

Get In The Swing of Physics

The Physics of Baseball Bats

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Physics and Baseball Web Site:
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Sorry, but I was watching the MLB playoffs and.....



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Conservation of Momentum



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Conservation of Momentum





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To understand the images produced by the camera we need to investigate two key ideas:

- Center of Percussion (CP)
- Vibrational Nodes (VN)

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Center of Percussion (CP)

We locate the CP by finding where we can hit the stick so that there is no jerk at the top. In other words, the bat goes into pure rotation.

For the simple stick the CP is $2/3$ of the way down the bat.

This is where you want to hit the ball so you don't get thrown around by the motion of the bat handle.



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Vibrational Nodes (VN)



You can demonstrate vibrational nodes with a flexible stick.

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If you wrap a paper megaphone around the top of the stick you can hear the vibrations.

The place where the sound is minimum is the VN. For the simple stick, the node is $\frac{3}{4}$ of the way down the bat.



At the node, little energy will go into bat vibrations, leaving more energy in the ball.

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The CP and the VN are in different spots for a simple stick.

If we could redistribute the mass of the stick, perhaps we could get them to overlap.

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A bat is shaped like it is because the CP and the VN are in the same spot –

“The Sweet Spot.”



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The New York Times

The Mets' Bat Whisperer



Uli Seit for The New York Times

Some people might consider the Mets slugger Carlos Beltran an eccentric: when he receives a new box of bats he likes to listen to them. "It's part of me," he said.

By DAVID WALDSTEIN

Published: June 11, 2011

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Using this rubber bat, you can actually see the “sweet spot!”

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Back to the images from the camera...



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Inside the Sweet Spot



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Outside the Sweet Spot



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On the Sweet Spot!



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On the Sweet Spot!





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Breaking Bat?

The bat breaks because the amplitude of the vibrations exceeds the elastic limit of the wood fibers in the bat.

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Broken Bat Outside the Sweet Spot



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Broken Bat Inside the Sweet Spot



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Why does the Cardinal's shortstop move the wrong way at this critical moment in Game 7?



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The high speed camera reveals a truly remarkable event.



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The high speed camera reveals a truly remarkable event.



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What have we learned?

- A baseball bat is shaped in such a way to have a “sweet spot.”
- The sweet spot is due to the fact that the CP and the VN coincide.
- The vibration of the bat takes energy away from the ball. So, well hit balls are struck at the sweet spot.
- The bat breaks when large amplitude vibrations reach the thin part of the handle.
- All of this is verified in actual games with high speed video.

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For more baseball physics activities:

phys.csuchico.edu/baseball

