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SEB Spill Structure

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Subject SEB Spill Structure

Observations and Conclusion

The purpose of this study was to measure the Lilco and Siemens synchronized components in the SEB spill, essentially repeating the measurements reported in AGS Technical Note 199. The results of this study together with comparable results from Technical Note 199 are given in Table 1. Some observations will be given regarding this table following a discussion of the technique used for the measurement (to the extent that it differs from Technical Note 199). Finally, some general comments about this spill structure will be made.

The present spill measurement used a filtered telescope output (C telescope) as input. The filter - a simple low pass RC network ($R = 3.3\ K\Omega$, $C = 0.1\ \mu f$) - has a characteristic frequency $(\frac{1}{2\pi RC})$ of 500 Hz and hence attenuates a 500 Hz signal by 0.7, and 1 KHz by 0.44. We do not correct for this attenuation. The average pulse frequency from C Tele was 200 KHz, each pulse was 300 ns wide and 1.6 volts high (unterminated); hence, for this frequency the filter output was $V_2 = V_1 \left(\frac{t_1}{t_2}\right) = (1.6\ V) \left(\frac{300\ ns}{5\ \mu s}\right) = 0.1\ V$.

It is the modulation of this frequency that we are measuring. A typical output from the filter and C Tele is given in Figure 1.

As in Technical Note 199, this signal is further filtered by an AC coupling capacitor, and an active band pass filter (30 Hz $\leq$ f $\leq$ 1

KHz);and then digitized using a LeCroy digitizer. The clocking frequency, synchronization of that clock, and start time for the digitizing interval are controlled by the experimenter. Most data was taken with a 2.048 KHz clock and synchronized either to Lilco or to the Siemens set.

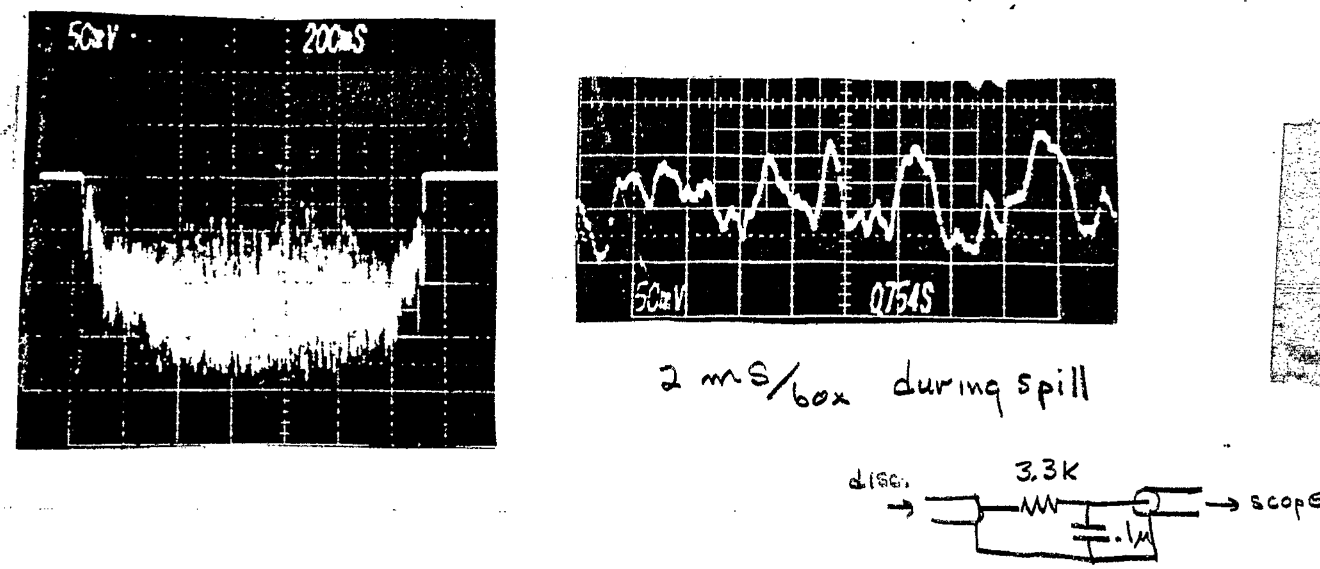

Figure 1 - Filtered C Telescope.

The point of the synchronization is that by summing over many spills any component which is not locked to the synchronizing signal is gradually suppressed.

A few problems with the recent data taking should be noted. The filtered signal from C Tele was clean but small. Lilco synced "ground loop" signals between the active filter and digitizer were of comparable size to the signal being measured. The sync technique removed this noise from the Siemens measurement. For the Lilco measure, the background was measured separately (terminated input to the active filter) and found to be significant only for 60, 120, and 180 Hz. An amplifier was added in an attempt to improve the signal to noise. This gave reasonable rsults at 60 and 120 Hz (as checked by the Siemens results with and without the amplifier) but introduced a spread in measured frequencies at higher frequencies. This has not been studied further.

