Cochlear Modeling

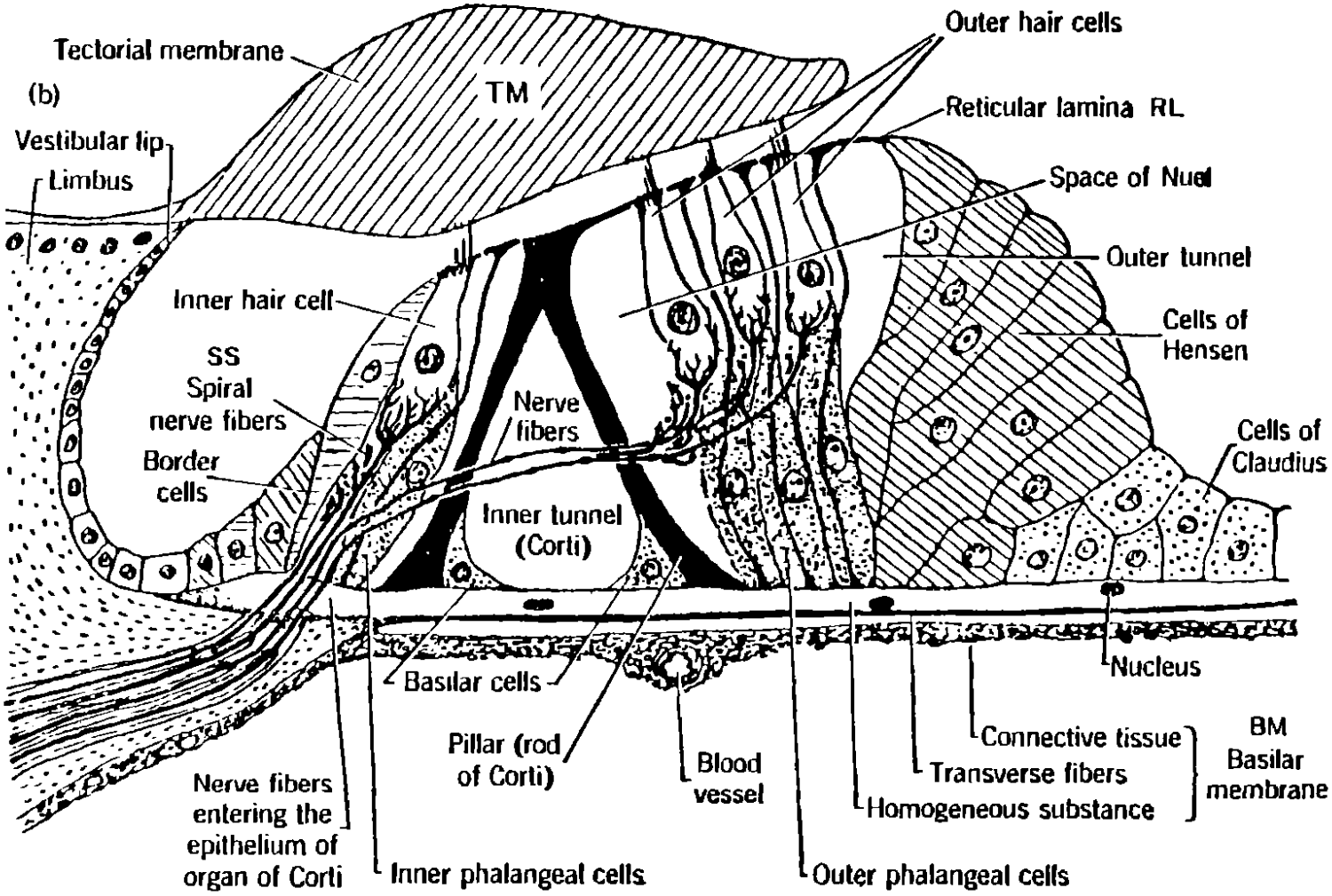
Micromechanics

Jont Allen

ECE-537

