

Beam Based Measurements for Stochastic Cooling Systems at Fermilab *

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Abstract

Improvement of antiproton stacking rates has been pursued for the last twenty years at Fermilab. The last twelve months have been dedicated to improving the model of the Stacktail system. The production of antiprotons encompasses the use of the entire accelerator chain with the exception of the Tevatron. In the Antiproton Source, two storage rings, the Debuncher and Accumulator, are responsible for the accumulation of antiprotons in quantities that can exceed 2×10^{12} , but more routinely, stacks of 5×10^{11} antiprotons are accumulated before being transferred to the Recycler ring. Since the beginning of this recent enterprise, accumulation rates have increased from 2×10^{11} to greater than 2.3×10^{11} antiprotons per hour. A goal of 3×10^{11} per hour has been established. Improvements to the stochastic cooling systems is but a part of this improvement program. This paper will discuss Stacktail system measurements and experienced system limitations.

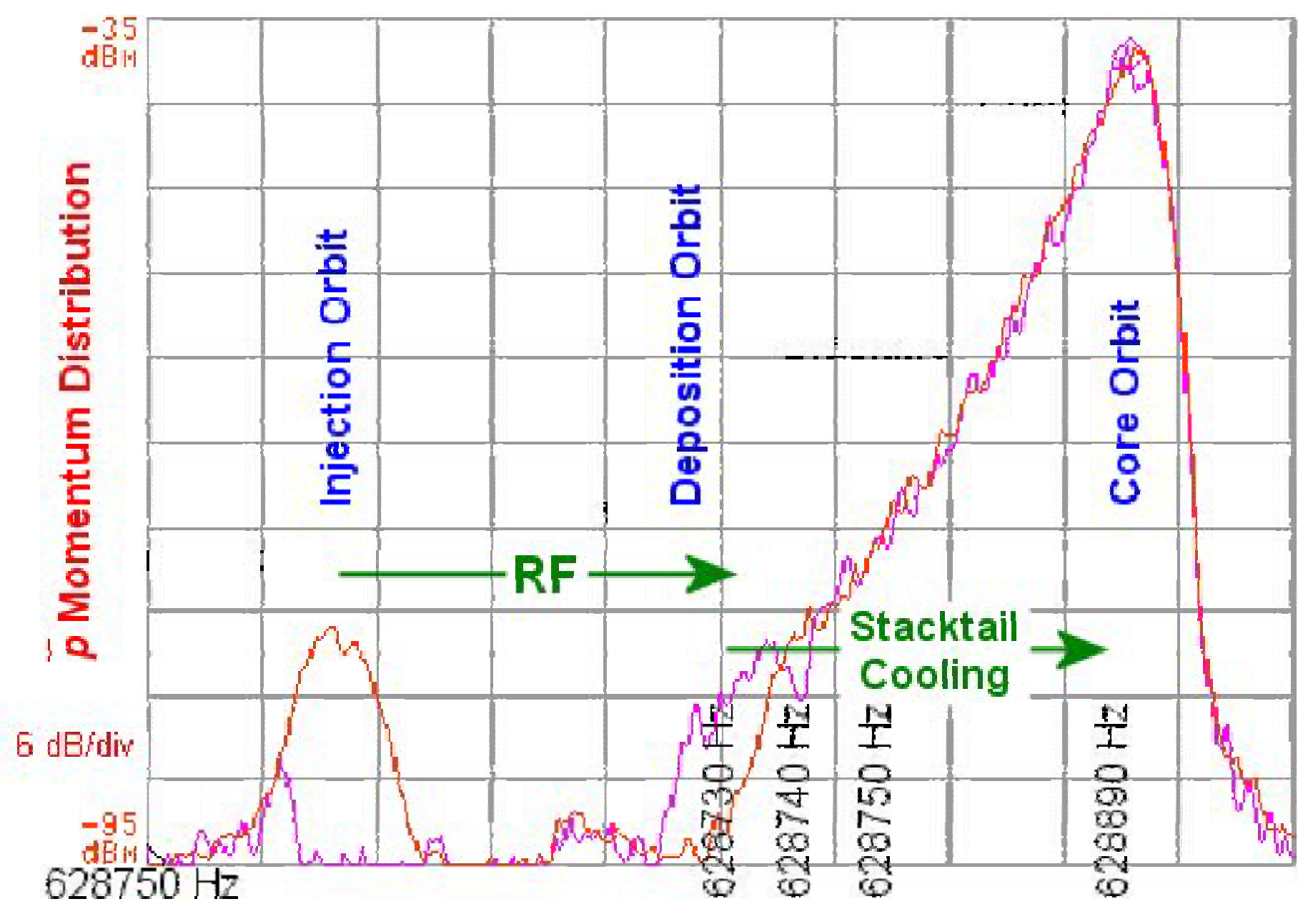


Figure 1: Stacktail Schottky profile vs. revolution frequency. Red trace with freshly injected antiprotons on the injection orbit, purple trace shows remnant antiprotons not picked up by the RF system and the resultant momentum displacement due to the Stacktail cooling.

