

# MUSIC OF THE SPHERES ver 1.1

cosmic emulation synthesizer

## User's Guide

**MUSIC OF THE SPHERES** ver 1.1 created by Sean Luciw

SUN MERCURY VENUS EARTH MARS JUPITER SATURN URANUS NEPTUNE PLUTO

SPEED  
34 Octaves Up

GRADIENT  EXACT OCTAVES

STOP  GO

SPINS

ORBITS

click to pause

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## **MUSIC OF THE SPHERES ver 1.1**

### cosmic emulation synthesizer

standalone music software created by Sean Luciw  
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Music Of The Spheres  
version 1.1  
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created using Synthmaker

## **SYSTEM REQUIREMENTS**

Processor: Pentium III/AMD with SSE support  
Speed: 1200 MHz  
Memory: 256 MB RAM  
Operating system: Windows 2000 or XP

## **DISCLAIMER**

This software (Music Of The Spheres ver 1.1) is provided "as is" without warranty of any kind. The author makes no guarantee of correctness, accuracy, reliability, safety or performance. The user alone is responsible for determining if this software is safe for use in their environment. Neither the author nor anyone else who has been involved in the creation or delivery of this product shall be liable for any direct, indirect, consequential, or incidental injury or damages arising from the use or inability to use such product.

## **INSTALLATION**

To install Music Of The Spheres ver 1.1, simply double-click the file *MusicOfTheSpheres\_v1.1\_Setup.exe* and follow the instructions.

On the last page of the install procedure, you will have a chance to view the .pdf version of this User's Guide. You will also see a checkbox prompting whether or not you want to launch the Music Of The Spheres program upon completion of the installation.

A shortcut to the program will be installed on the desktop. The Start menu will contain shortcuts to the program, the User's Guide and the Uninstaller.

## **UNINSTALLATION**

If you decide to uninstall Music Of The Spheres for some reason, use the Uninstall shortcut in the Start menu.

## **LICENSE**

Version 1.1 of Music Of The Spheres is donationware. Donations are gratefully accepted at <http://seanluciw.com>, where the program is also available for download.

## INTRODUCTION

Our planet spins around in a full 360 degree circle once every 24 hours. Repetitive occurrences (such as spinning) automatically produce musical tones. So, the Earth is singing. However, its voice is so slow, and so low, that our tiny eardrums are unable to ride its wave. Just as a dog-whistle is too high-pitched for humans to hear, the Music Of The Spheres is too low.

In music composition and performance it is common practice to raise or lower the pitch of a melody, chord, or song without sacrificing the integrity of its internal structure and emotion. A fun way of doing this is to adjust the speed slider of a vinyl record player: as the record is sped up, the notes and chords sound higher and higher. If you put your finger on the record and gradually increase pressure, you can slow the music down until it is too low to hear and finally stops.

After I learned that the orbits of Venus and Mars produce a musical power chord (the backbone of hard rock music and the seed of the entire chromatic scale), I envisioned a computer program that could deliver the tones of the planets, faithfully proportioned, sped up so humans can hear them. There would be one main slider for adjusting the speed of the Solar System, and a few other user controls.

As with any creative project, the result is a little different from the original mental manifestation - I still have leftover ideas for future revisions and enhancements. For now, I hope you enjoy this cosmic emulation synthesizer.

## THE INTERFACE

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The interface is divided into several sections:

- Planets:** A row of ten zodiac symbols above ten black knobs. From left to right: SUN (☉), MERCURY (♿), VENUS (♀), EARTH (♁), MARS (♂), JUPITER (♃), SATURN (♄), URANUS (♅), NEPTUNE (♆), and PLUTO (♇). Red dots are present above the knobs for SUN, MERCURY, VENUS, EARTH, MARS, and JUPITER. Callout 7 points to the Venus knob, and callout 6 points to the Pluto knob.
- Planets with Images:** A row of ten planet images below the knobs. Callout 11 points to the Sun image, and callout 4 points to the Pluto image.
- Controls:**
  - STOP GO:** A toggle switch with 'STOP' and 'GO' labels. Callout 1 points to the 'GO' side.
  - SPEED:** A slider control with '34 Octaves Up' below it. Callout 2 points to the slider.
  - GRADIENT EXACT OCTAVES:** A toggle switch. Callout 3 points to the 'EXACT OCTAVES' side.
  - SPINS:** A knob with a waveform display above it. Callout 8 points to the waveform, and callout 4 points to the knob.
  - ORBITS:** A knob with a waveform display above it. Callout 9 points to the waveform, and callout 5 points to the knob.

Callout 10 points to the Pluto zodiac symbol, and callout 10 also points to the SPINS knob. Callout 11 points to the Sun planet image.

