What is all the fuss about Fluxor and Tesla?

Fluxor is Audeze's patented technology that lets us pack more Teslas (a measure of the strength of magnetic flux, i.e. magnetic induction) in our planar magnetic drivers.

Planar magnetic drivers use a flat, lightweight diaphragm suspended in a magnetic field created by an array of permanent magnets. The diaphragm is a thin film with conductors spread across its surface. When current flows through the conductor, the magnetic field exerts force on the conductor, thus causing the conductor and the diaphragm to move (see Lorenz force in action). This movement of the diaphragm is what produces the sound you hear.

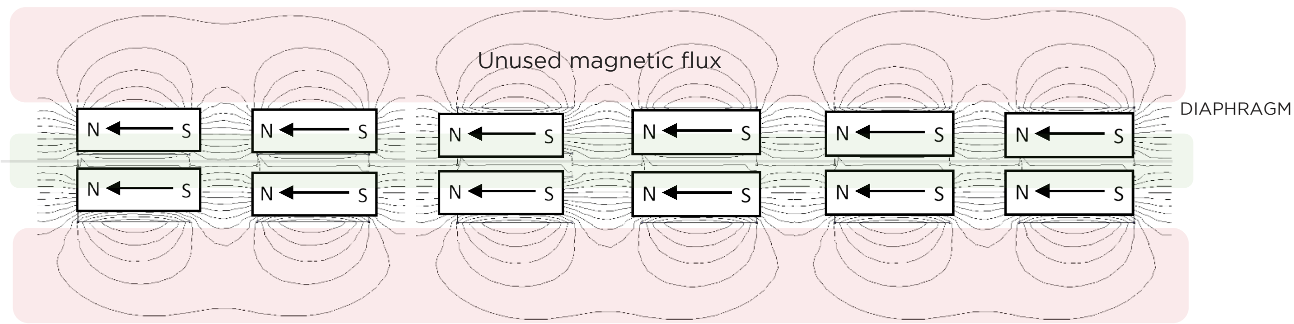

Fig. 1: Example planar magnetic array, similar to one used in LCD-3 series

In a typical planar magnetic transducer design, only part of the magnetic field, the magnetic field from the magnetic array facing the diaphragm is used. The magnetic field on the opposite side of the magnetic array is wasted or redirected by steel poles. This is like throwing away half the magnets or adding a lot of extra mass using steel! Magnets and/or added steel contribute to the majority of the weight of a planar magnetic driver.

It can be seen (Fig. 2 and Fig. 3) that in the magnetic circuit used by LCD-3, in spite of being an unconventional open circuit design and 'throwing away' the magnetic flux on the other side of the diaphragm, still results in a very uniform and strong (0.5 T) magnetic flux sandwiched between the magnets (red line in Fig 2). The LCD-3 circuit does not waste the space between adjacent magnets either (blue dotted line in Fig 2). Here too we manage to keep the flux relatively uniform and strong (Fig 4).

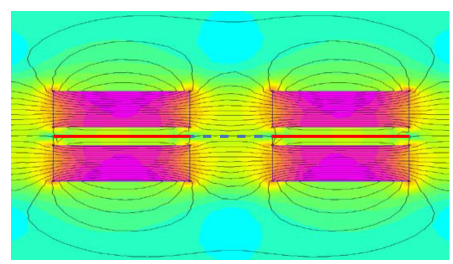

Fig. 2: Simulation of magnetic flux for an arrangement similar to one used in LCD-3

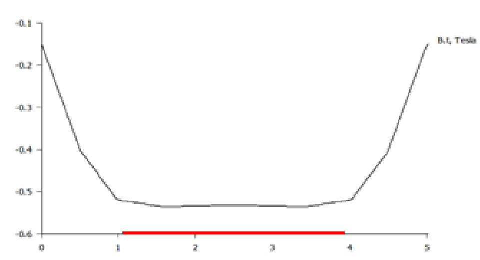

Fig. 3: Strength of magnetic flux as measured in the space sandwiched between magnets (at the red line)

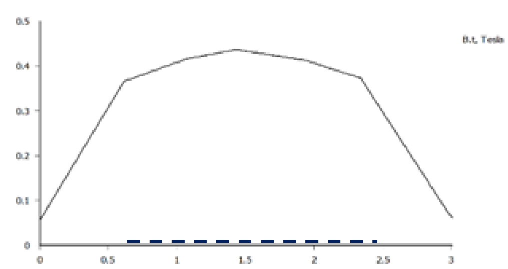

Fig. 4: Strength of magnetic flux as measured in the space between adjacent magnets (at the blue dotted line line)

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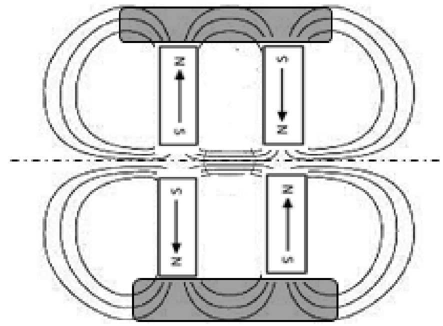

Fig. 5: A typical magnetic circuit design with steel plates used by most non Audeze planars

Fig 5 shows a more conventional magnetic circuit design where magnets are laid vertically and stators (steel plates) are used to redirect some of the magnetic flux. However, this design has some disadvantages. Though it results in increased magnetic flux, this increase is not uniform hence the resulting force on the diapghram is not uniform either. This can be seen in Fig. 6 and Fig. 7.

