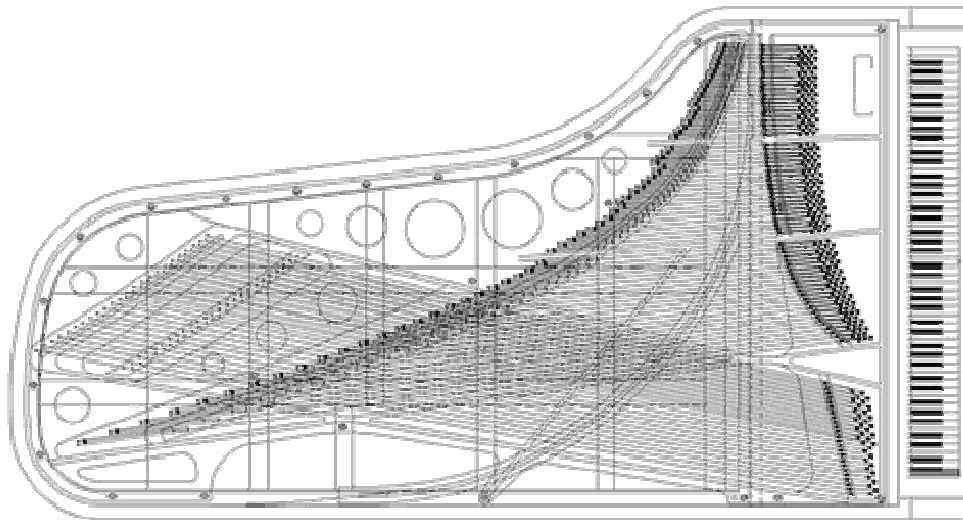
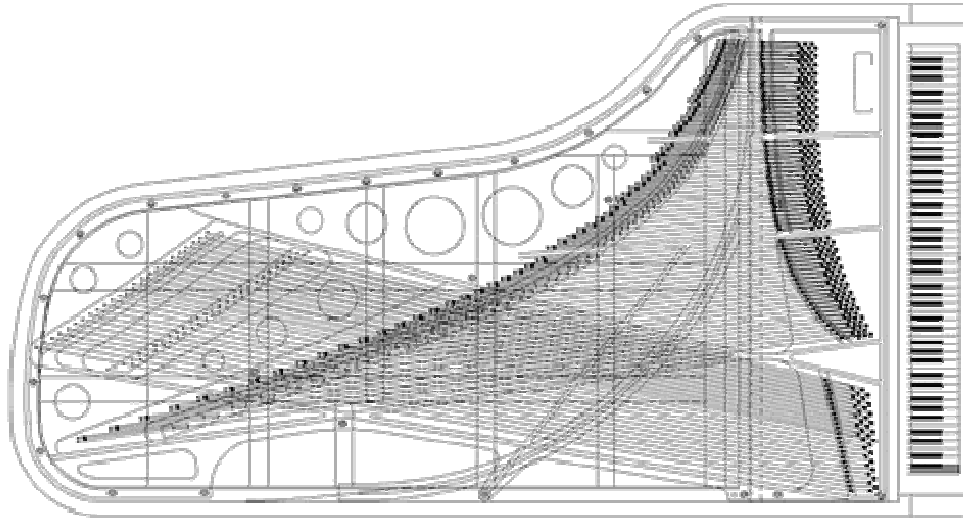




The Grands

James Whitehead / JLIAT



THE GRANDS

THE GRANDS

A series of thought experiments exploring the “Great Outdoors” via Non Correlational, Non Cochlear ‘*Music*’.

(NC NC)

James Whitehead/JLIAT 2014

WWW.JLIAT.COM
WWW.JAMESWHITEHEAD.ORG

Grand Pianos.

This text documents a series of thought experiments¹ concerning the possibility of non-correlationist music². I have argued elsewhere³ that not only is noise more than sound, noise itself is non-correlationist as it exists, has and will, independent of human experience⁴. Here I will not offer alternatives to music made by and for humans, alternative methods of structuring sound, but rather using the methodology of the thought experiment show the speculative possibility of devices which make 'music' which is not *properly* experienceable by any human. That these devices are imaginary, in my opinion, does not invalidate their 'construction'. I see nothing in principle to invalidate the product of the imagination in the positing of such objects. That they are humanly identifiable only allows us access to a reality, the *great outdoors*, which science and mathematics has long enjoyed⁵. Other sources of such phenomena could be speculated and even occur as actual physical realities in nature⁶.

Amongst other things, for instance challenging the parochial nature of art, these mechanisms open up a world to appreciation, in thought and imagination, which is not limited by our human context and perceptions. They form part of a move into a 'speculative materialism' within the context of the recent conceptualisation or re-conceptualisation of Music⁷.

These proposed objects are neither 'scientific' or 'philosophical' thought experiments, though whilst they may borrow from both disciplines, such a borrowing does not mean that the work has either of these disciplines as anything other than source material for a *musical* speculation, neither is in anyway foundational⁸.

¹ 'Thought Experiments' (Gedankenexperiment), in science are where the consequences of conducting an imaginary experiment which may not in practice be possible, or where there is no intention to do so, are presented to 'thought' and examined. Schrödinger's cat, (illustrating quantum indeterminacy) is a classic example of the latter, Maxwell's sorting Demon is an example of the former. In all cases they intended to show and explore the consequences of a theory or hypothesis in order to allow a greater understanding of the logical consequences of the hypothesis and attempt to reveal new knowledge and/or understanding from this process.

² 'Correlationism' as first coined by Quentin Meillassoux, *After Finitude: An Essay on the Necessity of Contingency*. (Continuum, 2008), Trans. Ray Brassier. – 'the philosophy that humans cannot exist without the world nor the world without humans' is much more susceptible to critique than the idea that "Music" cannot exist without humans to create and perceive it. For a good summary of the ideas associated with such thinking, i.e. Speculative Realism/Materialism see *Speculations III*, in particular p.241 Speculative Realism, After Finitude and beyond? by Louis Morelle, (Punctum books, 2012).

³ See Chapter 2 Un-sounding Music: noise is not sound in *Noise in and as Music* (University of Huddersfield press, 2013) eds. Aaron Cassidy and Aaron Einbond.

⁴ Noise exists in any communication system, human and non human (computer systems), as well as in the randomness within the electromagnetic spectrum, organic systems (DNA/RNA mutation) and inorganic systems, chaotic and unpredictable quantum systems, et. al.

⁵ See *After Finitude: An Essay on the Necessity of Contingency*, *ibid*.

⁶ E.g. 'Cosmic Strings'.

⁷ For instance, Seth Kim-Cohen *In the Blink of an Ear: Toward a Non-Cochlear Sonic Art*, (Continuum, 2009).

⁸ For another exposition of this idea see Deleuze and Guattari, *What is Philosophy* (Verso, 1994) p. 217.

Hyper Objects⁹.

Hyper Objects reveal the non correlationist reality which extends outside the human, both spacio-temporally and in praxis, behaviour and onticity. In this text they relate to imaginary objects which provide an access which could be called 'musical', to spacio-temporal events in some cases which preceded human existence, and organic life, (Meillassoux's Arche fossil¹⁰) and which will exceed human and organic existence.

The actual impracticality of such mechanisms is not in dispute, physics at these scales dictate that matter of such volumes and densities would collapse, that the simpler Newtonian operations of such machines on the Earth would no longer function on such scales. Moreover these machines would require more matter that is locally available, and in some cases even cosmically available. Relativity would effectively 'take over' and dominate the actual behaviour of such objects. And so it readily becomes apparent that the present 'behaviour' of local 'music machines', and of the music they create, are not universal events but (merely) local events. Local in time, size and functionality. And one of the motivations and consequences of speculating these hyper objects is to break out of such a local confinement, which knowingly or not, is a vehicle of privilege, commodification, exploitation and use. And so to deterritorialize music in the democratic encounter with reality, qua reality.

