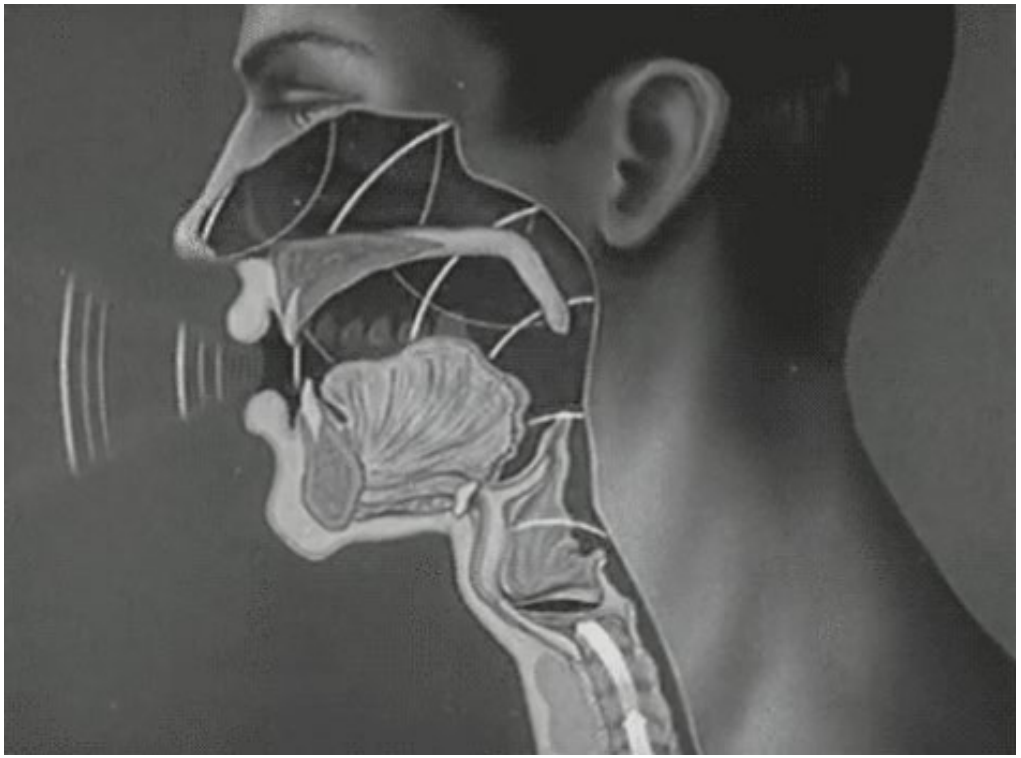
Physics 1240: Sound and Music

Today (7/31/19): The Human Voice, Language

Next time: Sound Production in Nature



Review

Types of Instruments
(Hornbostel–Sachs classification)

- Chordophones: vibrating strings

- Aerophones: vibrating columns of air

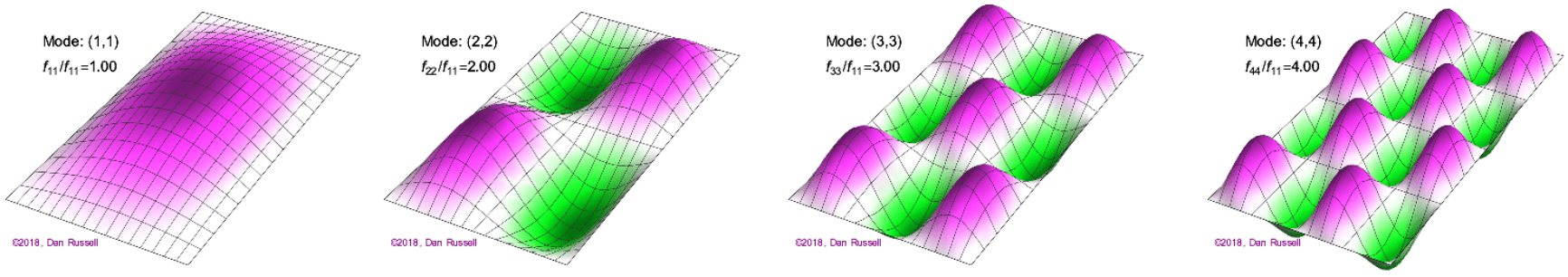
- Idiophones: vibrating the whole instrument

