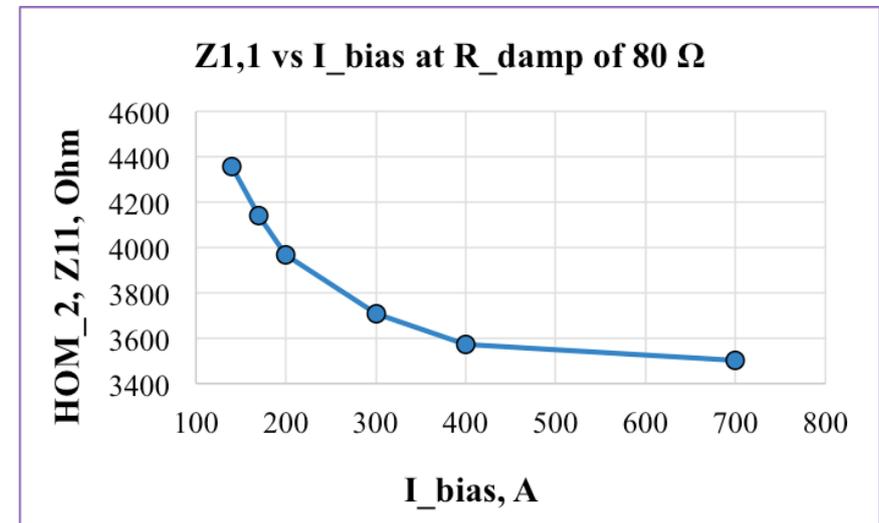
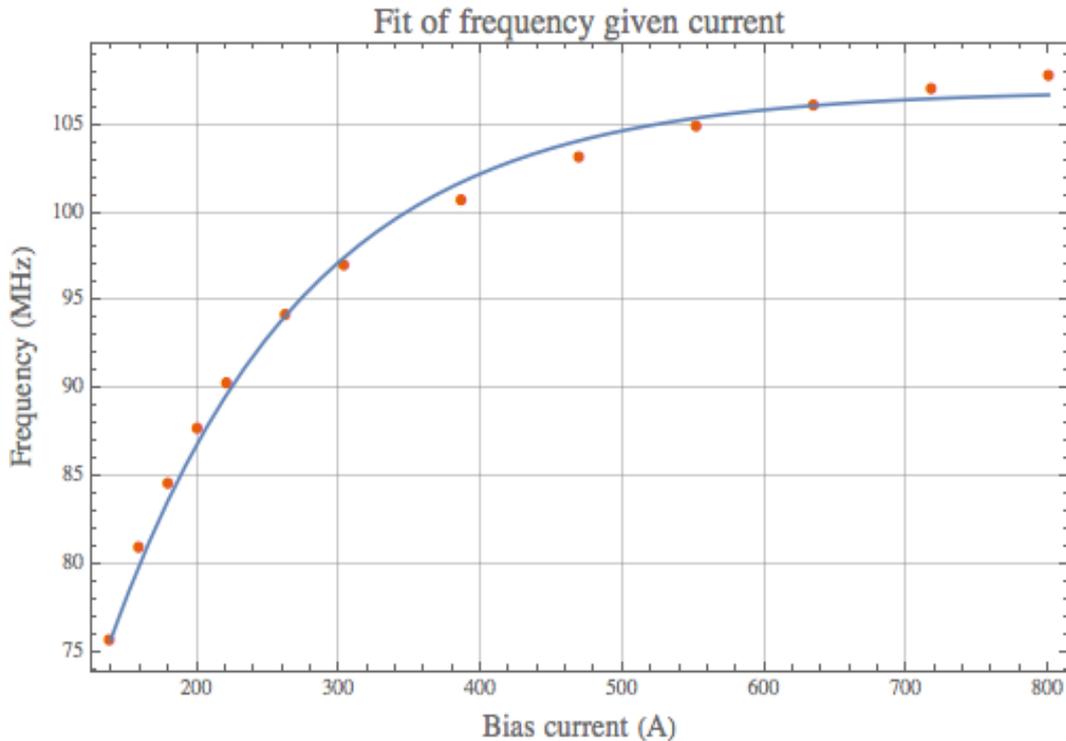