Modern physics has replaced one consequence of Newton's ideas, which was never satisfactory, of the instantaneous effect of actions at any distance¹¹. Our sun as we see it is eight minutes old, stars even older, some 1,000s of years. This means there is no universal 'now'. Your feet are microseconds older than your eyes. The experience of *the universe* as it is now as a universal object in time at space and as *your* now, is an impossibility because space 'generates' time, the two are inseparable. Time like space is relative, we inhabit our own space and so our own time. This space-time has no limit, it needs to be taken into consideration in the design of computers, and in the understanding of the nervous system. Even in our brains the systems which create the illusion of "now" are in themselves creating the illusion of a unified consciousness which exists in an illusory 'now'.

The physical universe as we currently understand it is dominated by the limitation of the speed of light. It offers an absolute, but also explains why the most distant objects we see, at the time of writing is UDFj-39546284 - 13.42 billion light-years¹², are 'historical' events¹³.

⁹ The term 'Hyperobject' first appears in Timothy Morton's book, *Ecology Without Nature: Rethinking Environmental Aesthetics* (Harvard University Press, 2007), Morton is a member of the object-oriented philosophy movement, which is associated also with Speculative Realism/Materialism.

¹⁰ See *After Finitude: An Essay on the Necessity of Contingency*, *ibid.*

¹¹ "a phenomenon in which a change in intrinsic properties of one system induces a change in the intrinsic properties of a distant system, independently of the influence of any other systems on the distant system, and without there being a process that carries this influence contiguously in space and time" Berkovitz, Joseph (2008). "Action at a Distance in Quantum Mechanics". In Edward N. Zalta. *The Stanford Encyclopedia of Philosophy* (Winter 2008 ed.).

¹² A light year is a measure of distance and time! 1 light-year = 9,460,730,472,580,800 meters, or approximately 5.878625 trillion miles, light travels at 299,792,458 meters per second, approximately 186,282.4 miles per second, or about 671 million miles per hour. So a 'light year' is the distance light travels in a year.

A light second is 299,792,458 meters (approx 186,282 miles), the light from the sun arrives just over 8 minutes late. This raises the question 'What is happening on the sun (or other distant objects) NOW?' There is no satisfactory answer to this, the speed of light being an absolute, no knowledge of a universal and absolute now is possible.

The 'Cosmic Grands' are hypothetical instruments of vast dimensions, and though practically and physically impossible they open up space and time to 'musical' speculations, which as previously mentioned, was limited by the parochialism in art to the concert hall and art gallery. Something that perhaps unfortunately limited music to time frames of minutes and hours¹⁴.

Our local environment has much going for it, without it life and so thought and art would not be possible, and therefore considerations of such a 'special' environment are understandable. However a danger arises when we see this environment as not being just special for us, but in some way privileged in itself from all other environments. Such a world view is anthropocentric, Ptolemaic, and not even heliocentric. And likewise we can become logocentric, thinking without reason, that the universe is reasonable, and open to rational understanding and knowledge. This it may well be, and the descriptions of the universe which I will use are those from modern science. However in 'music'¹⁵ we need not be bound in such a manner, and so the possibility arrives in music for speculation. In this case of machines for making music on a universally real scale¹⁶.

Here then I speculate on truly "Grand" pianos, increasing in scale from that of an object of solar system dimensions to ever larger objects. An underlying intention and motivation being a desire to 'open' up music and art to speculative and imaginative creativity- Meillassoux's Great Outdoors¹⁷.

UDFj-39546284, 13.42 billion light-years distant from us- and we detect it as it was that time ago, like watching a distant firework display,(the universe is estimated to be about 13.798 billion years old) we see the display now, our 'now' but in fact we see it historically, the real now of it, and everything else is lost to us.

¹³ This is interesting because as far as I'm aware it is not taken into consideration in Meillassoux's *After Finitude* where he critiques Correlationism by virtue of the human absence from events prior to human existence, and yet we see these events 13.2 billion years ago as part of our now, they are present to us now in no more a temporal remove than from watching someone walk down the street, now. Meillassoux's 'time before' appears still to be Newtonian!

¹⁴ I'm aware of other musics which are similar in scope, one example which I'm particularly impressed with being Stockhausen's - *Aus den Sieben Tagen* (1968), (*The Seven Days*).

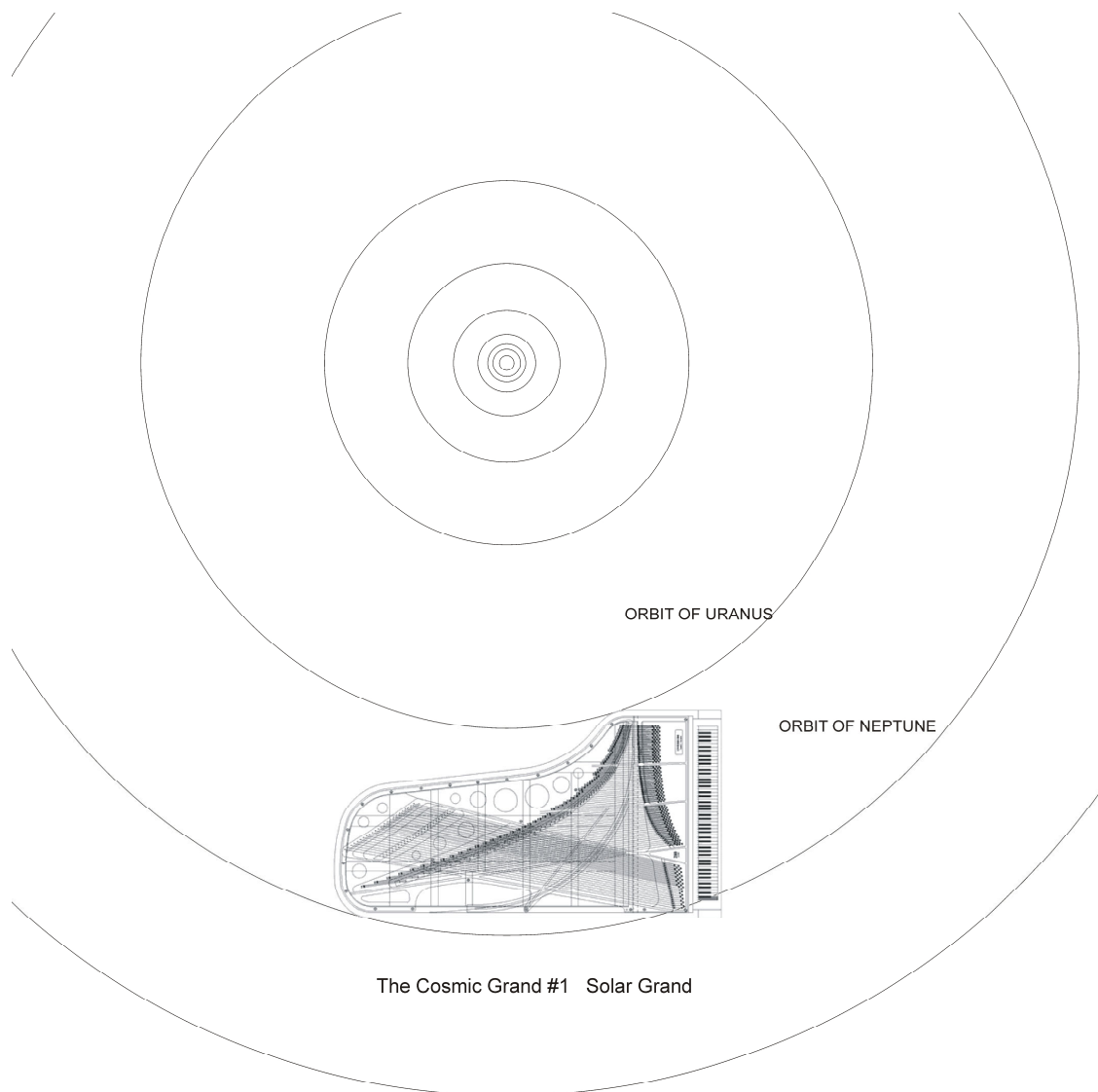
¹⁵ Music - the word - is derived from Muse, to Muse or "to reflect, to be absorbed in thought," mid-14c., from Old French *muser* (12c.) "to ponder, dream, wonder; loiter, waste time," literally "to stand with one's nose in the air" (or, possibly, "to sniff about" like a dog who has lost the scent), from *muse* "muzzle," - Which allows us a certain 'free play'. We *play* music.