- Membranophones: vibrating membrane/skin

- Electrophones: vibrating loudspeaker

Review

- Natural modes in 2D: nodes are lines instead of points
- Nodes shown on Chladni figures
- Membranophones: have circular node around outer edge
- Pitched percussion: certain modes damped out due to instrument's shape or striking point
- Damping time: time it takes for amplitude to drop 60 dB



Clicker Question 16.1

How are church bells able to produce sound with definite pitches?

A) The shape and stiffness of various parts are different from an ideal circular membrane
B) They have to displace the volume of air within the bell
C) Higher modes decay quickly
D) The striking point causes many modes to be absent
E) All of the above

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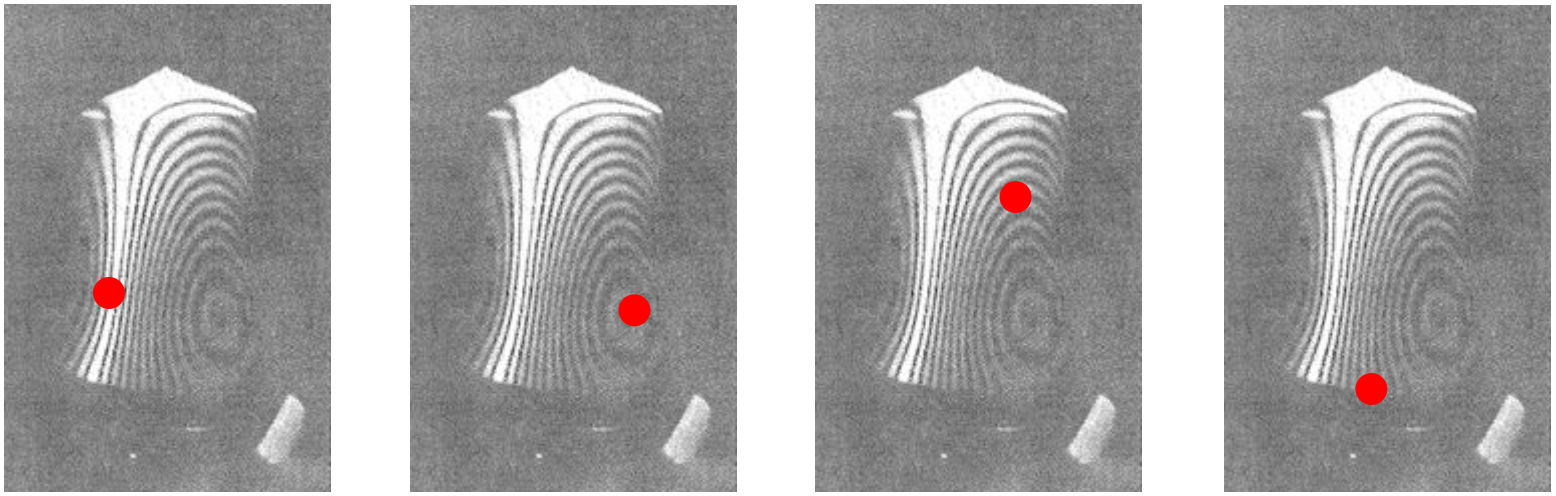
Clicker Question 16.2

Where should a hand bell be struck so that its fundamental mode (shown below) does not sound?

