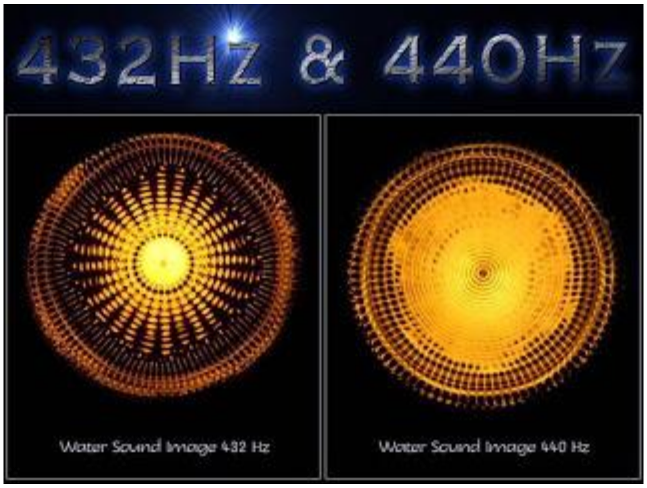
What does music hide?



“If you want to reveal the secrets of the universe,
think in terms of energies, frequencies and vibrations "
Nikola Tesla

We will try once again to understand the tuning of musical instruments, how and for what purpose the choice and standardization of tuning fork frequency took place. Now there are many discussions on the topic of what music to listen to 440 hz or 432 hz. In almost every article, there is a confusion and substitution of concepts, which leads away from the essence and introduces confusion.

Error analysis

1. Pictures and videos. This image, for example, shows a clear separation of waves on the surface of water in a vessel at 432 hz and not very clear at 440 hz, attributing this alignment to the resonance of water. In fact, these are the properties of the vessel: material, height, diameter, wall thickness (base frequency). When water is added, the base frequency is divided. A cleaner pattern with 432hz indicates that the vessel dimensions are tuned to this frequency. The result will be the opposite if you choose a vessel with a base frequency of 440 Hz. And it may be any other frequency is not an integer.
https://www.youtube.com/watch?v=DZP5u53xlUk -standing sound waves
https://www.youtube.com/watch?v=DZP5u53xlUk -standing sound waves
https://www.youtube.com/watch v=bskje44cpbq&list=PLWM8IO 3tqjndn4xppg_xfqoguk8ql-5J-
Transverse standing waves on a ruler with a free end.
https://www.youtube.com/watch?v=NvjIuDh3kh0 - the PATTERN of SOUND VI

Source: Glenbrook
Glenview, Illinois

The result of interference of two waves propagating in opposite directions: the blue wave moves to the right, and the green wave moves to the left
Examples of standing waves are the vibrations of a string, the vibrations of a column of air in wind instruments and drums.

https://www.physicsclassroom.com/Class/waves/u1014b.cfm

Standing waves are excited in any bodies capable of oscillating. Even if we hit a stone with a hammer, we stir up standing waves in it. The formation of standing waves occurs at the proper resonant frequencies of the body, which are determined by the size of the body.

All the above videos show the properties of standing waves in relation to the object, its size and can be almost any frequency.

As the output for this part:

Beautiful pictures and videos prove the existence of standing waves, no more.

2. Numerology

A lot of importance is attached to the frequency numbers themselves, for example: 24 hours a day (43,200 * 2 seconds);

Kali Yuga lasted 432,000 years;

The Egyptian pyramids are measured in 432 segments (of unknown length), so you can at least divide something;

With the 432 standard, C is tuned to 512 Hz, 256 Hz, and so on 128-64-32-16-8-4-2-1 Hz, which is considered something unusual and special, in fact it is just numbers and the rest of the notes do not look so special.

Tab. 1

Частоты в герцах (интервал от средней До в полутонах)/ Frequencies in Hertz (range from middle to semitones)										
Октава/Octave → Нота/Note ↓	**Суб-контр**	**Контр**	**Большая**	**Малая**	**1**	**2**	**3**	**4**	**5**	**6**
C	16,352 (−48)	32,703 (−36)	65,406 (−24)	130,81 (−12)	261,63 (0)	523,25 (+12)	1046,5 (+24)	2093,0 (+36)	4186,0 (+48)	8372,0 (+60)
C# / D♭	17,324 (−47)	34,648 (−35)	69,296 (−23)	138,59 (−11)	277,18 (+1)	554,37 (+13)	1108,7 (+25)	2217,5 (+37)	4434,9 (+49)	8869,8 (+61)
D	18,354 (−46)	36,708 (−34)	73,416 (−22)	146,83 (−10)	293,66 (+2)	587,33 (+14)	1174,7 (+26)	2349,3 (+38)	4698,6 (+50)	9397,3 (+62)
D# / E♭	19,445 (−45)	38,891 (−33)	77,782 (−21)	155,56 (−9)	311,13 (+3)	622,25 (+15)	1244,5 (+27)	2489,0 (+39)	4978,0 (+51)	9956,1 (+63)
E	20,602 (−44)	41,203 (−32)	82,407 (−20)	164,81 (−8)	329,63 (+4)	659,26 (+16)	1318,5 (+28)	2637,0 (+40)	5274,0 (+52)	10548 (+64)
F	21,827 (−43)	43,654 (−31)	87,307 (−19)	174,61 (−7)	349,23 (+5)	698,46 (+17)	1396,9 (+29)	2793,8 (+41)	5587,7 (+53)	11175 (+65)
F# / G♭	23,125 (−42)	46,249 (−30)	92,499 (−18)	185,00 (−6)	369,99 (+6)	739,99 (+18)	1480,0 (+30)	2960,0 (+42)	5919,9 (+54)	11840 (+66)
G	24,500 (−41)	48,999 (−29)	97,999 (−17)	196,00 (−5)	392,00 (+7)	783,99 (+19)	1568,0 (+31)	3136,0 (+43)	6271,9 (+55)	12544 (+67)
G# / A♭	25,957 (−40)	51,913 (−28)	103,83 (−16)	207,65 (−4)	415,30 (+8)	830,61 (+20)	1661,2 (+32)	3322,4 (+44)	6644,9 (+56)	13290 (+68)

