Introduction and Motivation
Ruggiero et al. (2000) compared threshold tuning curves of chinchilla basilar membrane (BM) vibrations and auditory nerve (AN) fibers. They noted that the AN tuning curves lacked the higher-than-CF frequency plateaus that are present in BM responses and suggested that BM vibrations do not translate into AN responses at greater than BF regions. [1]

In more detail, a given amount of BM vibration within the BF region elicits a response in the AN, but the same amount of BM vibration in the plateau region did not produce any response in the AN.

Hypotheses:
1) Curvature of the BM might play a role in determining whether hair cells get excited.
2) The feedforward model might include a mechanism where the hair cells in the plateau region are suppressed by the actions of the hair cells in the short-wave region.

This study might give us some clues to how the BM vibrations are translated into neural responses.

Methods

Results 1: Comparison of mechanical and neural responses

- **Method:**
  - Interpolate BM tuning curves from published BM data.
  - Match threshold SPL of the tip.
  - Overlay BM tuning curves on gerbil neural tuning curves.
  - Compare plateau sound pressure levels.

- **Remarks:**
  - BM data in the plateau region is not abundant.

Results 2: Subharmonics at high sound pressure levels

- **Result:**
  - Subharmonics were recorded in the ear canal at high SPLs.
  - Mostly even-order subharmonics; some odd-order subharmonics too.

Discussion and Relevance of the Findings to Cochlear Activity
We observed neural response in the supra-CF plateau region. Neural plateau (gerbil) is at least 10–15 dB higher than BM plateau (chinchilla).

- **1.** Gerbil BM data is usually in the high-BF region. We lack high-CF AN units to compare at this point.
- **2.** Windowing problem: it is possible that the synaptic/neural delay is not correctly accounted for. ie. spikes during a tone-on period are mistaken for a tone-off period. This problem would lead to false positive threshold attainment. However, this problem is eliminated by monitoring overall firing rate increase with the use of rate level functions.
- **3.** Spectral splatter problem: on ramp/off ramp in the stimulus envelope introduce frequencies other than the stimulus itself. It is conceivable that this frequency splatter could cause spurious transient response. This can be mostly avoided by a) inspecting raster plots to identify the transient response, b) using only the steady-state response, c) monitoring firing rates. (see Methods)
- **4.** It is possible for the high SPL stimulus to cause AN threshold shift and/or hearing damage.
- **5.** Subharmonics could be the source of the AN plateau response. AN units have a lower threshold (near CF) at subharmonics frequencies of the stimulus. (see Future Studies)

Future Studies
Identify the source of the plateau in the neural response
Look at firing patterns and calculate vector strength at phase locking frequencies to probe possible subharmonic response.

### References