# Proposed bias ramp

C.Y. Tan  
01 Mar 2018

# Frequency ramp

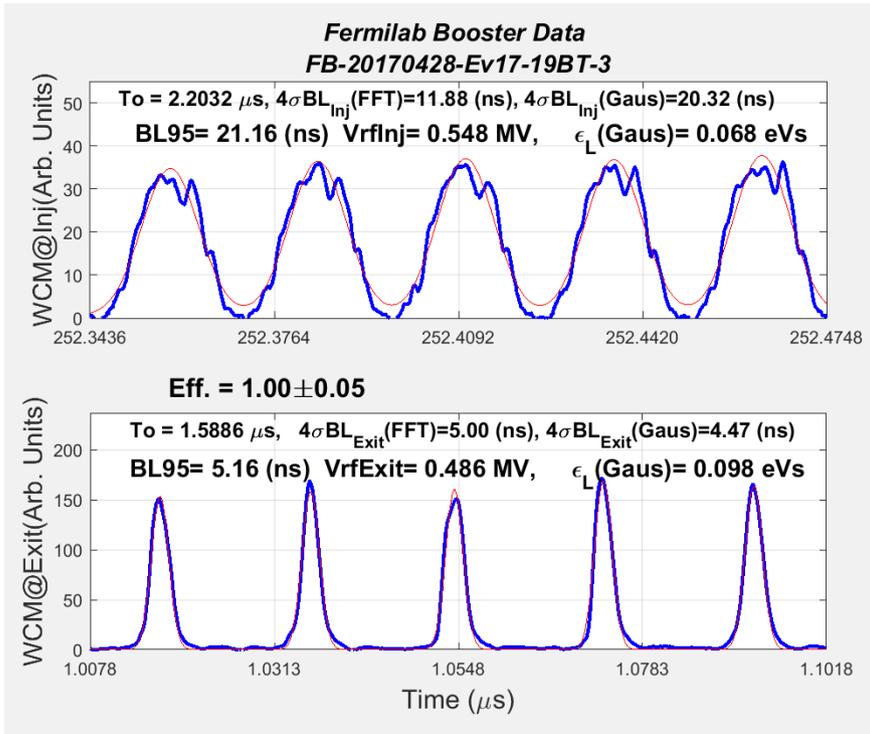


This is the frequency ramp as a function of bias current going into 59 turns.

At low bias (low freq), the next highest HOM mode has shunt impedance of about 2 kohms (Engineer's definition). Compare that to 93 kohms for fundamental.

Therefore, mainly worry about the fundamental.

# Bunch lengths and form factor



The form factor for a Gaussian beam is given by (Lee Eq. 2.220)