A	27,500 (−39)	55,000 (−27)	110,00 (−15)	220,00 (−3)	440,00 (+9)	880,00 (+21)	1760,0 (+33)	3520,0 (+45)	7040,0 (+57)	14080 (+69)
A# / H♭	29,135 (−38)	58,270 (−26)	116,54 (−14)	233,08 (−2)	466,16 (+10)	932,33 (+22)	1864,7 (+34)	3729,3 (+46)	7458,6 (+58)	14917 (+70)
H	30,868 (−37)	61,735 (−25)	123,47 (−13)	246,94 (−1)	493,88 (+11)	987,77 (+23)	1975,5 (+35)	3951,1 (+47)	7902,1 (+59)	15804 (+71)

Октава/Octave, Нота/Note, Суб-контр/Sub-counter, Контр/Counter, Большая/Large, Малая/Small

Everything in this case is relative, even the second as we know it. And so:

The second (Russian designation: s; international: s) is a unit of time measurement, one of the main units of the International System of Units (SI) and the SGS system.

It is a time interval equal to 9,192,631,770 periods of radiation corresponding to the transition between two hyperfine levels of the ground (quantum) state of the cesium - 133 atom at rest at 0 K in the absence of perturbation by external fields. This definition was adopted in 1967 (a clarification regarding temperature and resting state appeared in 1997). The exact text of the definition of the second, approved at the XIII General Conference on Weights and Measures (1967), Resolution I, is as follows[1] [2]:

9 192 631 770 / 440 = 20892344.93181818

9 192 631 770 / 432 = 21279240.20833333

Hertz (Russian designation: Hz, international designation: Hz) is a unit of frequency of periodic processes (for example, vibrations) in the International System of Units (SI). Hertz is a derived unit that has a special name and designation. In terms of basic units SI hertz is expressed as follows:

1 Hz = 1 s^{-1}.

1 Hz means one execution (implementation) of such a process in one second, in other words - one oscillation per second, 10 Hz — ten executions of such a process, or ten oscillations in one second.

It turns out that the numbers in this case are relative and the length of the second was formed only in 1967. Fig. 3 shows the calculated frequencies relative to different lengths of the second.

In the footsteps of A. M. Khatybov: The standard of a second is currently an atom of the isotope cesium, in which electrons rotate at a certain speed, recalculated according to the movement of stars. The second is an abstract concept and serves as a reference (synchronization) of time with different dimensions.

The progenitor of this standard was sand, solar, water, spring, electronic and other standards, the accuracy of which depended on the accuracy of their manufacture. It should be noted that the cesium atom is not bound to any system, and if the potential of the "electron" is changed, the entire time frame will crumble. Since the second is a purely mechanical concept, and this parameter cannot be used in a particular system in any way, this is also transferred to differential mathematics as a means of accurate calculations of any physical phenomena. However, no matter how accurately the standard for a second is chosen, 1 second in 100 years disappears somewhere. This means that for a macro object, such accuracy can turn into a disaster (maybe the Earth is moving in the wrong direction).

Таблица 3

Параметры	Классы			
	Высший	I	II	III
Номинальный диапазон воспроизводимых частот, Гц	20—20 000	31,5—16 000	50—12 500	50—10 000
Неравномерность частотной характеристики, дБ, не более:				
в диапазоне 63—8000 Гц	4	6	10	12
в диапазоне ниже 63 Гц и выше 8000 Гц	8	10	10	12
Допускаемые отклонения от номинального значения частоты вращения, %	±0,55	±1,2	±1,8	±2,1
Коэффициент детонации, %	0,1	0,1	0,15	0,25
Относительный уровень рокота, дБ, не хуже:				
без взвешивающего фильтра	—	—	—31	—28
со взвешивающим фильтром	—60	—46	—	—

Парамстрм/Parameters
Номииальный диапазон воснроизвдимых частот, Гц/Nominal range of reproducible frequencies, Hz
Неравномерноть чстотной ха ракгеристики, дб, не более: в диапазоне 63-8000 Гц в диапазоне иимже 63 Гц и вышс 8000 Гц/Frequency response unevenness, dB, not more: in the range of 63-8000 Hz in the range below 63 Hz and above 8000 Hz
Доиускаемые отклоиения от иоминального зачения частоты вращсиия, %/Achieved deviations from the nominal value of the rotation frequency,%
Коэффнциент дстонацнй, %/Коэффициент детонации,
Относительный уровень рокота, дб, не хуже:/The relative level of the rumble, dB, not worse:
без взвешивающего фильтра/without weighing filter
со взвешивающим фильтром/with weighing filter

Conclusion by reference to numbers: The numbers indicating frequency and time are not applicable in this case as something "secret unusual", but can be used as a reference point for comparing different parameters.