Turning then to the results (Table 1 and Figure 2) there are a few significant changes over the year. The Siemens component at "60" Hz is reduced by a factor of 5 at "120" Hz it has increased a bit. More striking are the reductions in Lilco components. In particular, what was a huge spike at 360 Hz is now reduced to be comparable with the 60 and 120 Hz components.

A problem was found in the circuitry of the power backleg winding supplies early on during this running period. That this change was responsible for the improvement was not investigated. If so, it slipped past the Technical Note 199 search.

Table 1

Percentage Synchronized Spill Structure

Freq.*: (Hz)	60	120	180	300	360	420	720
(data: this study, June, 1984)							
Sync							
Lilco	8 ±2	8 ±1	<9	<6	12 ±1	<4	3 ±1
Siemens	6 ±1	10 ±1	0	1	14 ±1	<1	4 ±1
(data: Technical Note 199, May, 1983)							
Lilco	13 ±3	9 ±1	4	3	46 ±6	—	18
Siemens	28 ±1	6 ±1	0.5	2	11 ±2	—	6

*For the Siemens results, the frequencies measured are slightly less than those listed; for example, the "720" column actually was nearer 715 Hz.

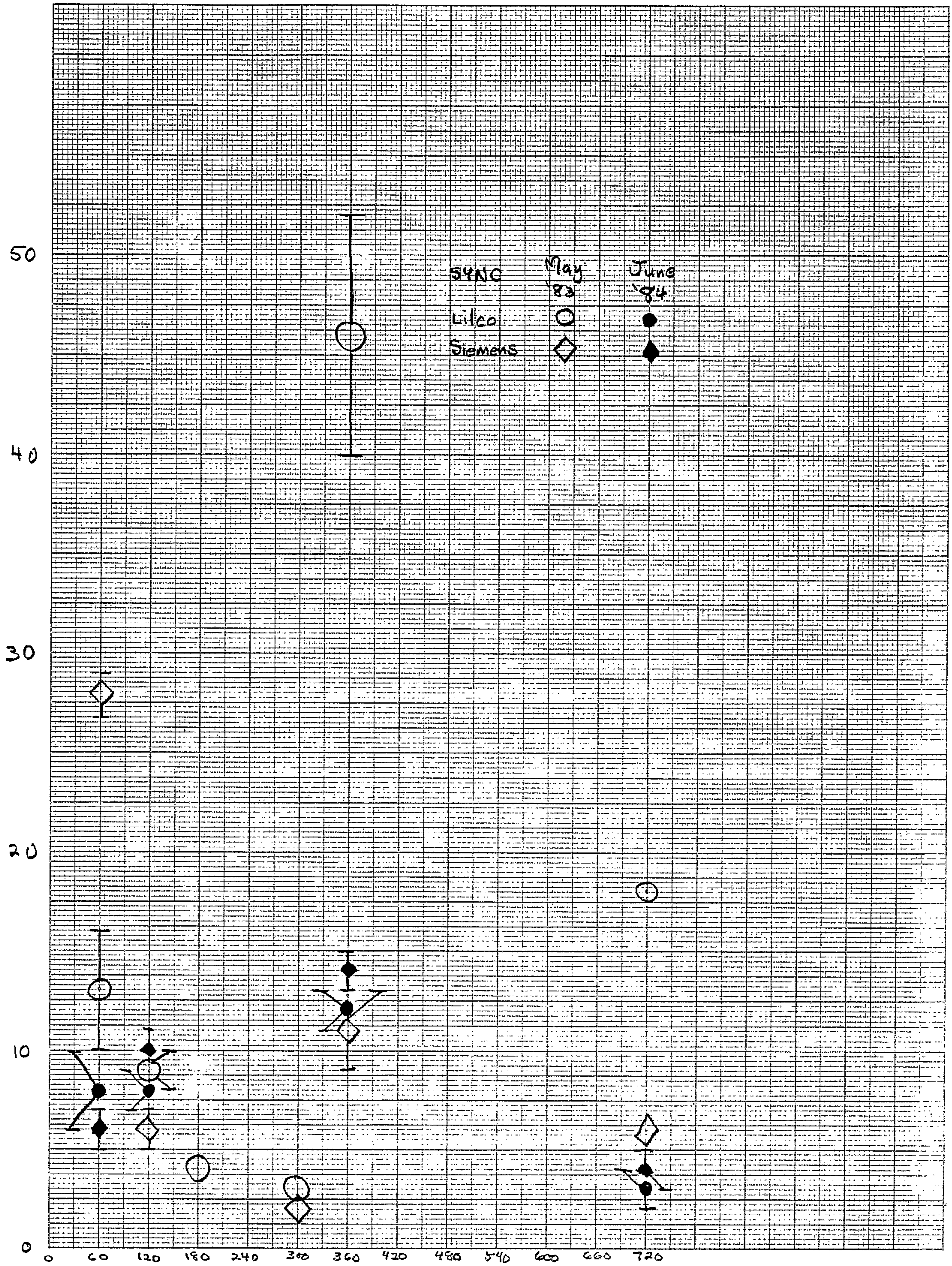

Figure 2 ripple frequency

Finally, it is useful to make a connection between percent spill ripple as defined in Technical Note 199 (100% spill ripple means the peak-to-peak excursion at a given frequency equals the average value of the spill) and a parameter closer to the spill quality as relevant to the experimenter.