¹⁶ Anyone unfamiliar with just where we are now! might be interested in the film based on 'Cosmic View' by Kees Boeke that combines writing and graphics to explore size from the astronomic to the atomic. Originally published in 1957. Also see <http://www.youtube.com/watch?v=bhofN1xX6u0> (best without sound!)

A 'picture book' version - *Powers of 10*, Charles and Ray Eames(Office/Optical Toys co-production; illustrated edition , 1999).

¹⁷ I very much hope to engender and promote such activity in others so that I can not so much be said to stand on the 'shoulders of giants', but in proposing these giant machines, offer a 'leg up' to others.....

The Cosmic Grand. #1 (Solar Grand 1,017,060,367,454 x larger than concert grand)
(fits between orbits of Uranus and Neptune)



Concert Grand	Size in Km	Miles	Millions of Miles	Light Minutes	Light Hrs
Overall Size	3,100,000,000.00	1,926,250,695.20	1926.25	172.34	2.87

(4,366,813 km Sun Circ 40,075 km Earth Circ)

The Cosmic Grand. #1 Solar Grand – Some details:

123 years per oscillation of C₄¹⁸

Examples of possible performances..

Piece

Time of performance using the above Grand

Webern Variations Opus 27 - @ 5'13" -

10,094,491.85 years (10 million years)

Cage 4'43" -

9,126,968.67 years

Relative events:

150 million years ago birds appeared.

130 million years ago, flowers.

60 million years ago, the family Hominidae (great apes).

2.5 million years ago, the genus Homo (human predecessors).

1.0 million years ago first evidence of hominid ancestors using fire.

200,000 years ago anatomically modern humans first appeared.

¹⁸ For the sake of simplicity the calculations ignores the 'subtleties' of the mechanics of vibrations of length and tensions of such 'strings' so that simple arithmetic is employed, the 'strings' tension, length and diameter making such subtleties irrelevant to the thought experiment, a practical implementation being impossible, certainly for the 'larger' grands, though is scope for more reflection!

Audio CD rendition:

Webern Variations Opus 27¹⁹ - @ 5'13" - 10,094,491 years

This amounts to 5,305,664,916,885 hours which would be recordable on 4,301,890,473,150 Audio CDs of 74 minutes playback time. (Approximately 4 Trillion CDs)

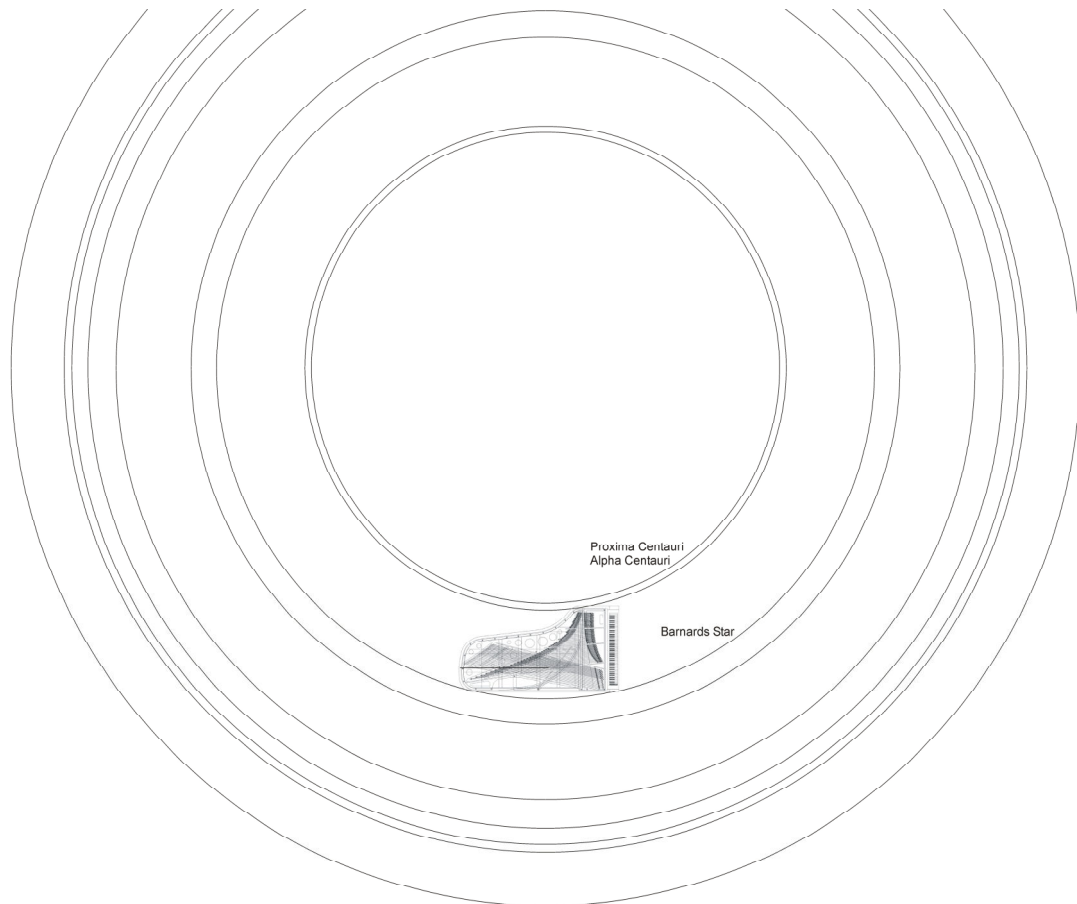
In another thought experiment I speculated on all possible audio CDs²⁰, which is 2 to the power 6265728000, where each CD was a 'unique' recording. In the case of this Webern piece played on a Hyper Grand the recording would not be in the set of all possible audio CDs, as in a real time recording a sample can change at its fastest 1/44100 of a second. Expanding this to the Hyper Grand gives us the shortest change as of 1/44100 effectively enlarged by a factor of 101,706,036,745.41 (the size difference- between the 'normal' grand and the hyper grand), which is 38,437.66 minutes or 519.4278 Audio CDs of continuous identical data before a single sample value changes. As 'All possible Audio CDs' is a non repeating sequence the Hyper Webern would not be included, as any change in a sample would require 519.4278 CDs to accomplish this²¹.

¹⁹ This is being used as a reference work, and *here!* of no particular significance....

²⁰ An audio CD stores music by patterns of bits. Each audio sample is 16 Bits, and each second of sound has 44100 samples. So a second of sound is 16 multiplied by 44100 bits, or zeros and ones in the binary number system. Multiply this by two for stereo, and then by 60. And this gives the number of bits which make up one minute of sound. The original Audio CD standard allowed for a maximum recording time of 74 minutes, so multiply this number again by 74, And this will give us the maximum number of bits on a CD. (For longer disks, or DVD and blue ray the number of minutes is greater but still finite.) Multiply 16 by 44100, by 2 by 60 by 74 and we get 6265728000. That is the total number of bits that can be stored on a normal CD or CDR. If you convert this to bytes, you get around 740 megabytes, which is about right, 740 megabytes is the storage capacity of CDs and CDRs. Given that each bit in this totality can be different this gives us 2 to the power 6265728000 possible CDs, and no more, in this format. What we have done in effect is to create a virtual fixed universe of finite objects. The arithmetic is simple, if we only had 2 bits, then the possible number of combinations would be , 0 0, 0 1, 1 0, and 1 1. No more possible combinations using only two bits can be made. For 3 bits there are 8 possible combinations, for 4 bits 16 possible combinations. The formula then is 2 to the power of the number of bits. 2 to the power 2 is 2 times 2 which is 4. 2 to the power 3 is 8, two to the power 4 is 16, and so on. 2 to the power 6265728000 is extremely large but a finite number.

²¹ It might be thought such low frequencies are not recordable on audio CDs. This is in fact not the case, though there is a fixed upper limit of 22.05 kHz the format does not have a lower limit, frequencies below 50 hztz are recordable, and down to 1 hztz and below. These will no be heard but will produce effects when played back through a Hi Fi. The speaker cone will vibrate at these frequencies.

