

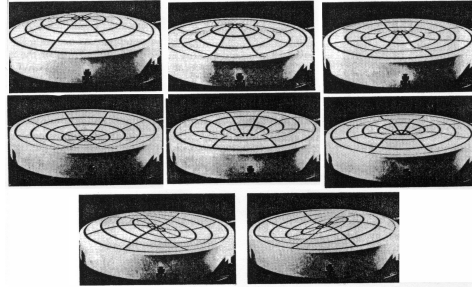
Physics of Musical Sound

Class 22
Read Chapter 13 rest.
Quiz

8/30/01

Physics 120

Drum Modes



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Physics 120

Drum Modes

- Drum modes are somewhat different because the edge is pinned but the center is now free to move.
- Can visualize drum modes by exciting the drum head with a sound wave at a normal mode frequency. The nodes lines can be made visible with fine powder in the same way as the Chladni plate.
- Like the cymbal there are two families of modes
 - Modes with circular symmetry.
 - Modes with Pie shaped symmetry.
 - Various combination modes are also possible.

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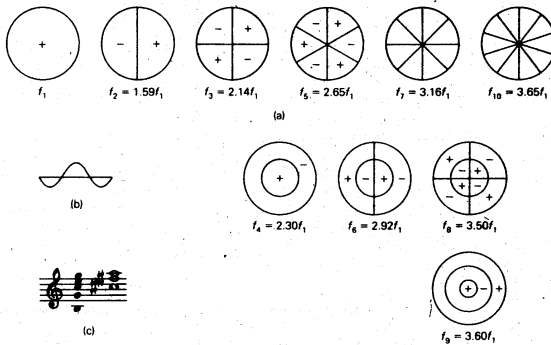
Exciting Drum Modes

- Drums follow the same basic rules as cymbals and tuned bar instruments.

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 - The length of time that the stick is in contact with drum skin determines the maximum frequency that can be excited. Any mode with a period less than the contact time will be strongly damped. Thus hard sticks produce a brighter sound than soft sticks.

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Exciting Drum Modes

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 - The player has a some of control over the duration of the contact by the way that she plays and so has extra control over the sound.

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Exciting Drum Modes

- The player can also exert a degree of control by hitting the drum at different locations.
 - Different locations will tend to excite some modes more than others. Remember that striking will most excite modes with anti-nodes near the strike point and least excite modes with nodes at that point.

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 - The length of time that the stick is in contact with drum skin determines the maximum frequency that can be excited. Any mode with a period less than the contact time will be strongly damped. Thus hard sticks produce a brighter sound than soft sticks.
 - The player has a some of control over the duration of the contact by the way that she plays and so has extra control over the sound.
 - Bass drum players sometimes put a towel over the drum skin to further dampen upper modes and so produce a lower, duller, sound.

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 - Hitting near the center of the drum will emphasize the ring shaped modes, especially the fundamental. Since the center is a node for the pie modes they will hardly be excited at all. The sound tends to be lower pitched and duller when struck near the center.

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 - Hitting near the center of the drum will emphasize the ring shaped modes, especially the fundamental. Since the center is a node for the pie modes they will hardly be excited at all. The sound tends to be lower pitched and duller when struck near the center.
 - Hitting near the edge of the drum will tend to excite the higher modes since they have anti-nodes out towards the edge. The sound will be sharper and more percussive, with many upper partials.
 - The ultimate version of this is the rim shot where the drummer hits the rim of a snare or tenor drum to produce a sharp, shot-like sound.

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Exciting Drum Modes

- Drums have an additional degree of freedom that is missing in cymbals. The player can alter the tension of the drumhead while playing the drum to alter the modes and so the sound while the note is sounding.
 - Many folk drumming traditions involve altering the drumhead tension either with a system of cords holding the drumhead in place, as in the African talking drum, or by pressing on the drumhead with some fingers while drumming with others.
- The drummer can also alter the sound of the drum (or cymbal) by lightly resting a finger on the head, this will force a node to appear where the finger rests. This will alter the sound by allowing only those modes to sound which have a node at that point.

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 - 1) Simple drums with no body are called Frame Drums, examples are the tambour/tambourine, the Irish bodhran, and the .
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 - These produce pure drumhead modes with no modification from the body. They are completely un-tuned.
 - 2) Next is a family of drums with cylindrical bodies either open at the bottom or, more commonly, closed with a second drumhead. These include the snare drum, the tenor drum, and the bass drum.
 - The body has broadly resonant normal modes that emphasize certain regions of the spectrum but the sound is basically the non-harmonic sound of a drum head.

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Drum Bodies

- 3) The Tympani have hemispherical bodies made of metal with a hole in the bottom.
 - The metal bodies make the resonances much sharper than the wooden bodies of the tenor drum family. This means that the kettle plays a larger role in determining the sound structure. In addition, the hole in the bottom is chosen to offer significant resistance to air moving in and out of the drum at low frequencies. This damps the lowest mode of the drum head and forces it to operate primarily in its upper modes. The interactions with the resonant cavity make the upper modes fairly harmonic and the Tympani have reasonably clear pitches.
- 4) There are lots of different kinds of drums with wooden or similar vegetable resonator bodies such as congo drums, djembe drums, the tabla and mrdngam of India..

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- 4) There are lots of different kinds of drums with wooden or similar vegetable resonator bodies such as congo drums, djembe drums, the tabla and mrdngam of India.
 - In these the resonator is not as active as in the Tympani but does significantly color the sound. The drums vary from strongly pitched to loosely pitched depending on the importance of the resonator.

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