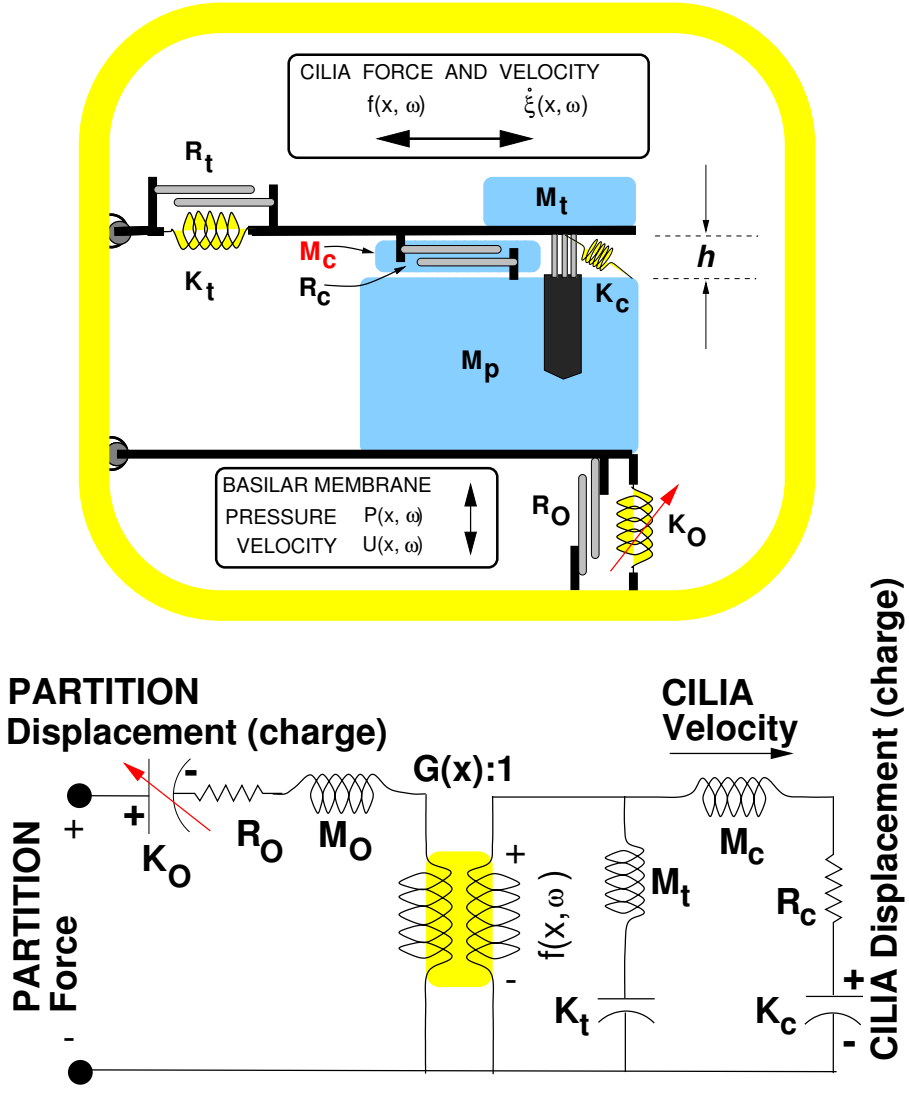
Organ of Corti Anatomy

- It happens here & we DO NOT understand how!