Let's pay attention to the recording and sound reproduction techniques and frequency fidelity, in the era of records, cassettes and reel-to-reel tape recorders. Even with the highest quality players, the playback speed was slightly different, a shift of about half a tone, which was almost impossible to catch in normal listening without comparing it with a tuning fork. In orchestras, the frequencies also floated in a few hertz. So it's hard to talk about a fixed frequency for this time, maybe the range played a role. Based on the table 0.5%, the speed deviation leads to ±2.5 Hz for higher and ±9.24 hz for 3rd class. (A 430 ÷ 450 Hz).

The following information is taken from the forum of professional musicians:

In the 16th - 17th century, A (la) was fixed at 405-407 hertz (This is a low A flat) and remained so until the French Revolution. The Napoleonic wars swept across Europe, and A crept up.

Why did this happen? I think it's the psychology of violinists. They are still trying to tune a little sharper than the wind instruments. When the wind instruments were adjusted, they again overestimated.

When introducing the metric system, Napoleon ordered the adoption of a new standard for la - 435 Hz. Fortunately, all of Europe was in subjection.

After Napoleon, la again "broke" and according to some sources reached 460 hz.

Woodwinds and the nascent brass chromatics were particularly affected at that time.

Finally, the musicians could not stand it and called the "Stuttgart Convention" in 1836, at which la 440 was adopted.

The USSR joined it in 1936.

In France, famous woodwind companies still produce instruments at both 440 and 435 hz. Somewhere apparently there are still orchestras according to the precepts of Napoleon.

But there is still a dispute; our violinists are pulling up the line. Justifying this with the new 442hz standards. No one has seen any documents confirming this. But industry (back in the USSR) released tuning forks 442 and even 443hz.

The orchestra bells and xylophone are tuned to 442hz, which is written on them.

Our smart guys even sent a request to the firm.

I got something like this answer:

Standard LA 440, drum tuning in 442 is due to the physical phenomenon of sound attenuation with a decrease. That is, when the sound departs from the xylophone, it will just drop to 440.

Proceeding from this, all concert grand pianos are apparently overstated.

But our clever people tune in to the piano, and it is again against the background of the orchestra visit.

Accurate frequency transmission became possible only with the advent of Compact Discs (CDs), computers and other digital recording devices. They were widely used in the 90s. Here draw your own conclusions; the fact is that the frequencies were very unstable, especially for players of the 2nd and 3rd classes.

Music in my understanding carries the color and content of the author and performers of the work superimposed on the carrier frequency of sound vibrations. There is an overlap of their essence, thoughts and emotions. I used to be a member of musical groups and am familiar with these effects. Rocking, superimposing images and linking them to the rhythm, and some other methods of interaction in the team and with listeners. In the video below, N. V. Levashov explains the essence of healing or destroying icons and paintings, I think a similar situation with musical works. For some reason, this component of music was not given much attention, although this is one of the most important reasons for its popularity. https://www.youtube.com/watch?v=hBjiB8oQH90 **the issue of paintings is being considered, but there should be parallels.**

Additional research on the influence of music addresses the following question. How do the main components of music affect us: rhythm, melody, harmony and timbre?

- RHYTHM has the strongest and most direct impact on a person - both on his body and on his emotions. The life of our body is based on different rhythms: breathing, heart, various movements, activity and rest, not to mention the more subtle rhythms at the level of cells and molecules.

- MELODY affects the listener in a particularly intense and diverse way.

The melody awakens not only emotions, but also feelings, images and beliefs, strongly affects almost all vital functions, especially the nervous system, breathing and blood circulation.

- HARMONY is produced by the simultaneous sounding of several sounds in harmony with each other, which form chords. Thanks to the various vibrations emitted by these chords, either a sense of harmony or dissonance arises in the soul of the listeners, which in any case has a certain physiological and psychological effect.

The predominance of dissonances in modern music is an expression of discord, conflicts, crises that bring suffering to modern man.

- TIMBRE. Everyone who has a musical ear feels differently the charm of the violin or flute, harp or soprano. The composer, skillfully combining various instruments in the orchestra, can bring a huge audience to frenzy.

Music can both create and destroy. In Japan, an experiment was conducted in which 120 nursing mothers participated. Some mothers listened to classical music, others to pop music. In the first group, the amount of milk in mothers increased by 20 percent and in fans of modern rhythms - decreased by half. Again, no one bothered to take into account the performers but here, as they say, what kind of music is this and the performer (mostly).