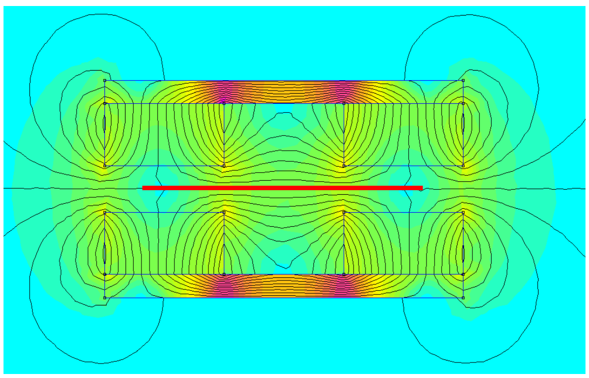

Fig. 6: Simulation of magnetic flux for a conventional magnetic circuit that uses steel plates

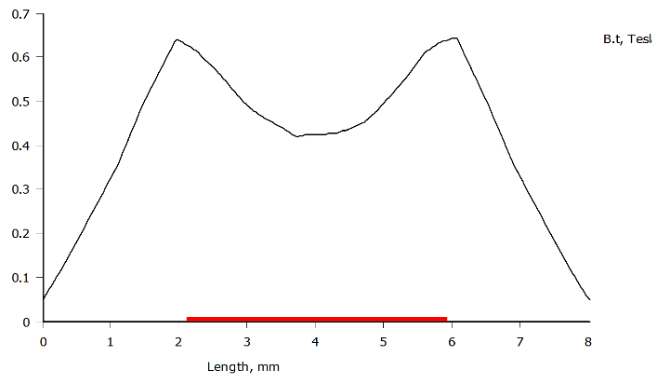

Fig. 7: Strength of magnetic flux as measured in the space sandwiched between magnets (at the red line)

What if one could push all the magnetic flux (well, most of it) to the portion of the magnets facing the diaphragm with minimal flux on the opposite side? This would have multiple implications and offer greater design flexibility:

- For the same weight of magnets we could create a stronger magnetic field (i.e., pack more Teslas), this would help us exert higher force on the diaphragm with better control of its motion and result in the smooth response you are so used to in Audeze's.
- A stronger magnetic field would mean higher efficiency and less current to drive. We have designed some of the most efficient planar magnetic drivers in the world.
- With a stronger magnetic field we could use thinner conductors without compromising too much on efficiency. Thinner conductors lead to higher total conductor length and increased total force. This leads to faster diaphragm movement and more transparent sound.

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There are a myriad ways to arrange magnets around a diagram, but it is common for the magnets themselves to be magnetized either horizontally or vertically (Fig. 8). The Fluxor array uses a novel patented approach where the magnets are magnetized diagonally (at 45 degree angle, Fig. 9) and arranged in pairs touching each other. On each of these pairs, the North and South poles near the diaphragm correspond to corners facing away from each other and result in a larger magnetic field. On the opposite side, the corners North and South poles of the adjacent magnets touch each other and the magnetic field is nearly canceled out.

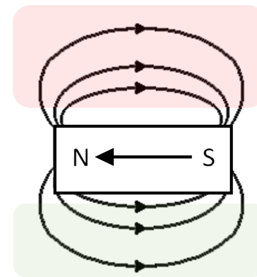

Fig. 8: A magnet magnetized horizontally (used in our LCD line of headphones, except LCD-4)

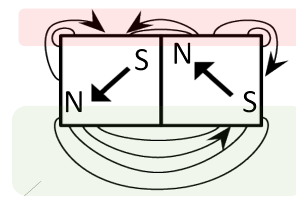

Fig. 9: A pair of Fluxor magnets similar to one used in LCD-4

Using the Fluxor magnets, we have managed to pack a whopping 1.5 Tesla between magnets in our LCD-4 headphones. This is similar to the magnetic field inside a MRI scanner! Fig. 10 shows an example magnetic circuit similar to one used in LCD-4.

Fig. 11 shows the magnetic flux distribution for a Fluxor magnetic array. It can be seen in Fig. 12, a peak magnetic strength of 1.5 T is reached in the space sandwiched between pairs of Fluxor magnets (as measured at the blue line). Rest assured, the magnetic field of 1.5 T is restricted to the gap between magnets and is cancelled outside. However, we advise you not to bring your credit cards too close to our headphones.

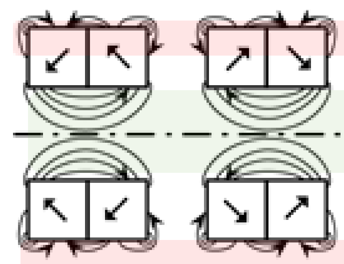

Fig. 10: A Double Fluxor magnetic array, similar to one used in LCD-4

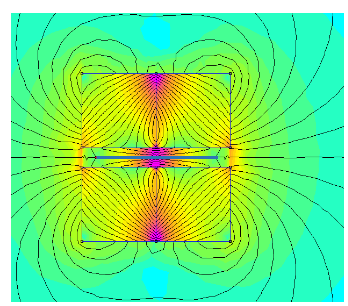

Fig. 11: Simulation of magnetic flux for a double Fluxor magnetic array

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