BNL-104125-2014-TECH

AGS.SN249;BNL-104125-2014-IR

Instabilities on the Booster Front Porch

E. Gill

February 1989

Collider Accelerator Department

Brookhaven National Laboratory

U.S. Department of Energy

USDOE Office of Science (SC)

DISCLAIMER

Number 249

AGS Studies Report

Date(s) February 15, 1989 Time(s) 1200 - 1600

Experimenter(s) E. Gill, E. Raka, J.M. Brennan

Reported by E. Raka, L. Ahrens

Subject Instabilities on the Booster Front Porch

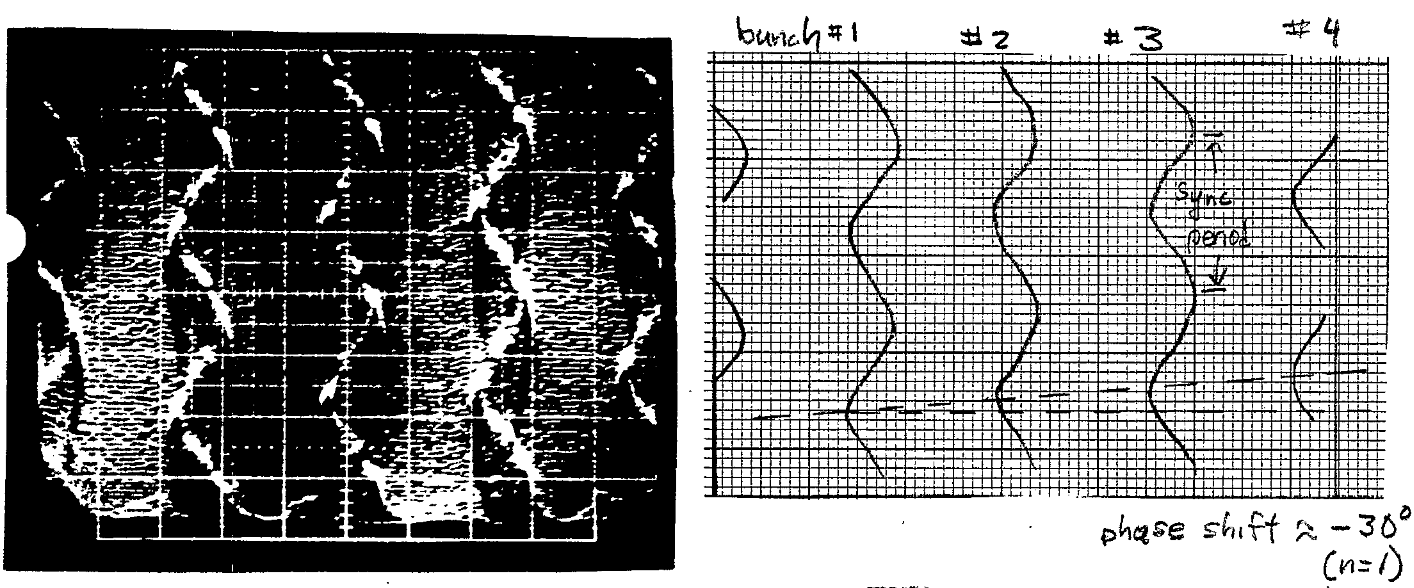
As part of the VHF cavity study of February 15, 1989, the high intensity characteristics of the beam without 268 f_o excitation (VHF cavity off) were investigated. It was first noted that at intensity approaching 10^{13} protons (total in 12 bunches) there was a strong transverse vertical instability present. This was suppressed by lowering the vertical tune on the 1.5 GeV flattop (GC ≈ 4900) while maintaining the "normal" damper settings. Next, we found that the beam became significantly debunched before the end of the 200 msec flattop was reached (at ≈ 10^{13}). As the intensity was increased to approximately 1.2 x 10^{13}, the blowup began 50-60 msec from the start of the flattop and some beam loss ensued. One could see unequal bunch population at the end of the flattop and significant bunch shape distortion and elongation.

At lower intensity, approximately 6 x 10^{12}, the instability was not present. Also, at intermediate intensity when there was blowup but no loss, the beam went through transition with no loss. Using a mountain-range display, it was possible to make a tentative identification of the coupled bunch mode present during the early part of the growth. It is either an n = 1 or n = 11 mode. This was also verified by using the spectrum analyzer (J.M. Brennan) to measure the amplitude of the 11th harmonic of the beam current relative to the 12th or rf component with and without the instability present. For the former, there was less than 10 db difference while at lower intensity the difference was > 30 db. We note that the rf frequency was 4.171 MHz on the flattop.

This study marked the first time intensities above 10^{13} have been accelerated across what will be the Booster injection porch. Understanding and controlling instabilities on this porch at these and higher intensities is clearly essential--a high priority effort.

The figure below shows the mountain range with the instability present (bunch intensity vs. time looking at the same bunches at 25 μs intervals during the porch). One presumably trivial but as yet unexplained problem is that the synchrotron frequency derived from this picture (1.2 kHz) is too small (2 kHz calculated from reasonable rf parameters).

The first step in a study program to clarify the longitudinal blowup could involve observing the dependence of this phenomenon on frequency (vary the energy of the porch).



F-20 wall monitor "mountain range" photo and sketch; 25 μs delay between sweeps, sweep speed adjusted to show 4+ bunches (100 ns/cm), 2 ms total time for display.