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Tandem Gold Beam Two Injections Study at the Booster

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Study Period: April 2000

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Reported by: S.Y. Zhang and K. Zeno

Machine: Tandem and Booster

Beam: Gold Ions

Tools: Dump Bump and Current Transformer

Aim: To study the effect of the lost particles in the first injection on the efficiency of second injection at the Booster.

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Summary

1. Two movable Gold beam injections at the Booster are established at a 600 Gauss porch to study the effect of first injection on second one.
2. It is found that the beam dumped in the ring by the first injection affects the second injection. The time structure of this effect is approximately consistent with the one of previous studies, i.e., the vacuum bump created by the lost beam decays in 100 to 150 ms.

Experiment

The gold beam loss mechanism was studied by scraping beam in the Booster ring, e.g. in [1], and it was found that the lost beam created vacuum bump might cause further beam loss. In specific, this vacuum bump has a decay time constant of 35 ms [2].

It is of interest, therefore, to establish two Tandem beam injections that are close enough to compare, or to observe the effect of first injection on second one.

Two Tandem beams were established as close as 20 ms, for the Booster injection. At the Booster, a 600 Gauss porch of more than 200 ms long was tuned to accommodate two injections.

With the second request of beam this close, the cesium replenishment at the ion source becomes insufficient. Therefore, the intensity of the second pulse was significantly lower than the first one. After several tries of tuning, the plan to directly compare two injections was abandoned.

The study then was focused on the effect of first injection on second one.

The two injections were set apart by 20 ms. The first injected beam was dumped by the Booster dump bump about 10 ms after the injection. This is compared with the case that the beam stopped outside of the Booster ring. In Fig.1, it is shown that without the beam loss in the ring, the beam life time of second injection is longer.

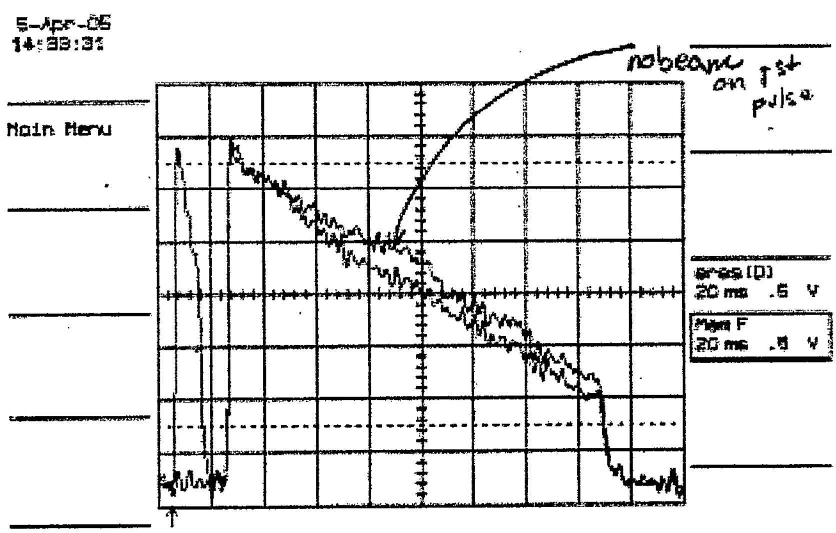

Fig.1. *First injected beam dumped outside of Booster ring, and dumped 10 ms after injection.*

The beam was also dumped 5 ms and 15 ms after the injection, and this did not show visible difference from the ones dumped at 10 ms. Since the vacuum bump created by the beam loss lasts more than 100 ms, the difference in these situations might be too subtle to identify.

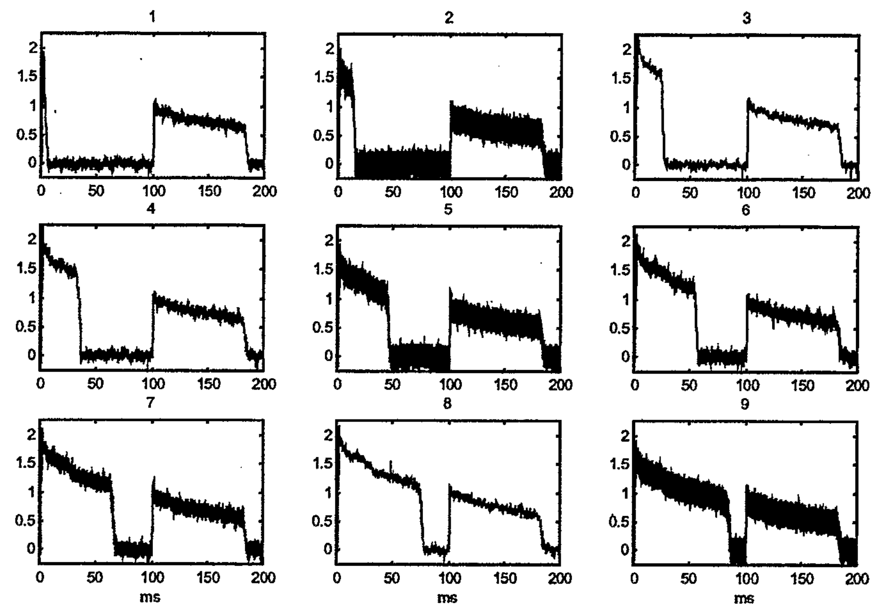

Fig.2. *First injected beam was dumped at different times.*

To get more systematic comparison, two injections were moved 100 ms apart, and the dump bump was set to dump the first injected beam every 10 ms apart. The beam currents of these 9 cases are shown in Fig.2. Tandem intensity of the first and second injections was about 2×10^9 and 10^9 ions.

