

haptician.org

inaudible music

# What is Music?

- Does it really require sound?
- Does it require transmission from musicians to an audience?
- Can other senses be trained to the resolution and subtlety of hearing?
- Can senses combine to augment this inaudible music?

# Sense and Resolution

- **Hearing:** a little less than 10 octaves, with different "Just Distinguishable Pitches" depending on frequency, but roughly 1,400 pitches.
- unfused event time resolution: about 50 ms, about 20Hz, or 1200 bpm.
- Measure, beat, event, note
- Meaningful Sound Pressure:  $> 100\text{dB}$ , from a very low level

# Synesthesia

- Mapping stimuli for one sense to other senses
- Sound -> light, light->sound
- At a higher level, event (symbol)-> event
- With more subtlety, maps multidimensional effect -> multidimensional effect

# Musical events

- They really don't exist as physical phenomena
- Don't get hung up on pitch.
- Signals in time + memory + modeling = event
- Modeling involves rules, which implies data compression
- Once sensations become symbolic, they can be synesthetic.

# Balloon Research

Balloons as haptic interfaces

- Balloons are cheap!
- With the speed of sound at a nominal 345.6 m/s
  - 1 hz = 345.6 meters
  - 440.0 hz = 0.785454 meters (78.5 cm, 30.9 in)
  - harmonics also resonate

## Harmonics of 440.0 Hz

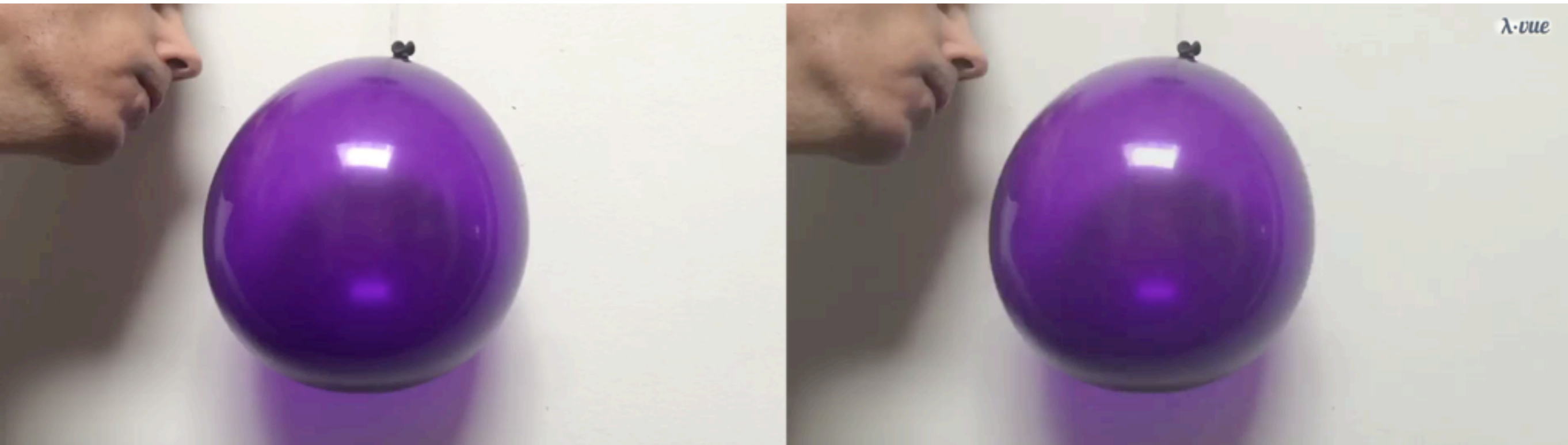
Harmonic	Centimeters
1	78.55
2	39.27
3	26.18
4	19.64
5	15.71
6	13.09
7	11.22
8	9.82
9	8.73
10	7.85
11	7.14
12	6.54
13	6.04
14	5.61
15	5.23
16	4.9

The higher harmonics here have plenty of power and are in the right size to set up standing waves in a balloon.

That means we should be able to do a cymatic test on the balloon.

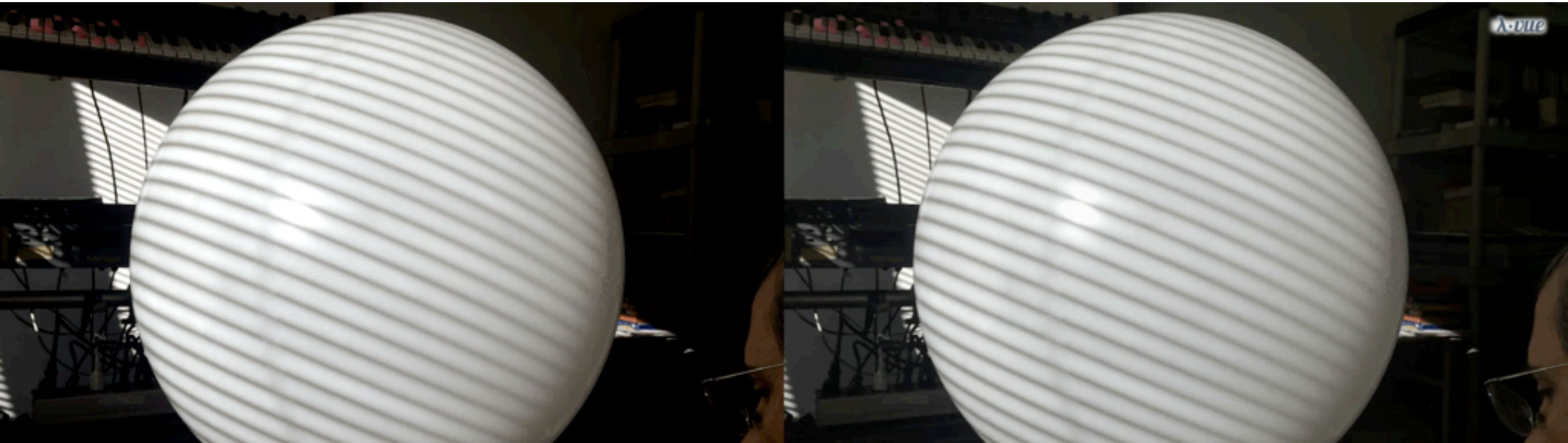


Motion amplified balloon resonating with me singing a little.



video: Thanks to LambdaView <https://lambda.qrilab.com/site/>

## More balloon motion amplification



It's not too apparent here, but with a speaker, balloon, and sine wave generator you can feel nodes and antinodes.