$$F(\omega; \sigma_t) = e^{-\omega^2 \sigma_t^2 / 2}$$

At injection, the form factor for  $\sigma_t = 20.32/4 \approx 5$  ns

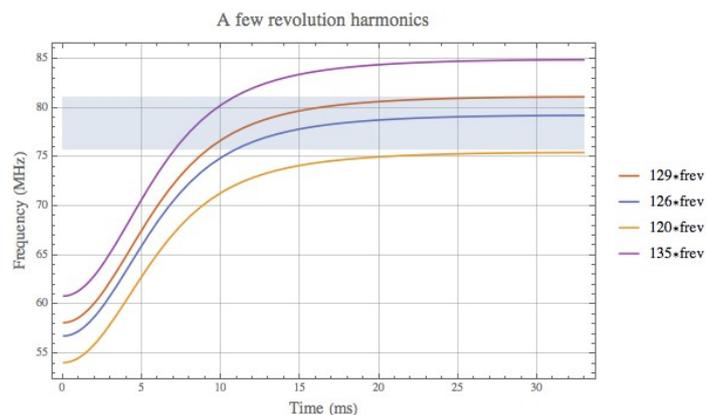
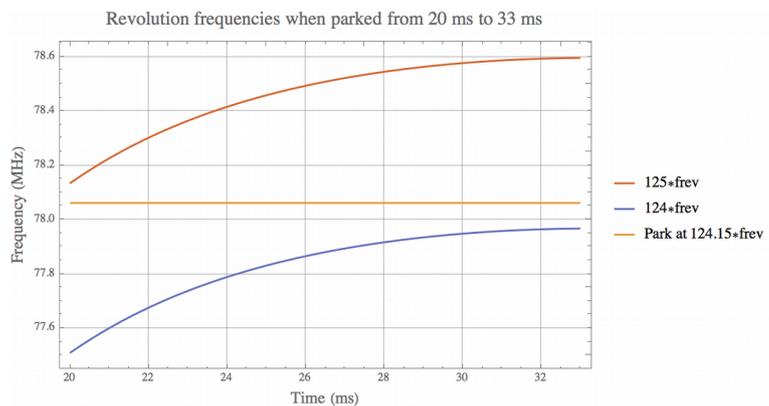
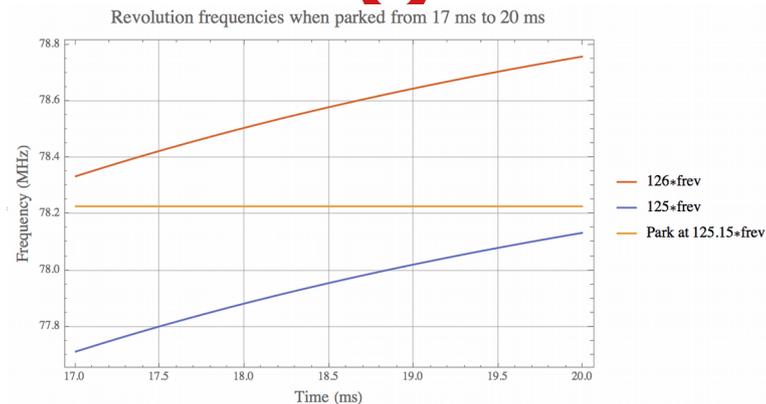
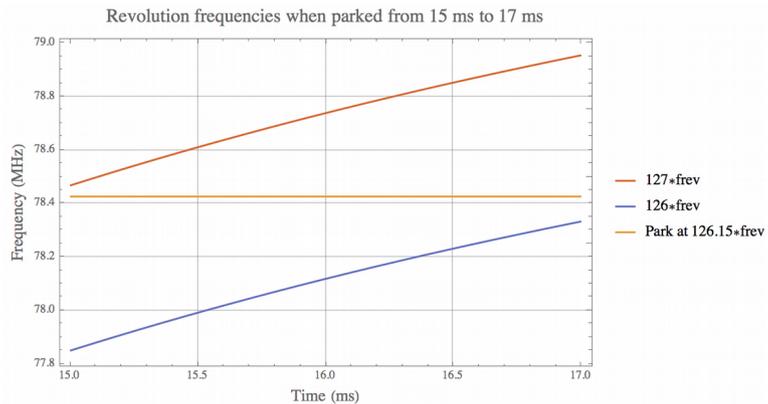
$$F_{inj} = \exp \left[ -(2\pi \times 76 \times 10^6)^2 \times (5 \times 10^{-9} \text{ s})^2 / 2 \right] = 0.06$$

At extraction, the form factor for  $\sigma_t = 4.47/4 \approx 1$  ns

$$F_{ext} = \exp \left[ -(2\pi \times 106 \times 10^6)^2 \times (1 \times 10^{-9} \text{ s})^2 / 2 \right] = 0.8$$

Therefore, it is only at higher energies that we need to worry about the HOM modes because the bunch is a lot shorter.

# Parking

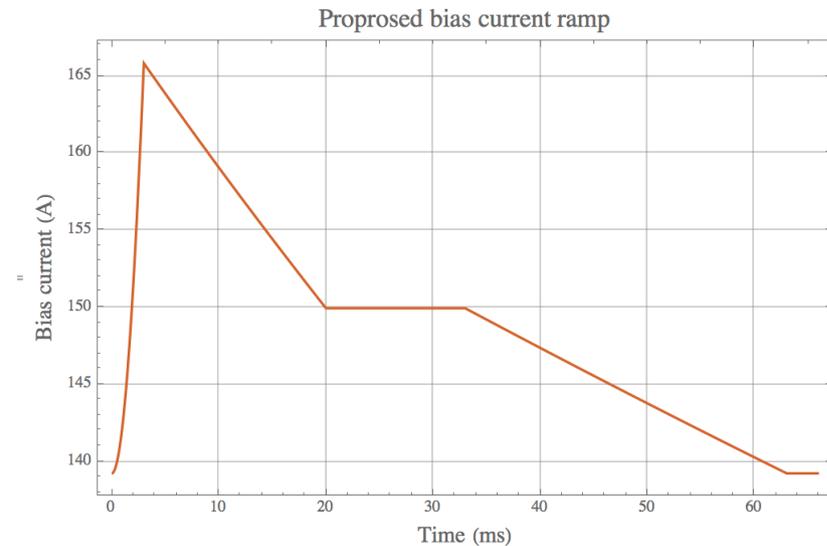
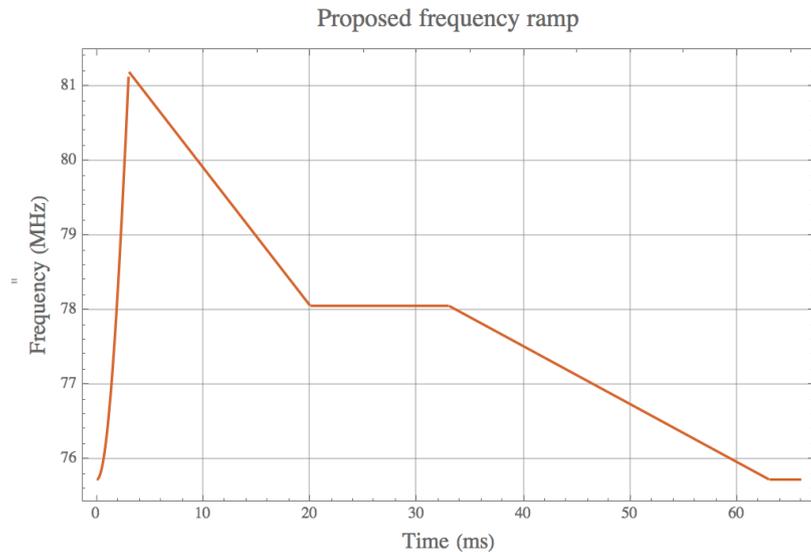