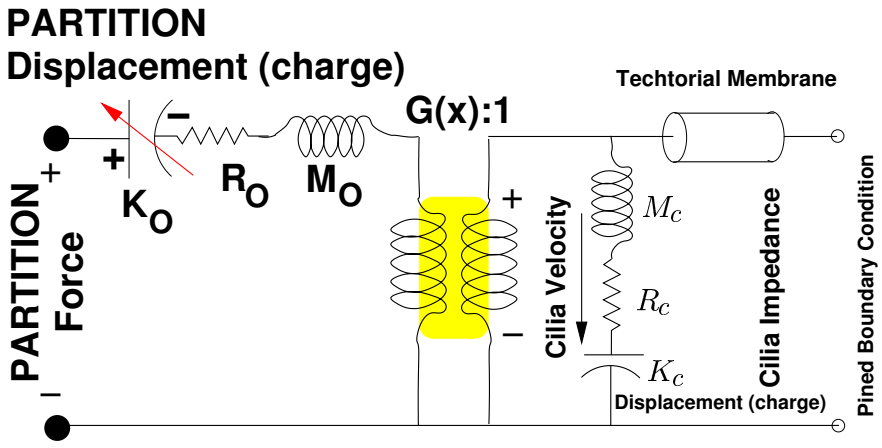
Basic Organ of Corti Mechanics

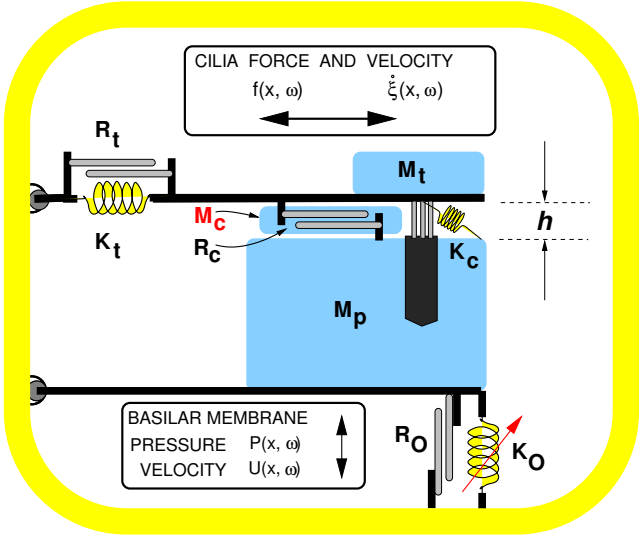
- Organ of Corti: lumped circuit model



Basic Organ of Corti Mechanics

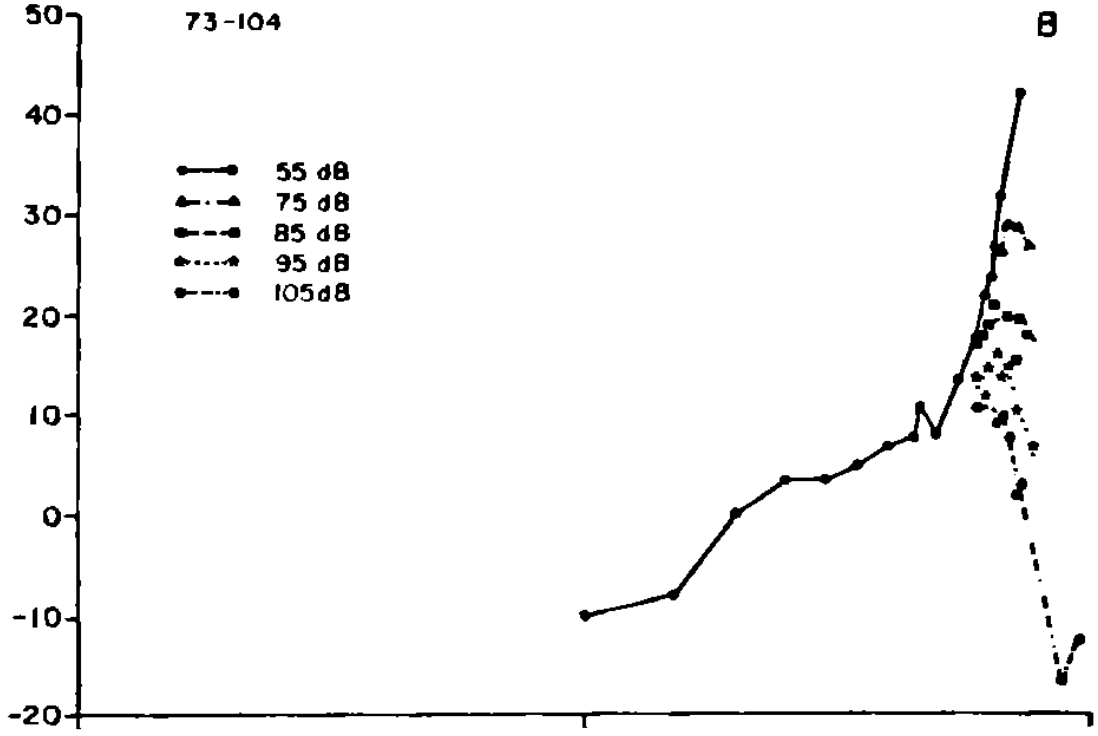
- Organ of Corti: transmission line model