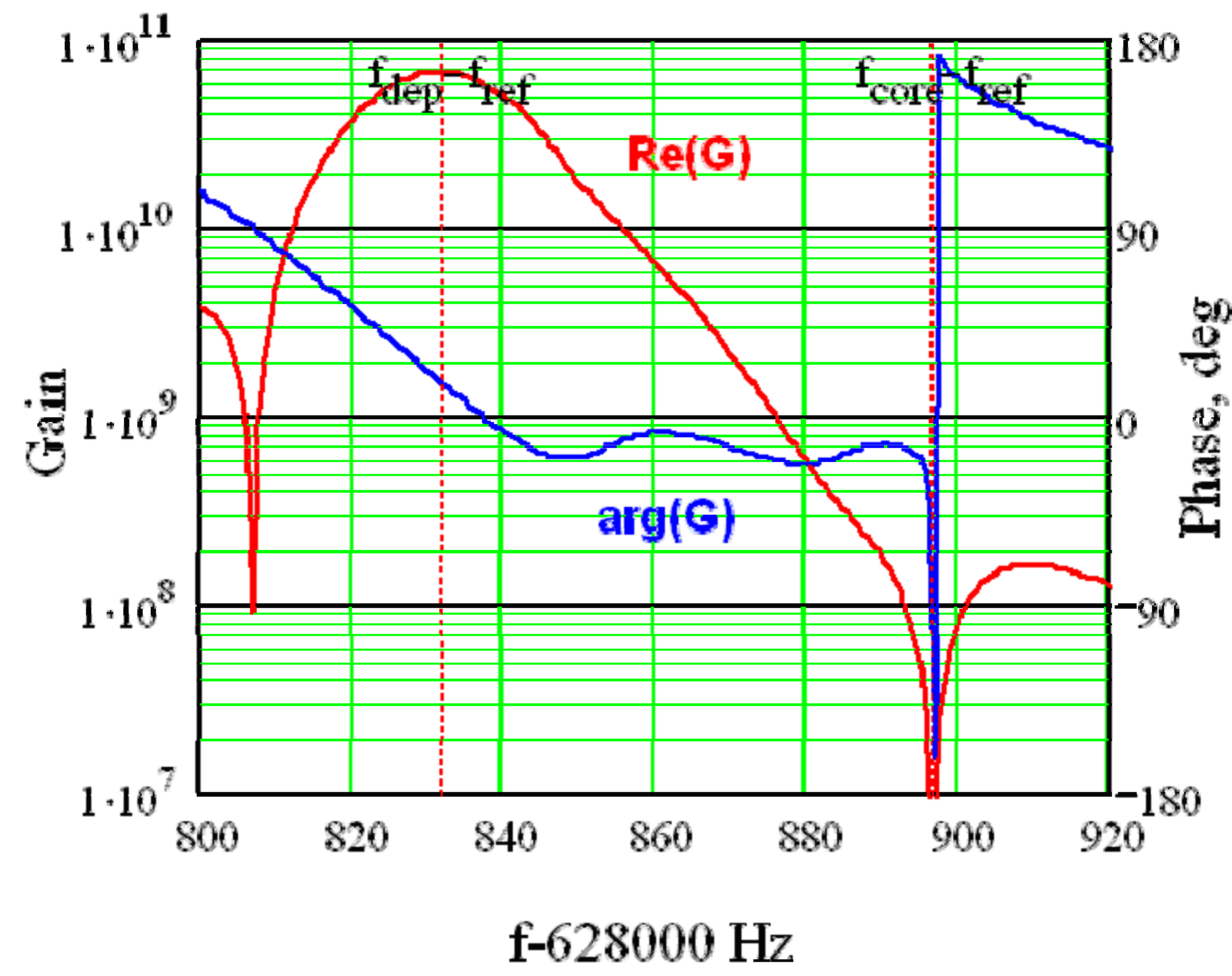


Figure 3: Gain profile of the Stacktail with real part of the gain function and phase as a function of revolution frequency.