Rock music affects ultra-and infrasound, which we do not hear, but which all our organs "hear", and is able to destroy the brain on the principle of the well-known "25th frame", when the viewer watches a film in which an extra invisible frame with an advertising slogan is embedded. Experiments have found that if the beat of drums of the "tam-tam" type exceeds 100 decibels, then listeners fall into a fainting state.

N. V. Levashov **about music:**

- https://www.youtube.com/watch?v=pYNKzEZVma0
- https://www.youtube.com/watch?v=qekMZ5n3CRM

Let us now consider the most debated part of the musical world in the "advanced" part of the population. At what frequency should musical instruments be tuned for the “correct” impact of music? There are more options than you can imagine. They will be listed below.

In the previous chapters, we found out that accurate frequency reproduction on music equipment became possible only in the 90s. This period is associated with the collapse of the USSR and many other changes in mentality. Whether the musical culture influenced the course of events, I cannot say, but I definitely took part in it accompanying everyone at home, on the road and often at work.

When searching for information, you come across a lot of commercial projects with "healing music" to confirm or deny a systematic approach is necessary. But knowing the local principles of making money, most likely the statements are groundless.

- http://altered-states.net/barry/update205/ The 528 Hz Healing Theory, How Simple. (and "SvetL" is not needed)
- http://www.liveinternet.ru/users/ppp/post234167046/ Loud statements that the frequency of 440 Hz destroys.
- http://bambooway-ru.livejournal.com/53772.html Meditative bamboo flutes Zentaku, as well as Shakuhachi, Hotiku, Bansuri and others ...
- http://janosh.lv/ru/celitelnaya-chastota-432-gerca.html - Healing frequency of 432 Hertz
- http://nashsolyaris.blogspot.ca/2014/04/440_13.html - Cult Music Control: How the Standardized Music Tuning to A = 440 Hz was introduced

Covering a huge number of articles with a discussion of only one note A (la) which only sometimes skips in the works, could not find statistics, but on the piano 88 keys and only one (la 440Hz). Although it is natural to shift in all octaves.

From what came across about the "amazing" properties of the frequency of 440 Hz, all that makes sense is the ability of this frequency to cause irritation and restlessness. As for example, the cry of a newborn, by the way, the frequency of the cry decreased to 435÷430 hz when calming down and then the child usually fell silent.

It can be assumed that at 440 Hz there is irritation of certain areas of the brain "convenient" for laying various programs. And the frequencies of 435÷430 hz allow you to calmly and deliberately perceive information in the "correct" order.

Home experiment: We played classical works on a professional electronic piano Roland FP2, at tuning frequencies A 430, 432, 433.9, 435, 440, 444. The first three sound unnatural and unpleasant, 435 is the most comfortable and creates a sense of comfort in a confined space, and also felt the flow of energy in the participants of the experiment. Frequency 440 sounds familiar but more aggressive than 435. 444 also like the first three. Where the frequency 433.9 came from can be seen by reading Figure 3.

Piezoelectric elements in the spinal cord
http://samlib.ru/s/shkrudnew_fedor_dmitriewich/osnovy-24.shtm

Accurate exposure is possible only with high-quality frequency transmission, visiting "live" concerts or listening to digital recordings. Information about the frequency ranges of perception is not available.

What is a musical octave?

The frequencies of a uniformly tempered series are calculated by the formula:

f = A*2^[(i - 1)/12], where i is a natural series of numbers, i.e. 1,2,3,4.... etc.

A is the initial frequency from which "everything starts".

If A = 1, then for "La" the frequency = 430,5389646 Hz (only in this case the octave frequencies are 2,4,8,16,32,64,128, etc.)

If A = 1.021975, then for "La" frequency = 440 Hz.

In this case, the duration of ONE second is important, as I said above. I hope this is understandable, since the calculated values have a relative value, i.e. relative to the selected duration of 1 second.

In a more general case (if someone wants to calculate frequencies instead of 12, for example, as in Chinese music, 48 frequency intervals), the formula will look like:

f = A*2^[(i-1)/N], where N is the number of intervals (in European music, N = 12). "

Let's try to find out what makes sense in the light of the knowledge obtained from

A.M. Khatybov: http://lit.lib.ru/h/hatybow_a_m/glossar.shtml

GLOSSARY

***

1.1. **Music**, or the command octave.

8 tones DO RE MI FA SOL LA SI NA.

Each tone is split into 8, respectively. The maximum number of splits is 8.

The DO tone corresponds to the French system. (See above the history of French music)

***

Time must be assigned to the magnetic field of the macro object.

The system clock is mentioned, which was changed from 1.0007 “to 1.008". Perhaps if you build musical octaves using this period as a point, then unexpected properties of music will appear. Using this information, I recalculated the possible musical frequencies (Fig. 3), but the result of listening at these frequencies was not impressive. Try it, maybe my perception can't be used for evaluation.