The Cosmic Grand. #2 (Stellar Grand = 5,587,045,554,673,700 x larger than concert grand)



Concert Grand	Size in Km	Miles	Trillions of Miles	Light Years
Overall Size	17,029,314,850,645	10,581,525,667,688	10.5	1.8

The Cosmic Grand. #2 Stellar Grand – Some details:

677,166 years per oscillation of C₄

Relative events:

1.2 Million years ago	Evolution of Homo antecessor.
600,000 years ago	Evolution of Homo heidelbergensis.
350,000 years ago	Evolution of Neanderthals.
300,000 years ago	Gigantopithecus, a giant relative of the orangutan dies out from Asia.
200,000 years ago	Anatomically modern humans appear in Africa. Around 50,000 years before present they start colonising the other continents, replacing the Neanderthals in Europe and other hominins in Asia.
4,000 years ago	The last of the giant monitor lizards (Megalania) die out.
30,000 years ago	Extinction of Neanderthals, first domestic dogs.
15,000 years ago	The last Woolly rhinoceros are believed to have gone extinct.
11,000 years ago	The giant short-faced bears (Arctodus) vanish from North America, with the last Giant Ground Sloths dying out. All Equidae become extinct in North America.
10,000 years ago	The Holocene Epoch starts 10,000 years ago after the Late Glacial Maximum. The last mainland species of Woolly mammoth (Mammuthus primigenius) die out, as does the last Smilodon species.

Examples of possible performance..

Piece

Time of performance using the above Grand

Webern Variations Opus 27 - @ 5'13" - 55,452,348,383 55 billion years.

Relative events²²:

The present universe began 13.8 billion years ago.

-13.87 billion	Big Bang.
-150 million to -1 billion	Formation of stars, galaxies, groups, clusters and superclusters.
-9 billion	Formation of the Solar System.
-3 billion	Single celled life forms.
-1 billion	Multicellular life.
-550 million	Complex animals.
-500 million	The first fish appear.
-475 million	Plants colonise the land.
-400 million	Insects and seeds appear.
-225 million	Early dinosaurs.
-215 million	Mammals evolve from a reptilian off-shoot.
-6.5 million	The first hominin is recorded.
-2.58 million	Global glaciation events.
-2 million	The first genus Homo.
10,200 BCE	Stone Age.
2000 BCE	Bronze Age.
1800 BCE	Iron Age.
1800-800	Egyptian Civilization.
1700-1400	Shang Dynasty.
650-300	Persian Empire.
300-0 BCE	Greek Civilization.
300 BCE-400AD	Roman Empire.
300-1400	Byzantine Civilization.
1300-1600	The Renaissance.
1600-Present	Age of Reason, Industrialization.

Years in future

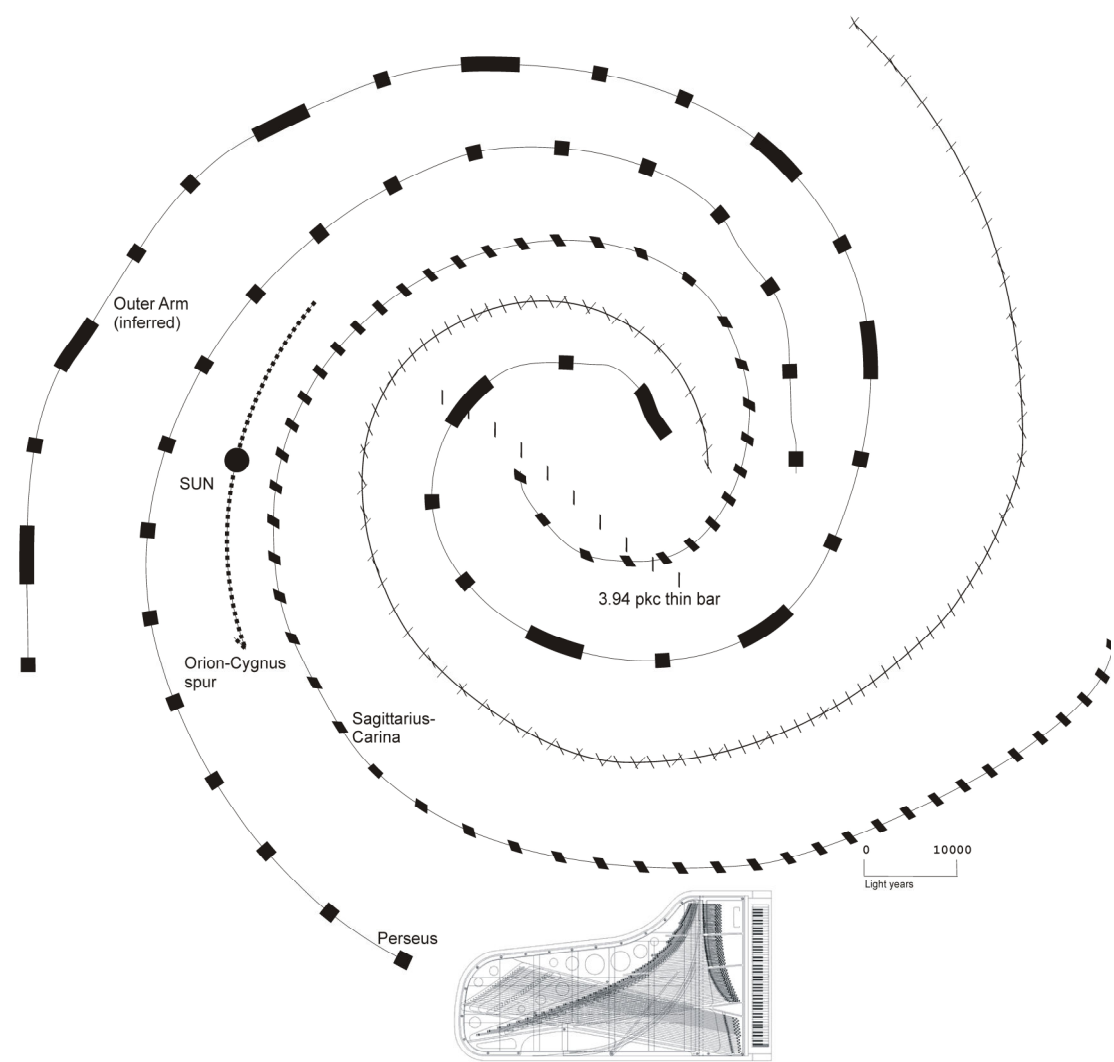
+36,00	The small red dwarf star Ross 248 passes within 3.024 light years of Earth.
+100,000	Many of the constellations unrecognisable.
+100,000	Earth will likely have undergone a supervolcanic eruption.
+100,000	Earth will have likely been hit by a meteorite of roughly 1 km in diameter.
+10 million	The widening East African Rift valley is flooded by the Red Sea.
+50 million	The Californian coast begins to be subducted into the Aleutian Trench.
+230 million	Beyond this time, the orbits of the planets become impossible to predict.
+240 million	The Solar System completes one full orbit of the Galactic center.

²² Approximate timescales gathered from various sources - http://en.wikipedia.org/wiki/Timeline_of_the_far_future Accessed 16/10/13 - "Reader's Digest" Atlas of the World et. al.