Basilar membrane nonlinearity

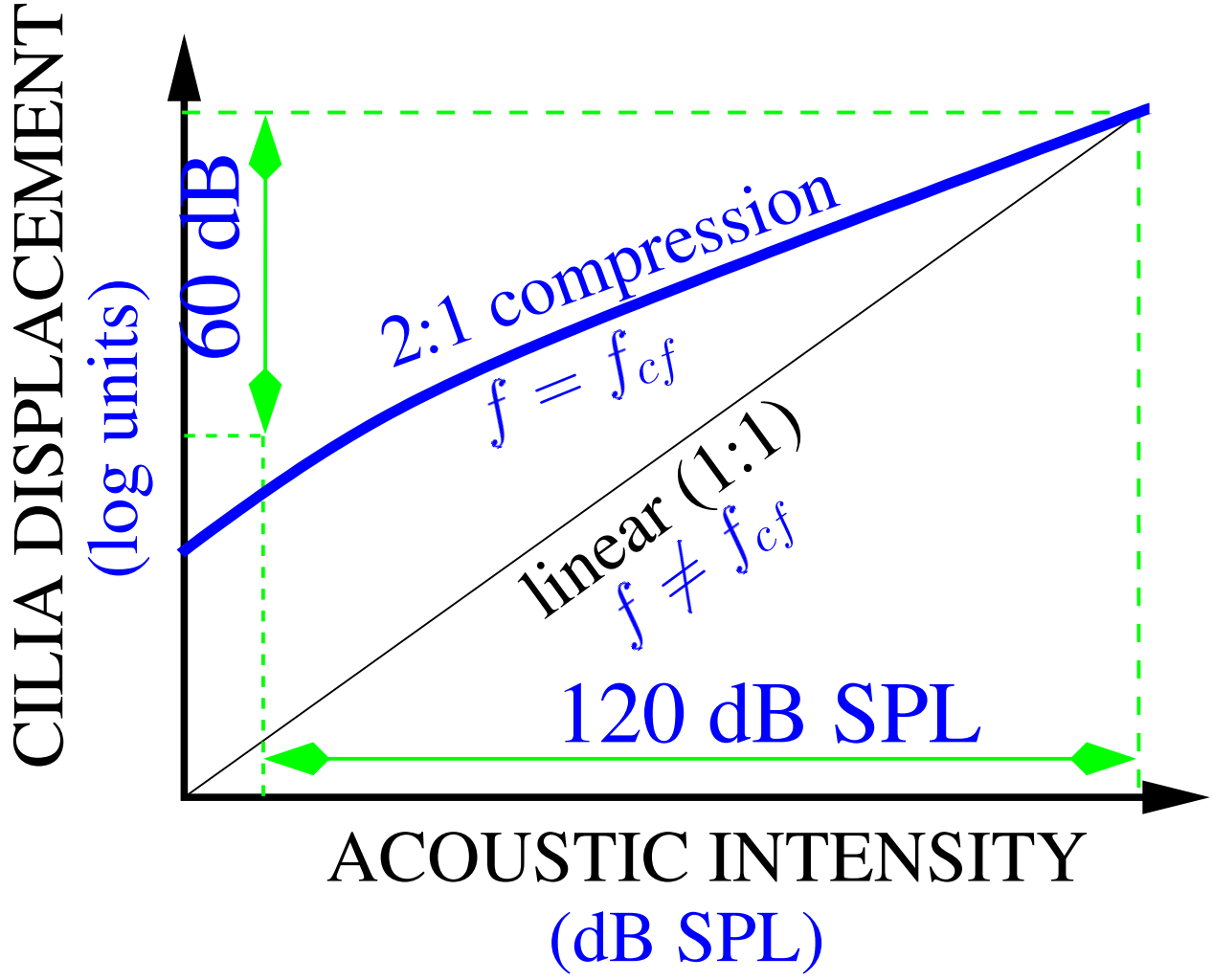
- The cochlea is highly nonlinear, with signal level
- The response is highly compressed