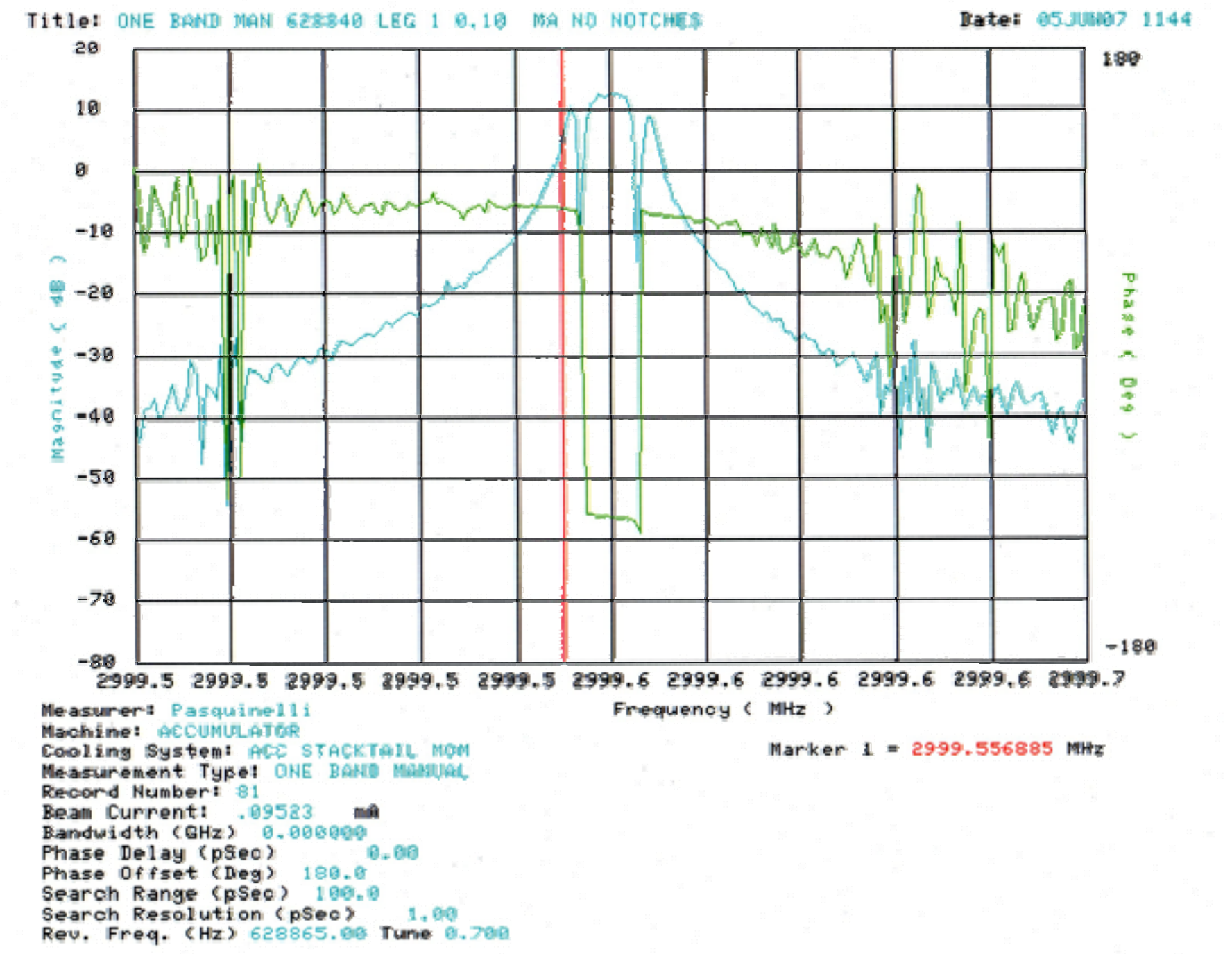


Figure 4: Single Schottky band transfer function measurement. Center frequency is at the revolution harmonic, red line marker off resonance frequency. Note 180-degree phase shift along with reduced amplitude response.