There are a few parking choices. But it is more important to park properly at higher energies, so choose 20 to 33 ms.

We can bump the bias ramp at 17 ms and 20 ms. Maybe this is what we will do later. But note that every time we bump, we will cross a revolution harmonic.

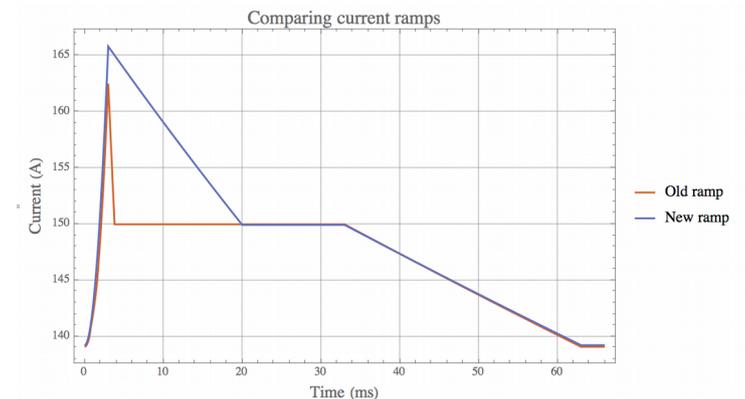
Choose 124\*frev and 125\*frev which is about half way between 76 MHz and 81 MHz for now.

# Proposed frequency ramp

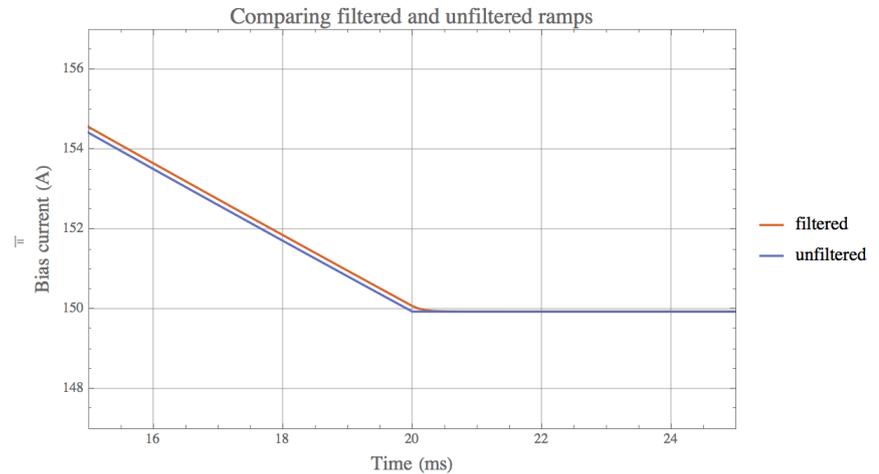
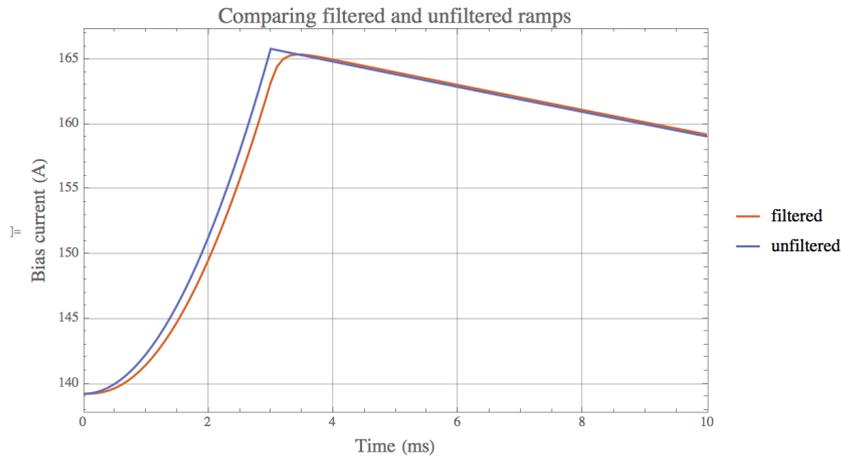