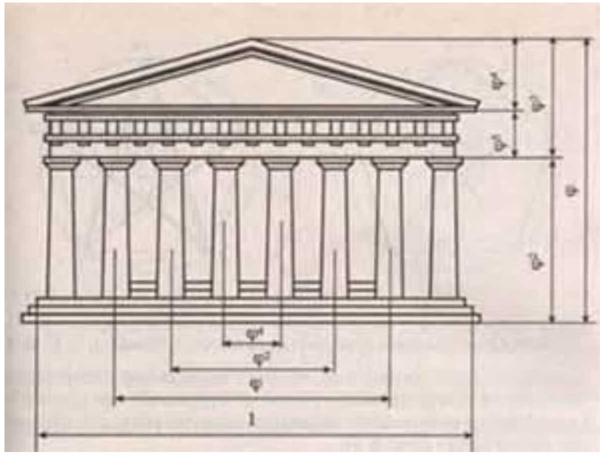
		Частоты в привязке к официальной секунде									
		f = A*2^[(i - 1)/12]							f = A*2^[(i - 1)/7	f = A*2^[(i - 1)/8]	
		частота для нового (родного) такта при 7ми нотах с полутонами 1.008	A 440 Гц 1.021975 -	A 432 гц Такт 1.00339сек	Такт Эрбов 1.0007	7 Нот 1 сек., с полутонами		7 нот 1.008	7 нот для 1секунды по цезию	По Хатыбову 8 основных нот для нового (родного) такта	
C	1	1.008	1.022	1.003	1.001	1.000	До	1.008	1.000	1.008	DO
C#	2	1.068	1.083	1.063	1.060	1.059	Ре	1.113	1.104	1.099	RE
D#	28	4.795	4.861	4.773	4.760	4.757	Си	14.608	14.492	10.458	FA
E	29	5.080	5.150	5.057	5.043	5.040	До	16.128	16.000	11.404	SOL
F	30	5.382	5.457	5.357	5.343	5.339	Ре	17.807	17.665	12.436	LA
F#	31	5.702	5.781	5.676	5.661	5.657	Ми	19.660	19.504	13.562	SI
G	32	6.041	6.125	6.014	5.997	5.993	Фа	21.707	21.534	14.789	NA
G#	33	6.400	6.489	6.371	6.354	6.350	Соль	23.966	23.776	16.128	DO
H	48	15.223	15.434	15.153	15.113	15.102	Ля	105.843	105.003	59.158	NA
C	49	16.128	16.352	16.054	16.011	16.000	Си	116.860	115.933	64.512	DO
C#	50	17.087	17.324	17.009	16.963	16.951	До	129.024	128.000	70.351	RE
C	61	32.256	32.703	32.109	32.022	32.000	Соль	383.458	380.415	182.467	SOL
C#	62	34.174	34.648	34.018	33.927	33.903	Ля	423.372	420.012	198.982	LA
D	63	36.206	36.708	36.041	35.944	35.919	Си	467.440	463.731	216.992	SI
D#	64	38.359	38.891	38.184	38.081	38.055	До	516.096	512.000	236.631	NA
E	65	40.640	41.203	40.454	40.346	40.317	Ре	569.816	565.294	258.048	DO
F	66	43.057	43.654	42.860	42.745	42.715	Ми	629.128	624.135	281.403	RE
F#	67	45.617	46.249	45.408	45.287	45.255	Фа	694.614	689.101	306.873	MI
G	68	48.329	48.999	48.109	47.979	47.946	Соль	766.916	760.829	334.647	FA
G#	69	51.203	51.913	50.969	50.832	50.797	Ля	846.744	840.023	364.935	SOL
LA	70	54.248	55.000	54.000	53.855	53.817	Си	934.881	927.461	397.964	LA
LA#	71	57.474	58.270	57.211	57.057	57.018	До	1032.192	1024.000	433.983	SI
H	72	60.891	61.735	60.613	60.450	60.408	Ре	1139.632	1130.588	473.262	NA
C	73	64.512	65.406	64.217	64.045	64.000	Ми	1258.256	1248.270	516.096	DO
F#	79	91.234	92.499	90.817	90.573	90.510	Ре	2279.265	2261.175	867.967	SI
C#	86	136.696	138.591	136.072	135.706	135.611	Ре	4558.529	4522.351	1591.858	LA
D	87	144.825	146.832	144.163	143.776	143.675	Ми	5033.025	4993.080	1735.933	SI
D#	88	153.436	155.564	152.735	152.325	152.219	Фа	5556.910	5512.807	1893.048	NA
E	89	162.560	164.814	161.817	161.383	161.270	Соль	6135.326	6086.633	2064.384	DO
H	96	243.565	246.942	242.452	241.801	241.632	Соль	12270.651	12173.265	3786.097	NA
C	97	258.048	261.626	256.869	256.179	256.000	Ля	13547.897	13440.374	4128.768	DO
LA	106	433.983	440.000	432.000	430.840	430.539	До	33030.144	32768.000	9004.907	RE
LA#	107	459.789	466.164	457.688	456.459	456.140	Ре	36468.236	36178.805	9819.921	MI
H	108	487.130	493.883	484.904	483.602	483.264	Ми	40264.197	39944.639	10708.699	FA
C	109	516.096	523.251	513.738	512.358	512.000	Фа	44455.277	44102.458	11677.919	SOL
C#	110	546.785	554.365	544.286	542.825	542.445	Соль	49082.605	48693.061	12734.861	LA
G#	117	819.251	830.610	815.508	813.318	812.749	Соль	98165.211	97386.122	23355.839	SOL
LA	118	867.967	880.000	864.000	861.681	861.078	Ля	108383.180	107522.996	25469.723	LA
LA#	119	919.579	932.328	915.377	912.919	912.280	Си	119664.732	118715.012	27774.930	SI
G#	129	1638.503	1661.219	1631.016	#######	1625.499	Ми	322113.572	319557.115	66060.288	DO
LA	130	1735.933	1760.000	1728.001	#######	1722.156	Фа	355642.217	352819.660	72039.255	RE
LA#	131	1839.157	1864.655	1830.753	#######	1824.561	Соль	392660.843	389544.487	78559.365	MI
H	132	1948.519	1975.533	1939.615	#######	1933.055	Ля	433532.719	430091.983	85669.594	FA
C	133	2064.384	2093.005	2054.951	#######	2048.000	Си	478658.929	474860.048	93423.355	SOL