+250 million	All the continents on Earth may fuse into a supercontinent.
+600 million	The Sun's increasing luminosity begins to disrupt the carbonate-silicate cycle; higher luminosity increases weathering of surface rocks, which traps carbon dioxide in the ground as carbonate. As water evaporates from the Earth's surface, rocks harden, causing plate tectonics to slow and eventually stop. Without volcanoes to recycle carbon into the Earth's atmosphere, carbon dioxide levels begin to fall. By this time, they will fall to the point at which C3 photosynthesis is no longer possible. All plants that utilize C3 photosynthesis (~99 percent of present-day species) will die.
+800 million	Carbon dioxide levels fall to the point at which C4 photosynthesis is no longer possible. Multicellular life dies out. 1 billionThe Sun's luminosity has increased by 10 percent, causing Earth's surface temperatures to reach an average of ~320 K (47°C, 116°F).
+1.3 billion	Eukaryotic life dies out due to carbon dioxide starvation. Only prokaryotes remain.
+2.3 billion	The Earth's outer core freezes.
+2.8 billion	Earth's surface temperature, even at the poles, reaches an average of ~420 K (147°C, 296°F). At this point life, now reduced to unicellular colonies in isolated, scattered microenvironments such as high-altitude lakes or subsurface caves, will completely die out.
+3 billion	Median point at which the Moon's increasing distance from the Earth lessens its stabilising effect on the Earth's axial tilt. As a consequence, Earth's true polar wander becomes chaotic and extreme.
+3.5 billion	Surface conditions on Earth are comparable to those on Venus today.
+4 billion	Median point by which the Andromeda Galaxy will have collided with the Milky Way.
+7.5 billion	Earth and Mars may become tidally locked with the expanding Sun.
+7.9 billion	The Sun red-giant. In the process, Mercury, Venus and possibly Earth are destroyed.
+8 billion	Sun becomes a carbon-oxygen white dwarf.
+14.4 billion	Sun becomes a black dwarf.
+20 billion	The end of the Universe in the Big Rip scenario.
+50 billion	Assuming both survive the Sun's expansion, by this time the Earth and the Moon become tidelocked.

Near by Stars	Light Years Distance from Sun.
Proxima Centauri	4.240
Alpha Centauri	4.360
Barnards Star	5.960
WISE 1049-5319	6.420
Wolf 21185	7.780
Lalande 21185	8.290
Sirius A Major	8.580
Luyten 726-8	8.720
Ross 154	9.680
GJ 1061	11.991

The Cosmic Grand. #3
 (Galactic Grand = 99,325,254,305,310,200,000 x larger than concert grand)



Concert Grand	Size in Km	Trillions of Km	Light Years
Overall Size	302,743,375,122,586,000	302,743	32,000

12,038,514,481 years (12 billion) per oscillation of C₄

Piece *Time of performance using the above Grand*

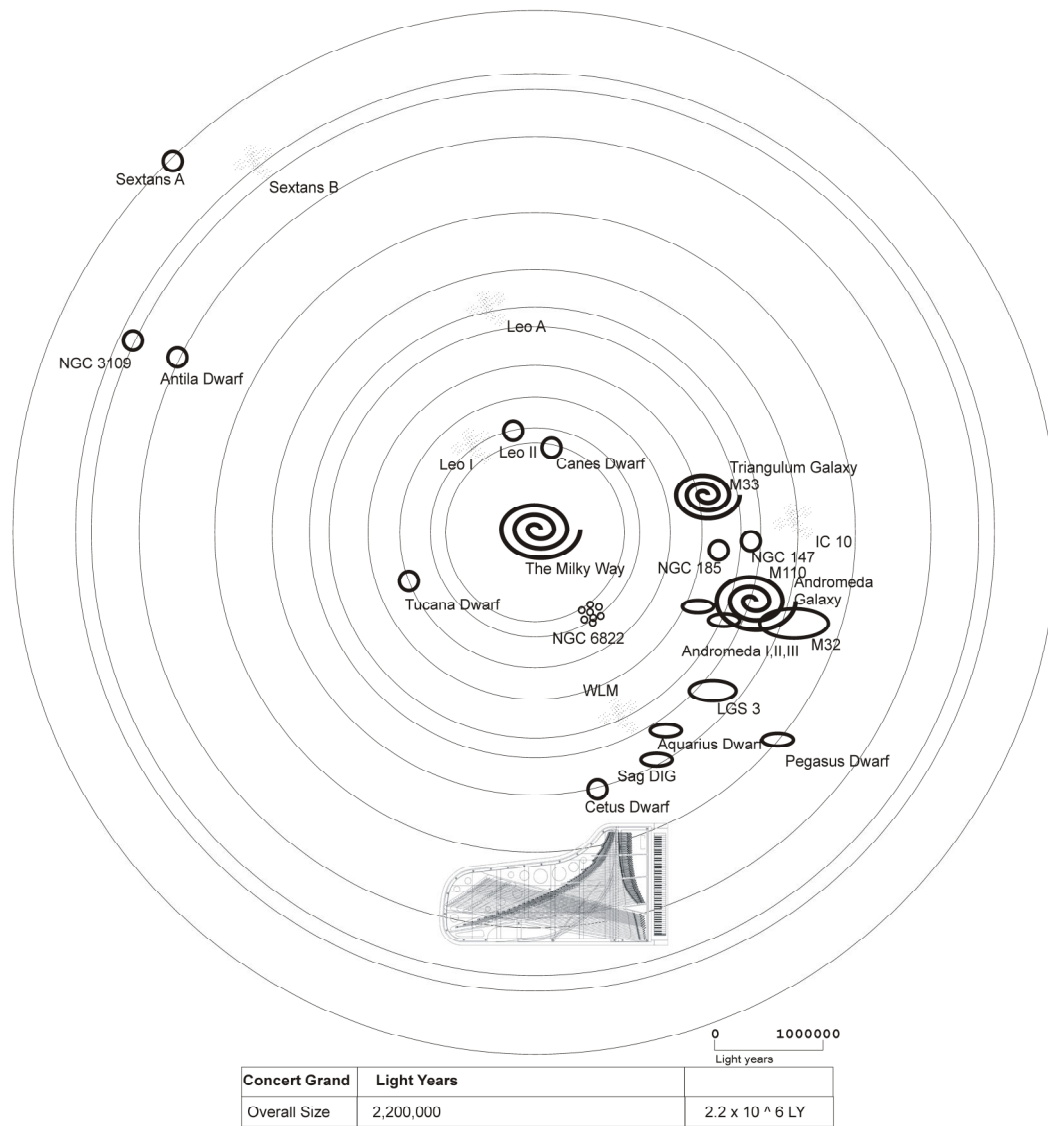
Webern Variations Opus 27 - @ 5'13" - 985,819,526,812,599 years (985 trillion)

Relative events²³

+100 billion	The Universe's expansion causes all galaxies beyond the Milky Way's Local Group to disappear beyond the cosmic light horizon, removing them from the observable universe.
+450 billion	Median point by which the ~47 galaxies of the Local Group will coalesce into a single large galaxy.
+800 billion	Expected time when the net light emission from the combined Milky Way galaxy begins to decline as the red dwarf stars pass through their blue dwarf stage of peak luminosity.
+10 ¹² (1 trillion)	Low estimate for the time until star formation ends in galaxies as galaxies are depleted of the gas clouds they need to form stars.
+10 ¹⁴ (100 trillion)	High estimate for the time until normal star formation ends in galaxies. This marks the transition from the Stelliferous Era to the Degenerate Era; with no free hydrogen to form new stars, all remaining stars slowly exhaust their fuel and die.
+1.1–1.2×10 ¹⁴	Time by which all stars in the universe will have exhausted their fuel.
+10 ¹⁵ (1 quadrillion)	Estimated time until stellar close encounters detach all planets in the Solar System from their orbits.
+10 ²⁰	Estimated time until 90% - 99% of brown dwarfs and stellar remnants are ejected from galaxies.
+10 ²⁰	Estimated time until the Earth collides with the Sun due to the decay of its orbit via emission of gravitational radiation.
+10 ³⁰	Estimated time until those stars not ejected from galaxies (1% - 10%) fall into their galaxies' central supermassive black holes.
+2×10 ³⁶	The estimated time for all nucleons in the observable Universe to decay, if the proton half-life takes its smallest possible value (8.2×10 ³³ years).
+10 ⁶⁵	Assuming that protons do not decay, estimated time for rigid objects like rocks to rearrange their atoms and molecules via quantum tunneling. On this timescale all matter is liquid.
+1.7×10 ¹⁰⁶	Estimated time until a supermassive black hole with a mass of 20 trillion solar masses decays by the Hawking process. This marks the end of the Black Hole Era..
+10 ¹⁵⁰⁰	Assuming protons do not decay, the estimated time until all baryonic matter has either fused together to form iron-56 or decayed from a higher mass element into iron-56.
+10 ^{{10^{26}}}}	²⁶ (10 ¹⁰ A double exponential function 10 ¹⁰ ^ 10 ²⁶) Low estimate for the time until all matter collapses into black holes, assuming no proton decay. Subsequent Black Hole Era and transition to the Dark Era are, on this timescale, instantaneous.
+10 ^{{10^{50}}}}	Estimated time for a Boltzmann brain to appear in the vacuum via a spontaneous entropy decrease.
+10 ^{{10^{56}}}}	Estimated time for random quantum fluctuations to generate a new Big Bang, according to Carroll and Chen.
+10 ^{{10^{{10^{{10^{1.1}}}}}}}}}	Scale of an estimated Poincaré recurrence time for the quantum state of a hypothetical box containing a black hole with the estimated mass of the entire Universe, observable or not.