- This compression comes from the OHCs

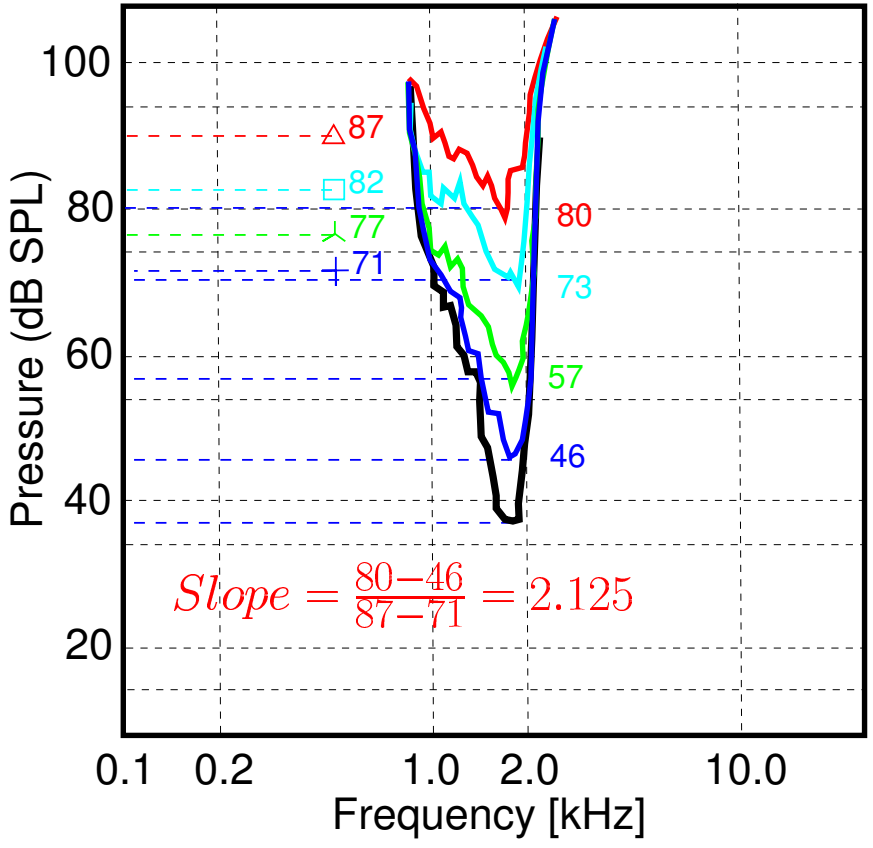
Effect of BM compression

- Small dynamic range of IHC: The need for OHCs



Two-tone suppression