A) B) C) D)



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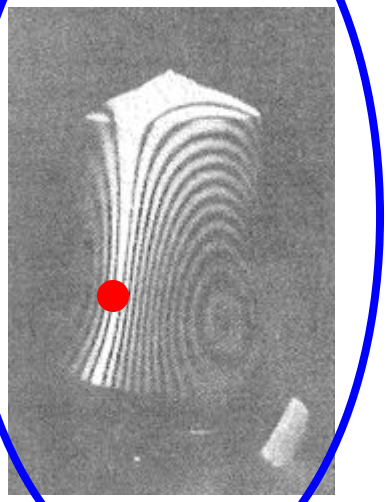
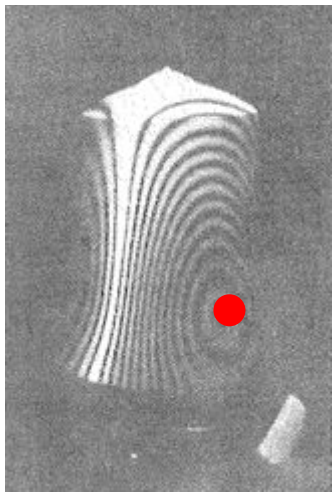
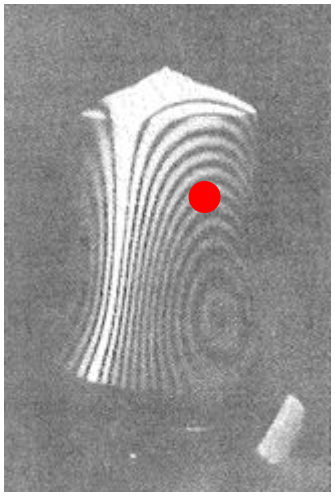


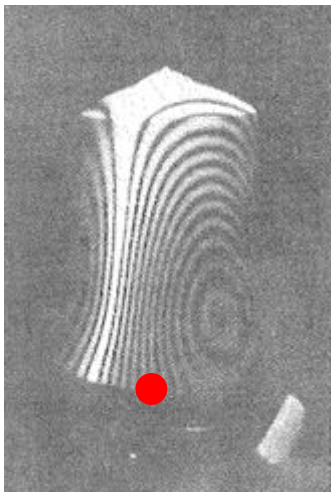
B)

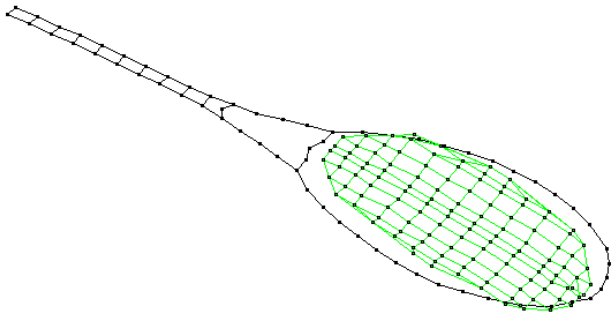


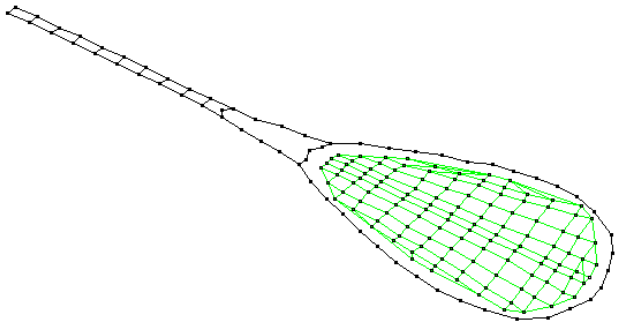
C)



D)



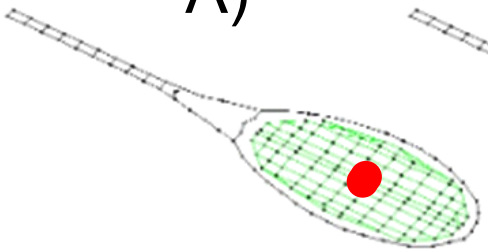




Clicker Question 16.3

If the two modes shown to the right are the only modes substantially excited in a tennis racket, at what point should you hit a tennis ball on the racket to cause the least amount of racket vibration and therefore the most energy transfer to the ball? (This is the racket's "sweet spot.")