²³ Ibid.

The Cosmic Grand. #4 (Local Group)



827,647,870,543 years ($82 \cdot 10^9$ years \sim 827 Billion) per oscillation of C_4

Piece

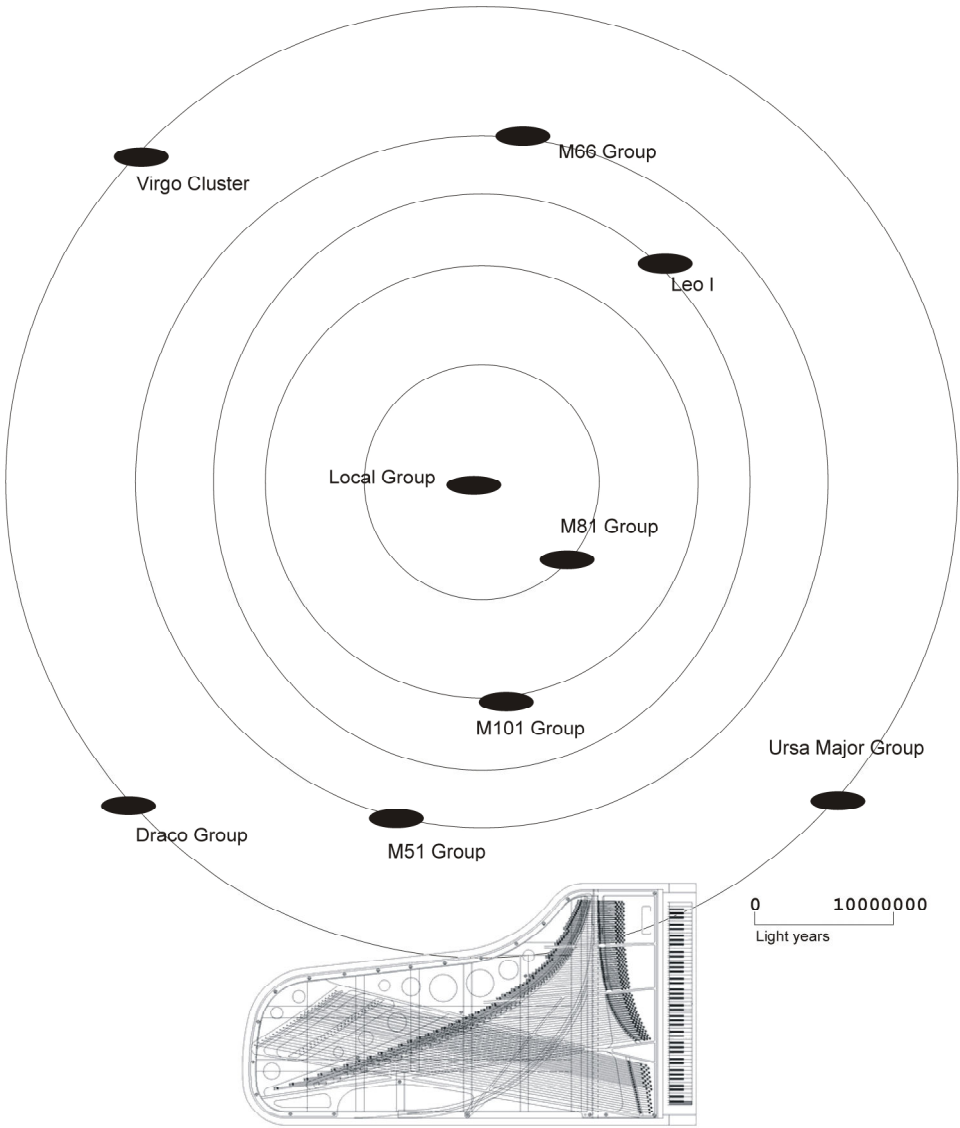
Time of performance using the above Grand

Webern Variations Opus 27 - @ 5'13" - 67,775,092,468,366,200 years (6.7×10^{15} years ~ 67 quadrillion)

The Local System:

SPIRAL GALAXIES	DWARF ELLIPTICAL GALAXIES	Antlia Dwarf
Andromeda Galaxy (M31, NGC 224)	M110 (NGC 205)	Leo I (DDO 74)
Milky Way	NGC 147 (DDO 3)	Sextans Dwarf
Triangulum Galaxy (M33, NGC 598)	SagDIG (Sagittarius Dwarf Irregular Galaxy)	Leo II
ELLIPTICAL GALAXIES	NGC 6822 (Barnard's Galaxy)	Ursa Minor Dwarf
M32 (NGC 221)	Pegasus Dwarf (Pegasus Dwarf Irregular, DDO 216)	Draco Dwarf (DDO 208)
IRREGULAR GALAXIES	DWARF SPHEROIDAL GALAXIES	SagDEG (Sagittarius Dwarf Elliptical Galaxy)
Wolf-Lundmark-Melotte (WLM, DDO 221)	Boötes Dwarf	Tucana Dwarf
Small Magellanic Cloud (SMC, NGC 292)	Cetus Dwarf	Cassiopeia Dwarf (Andromeda VII)
Canis Major Dwarf	Canes Venatici I Dwarf and Canes Venatici II Dwarf	Pegasus Dwarf Spheroidal Galaxy (Andromeda VI)
Pisces Dwarf (LGS3)	Andromeda III	Ursa Major I Dwarf and Ursa Major II Dwarf
IC 1613 (UGC 668)	NGC 185	IDENTIFICATION UNCLEAR
Phoenix Dwarf	Andromeda I	Virgo Stellar Stream
Large Magellanic Cloud (LMC)	Sculptor Dwarf (E351-G30)	Willman 1
Leo A (Leo III)	Andromeda V	Andromeda IV
Sextans B (UGC 5373)	Andromeda II	UGCA 86 (0355+66)
NGC 3109	Fornax Dwarf (E356-G04)	UGCA 92 (EGB0427+63)
Setans A (UGCA 205)	Carina Dwarf (E206-G220)	

The Cosmic Grand. #5 (Virgo Super Cluster)



