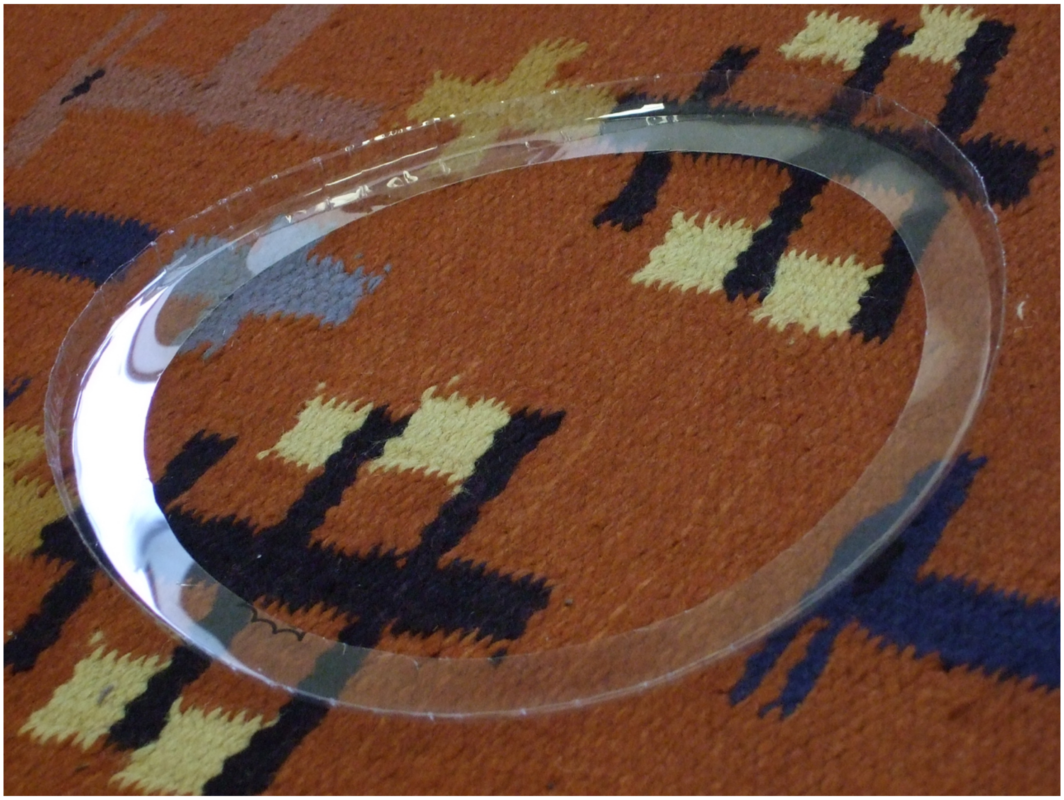

DIY Mylar Flange for a More Mellow Banjo Head

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A second mylar head is easily fashioned into a horizontal annular flange, inspired by the Bacon and Dobson tone rings. Its effect is dramatic, suppressing the “ping” associated with the attack sound of metal picks on metal strings on taut mylar heads but leaving most other features unscathed. The flange itself takes only minutes to make. An old or previously torn head can be used. It is installed directly under the regular head, without any further modifications, and, so, can be removed with no harm done.

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I. INTRO & OUTLINE

FIG. 1. A Deering Goodtime fitted with a home-made mylar flange

A friend, who is *very* serious about banjo sound, asked if I could think of a way to eliminate or reduce a particular "ping" that he sometimes finds undesirable. It is a common occurrence with metal picks on metal strings on a taut mylar head on a resonator banjo that is part of the "attack" or early sound of the pick. Changing any of those features — and, in fact, any variations of set-up that I imagined — worked on the ping, at least to some degree, but came with other undesired consequences as well. A further, crucial desideratum is retaining the highest degree of reproducibility of the sound from the set-up. I then thought of the Bacon tone ring, whose horizontal flange turns some of the ringing of a head near its edge into more of a thud.[1]

Installing a different tone ring in a particular banjo may well require irreversible wood removal or may simply be impossible. Why not make the horizontal flange out of a second mylar head? It is easy to do, inexpensive, and totally reversible. And the change in sound is dramatic. The result is related to but not identical with the sock or sponge that some open-back players stuff between the dowel stick and head just behind the neck joint.