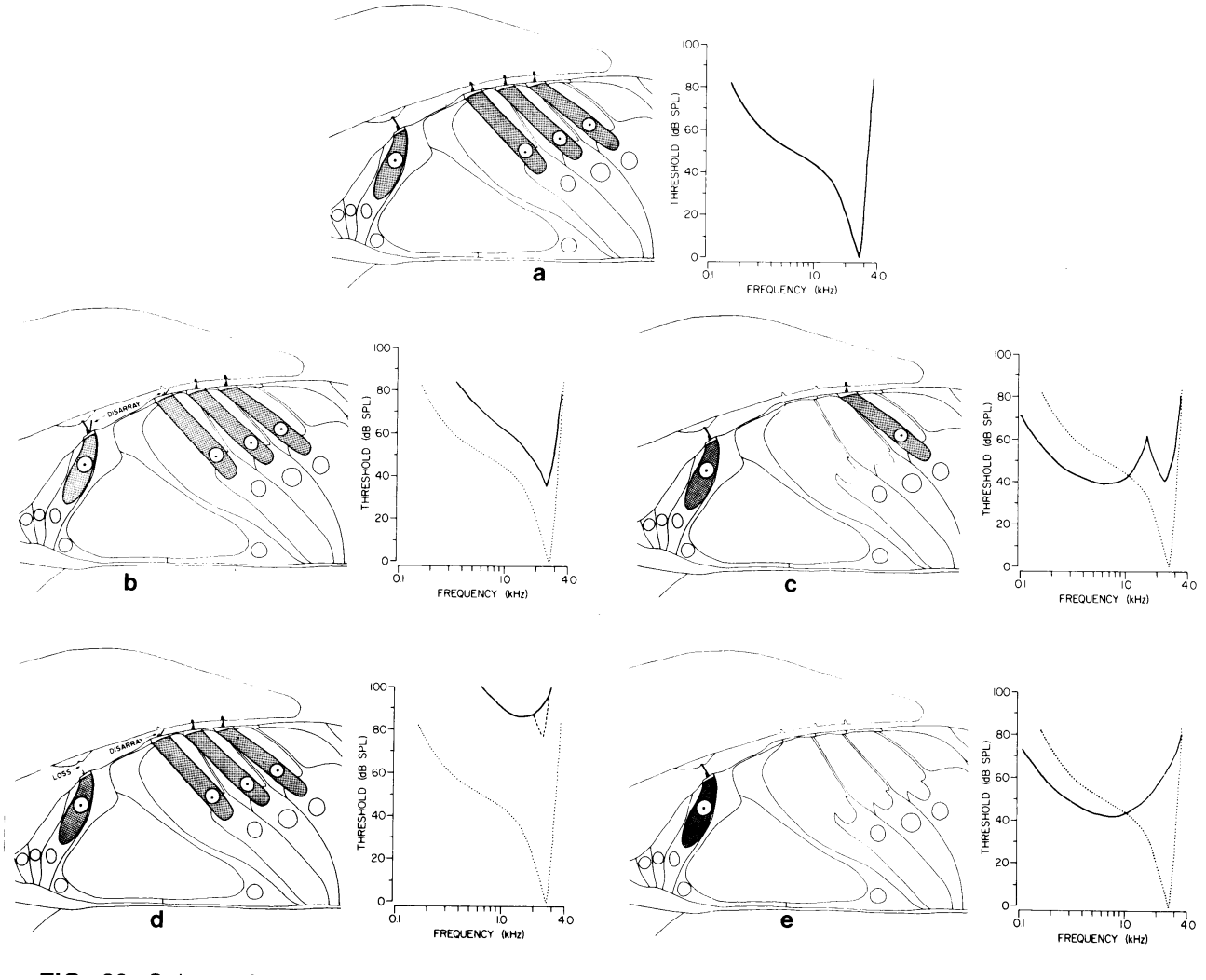
- The effect of a second tone changes the gain seen at the neuron
- The Neural response is compressed by a second tone!



