Fast rotation

D. Rubin

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Since $\hat{S}(\omega) = \hat{S}_1(\omega) + \Delta(\omega)$, if the frequency content of $\Delta(\omega)$ increases(decreases) then the frequency content of $\hat{S}_1(\omega)$ must likewise increase(decrease) albeit with opposite phase. And not the other way around. In the limit where $t_s - t_0 \sim 1$ turn then $\Delta(\omega)$ is the fourier transform of a delta function and contains all frequencies equally. That is why it is flat in the vicinity of the first harmonic. Indeed it is flat everywhere. As $t_s - t_0$ increases, the contribution to $\Delta(\omega)$ from frequencies far from the harmonics will decrease, as we see in Figure 8. I'm still not getting the uncertainty principal argument, or why it is necessary.

I like the second full paragraph on page 12 but perhaps we could add a few more sentences...

The second consideration is the presence of frequencies of $\hat{S}_1(\omega)$ that are outside the vacuum chamber. The full fast rotation signal $S(t)$ is comprised of particles circulating in the vacuum chamber of the storage ring. The momentum (frequency) band of those particles is limited by the finite aperture of the chamber. $\hat{S}(\omega)$ will include only harmonics of frequencies within that band. As per the symmetry discussed above, $S(t)$ extends over $\pm\infty$. On the other hand, $S_1(t)$ is not strictly periodic as it has a distinct start time. Therefore $\hat{S}_1(\omega)$ will include all frequencies (and their harmonics) outside the band defined by the chamber as well as those within the band. taking the Fourier transform of an incomplete FRS.