Head taps isolate the key change in the banjo's response. So a recording of those sounds is given in section II — as well as the sound on picks of a single string. A description of the actual fabrication is sketched in section III. Samples actual playing (section IV) are the proof of the pudding. Although now a standard for many players and listeners, mylar heads were first adopted (around 1959) as a compromise between sound quality ("They sounded awful!") and practical considerations of professional musicians. In a linked interview, J.D. Crow describes his experience. (See section V.) An attempted physics explanation (common to the Bacon ring[1]) is reviewed in section VI. No calculations are provided, and the arguments are certainly *a posteriori,* but they do suggest subtle differences that might be expected from slightly different implementation of the flange construction — in particular, how one might obtain somewhat less dramatic results if desired.

II. HEAD TAPS & SINGLE STRING PICKS

Most banjo players know to pluck or strike the strings rather than only hitting directly on the head. However, direct head taps can isolate important physics if the issue is the mechanics of the head itself. After all, essentially no produced sound comes directly from the strings. Rather, the strings get the head to vibrate, and it is the head motion that moves and compresses air. Tapping the head directly can give an exaggerated view of the head's sound-producing response to its being pushed.

In the accompanying recording, a piano hammer is used to tap the head in a sequence starting near the center and ending at the rim. The microphone is at $\sim 42''$. The first set is a stock Goodtime[2]; the second set is a Goodtime with the featured mylar flange installed. The strings were tuned to pitch but damped. The heads were identical and tightened to DrumDial 90. Both had a $1/2''$ plywood snap-on flat disk resonator back.

The Sound of Head Taps: If you're Web-enabled, the following link might be live; otherwise it should be retrievable.

http://www.its.caltech.edu/~politzer/mylar-flange/head-taps-disk-back.mp3

FIG. 2 is a spectrogram of that head tap recording. Time is horizontal in seconds. Frequency is in distinct bins, going vertically on a logarithmic scale. And intensity is color-coded, with a gain of 35 dB per distinct color.

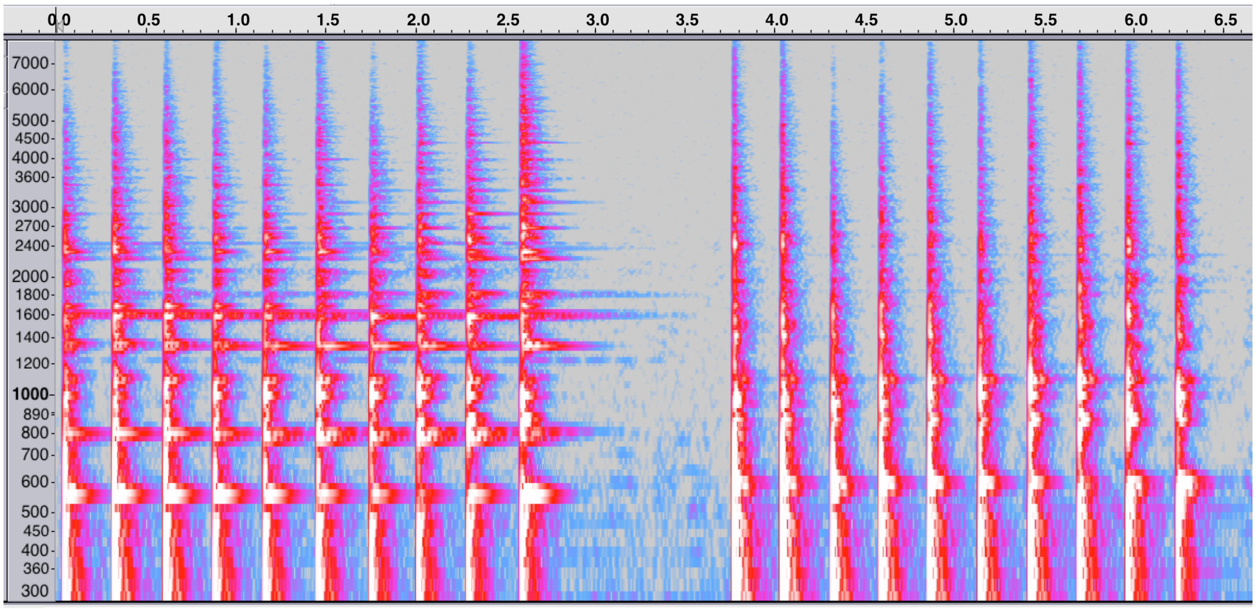

FIG. 2. Spectrogram of the head tap recording; taps start near the center and move outward to the rim, first on the stock banjo and then with flange installed

