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2/18/92
PBAR NOTE 526

Recent measurement of Debuncher longitudinal beam size during stacking

During the recent collider studies period there were a few time periods when 120 GeV beam was delivered with a slow repetition rate. This gave us a rare chance to study the effectiveness of additional cooling in the antiproton source.

The measurements shown below were taken on 1/15/92. Although we have several FFT analyzers connected to the debuncher schottkey monitor we cannot readout the measured spectrum except with a TV camera. The following measurements, therefore, were taken with a spectrum analyzer. It is necessary to use a resolution bandwidth of 100 HZ to see the effectiveness of the momentum cooling system, and therefore the sweep time was 3 seconds. It took about 1 hour to complete the series of measurements. The main ring performance was up to it's normal standards during this time period, but it's performance can vary greatly from on minute to the next.

The debuncher longitudinal schottkey spectra are shown in Figures 1-5 with different trigger times for the spectrum analyzer. These are shown using a scale linear in power, which should also be linear in particle density. There are two effects of momentum cooling that are apparent. 1) The momentum distribution after bunch rotation has very long non-gaussian tails, momentum cooling rapidly pushes these tails into the central peak. 2) The width of the central peak is gradually reduced, as is shown in Table I. The FWHM shown in TABLE I is at h=127, and the 95% dp/p is the full width in percent dp/p that contains 95% of the beam.

TABLE I

Width of central peak v.s. cooling time

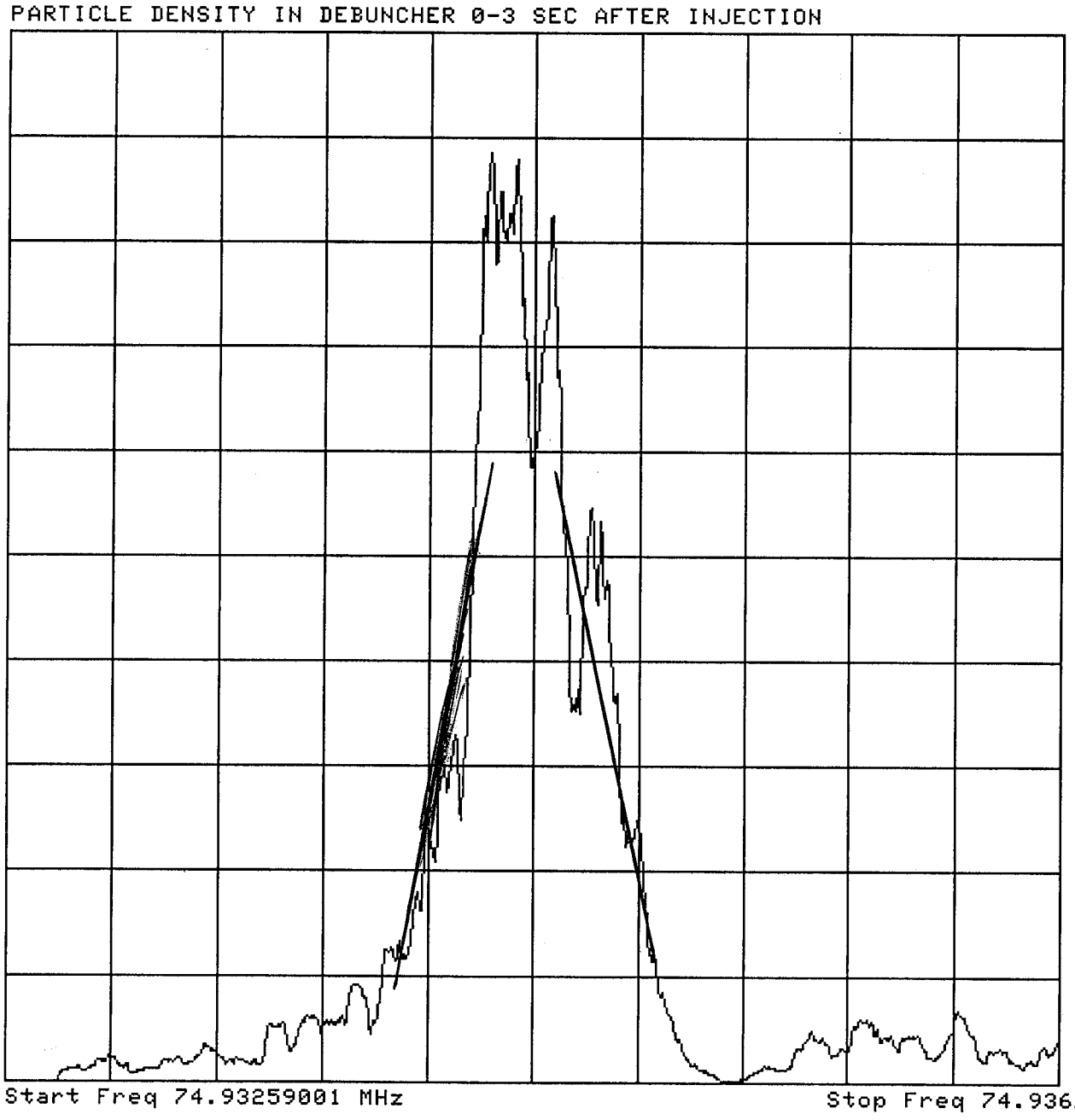
Cooling time	FWHM in HZ	Full 95% dp/p
1.5	644 HZ	0.24%
3.5	492 HZ	0.18%
6.5	415 HZ	0.15%
9.5	376 HZ	0.14%
12.0	440 HZ	0.16%

