

# **Pulsars**

**for three retuned, computer-driven pianos**

**by Kyle Gann**  
**2017**

## Technical Specifications

The 33-pitch tuning of the three pianos (the same in every octave) is as follows, given first in the number of cents above E-flat, and then as ratios to the nearest E-flat 1/1 below:

Piano	1		2		3	
D	1088	15/8	977	225/128	1044	117/64
Db	969	7/4	938	55/32	906	27/16
C	857	105/64	773	25/16	840	13/8
B	738	49/32	755	99/64	729	195/128
Bb	702	3/2	590	45/32	609	91/64
A	551	11/8	551	11/8	481	169/128
Ab	471	21/16	440	165/128	408	81/64
G	386	5/4	320	77/64	342	39/32
Gb	204	9/8	275	75/64	275	75/64
F	155	35/32	192	143/128	192	143/128
E	92	135/128	53	33/32	27	65/64
Eb	0	1/1	1103	121/64	1173	63/32

Note that no string needs to be raised higher than its natural tuning except for the B-flat on piano 1, which is 2¢ sharp (or if one prefers, 2¢ could be subtracted from all quantities).

For electronic realization of the piece, it can prove helpful to reconfigure the tuning as a reference pitch in cycles per second for each piano, and ratios derived from that standard:

Tuning pitch:	38.891 cps	36.7641 cps	38.2833 cps
D	15/8	225/121	13/7
Db	7/4	20/11	12/7
C	105/64	200/121	104/63
B	49/32	18/11	65/42
Bb	3/2	180/121	13/9
A	11/8	16/11	169/126
Ab	21/16	15/11	9/7
G	5/4	14/11	26/21
F#	9/8	150/121	25/21
F	35/32	13/11	143/126
E	135/128	12/11	65/63
Eb	1/1	1/1	1/1

In the configuration of certain tuning softwares, the following sequences might facilitate getting the required tuning:

Piano 1:

38.891 = Eb0

1/1, 135/128, 35/32, 9/8, 5/4, 21/16, 11/8, 3/2, 49/32, 105/64, 7/4, 15/8

Piano 2:

36.7641485 = Eb0

1/1, 12/11, 13/11, 150/121, 14/11, 15/11, 16/11, 180/121, 18/11, 200/121, 20/11, 225/121

Piano 3:

38.283333 = Eb0

1/1, 65/63, 143/126, 25/21, 26/21, 9/7, 169/126, 13/9, 65/42, 104/63, 12/7, 13/7

For purposes of analysis, the entire scale (which I refer to as my 8x8 scale) is given below, grouping its pitches into eight harmonic series' on the 1<sup>st</sup>, 3<sup>rd</sup>, 5<sup>th</sup>, 7<sup>th</sup>, 9<sup>th</sup>, 11<sup>th</sup>, 13<sup>th</sup>, and 15<sup>th</sup> harmonics of E-flat, and naming each pitch in a typographical equivalent of Ben Johnston's just-intonation notation:

Pitch name	Ratio	Cents	1/1	3/2	5/4	7/4	9/8	11/8	13/8	15/8
Db^^-	121/64	1103						11		
D	15/8	1088	15	5	3					1
Db13	117/64	1044					13		9	
C#+	225/128	977								15
Db7	7/4	969	7			1				
C^	55/32	938			11			5		
C+	27/16	906		9			3			
C7+	105/64	857				15				7
Cb13	13/8	840	13						1	
B	25/16	773			5					
Bb^	99/64	755					11	9		
Cb77+	49/32	738				7				
Bb13	195/128	729							15	13
Bb	3/2	702	3	1						
Bbb713	91/64	609				13			7	
A+	45/32	590		15	9		5			3
Ab^	11/8	551	11					1		
Abb1313	169/128	481							13	
Ab7+	21/16	471		7		3				
G^	165/128	440						15		11
G+	81/64	408					9			
G	5/4	386	5		1					
Gb13	39/32	342		13					3	
Gb7^	77/64	320				11		7		
F#+	75/64	275			15					5
F+	9/8	204	9	3			1			
Fb13^	143/128	192						13	11	
F7+	35/32	155			7	5				
E+	135/128	92					15			9
Eb^	33/32	53		11				3		
Eb13	65/64	27			13				5	
Eb	1/1	0	1							
Eb7+	63/32	1173				9	7			

In Johnston's notation, + raises a pitch by 81/80, # raises it by 25/24, b lowers it by 24/25, 7 lowers it by 35/36, ^ raises it by 33/32, 13 raises it by 65/64, and F-A-C, C-E-G, and G-B-D are all perfectly tuned 4:5:6 major triads.

# Pulsars

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2017

$\text{♩} = 12$

Piano 1

Piano 2

Piano 3

$\text{♩} = 12$



8

Pno1

Pno2

Pno3

13  $\text{♩} = 10$   $\text{♩} = 11$   $\text{♩} = 12$

Pno1

Pno2

Pno3  $\text{♩} = 10$   $\text{♩} = 11$   $\text{♩} = 12$

The musical score consists of three systems, each for a piano (Pno1, Pno2, Pno3). Each system has a grand staff with a treble and bass clef. The music is primarily in the bass clef. The notation includes quarter notes, half notes, and dotted notes, often with a 'v' (accents) and a 'p' (piano) dynamic. There are also some notes with a 'p' dynamic and a 'v' dynamic. The score is divided into measures by vertical bar lines. Above the first system, there are tempo markings: '13', '♩ = 10', '♩ = 11', and '♩ = 12'. Above the third system, there are similar tempo markings: '♩ = 10', '♩ = 11', and '♩ = 12'. The first system starts with a 'fff' dynamic marking. The second system starts with a 'p' dynamic marking. The third system starts with a 'p' dynamic marking. The notation is complex, with many notes and dynamics, and some notes are marked with a 'v' and a 'p'.

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The image displays a musical score for three pianos, labeled Pno1, Pno2, and Pno3. The score is organized into three systems, each corresponding to one of the pianos. Each system contains a grand staff with a treble clef and a bass clef. The first system (Pno1) begins at measure 21. The second system (Pno2) begins at measure 22. The third system (Pno3) begins at measure 23. The score includes various musical notations such as notes, rests, and dynamic markings. The dynamic marking *fff* (fortississimo) is used in the first two systems. The dynamic marking *v* (pizzicato) is used in the third system. The score is written in a key signature of one flat (B-flat major or D minor) and a 4/4 time signature. The first system (Pno1) has five measures. The second system (Pno2) has five measures. The third system (Pno3) has five measures. The score is written in a standard musical notation style with a clear layout and legible text.

26  $\text{♩} = 10$   $\text{♩} = 11$

Pno1

Pno2

Pno3



32  $\text{♩} = 12$

Pno1

Pno2

$\text{♩} = 12$

Pno3

35

Pno1

ffff

ffff

v > f

Pno2

ffff

ffff

v > f

Pno3

ffff

ffff

v > f

38

$\text{♩} = 11$        $\text{♩} = 8$

Pno1

$\text{♭}$   $\text{♭}$   $\text{♭}$

Pno2

$\text{♭}$   $\text{♭}$   $\text{♭}$

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$\text{♩} = 11$        $\text{♩} = 8$

Pno3

$\text{♭}$   $\text{♭}$   $\text{♭}$