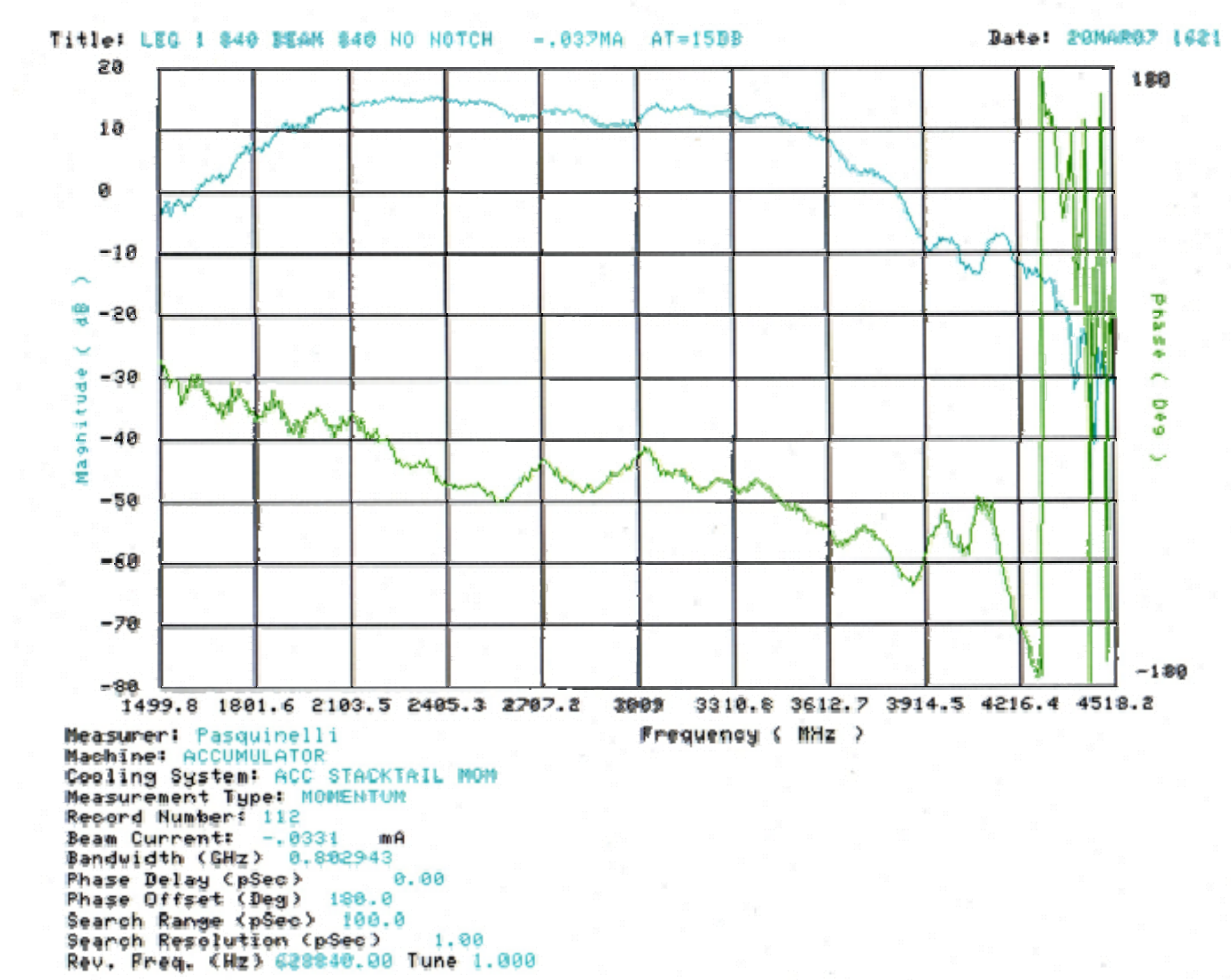
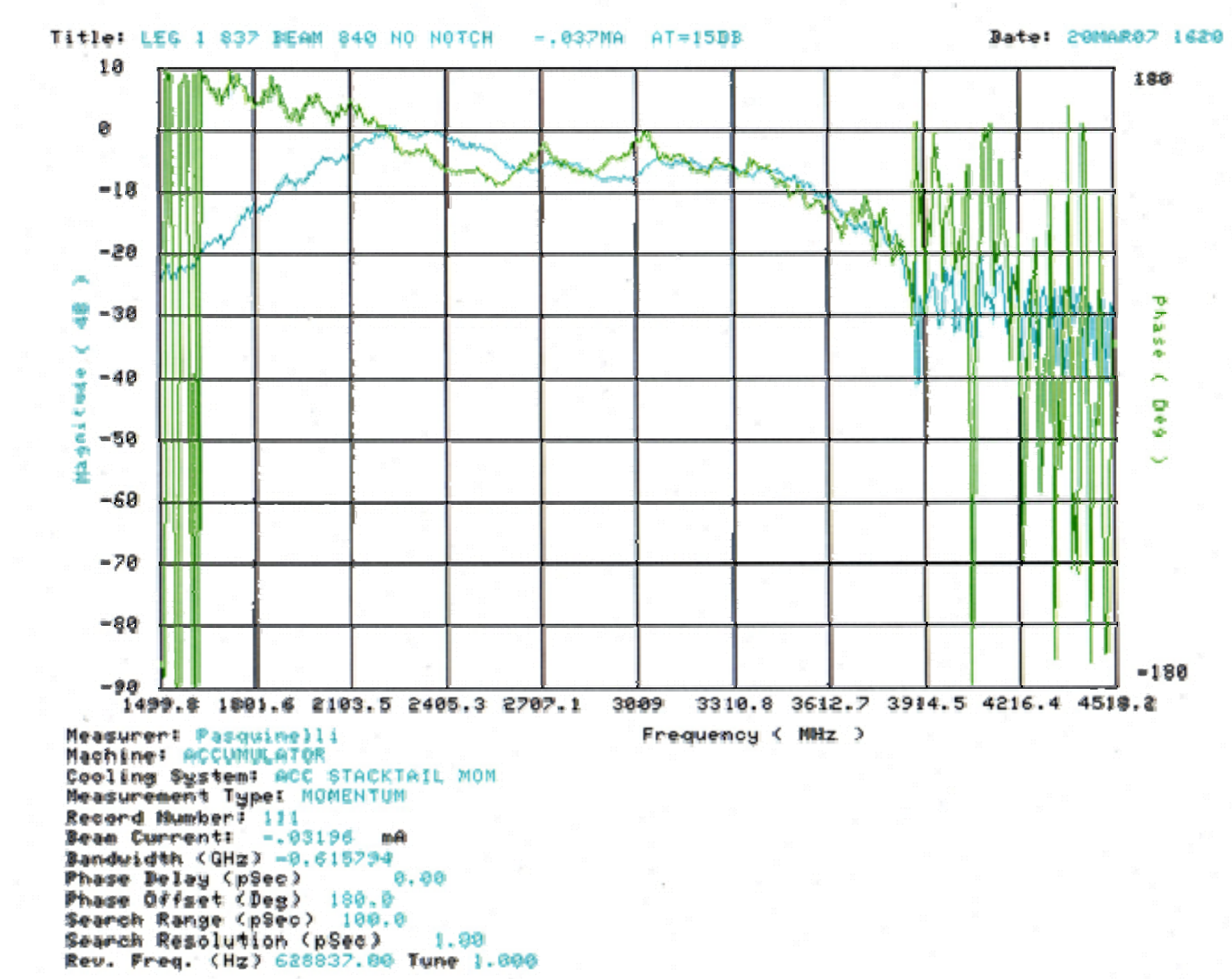