Single String Picks: Here is the sound of a (dental) pick on the 1st string, one inch from the bridge. The first set is on the standard head; the second has the mylar flange.

http://www.its.caltech.edu/~politzer/mylar-flange/1st-string-picks.mp3

III. DYI

The Bacon tone ring was studied in ref.[1]. A conclusion was that the vibrations of the horizontal flange directly under the head absorbed some of the highest frequency energy and also reduced its radiation efficiency. FIG.s 3 and 4 illustrate the Bacon ring currently sold by Stewart-MacDonald. For installation, the wood rim must be turned appropriately to get a good fit. Here I describe a much simpler flange made out of a second mylar head.

FIG. 3. The Bacon tone ring, as currently produced by Stewart-MacDonald

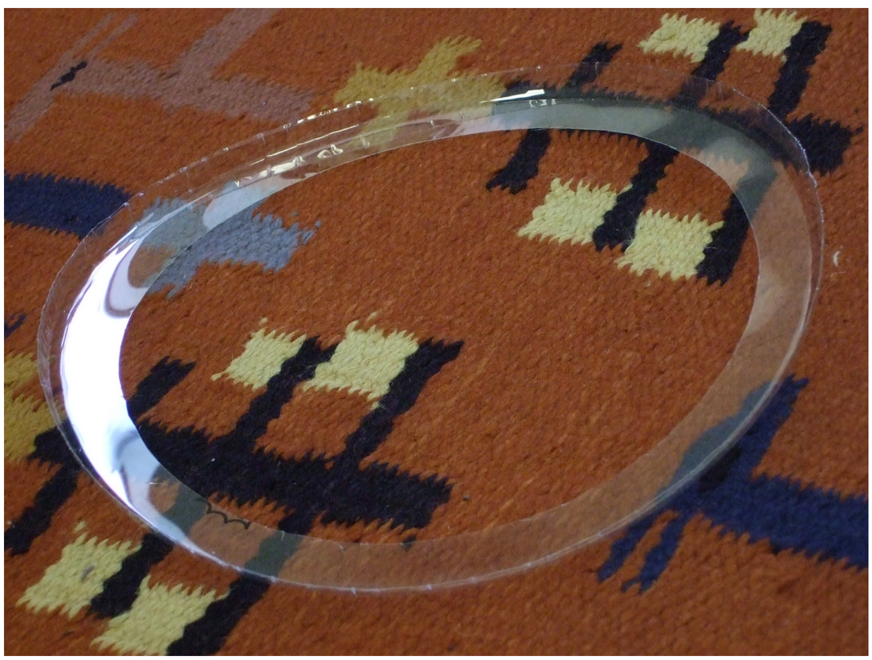

FIG. 4. Mylar ring cut from a clear mylar head

My own method was a follows. Draw concentric circles, $10\frac{1}{2}''$D and $9''$D on a piece of paper. Cut out along the larger one, and tape it to the inside of the head to be cut. (Out of some old heads lying around, I chose a clear one because it was the thinest and floppiest. I think that a frosted one (new, old, or torn) would do as well.) Cut the paper and head along the $9''$D circle. Cut the head hoop off the remaining head ring, as close to the hoop as possible. (I used a single edge razor blade. The “hoop” is the aluminum ring into which the mylar is bonded.) The resulting ring is shown in FIG. 5. That ring easily snaps into the underside of a regular head, which is mounted as usual — as shown in FIG. 1. That’s it.

IV. SAMPLE PLAYING

Here are samples of the two Goodtimes with wood disk backs, played with metal picks (including the thumb). You should be able to tell which is which.

http://www.its.caltech.edu/~politzer/mylar-flange/RGD-A.mp3

http://www.its.caltech.edu/~politzer/mylar-flange/RGD-B.mp3

V. A BIT OF HEAD HISTORY

Jim Mills did an interview with J.D. Crowe in 2014.[5] It's a treasure for any fan or history buff. Well into the half hour, i.e., around the 21:30 mark, they start talking about heads. Plastic only came in around 1959, "and I hated it," said Crowe. "...The first time I put one on... I thought 'Oh, no!'" ..."But I kinda dealt with it... The good thing was: I didn't have to change heads every week." Regarding skin heads, "Sometimes I busted a couple a week. Back then, they were still nineteen, twenty bucks." Mills: "Very expensive." "I hated the change, but it was kind of a necessity."