Fig.: 3 (click to zoom in the table)

After considering the calculations, the relationship between the "system beat" and the musical frequency could not be found. But A. Khatybov's mention of the French system coincides with personal feelings.

In continuation, there is more interesting information about the Golden Section.

The golden ratio in musical works.



Rosenov analyzed the most popular and most favorite works of brilliant authors Bach, Mozart, Beethoven, Chopin, Wagner, Glinka, as well as works of folk art of the most ancient origin, the vitality of which is sufficient proof of their aesthetic value and wide popularity.

But beyond establishing the fact of the existence of the law of the Golden section in musical works and its great aesthetic value in music mathematical analysis of music (even a basic one) allows us to draw some conclusions about the characteristic features of the work of the composers themselves. Thus, comparing the manifestation of the law of the golden ratio in Bach and Beethoven, Rosenov writes: "We find in Bach a comparatively more detailed and organic cohesion. The law of the golden division manifests itself in him with amazing accuracy in the proportions of large and small parts in both strict and free forms, which undoubtedly corresponds with the character of this brilliant master-worker, strong, healthy and balanced, with his deeply focused attitude to work and detailed manner of writing. Beethoven's manifestation of the law of the Golden section is deeply logical in relation to the size of the parts of the form, but mainly indicates the strength of the temperament of the author on the accuracy of matching all of the moments of highest tension of feeling and the resolution of prepared expectations with moments of Golden sections. In Chopin, the internal formal connection is comparatively weaker and does not manifest itself entirely, but only in places. In the strength of his temperament, he is similar to Beethoven, but this manifestation is more external and concerns more often the graceful elegance of the presentation of thought than its internal logic. In Mozart, the temperament is relatively weaker; the law of the golden section is directed especially often to emphasize dramatic elements (psychological contacts, contrasts of characters) and tragic positions. In Glinka we find the application of this law only on a large scale, with the almost complete absence of the petty correspondences that occur so often in Bach and Chopin."

Analysis of J. S. Bach's Chromatic Fantasy and Fugue

The chromatic fantasy and fugue of J. S. Bach are united by a common key in D minor and are contrasting in genre and image.

The chromatic fantasy with fugue in D minor is one of Bach's greatest works, a model of perfection of form and content, "the most powerful harpsichord work".

Fantasy

Chromatic fantasy is written in 4/4 time and has 79 measures, that is, 79 x 4 = 316 quarter beats.

So, "whole" a = 316. The fantasy consists of two distinctly distinguishable parts, separated from each other by a pause. The first movement, the prelude, ends on an arpeggiated dominant triad with a resolution of the 2nd quarter of the 49th bar, on which there is a fermata sign (lengthening of the sound), and then there is a pause. Thus, the first part actually ends on the 3rd quarter of the 49th bar, i.e. on the 195th (48 • 4 + 3) quarters $a_1 = 195.$. The second part accounts for 121 quarters

$$(a_2 = a - a_1 = 316 - 195 = 121).$$

Calculating the "theoretical" length of the first part using the golden ratio, we find with amazing accuracy

