limited, so that they cannot accept the full beam in one pulse. Also there are other subtle questions such as adjusting electronic triggers, testing counters, where the relevant quantity is the frequency of pulses rather than the number of particles that is important. It is hard to time things when you have to wait 20 seconds for the next sweep. From the point of view of efficiency, then, solution 2 has maximum efficiency with respect to delivering protons to the various targets. With respect to use of protons the efficiency is a function of the data rate of the apparatus. With respect to equipment usage it is much better than solution 1, since equipment is not sitting around unused for large blocks of time, though in a data taking mode the length of time an experiment is on the floor is proportional to the fraction of pulses allotted. The testing time will probably scale more than linearly for reasons noted above. So, the overall efficiency of equipment utilization is good, but probably somewhat less than a direct scaling by the pulse sharing ratio would indicate.

Solution 3 sharing within a pulse whether 3a or 3b is less efficient than either solution 1 or solution 2 in terms of delivering protons to the target since in either mode the phase space is made worse for the second operation by the first so target or extraction efficiency is reduced. In addition some dead time on flat top will probably be necessary while equipment is turned off and on. From this viewpoint solution 3b is probably to be preferred, i.e., internal spill first and then SEB extraction, since the rise time of the SEB components is much less than the decay time. Assuming most experiments are inefficient in use of secondary particles merely because the particles are available, and presuming that spill times and structure are suitable, under mode 3 the group of experiments on internal and external targets could be done in the same time as if each target were running alone. This is certainly true when the experiments on a given target station are all in the testing phase. For solution 3, then, the efficiency for delivery of protons to the targets is probably down, but the efficiency of equipment utilization is up relative to solution 2. Data on the possibility of operation in this mode and the accompanying efficiencies for targetting and extraction would have to be folded into a proposed set of experiments to determine whether the over-all efficiency of utilization of the AGS complex is higher than for solution 1 or 2. It should be noted that in terms of radiation damage to the machine, that the higher inefficiency of solution 3 does not mean a greater absolute number of particles lost on the machine.

Solution 4 is, of course, the ideal solution, especially in view of the 10^{13} protons to be delivered by the conversion effort. However to be possible it would probably involve some sort of real or virtual septum within the machine to split the circulating beam into two distinct beams, one for internal targetting, the second for (simultaneous)spilling into the SEB. This requirement seems to place the ideal beyond the state of the art.

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