FIG. 5. Oh, no! So sad... Neglected to loosen before the humidity plummeted

Humidity softens a calf skin head, allowing it to stretch substantially when under tension. It shrinks up again when the humidity drops and it dries. A traveling, professional musician encountered variations so large and rapid that the extremes of barely playable at one end and self-destructed at the other were frequently encountered. So the "traditional," beloved sound was sacrificed for practicality.

To be sure, some people still use skin heads — purchased ready-made or mount-and-stretch yourself. A ploy sometimes used on open-back banjos with mylar heads is to wedge something soft (often a sock or piece of sponge) at the head's edge between it and the dowel stick. That shares some of the same physics and has some of the same effects.

VI. PHYSICS IDEAS

The region near the edge of the head plays a special role in banjo timbre for two reasons. Quantitative calculations do not exist and would be hard to produce. However, a simple, qualitative picture distinguishes high from low frequencies. First, at a given frequency of vibration, the head has adjacent regions of opposite motion. If it is a "high" frequency, then there are many small such regions. The ones at the edge are most effective at producing sound because they have the fewest neighbors going oppositely. The combined sound effect at a reasonable distance from the head involves substantial cancellation between such opposing neighbors if the wavelength on the head is small compared to the wavelength in air. (Over the range he studied, Joe Dickey's calculations[6] suggest that the waves in air are about three times longer than on the head.) This "edge" radiation efficiency can be demonstrated in calculations involving simpler geometries.[7]

The second edge effect is the effectiveness of some external, applied force at damping head motion of a given frequency near the edge. All head motions essentially go to zero amplitude as you approach the edge. However, the high frequencies will have maxima of their motion near the edge, while the low frequencies won't be moving much until you get further inward. Hence, near-edge damping is more effective on higher frequencies. The under-edge flange absorbs energy from the area above it when it is set into motion. It may also be relevant in producing extra dissipation in the air flow that would otherwise move more freely in the volume directly between it and the head.

To the extent that these ideas are correct, it seems that a narrower flange annulus would only begin to be effective at higher frequencies. Also, stiffer flange material might itself absorb less vibrational energy.

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[1] D. Politzer, *A Bacon Tone Ring on an Open-Back Banjo*, HDP: 16 – 01, www.its.caltech.edu/~politzer

[2] Rather than acquire yet another banjo, I used ones readily available. The "stock" Goodtime had a normal height rim used in ref.[3], i.e., with a no-knot tail piece and coordinator rod positioned slightly higher than normal. Note that, if the only difference between the two banjos were the tailpieces, then the no-knot is well-understood to give less ping and a more mellow sound than the standard Goodtime tailpiece[4], though the difference due to tailpiece alone is far more subtle than the difference under discussion here.

[3] D. Politzer, *The Open Back of the Open-Back Banjo*, HDP: 13 – 02, www.its.caltech.edu/~politzer

[4] D. Politzer, *String Stretching, Frequency Modulation, and Banjo Clang*, HDP: 14-02, www.its.caltech.edu/~politzer; and *Banjo timbre from string stretching and frequency modulation*, HDP: 14-03. Acta Acoustics u. w/ Acoustica **101**(1) 1, January 2015 (also at www.its.caltech.edu/~politzer)

[5] You should first try Jim Mills' Web site for the interview with J.D. Crowe: http://prewargibsonbanjos.com/crowe/. It's also posted on YouTube: https://www.youtube.com/watch?v=g4fxjdjYwwA. If all else fails, I've placed a copy with my archive: http://www.its.caltech.edu/~politzer/mylar-flange/JDCrowe-JimMills.mp4

[6] J. Dickey, http:www.joedickey.com → PHYSICS → LAY LANGUAGE PAPER ON THE DYNAMICS OF THE BANJO: *The Banjo: the Model Instrument*; *The structural dynamics of the American five-string banjo*, J. Acoust. Soc. Am., **114**(5) 11/2003, p 2958

[7] A. Chaigne and J. Kergomard, *Acoustics of Musical Instruments*, §13.4.3, Springer (2016); E. Skudrzyk, *Simple and Complex Vibratory Systems*, ch. 12, Pennsylvania State University Press (1968). I believe I came across this discussion in another text, too, where circular membranes were discussed. The very center can also be special in terms of incomplete cancellation and effective radiation. But I've been unable to remember where or to locate it. A heads up would be welcome.