You are living inside a massive musical instrument – and here's what it sounds like

23 February 2017, by Martin Archer

Credit: NOAA/NASA GOES Project

The ancients believed that the Earth was surrounded by celestial spheres, which produced divine music when they moved. We lived, so to speak, in a huge musical instrument. This may sound silly but modern science has proved them right to a certain extent. Satellites recording sound waves resonating with the Earth's magnetosphere – the magnetic bubble that protects us from space radiation – show that we are indeed living inside a massive, magnetic musical instrument.

There are two key things which control how the notes of musical instruments sound: the size and shape of the instrument and the speed of sound throughout it. These determine the pitch of the notes and the timbre, the character or quality of the sound, via the standing waves or resonances that are excited within the instrument as sound waves bounce around it. It's elegantly simple, yet explains the rich variety of musical sounds that are possible.

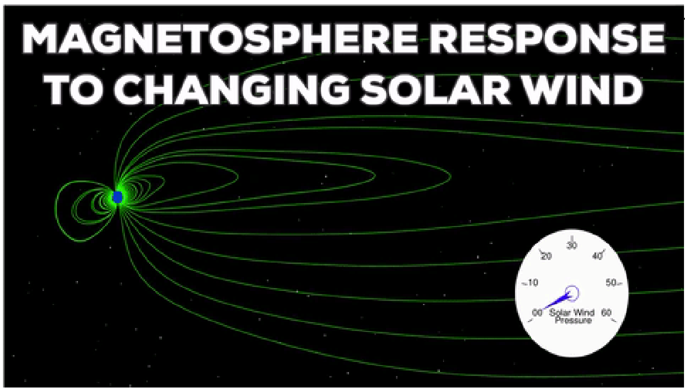
The same is true within Earth's protective magnetosphere, which is carved out by the solar wind. There are always a few sound waves – oscillations in pressure which travel through the medium that they're in – travelling around in space.

Well, they aren't exactly the same type of sound waves that we get on Earth. Space is filled with plasma rather than normal gas: a different state of matter made of charged particles which can generate and be affected by electric and magnetic fields. These kinds of interactions can give rise to the plasma-equivalent of sound waves: magnetosonic waves. These too are pressure waves, but with some added magnetism.

Such "magnetosonic" waves can bounce around within the magnetosphere and often set up "resonances", where the frequency is just right so that these waves grow and grow in energy rather than fizzling out quickly.

Most musical instruments support just one type of resonance – be that the vibrations of a string such as in a guitar, surface waves on a membrane like on a drum, or sound within a cavity like in a flute. However, the magnetosphere has analogues of all three of these types of resonance going on at once.

Another difference between Earth's magnetic instrument and the ones we're more used to is how it changes in time. Play a note on a musical instrument a few minutes, hours or even days apart and you wouldn't expect much of a difference in the sound produced. That's because not much has changed. Sure, eventually the instrument may need retuning by say tightening up the strings, but that's usually after quite some time.



Constant retuning

The magnetosphere, on the other hand, is almost always changing – it grows and shrinks in direct response to the ever fluctuating solar wind. One would imagine this should change the notes of the magnetosphere, given how a musical instrument works.

This is a topic I've been working on recently. The problem is that you can't just listen to how the notes change because it's often not possible to be sure what triggered the waves detected or what sort of resonance built up, simply because we don't have satellites placed at all points throughout this "instrument" listening to these sounds.

One potential way around this is to calculate how all the different types of notes should change using computer models of the magnetosphere under the different observed conditions. This approach has suggested a considerable amount of variability in these notes, some 35 to 105 percent. This is comparable to between five semitones and an entire octave. Thankfully, these models have also has revealed at least some of the controlling factors such as the density of the solar wind. Of course, these are only calculations and need to be tested against reality to be sure, so there's still more work to do.

We can't actually hear these magnetosonic waves in space – the levels are far below the human hearing threshold. But satellites can pick up the sound and we can then amplify them and squash them in time to make them audible.

These notes are hidden among the full set of space sounds I've posted online and now you can download the whole lot to do what you like with them. In fact, I'm inviting short films that incorporate these sounds in some creative way as part of a competition. This is your chance to play the strange magnetic musical instrument that you've unwittingly been living inside your whole life – whether you manage to produce divine melodies or not.

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