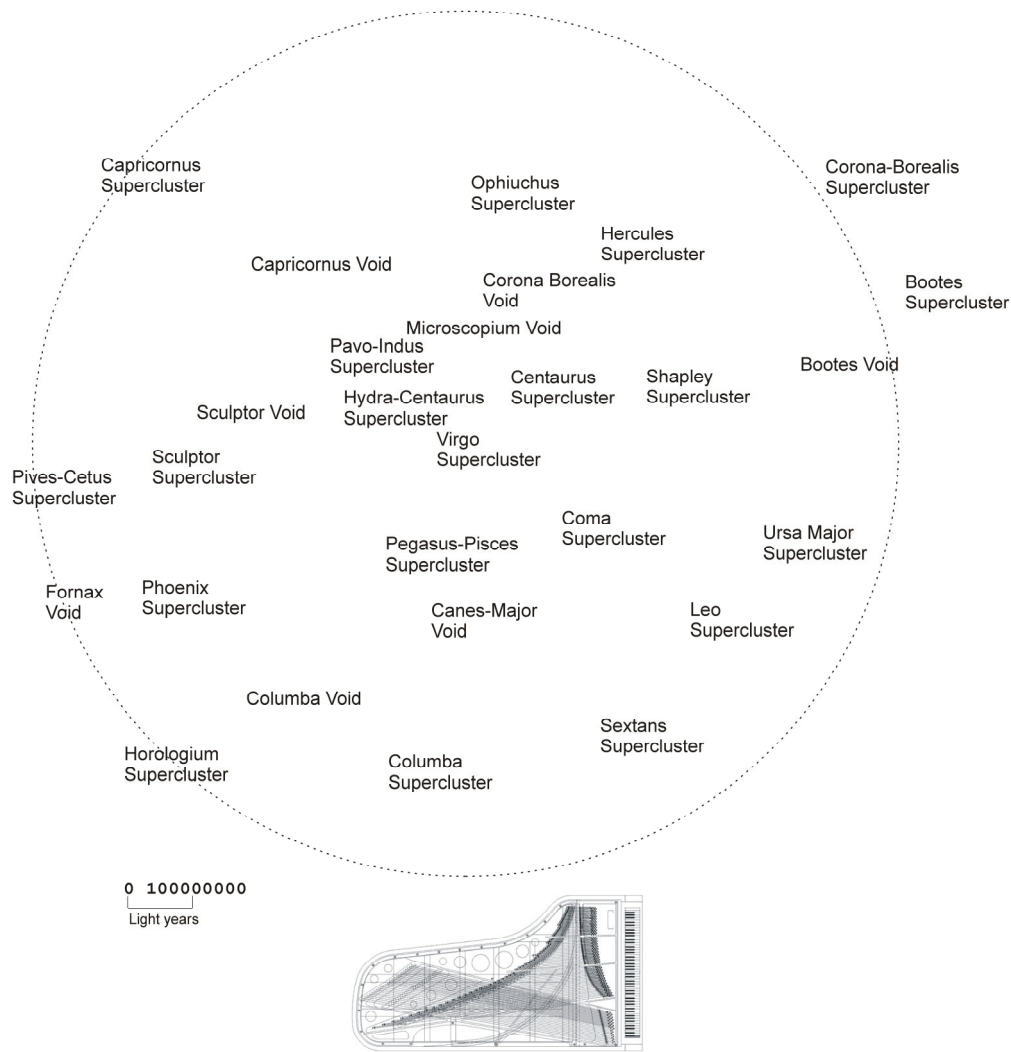
Concert Grand	Light Years	
Overall Size	30,000,000	3×10^6 LY

11,587,070,187,608 years (1.1×10^{12} years ~ 11 Trillion) per oscillation of C₄

Piece *Time of performance using the above Grand*

Webern Variations Opus 27 - @ 5'13" - 948,851,294,557,126,000 years (94×10^{15} years ~ 948 Quadrillion)

The Cosmic Grand. #6 (Local Super Clusters)



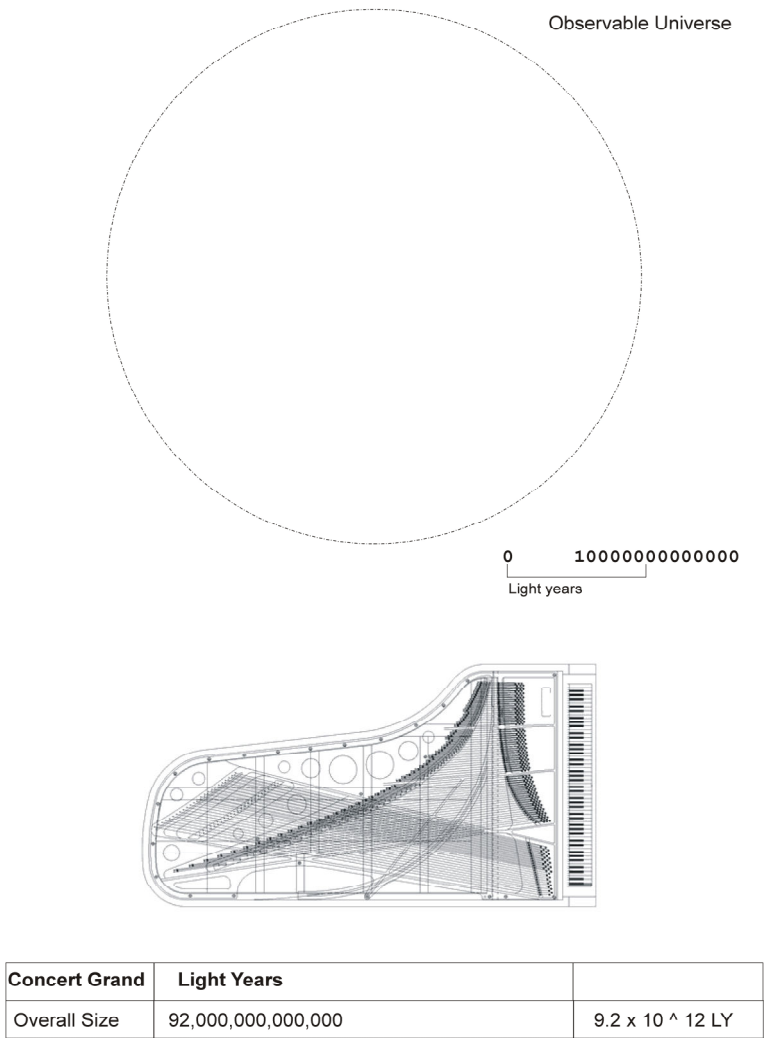
Concert Grand	Km	Light Years
Overall Size	3,676,169,555,059,970,000,000	388,571,429

146,493,673,086,185 years (14.6* 10 ^12 years ~ 146 Billion) per oscillation of C₄

Piece *Time of performance using the above Grand*

Webern Variations Opus 27 - @ 5'13" - 11,996,191,366,900,800,000 years (1.1 * 10 ^18 years ~ 11 Quintillion)

The Cosmic Grand. #7 (Visible Universe)

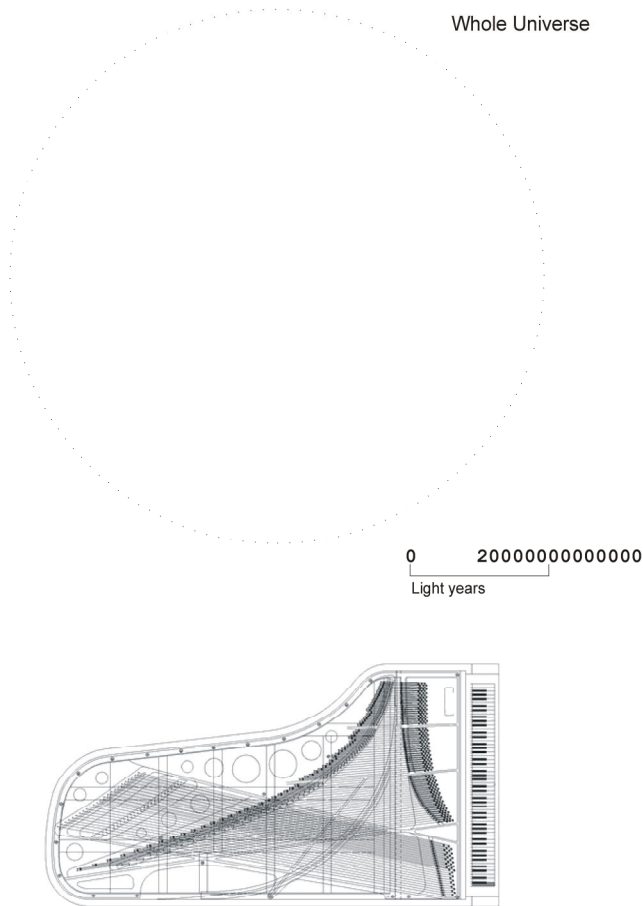


34,610,729,131,815,600,000 years (3.4×10^{18} years ~ 34.6 Quintillion) per oscillation of C_4

Piece *Time of performance using the above Grand*

Webern Variations Opus 27 - @ 5'13" - 2,834,231,139,586,220,000,000,000 years (1.2×10^{24} years ~ 2.8 Septillion)

The Cosmic Grand. #8 (Known Universe)



Concert Grand	Light Years	
Overall Size	182,000,000,000,000	18.2×10^{12} LY

68,469,051,108,591,800,000 years (6.8×10^{18} years ~ 68 quintillion) per oscillation of C_4

Piece *Time of performance using the above Grand*

Webern Variations Opus 27 - @ 5'13" - 5,606,848,558,746,650,000,000,000 years (1.5×10^{24} years ~ 5 Septillion)

Two more Grands remain here, though these are no longer cosmic, and I cannot produce any suitable objects of comparison. These are truly Hyper Grands, which begin to exhibit strange properties²⁴ which represent a 'greater' and yet greater non-correlational²⁵ outdoors.