The rms current for this current pulse is 150 A. This is within the specifications of the bias supply.

Note: ramping down will **always** make the fundamental resonance cross revolution harmonics. So must not linger before parking!



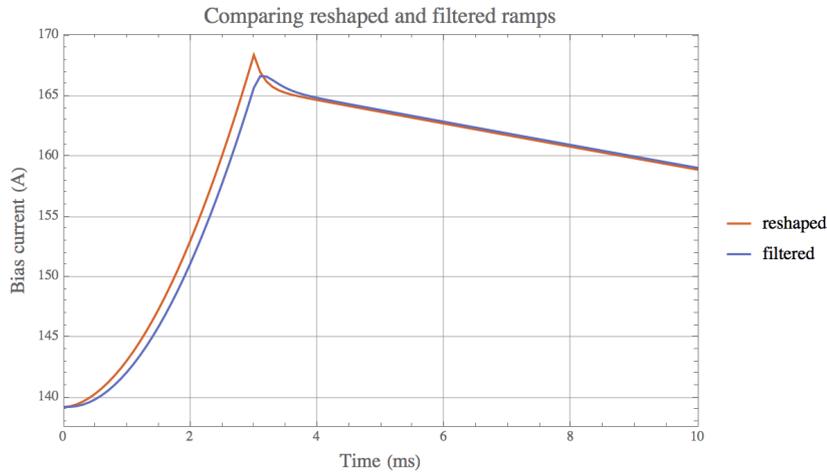
# Consequences of finite bandwidth of bias supply



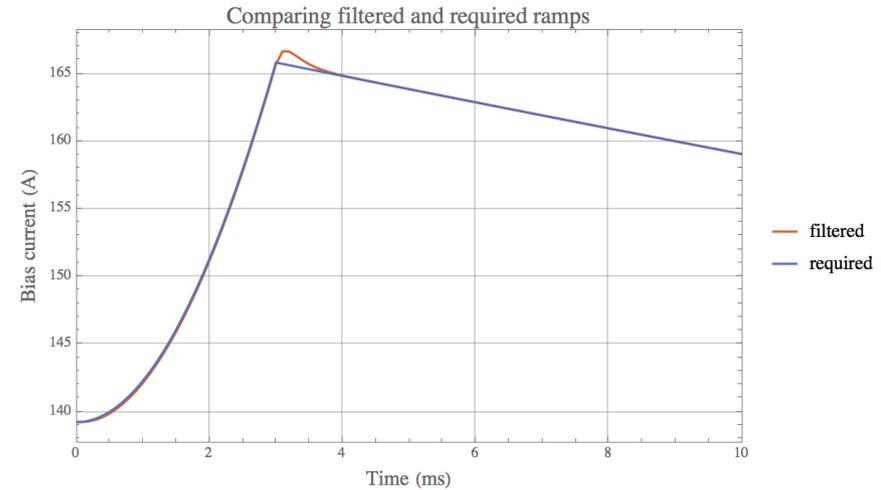
Assume that bias supply has 1 kHz bandwidth, then clearly the ramp does not follow what we want.

Therefore, must reshape the input curve, i.e. pre-shape it.

# Pre-shaped current ramp



Red is reshaped curve and after going through filter, the sharp peak is rolled off.



The filtered reshaped curve (red) compared to the required curve. Important to follow 0 to 3 ms required curve.

Of course, we will have a PLL that should make bias curve to give required resonance. But it's still important to be close.

# Conclusion

- Bias curve digitized and given to Matt.
- The bias curve will be played out using a VXI crate system that Brian Schupbach will resurrect. It will also provide 2x fundamental frequency.