Figure 5: Top transfer function off resonance, bottom transfer function on resonance. Note significant gain and 180-degree phase shift, but there is a linear relationship between the two indicating no saturation on resonance.

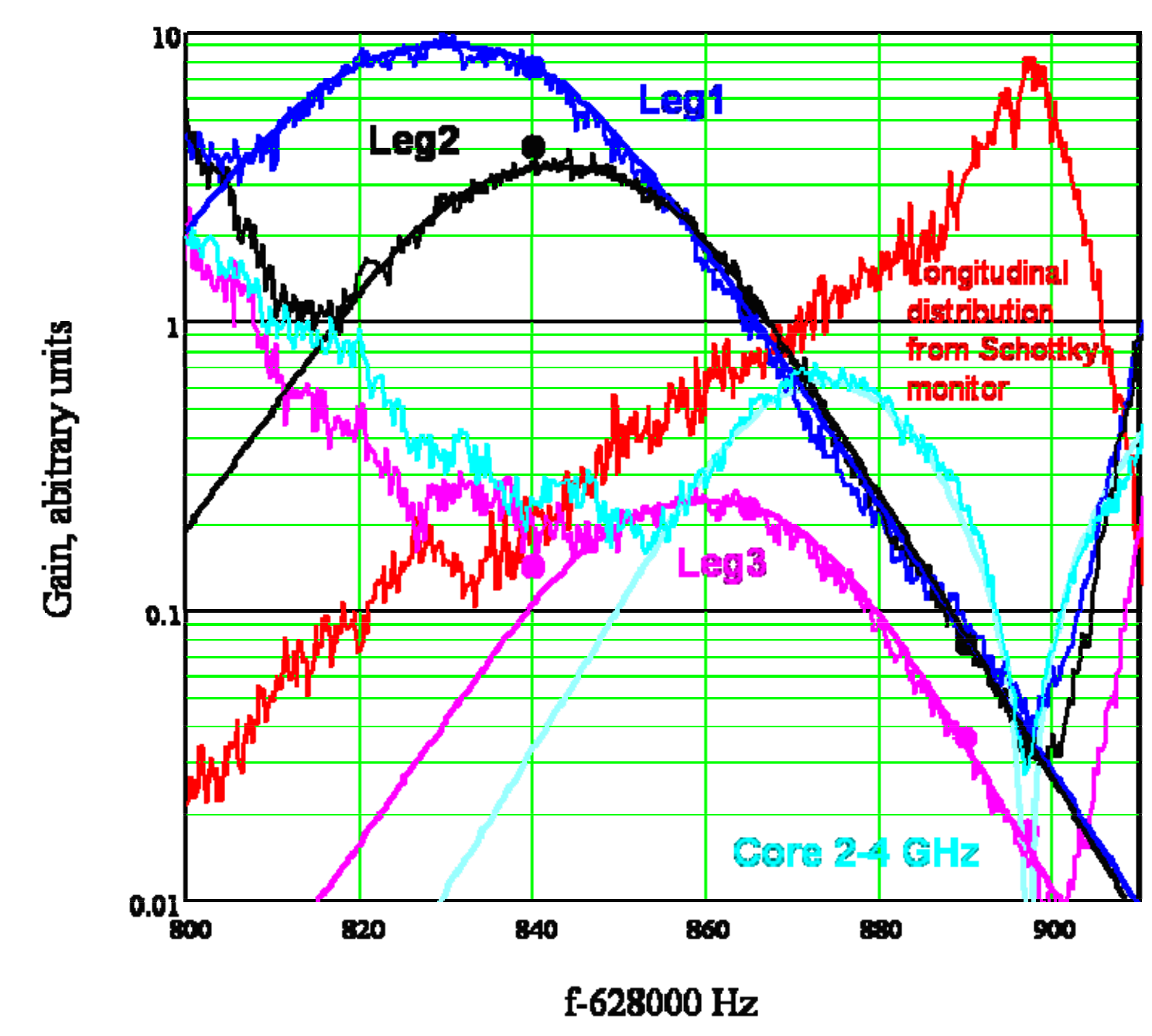
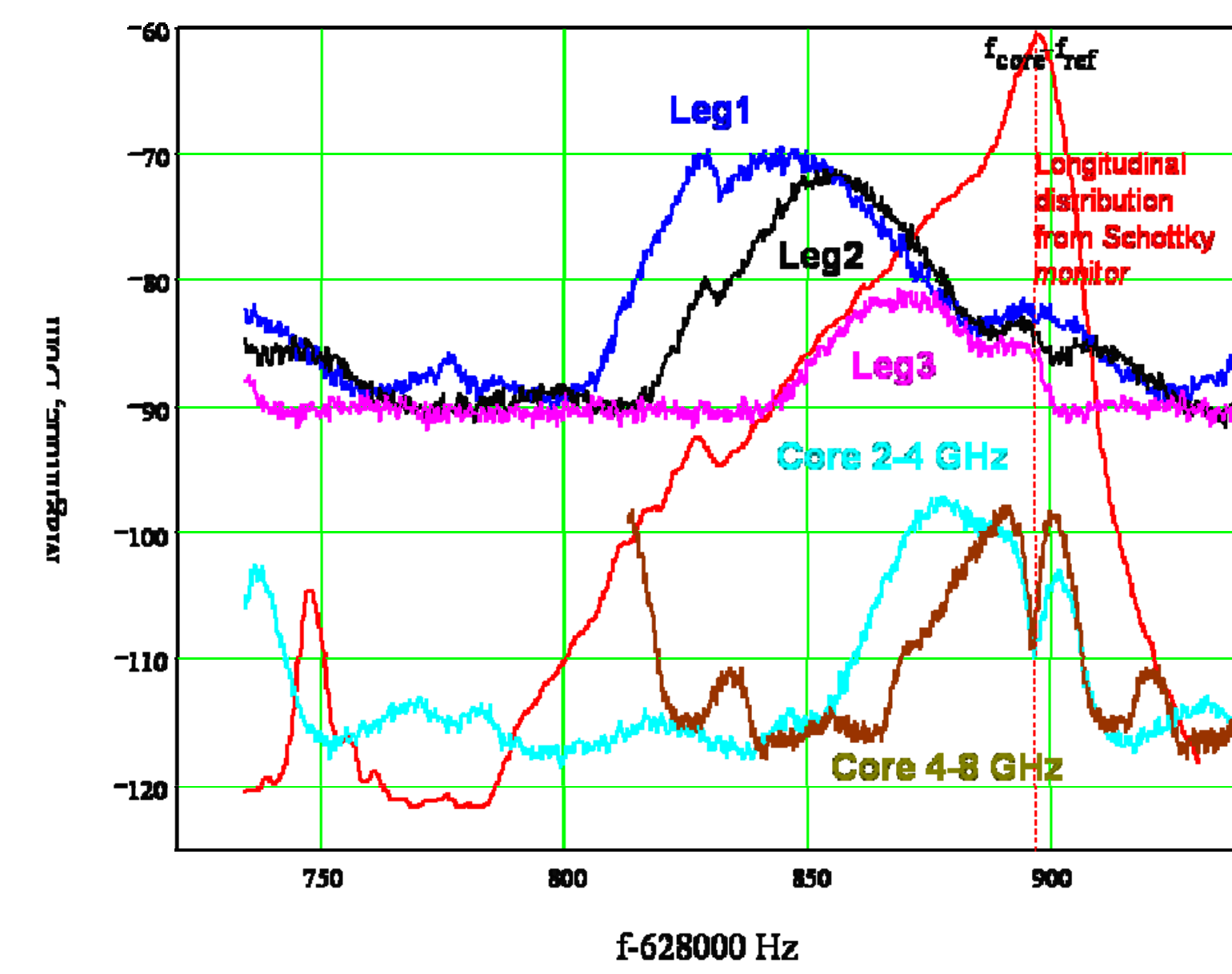