A)



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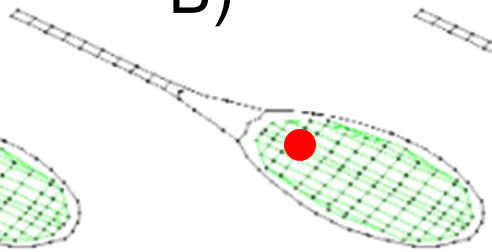

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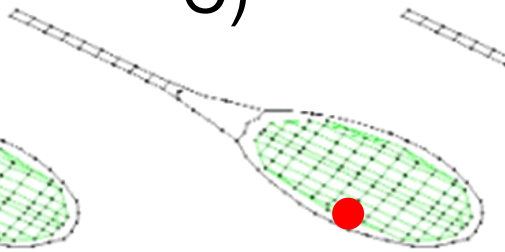

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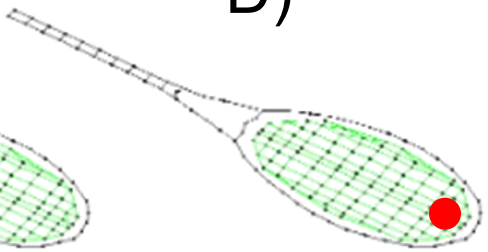

BA

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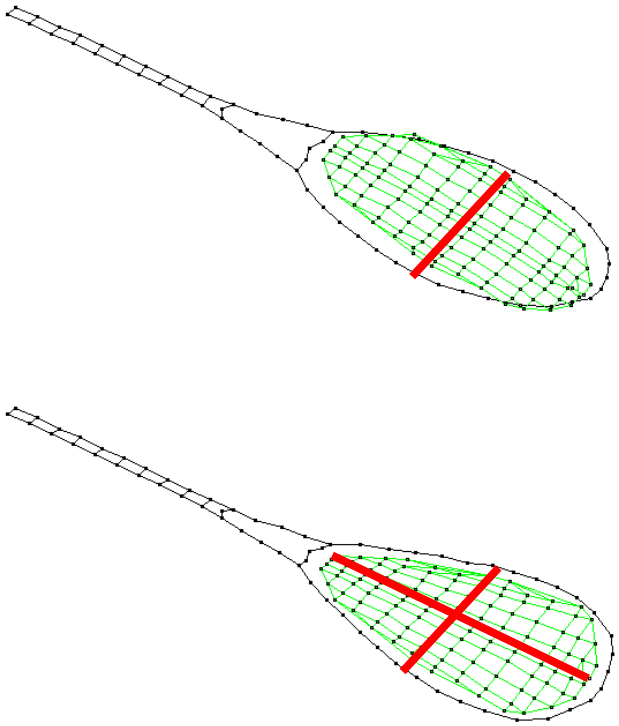