(see next page for descriptions)

1	STOP/GO switch. To hear the Solar System sing, switch to GO.
2	SPEED slider. To speed up the Solar System like a record player, slide it to the right. The range of this control is thorough; when it's all the way to the left (20 octaves higher than real speed), the entire Solar System is too low for humans to hear; when it's all the way to the right (50 octaves higher than real speed), it's too high for us to hear. Slide it to somewhere in the middle to hear the planets sing.
3	GRADIENT / EXACT OCTAVES switch. When switched to EXACT OCTAVES, each planet will sing exactly the same note it sings in real life (an F-sharp note, for example), but transposed up however many octaves you specify by the SPEED slider. "In between" speeds are not possible. When switched to GRADIENT, you have access to a continuous rainbow of speed adjustment. Holding <SHIFT> at the same time will allow a finer degree of control.
4	SPINS volume knob. This controls the collective loudness of the sound produced by the planets spinning on their own axes.
5	ORBITS volume knob. This controls the collective loudness of the sound produced by the planets traveling around the Sun.
6	Volume knob for each planet. Turning a knob affects the loudness of that planet's ORBIT tone and SPIN tone simultaneously.
7	Audibility indicator lights. The top light indicates whether or not that planet's SPIN tone is within audible range. The bottom light indicates whether or not that planet's ORBIT tone is within audible range. Red means yes, grey means no.
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8	SPINS graph. This is an oscilloscope-style visual representation of all SPIN tones which are being fed from each planet through the SPINS volume control. Click on the graph to pause the display, and click again to unpaue.
9	ORBITS graph. This is an oscilloscope-style visual representation of all ORBIT tones which are being fed from each planet through the ORBITS volume control. Click on the graph to pause the display, and click again to unpaue.
10	Mysterious looking planetary symbols.
11	Pretty pictures of the planets (thanks NASA).

## DESIGN PHILOSOPHY

Music Of The Spheres version 1.1 was designed with accuracy in mind; therefore, I used actual data describing the orbital periods and rotation periods of the planets to determine the frequencies of audible notes, rather than mere approximations. What you hear is the real harmony of the Solar System! I did not attempt to adjust the harmonies to sound more pleasant by finding the next closest match to the musical intervals defined by the "Just Temperament" (interval-ratio) or "Equal Temperament" systems which our ears are so accustomed to. What you hear is the real deal.

The program has a switch labeled "gradient/exact octaves". When set to "exact octaves", all planetary data are simultaneously multiplied by  $2^x$ , where x is an integer. In musical terms this is called octave transposition, and it means that a note will retain its "note class"; in other words, if a B-flat note has its frequency multiplied by 2, 4, 8, 16, 32, 64, 128, or some other such number, it will still sound like a B-flat note. I felt that preserving this aspect of the Solar System's musicality was an extremely important capability of the program. If the switch is set to "gradient", the user has a more continuous control - the ratios of planetary movement are still preserved in relation to each other, but the note classes are not preserved.

Any circular motion can be plotted to a sinusoidal wave. All oscillators within the program are sine waves. However, the planets move in elliptical paths around the Sun; at one point in the development of the program, an extra oscillator was provided to modulate the sine wave produced by each planet's orbital period, as an attempt to imitate the eccentricity of orbital trajectories. However, the elliptical modulation seemed to have no perceptible effect on the tones, so the idea was ditched in favour of saving CPU cycles.

In 2006, the International Astronomical Union demoted Pluto to dwarf-planet status. I created this computer program prior to Pluto's demotion, and so Pluto is present in the harmony. Even if the program is revised at some point in the future, I will probably continue to include Pluto because of my stubborn sentimental attachment. I may also choose to include other dwarf-planets such as Ceres, Eris, Haumea, Makemake, Varuna, Quaoar, Chaos, Logos & Zoe, Teharonhiawako & Sawiskera, Deucalion, and other various cubewanos and asteroid clumps.

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**ANSWERS**

**The Most Obvious Question:** "If the Solar System is making music, then what note is our home-planet Earth singing?"

There are two answers:

- 1) one note is sung by virtue of the Earth's orbit around the Sun
- 2) one note is sung by the Earth's rotation on its own axis

Both answers require a bit of math, unless you have super-low hearing and a perfect sense of pitch.