- This compression comes from the the OHCs

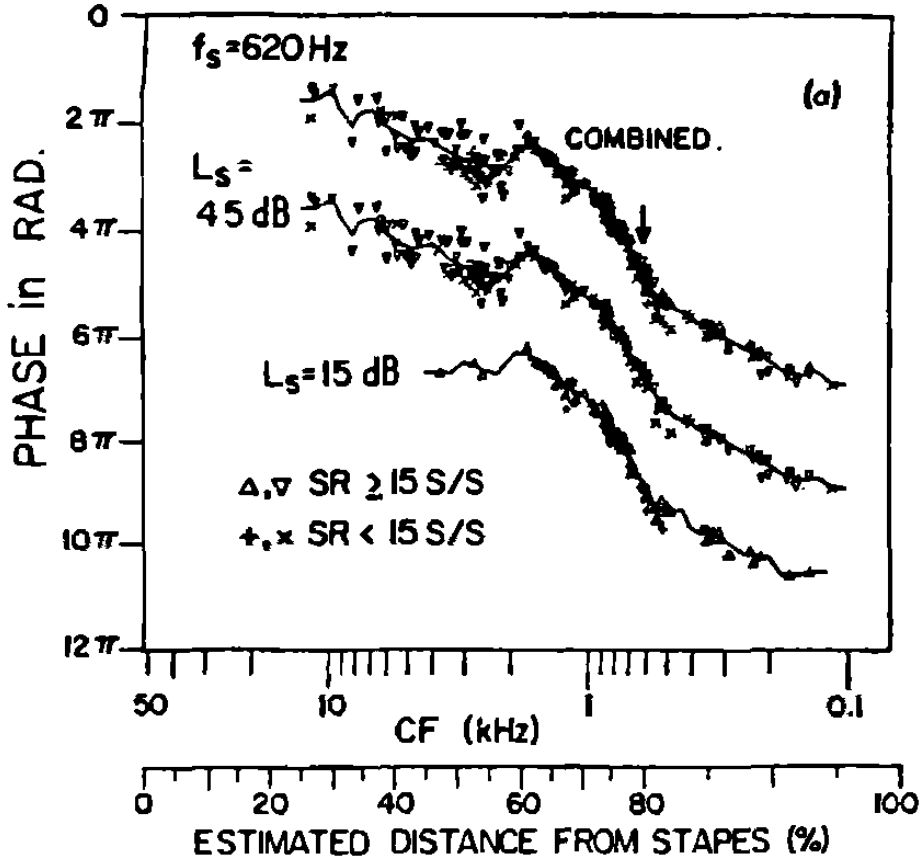
Liberman and Dodds experiment

- Noise trauma experiments of Liberman and Dodds



Neural Phase:

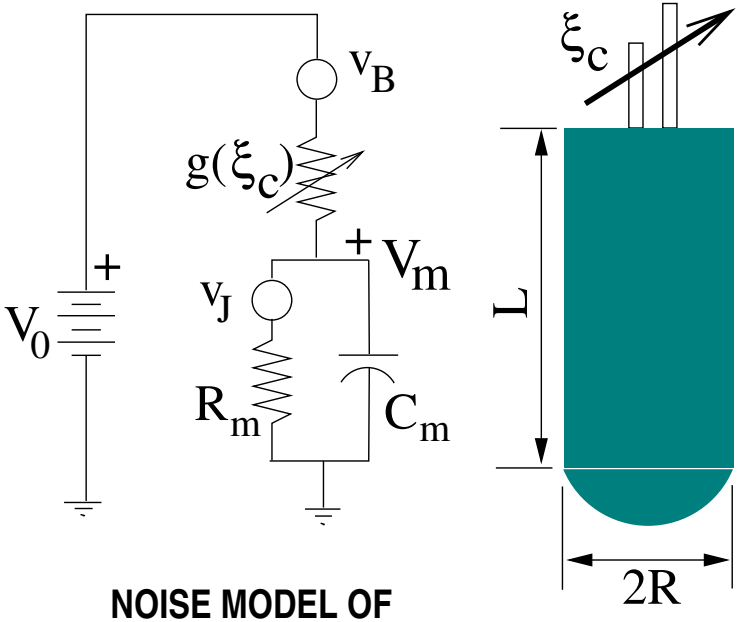
- Neural Population studies of pure tones: Kim *et al.*



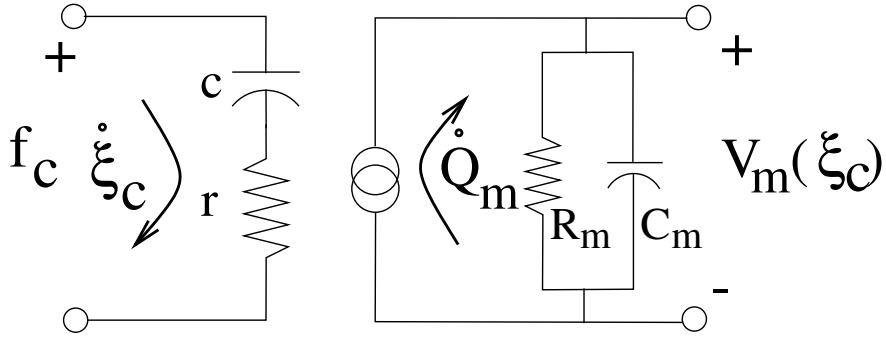
- π phase shift (from Tectorial Membrane?)

Hair cell model

- Thévenin Model of an inner hair cell (IHC)



NOISE MODEL OF
INNER HAIR CELL



FORWARD TRANSDUCTION
EQUIVALENT CIRCUIT