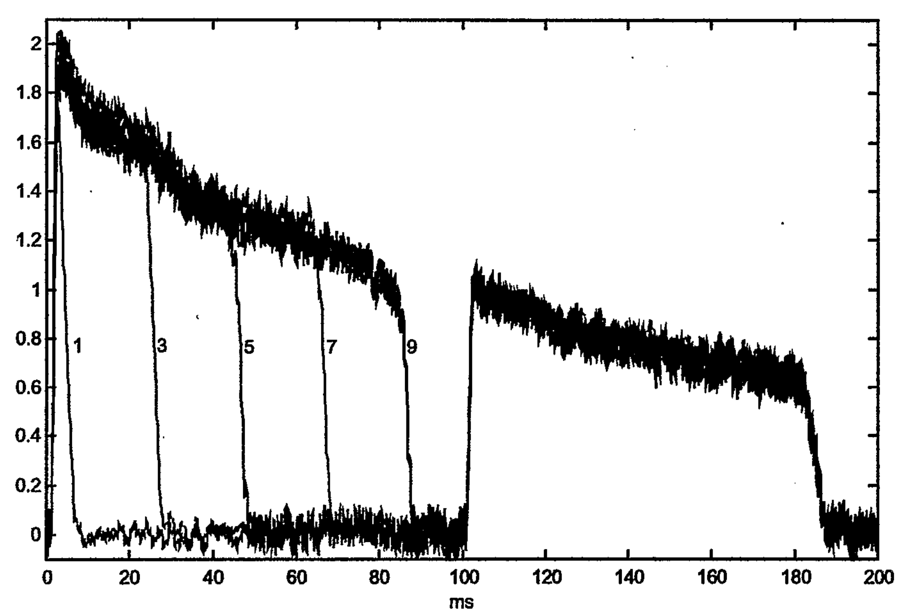

Fig.3. *Beam current of the cases of 1, 3, 5, 7, and 9.*

In Fig.3, the beam currents of the cases of 1, 3, 5, 7, and 9 are displayed, where the beam was dumped 100, 80, 60, 40 and 20 ms before the second injection, respectively.

In Fig.4a, a 10 ms filter is applied to these beam currents. In Fig.4b, the beam currents of the second injection are logarithmically displayed, where the slightly different peak beam intensity is normalized for better comparison of the beam life time. One may observe that the beam life time of second injection is 300 ms, if the first beam is dumped 100 ms prior to second injection, and it becomes 200 ms, if the first beam dumped 20 ms prior to second injection. It is observed quite consistently that, the first injected beam dumped closer, the beam life time of the second pulse is shorter.

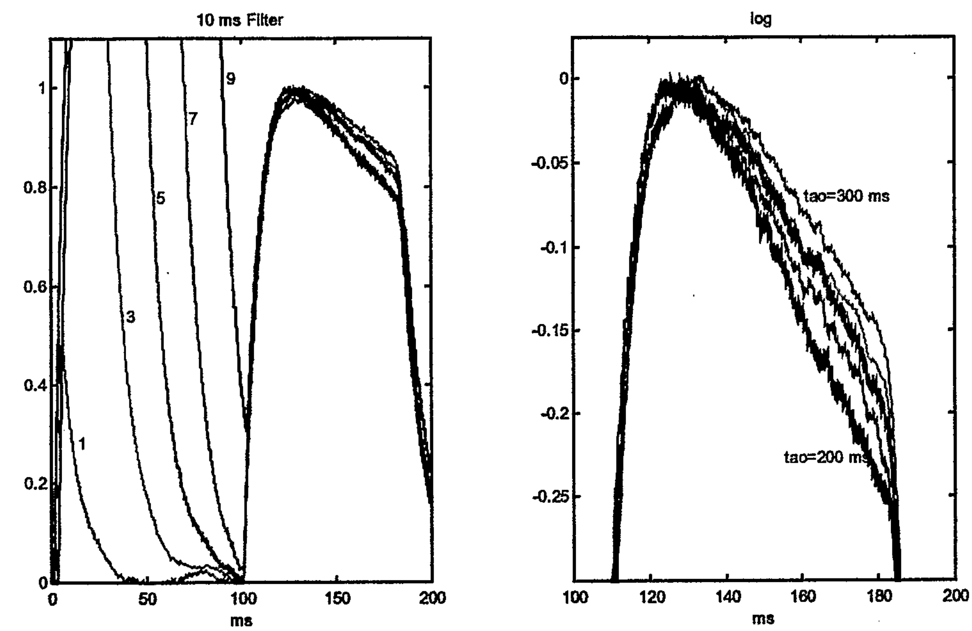

Fig.4. *a. Beam currents, 10 ms filter applied.*
b. Beam currents of the second injection are logarithmically displayed.

The 10 ms filter has smeared out the detailed beam current structure of the second pulse, however, the overall picture is consistent with the results obtained in previous studies, i.e., the vacuum bump created by the lost beam has a decay time constant of 35 ms, and it takes effect in 100 to 150 ms.

Acknowledgment

We would like to thank J. Benjamin and D. Steski for establishing the Tandem beams and also the help in the study.

References

1. S.Y. Zhang, AGS Study Report No.373, Oct. 1999.
2. S.Y. Zhang, AGS Study Report No.370, May 1998.