Momentum cooling definitely helps reduce the momentum spread of the beam. Even 1.5 seconds of cooling gives a small enough momentum byte that the central peak should fit through the DTOA channel. It takes longer for the non-gaussian tails to be swept in.

As a check we can measure the momentum byte on the accumulator injection orbit during stacking. The measurement taken more than a week later on 1/26/92 is shown in Figure 6, and was obtained by turning off ARF1 during stacking. The FWHM of the central peak is 2839 HZ, which gives a 95% emittance of 0.26%. This is a little larger than is expected, which may indicate that bunch rotation was not as effective at that time.

In the future we hope to make similar measurements using a FFT analyzer and a special applications program. This should enable us to more accurately diagnose problems with bunch rotation.

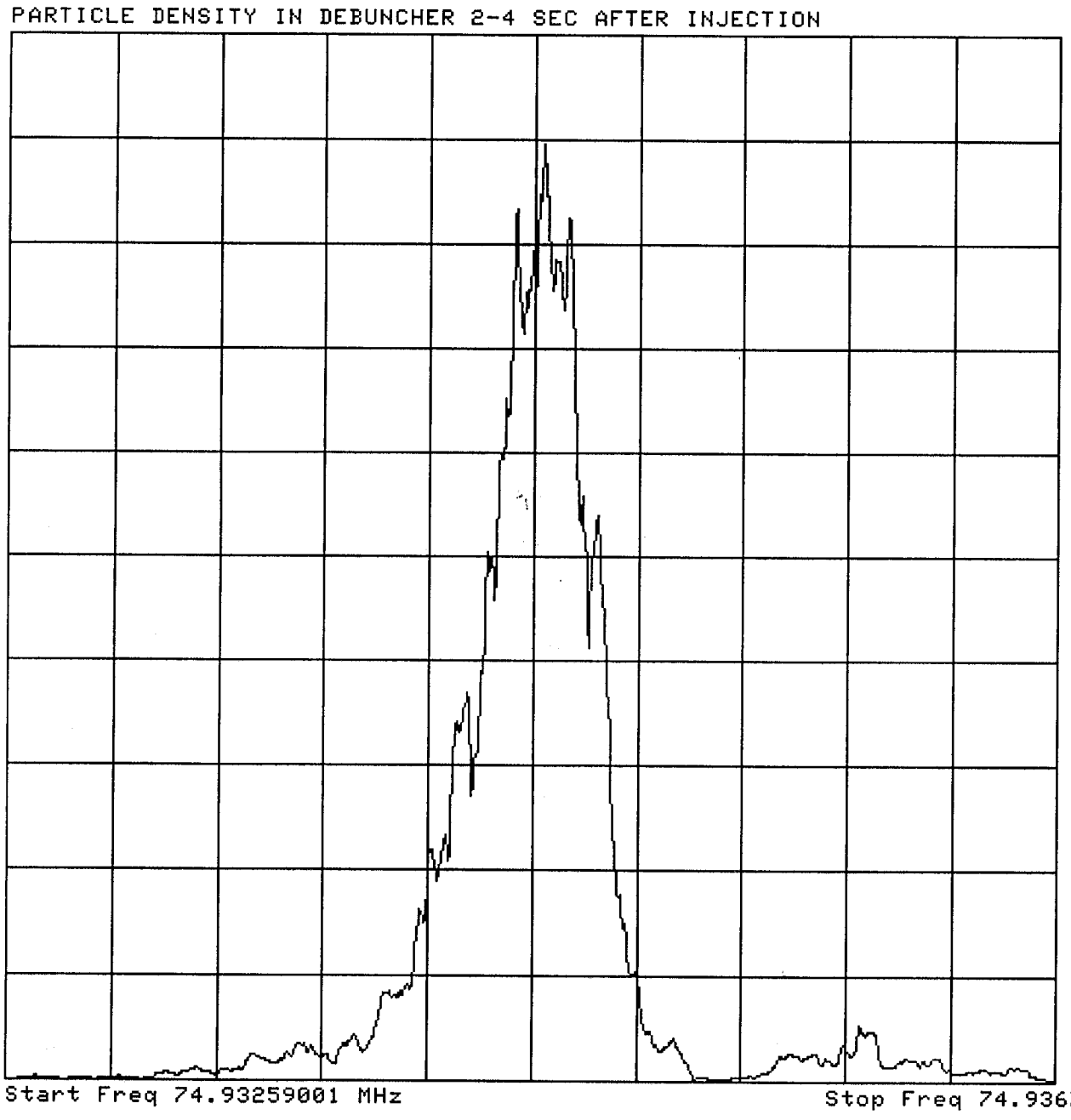
Figure1



FWHM = ~~570 Hz~~ 647

CONSOLE LOCATION 04, MCR-E2 18-FEB-1992 10:47
Pbar SA Plot