Times such as these :

- +10<sup>{10^{26}}} (10¹⁰ ²⁶ A double exponential function 10 ^ 10 ^ 26)
Low estimate for the time until all matter collapses into black holes, assuming no proton decay. Subsequent Black Hole Era and transition to the Dark Era are, on this timescale, instantaneous.</sup>
- +10^{{10^{50}}} Estimated time for a Boltzmann brain to appear in the vacuum via a spontaneous entropy decrease.}
- +10^{{10^{56}}} Estimated time for random quantum fluctuations to generate a new Big Bang, according to Carroll and Chen.}
- +10^{{10^{{10^{{10^{1.1}}}}}} Scale of an estimated Poincaré recurrence time for the quantum state of a hypothetical box containing a black hole with the estimated mass of the entire Universe, observable or not.}}

And Sizes:

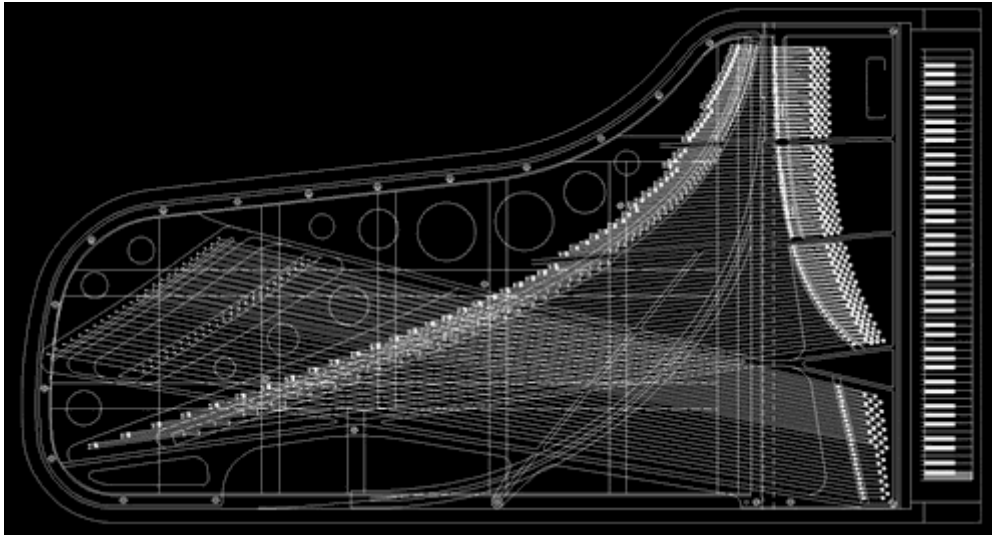
- = 10<sup>{10^{115}}}Ym²⁶
According to the laws of probability, the distance one must travel until one encounters a volume of space identical to our observable universe with conditions identical to our own.</sup>
- = 10<sup>{10<sup>{10^{122}}}}Ym
Size of universe after cosmological inflation, implied by one resolution of the No Boundary Proposal.</sup></sup>

²⁴ For instance they will reach a precise copy of this Universe and so this thought experiment again!

²⁵ 'Greater' in that I am unable, as above, to provide comparisons.

²⁶ Ym = yottametre = 10²⁴ metres, However with such large numbers the unit of measure be it Ym or Ly (light years) or megaparsecs, makes little difference. I will use these as both sizes and times to enable the last two Hyper Grands to 'play'. 10^{{10^{{10^{122}}}} is 1 followed by 10^{10¹²²} (a googolplex ^ 10 sextillion) zeroes.}}

Hyper Grand. #9 ($10^{10^{115}}$)



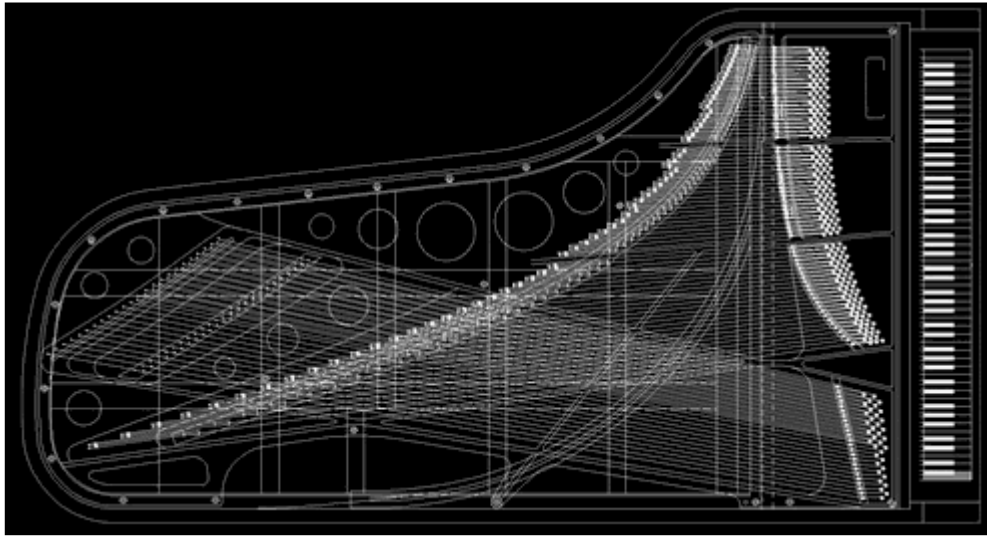
$10^{10^{115}}$ Ym

According to the laws of probability, the distance one must travel until one encounters a volume of space identical to our observable universe with conditions identical to our own.

$10^{10^{56}}$

Estimated time for random quantum fluctuations to generate a new Big Bang, according to Carroll and Chen.

Hyper Grand. #10 ($10^{10^{10^{122}}}$)



$10^{10^{10^{10^{1.1}}}}}$

Scale of an estimated Poincaré recurrence time for the quantum state of a hypothetical box containing a black hole with the estimated mass of the entire Universe, observable or not.

$10^{10^{10^{122}}}Ym$

Size of universe after cosmological inflation, implied by one resolution of the No Boundary Proposal.

The finite grands can continue indefinitely, there are much larger numbers²⁷, and the process of construction can be repeated forever. This also provides 'spaces' which are greater than the cosmos, and perhaps multiverses. However they will never reach infinity. Infinite Grands are a concept which is not explored here, perhaps another set and book is required. These 'Cantor' Grands can attempt to utilize the hierarchies of ever 'larger' infinities first discussed by the mathematician Georg Cantor. Having reached these non-limits²⁸, music as objects which generate time based sequences can continue, but now no longer constrained by Newtonian or Relativity's physics.

"The cardinality of the natural numbers is \aleph_0 (read *aleph-naught*, *aleph-null*, or *aleph-zero*), the next larger cardinality is aleph-one, then \aleph_2 and so on. Continuing in this manner, it is possible to define a cardinal number \aleph_α for every ordinal number ..."²⁹

Etc.!

J.W. (for F)

²⁷ http://en.wikipedia.org/wiki/Large_numbers

²⁸ Double exponential functions such as $10^{10^{100}}$ (googolplex) it appears, behave in strange ways as in the notes above - such that the sizes mean "changing the base from 2 to 10 won't change the number expressed by the double exponential very much" Frank J. Tipler, *The Physics of Immortality* (London: Macmillan, 1994) p.220.

²⁹ http://en.wikipedia.org/wiki/Aleph_number accessed 18/10/2013 See also Rudy Rucker *Infinity and the Mind* (Princeton University Press, 2004). As with very large numbers and infinity theories there are mathematicians who disagree with the very idea of the infinite - such latitude gives any 'musician' scope for speculative thought before resorting to greater imaginations. I for one see such 'spaces' as a territory or territories in which the multiple planes of real and virtual can exist.