$$a_1 = a\varphi = 0,316 \cdot 0,618 = 195,3.$$

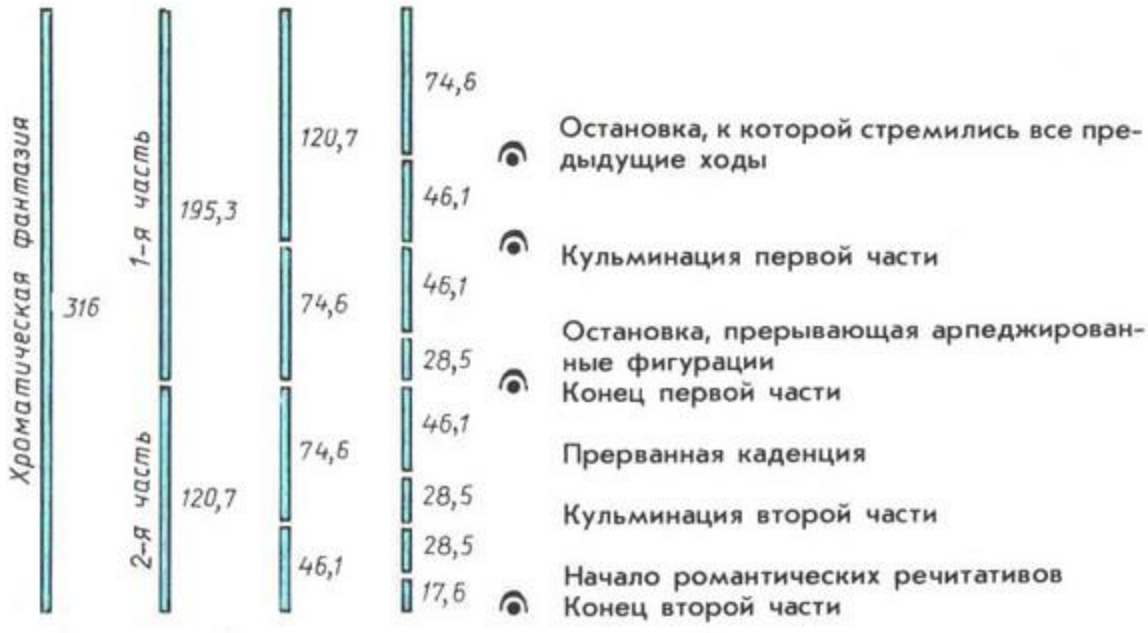
So, Chromatic Fantasy is divided into the first and second parts in the golden ratio:

$$\frac{316}{195} = \frac{195}{121}, \quad 195 + 121 = 316.$$

But this is just the beginning of the wonders of Bach's brilliant creation. Having constructed a series of the golden section at a=316, we have

$$316 \qquad 195,3 \qquad 120,7 \qquad 74,6 \qquad 46,1 \qquad 28,5 \qquad 17,6.$$

What must be our surprise when we find that on the 124th quarter is the culmination of the first part and there is a sign of fermata•, and on the 77th quarter from the beginning of the second part there is the culmination of the second part. Thus, the culmination of both parts with a small error, easily explained by the extensibility of the tempos, divides these parts according to the law of the golden section. Further, each of the resulting four sections of Chromatic Fantasy has characteristic features that also fall with stunning accuracy on the points of the golden section of these sections. Rosenov also found smaller divisions of the Chromatic Fantasy in the Golden ratio.



Хроматическая фантазия/Chromatic Fantasy
2-я часть/Part 2 1-я часть/Part 1

Остановка, к которой стремились все предыдущие ходы/The stop that all the previous moves were aiming for is the climax of the first part
кульминация первой части/The culmination of the second part
Остановка, прерывающая арпеджированные фигурации/Stop interrupting arpeggiated figurations
Конец первой части/End of the first part
Прерванная каденция/The interrupted cadence is the
кульминация второй части/climax of the second movement
Начало романтических речитативов/The beginning of romantic recitatives
Конец второй части/End of the second part

Figure 2: Basic golden sections of J. S. Bach's chromatic fantasy. The numbers indicate the number of quarters of the theoretical series of the Golden Section (a=316). On the right - a description of the corresponding characteristic places of the musical text of the fantasy.

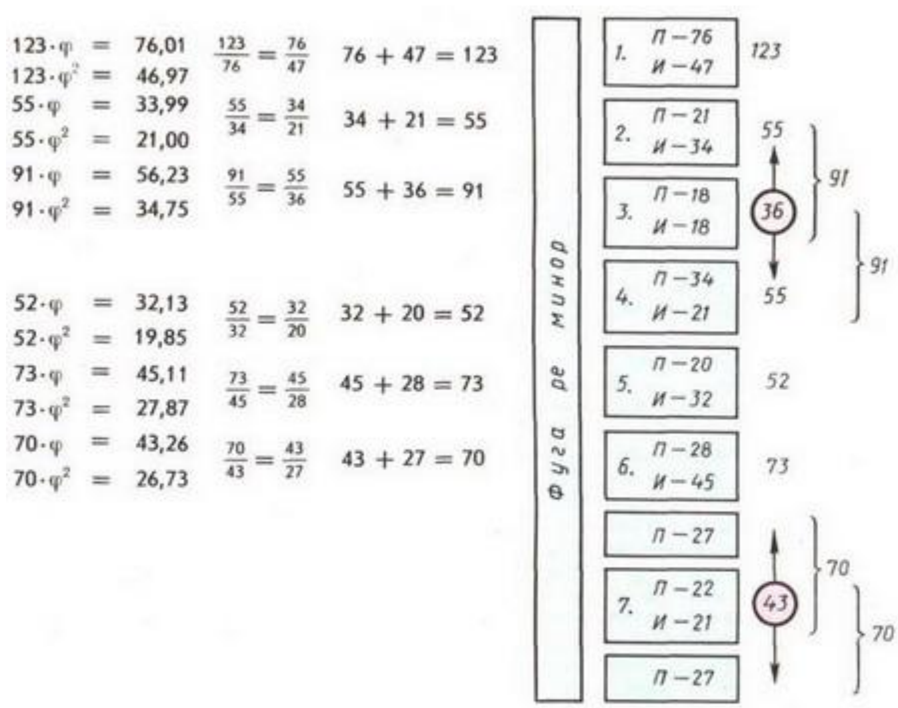
So, Chromatic Fantasy, a work of the free-form genre, is literally woven from golden proportions. Perhaps the aesthetic impression of mathematical analysis of Chromatic Fantasy is no less strong than that of listening to Bach's immortal creation. And taken together, sensory impression and rational analysis certainly bring us one step closer to the innermost recesses of genius.