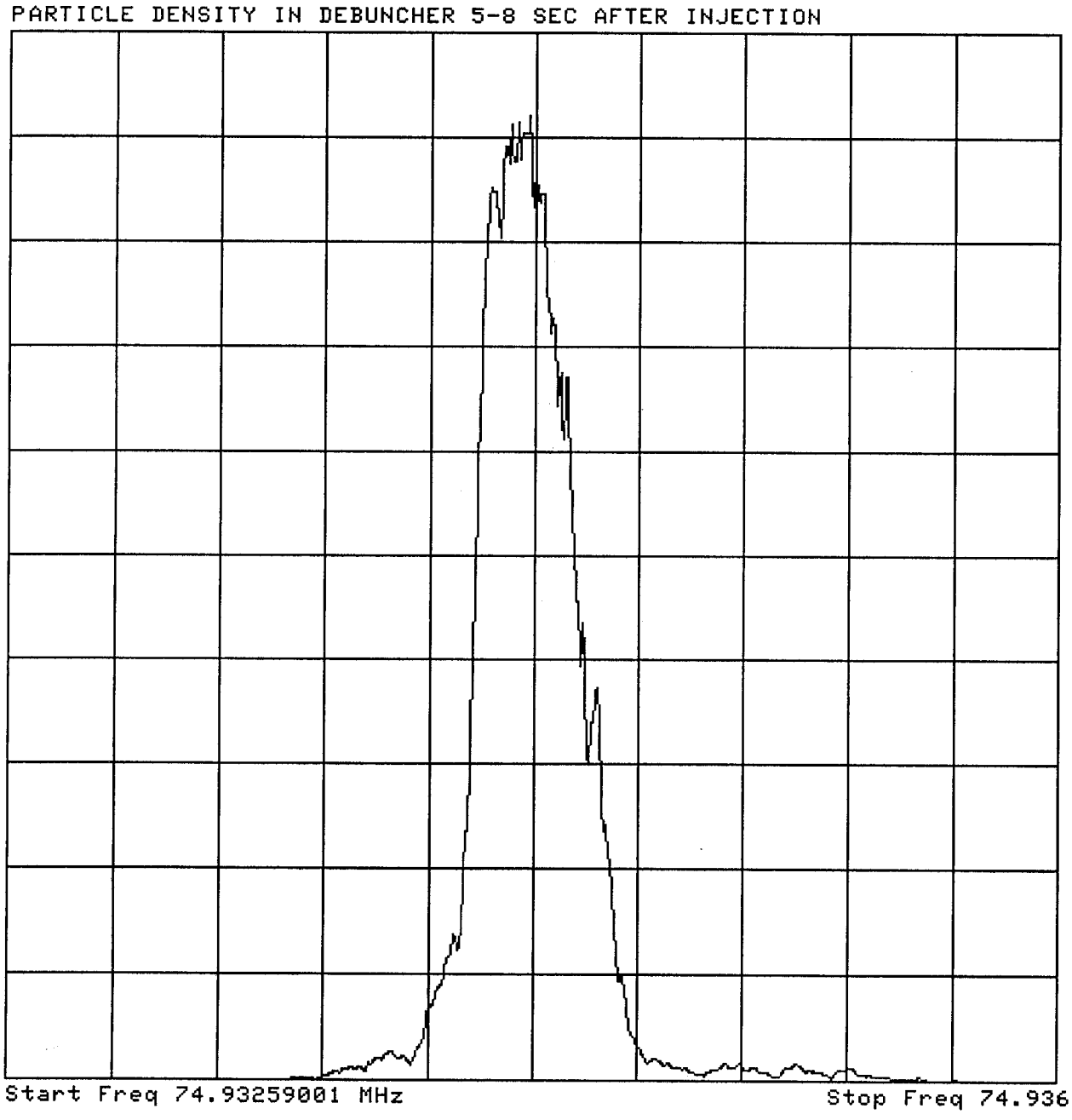
Figure 2



FWHM = 492 Hz

CONSOLE LOCATION 04, MCR-E2 18-FEB-1992 10:49
Pbar SA Plot

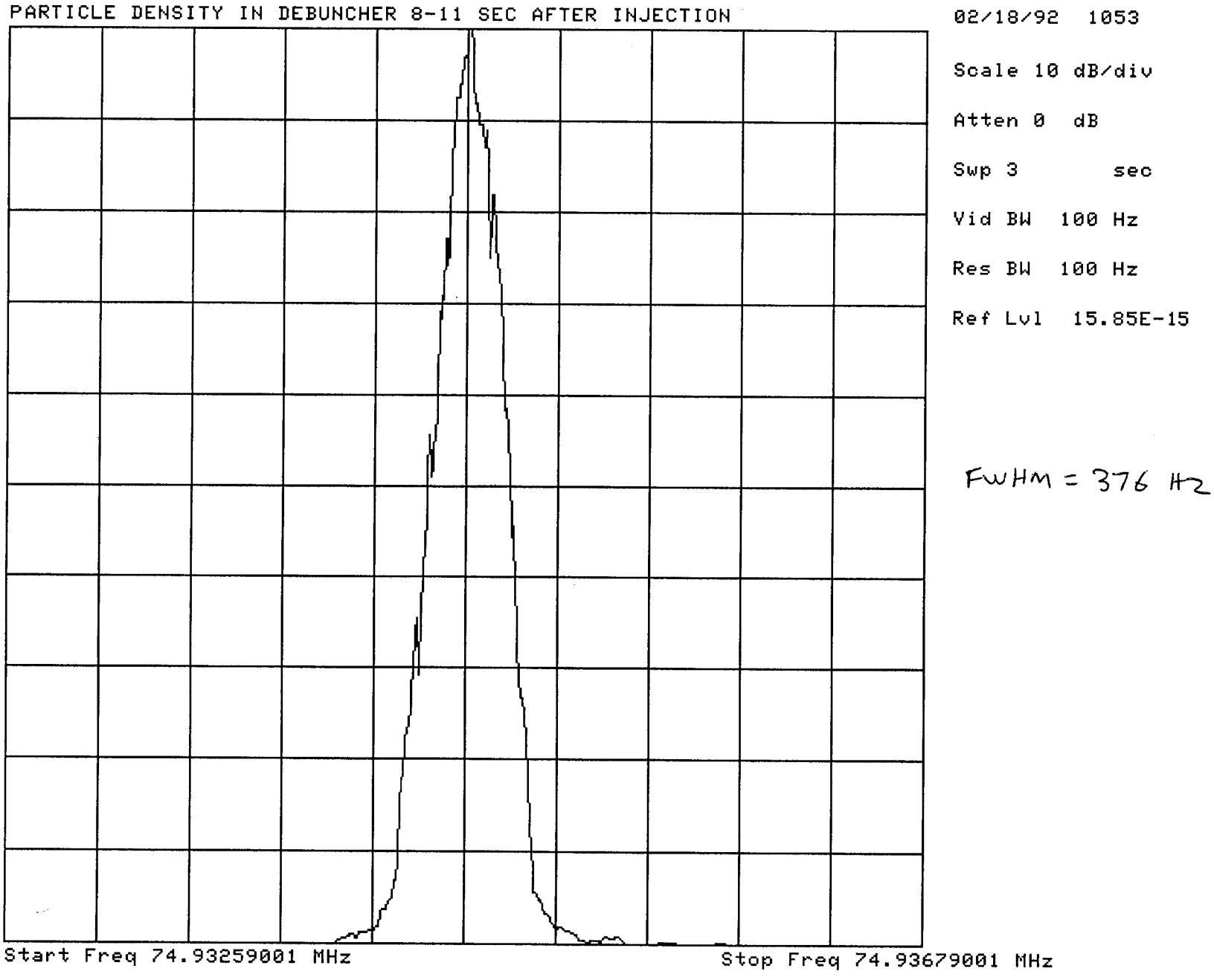
Figure 3



FWHM = 415 Hz

CONSOLE LOCATION 04, MCR-E2 18-FEB-1992 10:50
Pbar SA Plot

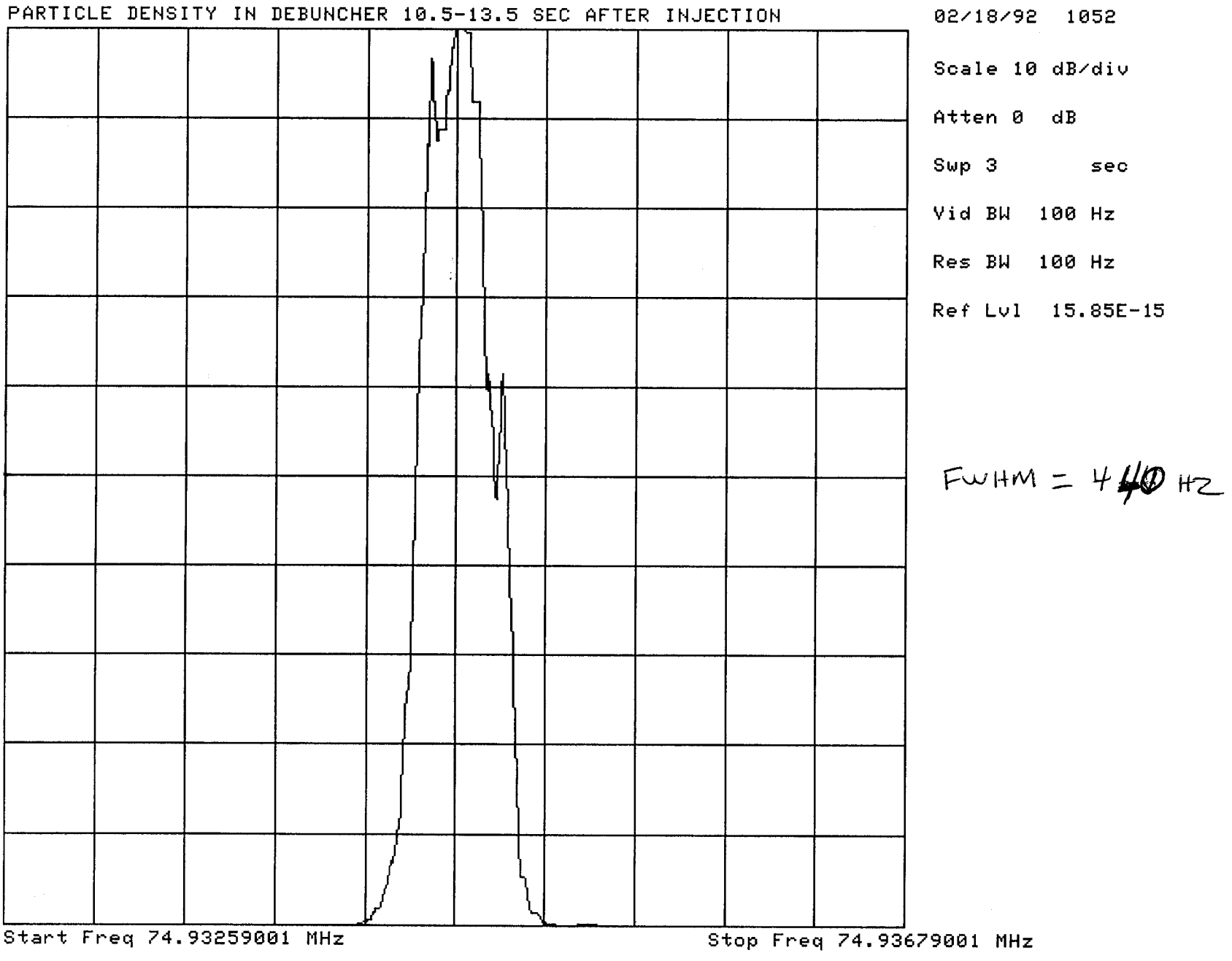
Figure 4



FWHM = 376 Hz