Figure 6: Top shows the superposition of Schottky signals from all longitudinal cooling systems in the Accumulator while stacking. Leg 1,2,3 refers to the Schottky signal from each individual pickup of the Stacktail system. Also included is the Stacktail longitudinal profile. Bottom shows the Schottky signals normalized to the distribution profile. The dots are the network analyzer transfer function measurements at various revolution frequencies. The close agreement indicates the transfer functions are truly representative of the system gain, which is most important for the computer model.

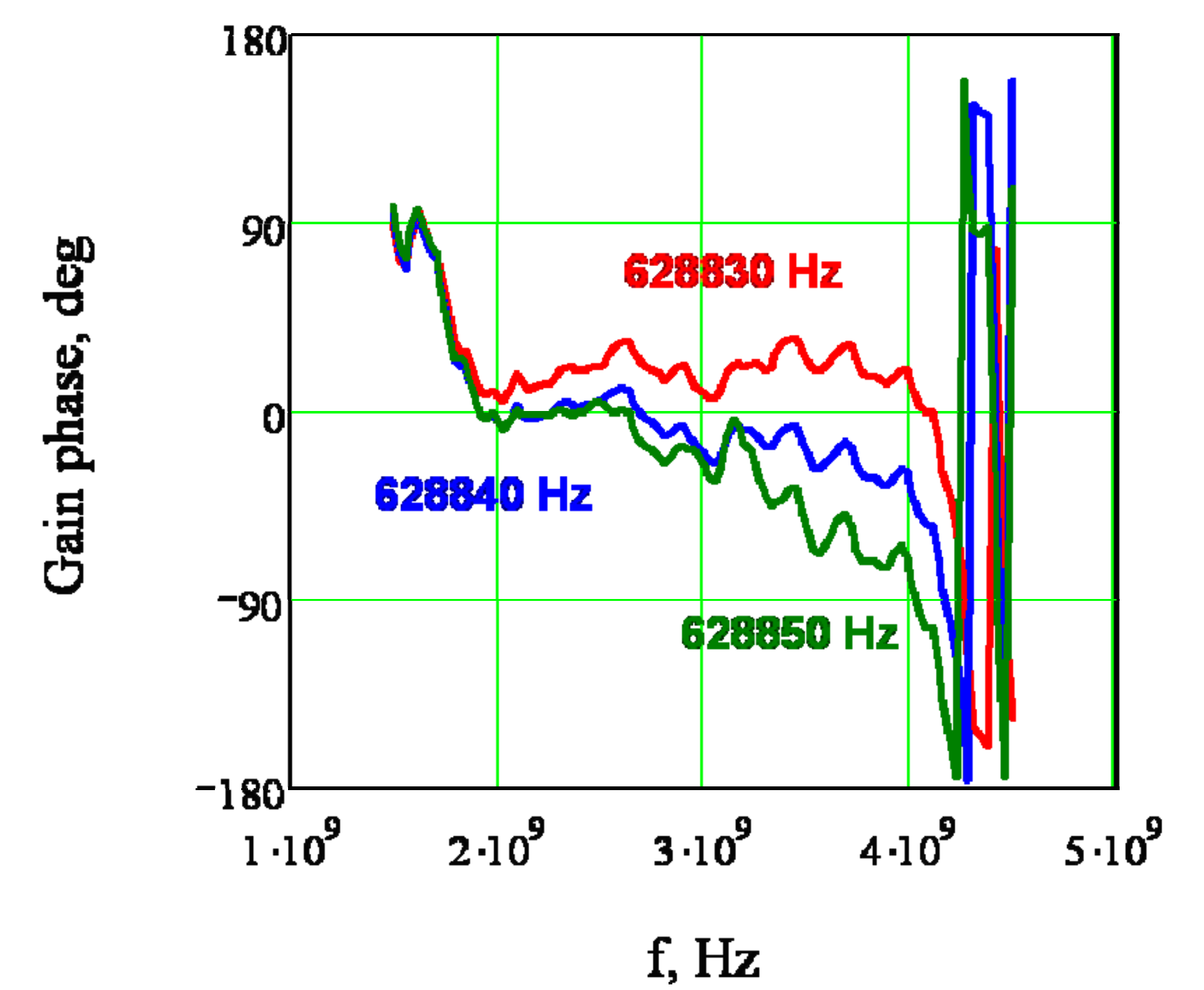
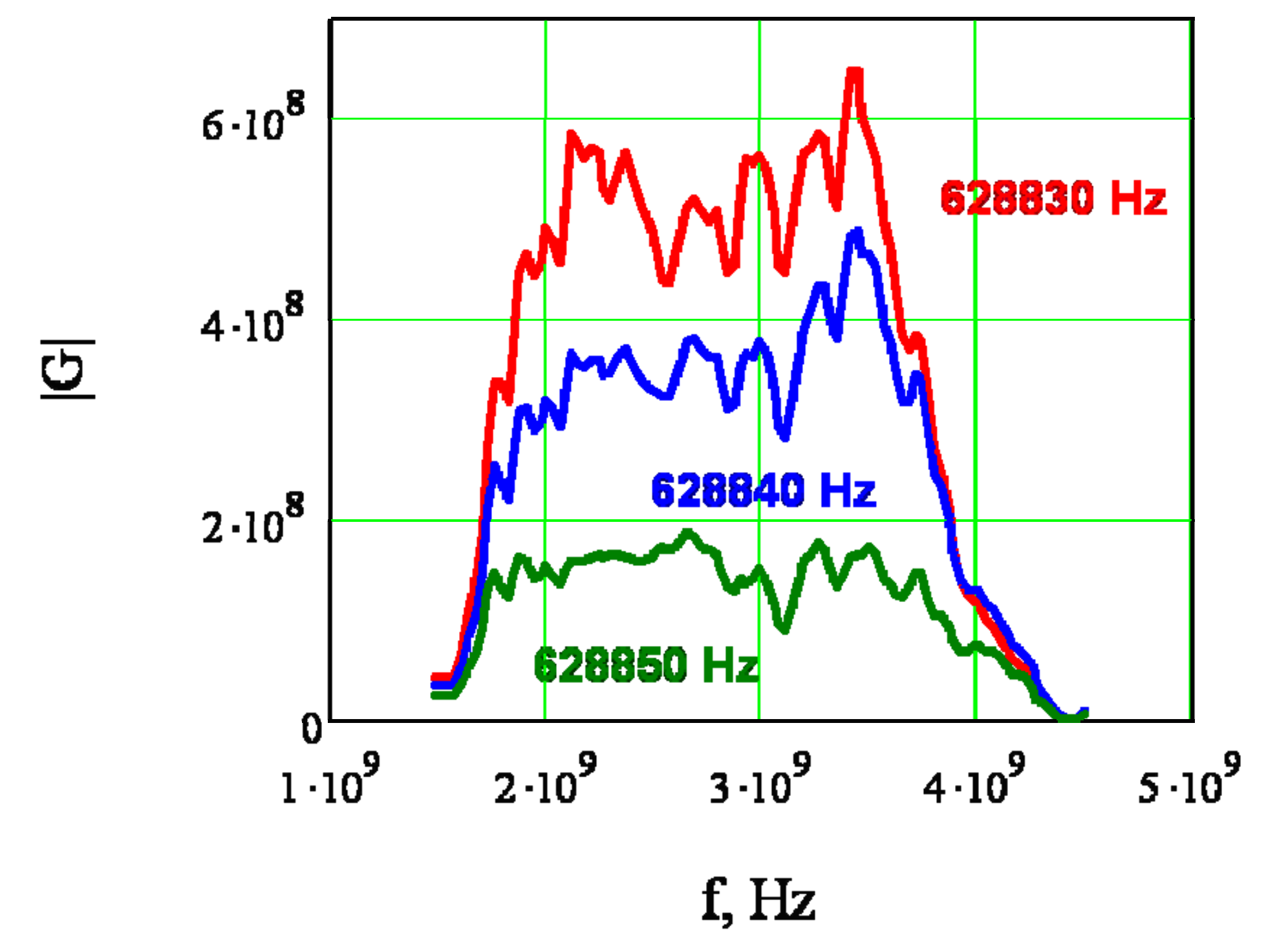


Figure 7: Transfer functions as a function of beam revolution frequency in the 2-4 GHz system bandwidth.