Fugue

Let's move on to the analysis of the fugue. Fugue (from Lat. Fuga - running) is the most perfect form of polyphonic music (polyphony). The fugue is based on multiple performances (repetitions) of the main musical theme in different voices.

The performances of the main theme are usually interspersed in the fugue with intermediate inserts called interludes. Thus, the fugue, unlike the fantasy, has a well-defined law of construction. But nevertheless, the accuracy of the "mathematical" construction of the fugue in D minor is simply amazing!

The fugue in D minor consists of seven pairs of passages and interludes and two independent passages. Of the seven "holding-interlude" pairs, five pairs strictly obey the law of the golden ratio. The same two pairs of "holding-interlude", for which the law of golden division is not fulfilled, are a kind of centers of symmetry with respect to the sections of the fugue framing them and with each of them are in golden proportion! It is in order to distinguish these two centers of symmetry that Bach specifically allows deviations from the golden division in their structure and makes these two "holding-interlude" pairs symmetrical.

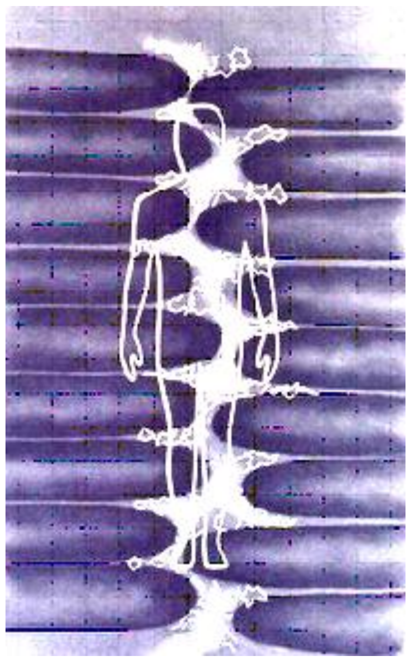


фуга ре минор /fugue in d minor

Figure 3: The structure of the fugue in d minor by J. S. Bach. Integers indicate the number of quarters in the fugue; fractional numbers indicate the theoretical value of the golden sections. The golden proportions in the larger parts of the fugue are marked with curly brackets; the centers of symmetry are marked with circles. P-holding, I-interlude.

The figure shows a diagram of the structure of the fugue in d minor. Here, the number of quarters in each section of the fugue is indicated (integers) and the theoretical values of the terms of the golden proportion (fractional numbers) are given.

As you can see, all five pairs of "holding-interlude" are divided with amazing accuracy in the golden ratio (absolute errors range from 0.05 to 0.15 quarters, relative errors - from 0.02% to 0.7%). Such relative errors can be the envy of many of the modern engineering calculations! In larger sections, absolute errors naturally increase. But even when dividing the largest partition (91 quarters), these errors do not exceed 1.25 quarters. We must not forget, however, that we are dealing with a work of art. Note that in the fugue in d minor, there are also smaller and larger ratios of the golden section.



So, a simple mathematical analysis, which does not go beyond arithmetic, allows us to look at a musical work with completely different eyes, to see its hidden inner beauty, which we only feel when listening to the work, and which we "see" when conducting its mathematical analysis.
http://nanoton.su/nastroika.html

The topic is very extensive and open to discussion, but I hope that I have managed to uncover common misconceptions about the physical processes and musical chats of the tuning tone. On my own experience, I checked that the frequency of 435 Hz is more comfortable than the rest (perhaps this is due to my genetics). When choosing musical compositions, it is advisable to monitor your own reaction and develop observation skills. The musical frequency acts as a carrier that excites and selects certain areas of perception, the rest of the impact occurs on completely different frequency ranges (octaves). Part of this program content are authors, performers and possibly interested "entities", since their" thoughts", programs and essence are superimposed on the carrier musical frequency. A separate topic should be the consideration of the interaction and susceptibility of different genotypes to music styles, the possibility of programming behavior and transmitting information. As well as the development or suppression of certain brain abilities.

But to do this, it is desirable to have the ability to "see" these interactions.
http://www.sozvezdieoriona.ru/publ/vozdejstvie_zvuka_muzyki_na_organizm_cheloveka_pljusy_i_minusy/5-1-0-44

Therefore, music should be considered much more broadly than just sound, applied and used wisely.

Vladimir Govorov

23.06.2014