**Answer #1:**

Earth takes 8766.14 hours to travel around the Sun; convert this to seconds, because musical frequency is expressed in cycles-per-second:

$$8766.14 \text{ hours} \times 3600 \text{ seconds/hour} = 31,558,104 \text{ seconds-per-cycle}$$

Flip this number upside-down to find cycles-per-second:

$$1 \div 31,558,104 = 0.0000000316875817 \text{ cycles-per-second}$$

This is the true frequency of Earth's orbit, which is way too low for us to hear. The next step is to transpose this frequency up several octaves into a range which is audible and can be compared to known musical frequencies. This is done by doubling the number several times (ie. multiplying by 2 to the power of some integer):

$$0.00000003.16875817 \times 2^{33} = 272.19425418 \text{ cycles-per-second}$$

Thirty-three octaves was chosen because the range from "Equal Temperament middle C" up to its octave is in the range from 261.63 Hz to 523.26 Hz. The range of human hearing

is much wider, but this range is convenient for comparison. The closest match from the Equal Temperament system is C#, with a frequency of 277.18 Hz.

So... *Earth's orbit sings a very low C-sharp!*

Is it perfectly in tune with your average piano? No, of course not - that would be too good to be true! So, what is the difference? Well, Equal Temperament uses a system of measurement called *cents* to measure small differences between note frequencies. One cent equals 1/100 of a semitone, much like a dollar is made up of 100 cents. On a guitar, each fret is 100 cents apart; on a piano, each key is 100 cents apart. If some given note was 50 cents sharp or flat, it would be exactly halfway between two "proper" notes, equally out of tune with both of them. A smaller difference means a closer, more accurate match. The formula for comparing two frequencies  $n$  and  $p$  looks like this:

$$\text{cents} = \log (n/p) \times 3986.3137$$

So Earth's transposed orbital frequency of 272.19425418 Hz compared to Equal Temperament's frequency for C# of 277.18 Hz is:

$$\log (272.19/277.18) \times 3986.3137 = -31.45 \text{ cents}$$

So... *planet Earth's orbit sings a tone which is 31.45 cents lower than a C-sharp, 33 octaves lower than middle C-sharp.*

**Answer #2:**

Using the same approach as shown above, *the spinning of planet Earth on its own axis produces a tone equivalent to G, 25 octaves down, 11.38 cents flat.*

**The Next Obvious Question:** *"Every planet sings two notes, just like Earth does. So, what are these notes?"*

The answer to this question is shown on the following tables:

<b>PLANETARY ORBIT NOTES</b>			
planet	note class	octaves below middle C	Equal Temperament deviation (cents)
Mercury	C#	31	33.18
Venus	A	33	9.64
Earth	C#	33	-31.45
Mars	D	34	-25.04
Jupiter	F#	37	-13.32
Saturn	D	38	11.96
Uranus	G#	40	-2.40
Neptune	G#	41	31.21
Pluto	C#	41	25.81

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PLANETARY SPIN NOTES			
planet	note class	octaves below middle C	Equal Temperament deviation (cents)
Mercury	G#	31	35.02
Venus	G#	33	-26.03
Earth	G	25	-11.38
Mars	F#	25	39.53
Jupiter	A#	24	12.56
Saturn	A	24	-10.48
Uranus	C#	24	-43.28
Neptune	D	24	-26.00
Pluto	B	28	-26.30

**Observations:**

The Planetary Orbit Notes table shows the notes A, C#, D, F# and G#. These 5 notes belong to the key of A major - you could say that *the planets orbit the Sun in the key of A major*.

The Planetary Spin Notes table shows the notes A, B, C#, D, F#, G and G#. These notes do not conform to any one traditional major key.

## **FUTURE ENHANCEMENTS**

I plan to eventually enhance the Music Of The Spheres synthesizer in the following ways:

- Save and Load presets, with descriptions displayed on screen
- apply panning to Spins tones, emulating orbital movement
- Solo and Mute buttons for each planet
- include all known moons in the Solar System, asteroid belts and Saturn's rings
- text box entry method for transposition
- gradient audibility indicators instead of only red or grey
- display frequency of each spin and orbit in Hz
- VSTi implementation (MIDI)
- user-selectable "pretty" tones or "pure" tones
- indication of corresponding notes from the chromatic scale

## BUGS / KNOWN ISSUES

Music Of The Spheres should operate smoothly under most circumstances. Here are a few known exceptions:

- 1) If you've enabled Full Screen mode, using Alt+F4 to exit may produce an error while closing.
- 2) If there are too many other programs running, they may interfere with the smoothness of the program's operation. For example, printing a document in the background may cause a jitter in the sound. Music Of The Spheres uses a total of 19 oscillators (sound generators), which can be a big demand for an average computer.
- 3) As specified in System Requirements, the program only works on Win XP and Win 2000; no Vista or Mac yet, sorry.

Please feel free to email bug reports, wish lists or other comments to [twistedmusictheory@gmail.com](mailto:twistedmusictheory@gmail.com).

Thank you for using Music Of The Spheres ver 1.1. Happy exploring!