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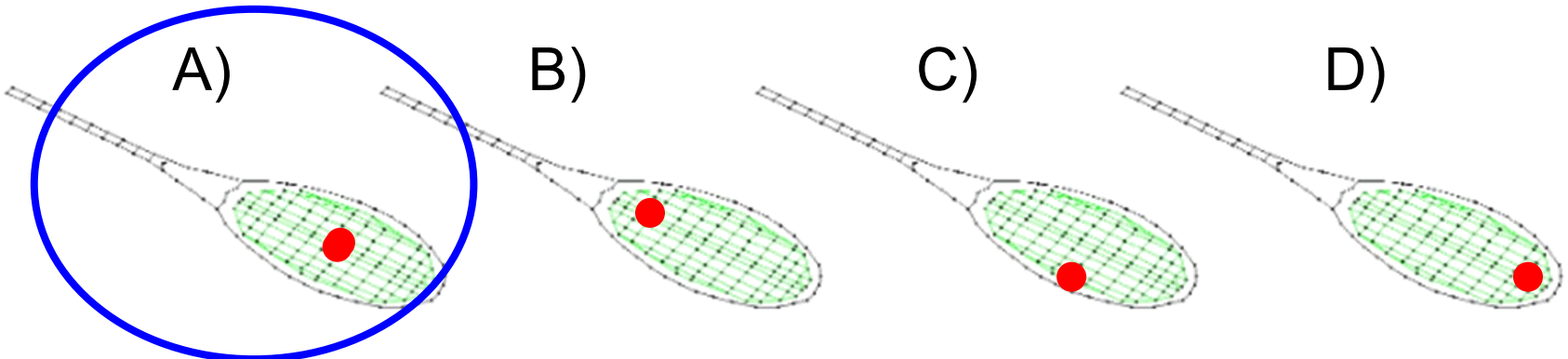

Clicker Question 16.4

If a certain mode of a timpani has an intensity that decays to 1/10th of its original intensity in 5 ms, what is that mode's damping time?

A) 5 ms
B) 10 ms
C) 20 ms
D) 30 ms
E) 50 ms

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C) 20 ms
D) <u>30 ms</u>
E) 50 ms

The Human Voice

- Phonation: the process of converting air pressure in the lungs into audible vibrations

Scientific Process

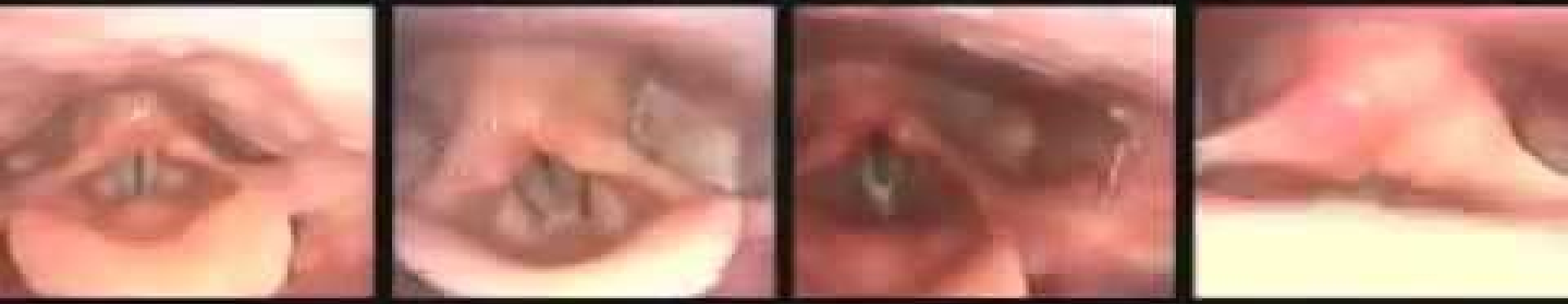
- Develop model to explain how standing waves resonate
- Use this model to determine what frequencies are possible
- Compare this model to real-life applications
- Determine mechanism behind how sound is initially produced

1. How is the sound initially produced? What models/mechanisms could we use to describe this?

2. What modes of standing waves are possible? What models could we use to describe this?

3. How can we change the sound's pitch, loudness, and timbre? What role do different parts have in this?

4. What limitations might your model have in describing vocalizations in real life?



Richard Wagner: "Oh Du, mein holder Abendstern" aus der Oper "Tannhäuser"
***Michael Volle**, Bariton*
Aufnahme: Matthias Echternach, Michael Burdumy, Louisa Traser, Bernhard Richter
(C) Universitätsklinikum Freiburg

QUARTZ