The spill structure figure of merit for an experiment limited in rate by accidental coincidences is proportional to (AGS Technical Note 163, Effecitve Spill Length Monitor, H. Weisberg) $t_{eff} = [\int f dt]^2 / \int f^2 dt$ with f(t) being the instantaneous beam flux and the integral taken over the spill. For f constant (a perfect spill) t_{eff} is just the spill length. For a modulation of the spill of x%, $f = f_o(1 + \frac{x}{100})$; and $t_{eff} = t_{spill} \left(\frac{1}{1 + \frac{1}{2}(\frac{x}{100})^2}\right)$.

This factor is plotted in Figure 3. This analysis concludes that a 50% modulation at one frequency would force a background limited experiment to run with a reduction of average intensity of 11%, not a large loss. A 10% modulation is almost undetectable (0.5%).

The Weisberg effective spill length monitor (Technical Note 163) in fact measures just the quantity being discussed and should cross check the above conclusion. Systematic observations of that monitor while varying and measuring given power harmonics should be carried out to increase confidence in the system.

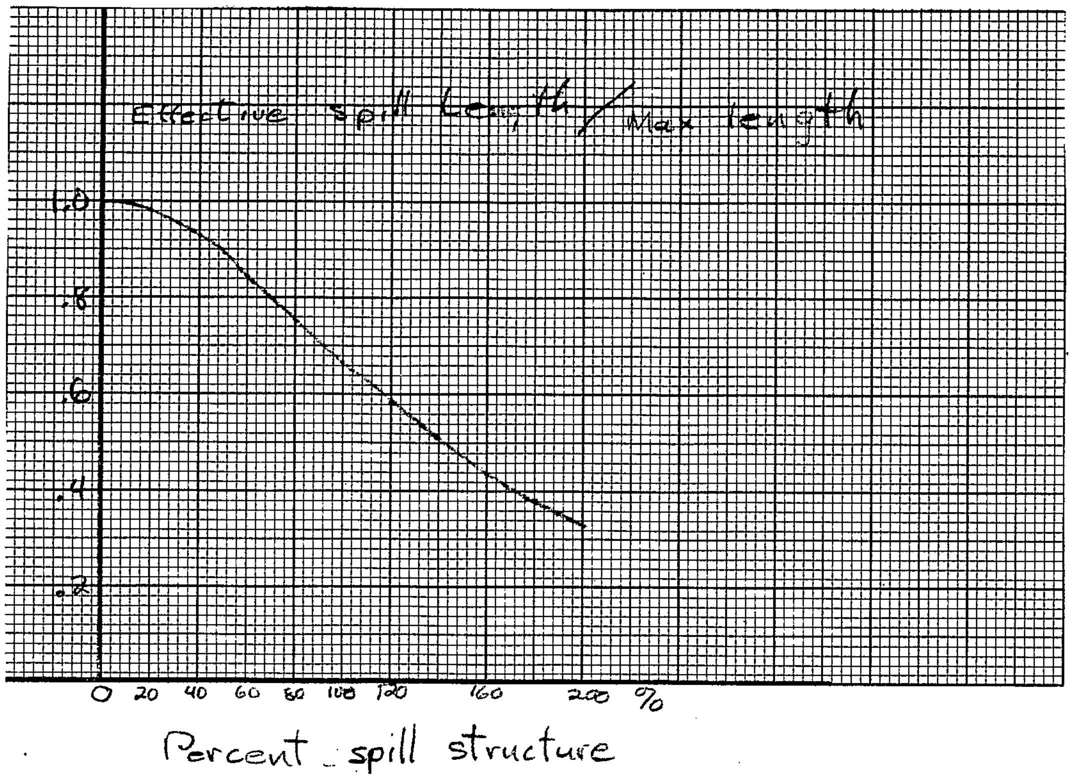

Figure 3 - Effective spill length vs percentage spill ripple.

mvh

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