CONSOLE LOCATION 04, MCR-E2 18-FEB-1992 10:53
Pbar SA Plot

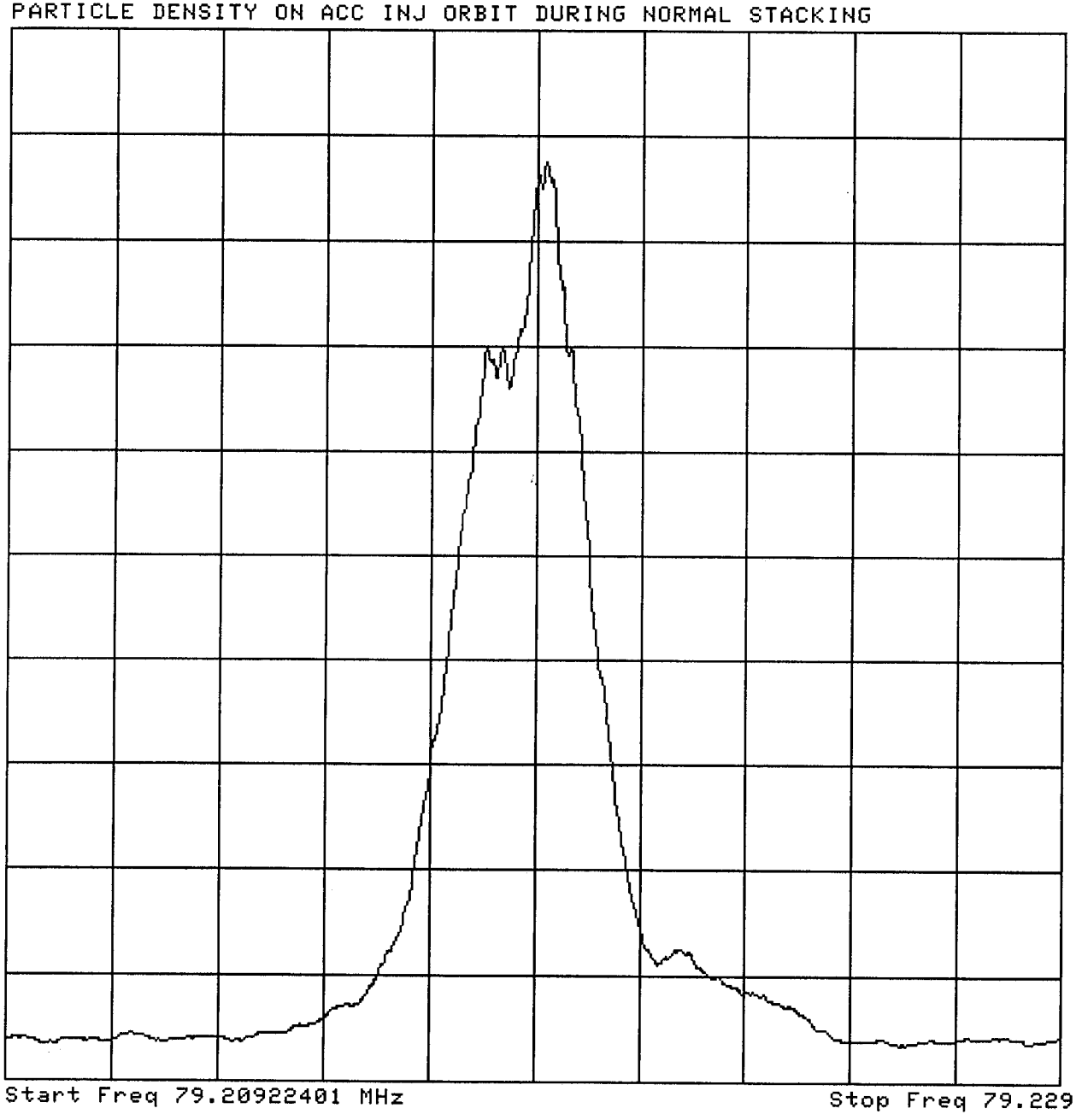
Figure 5



FWHM = 440 Hz

CONSOLE LOCATION 04, MCR-E2 18-FEB-1992 10:52
Pbar SA Plot

Figure 6



FWHM = 2839 Hz

CONSOLE LOCATION 04, MCR-E2 18-FEB-1992 10:56
Pbar SA Plot

CONSOLE LOCATION 04, MCR-E2 18-FEB-1992 10:29
Pbar SA Plot