

Pavane for a Dead Planet

for three retuned, computer-driven pianos

by Kyle Gann

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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 1st, 3rd, 5th, 7th, 9th, 11th, 13th, and 15th 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.

Pavane for a Dead Planet

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$\text{♩} = 32$

Piano 1

Piano 2

Piano 3

mf 5:4

pp

mf 5:4

pp

mf 5:4

pp

4

$\text{♩} = 34$

Pno1

Pno2

Pno3

p

mf

pp

pp

pp

mf 9:10

pp 3:2

mf 9:10

pp 3:2

2

7 $\text{♩} = 33$ $\text{♩} = 32$

Pno1

5:4

pp

3:2

Pno3

3:2

p



9 $\text{♩} = 30$ $\text{♩} = 27$ $\text{♩} = 32$

Pno1

6:4

Pno2

Pno3

12 3

Pno1

Pno2

f

pp

p

5:4

5:4

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4

15 $\text{♩} = 34$ $\text{♩} = 36$

Pno1

f

p

5:3

3

Pno2

5:3

3

Pno3

f

pp

p

pp

pp

pp

5:4

3

3

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18 $\text{♩} = 33$ $\text{♩} = 30$ $\text{♩} = 33$ 5

Pno1

pp *mf* 6:7

Pno2

f *mf* 6:7

pp 3

pp 6:7

Pno3

3 6:7

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6 21 $\text{♩} = 36$

Pno1

Pno2

Pno3

Pavane for a Dead Planet

24 $\text{♩} = 34$

Pno1

Pno2

Pno3

f *pp* *pp* *pp* *mp* *p* *mp*

9 3 3 3

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27 $\text{♩} = 32$

f

Pno1

f 5

p 5 5 7

Pno2

Pno3

The image shows a musical score for three pianos, labeled Pno1, Pno2, and Pno3. The music is in 3/2 time and spans measures 30 and 31. Measure 30 begins with a tempo marking of $\text{♩} = 29$. Measure 31 has a tempo marking of $\text{♩} = 31$. The score is divided into three systems, one for each piano. Pno1's part includes a melodic line in the right hand with a 7:5 interval marking, and a bass line with a 5-fingered passage. Pno2's part features a complex right-hand passage with a 7:5 interval marking and a 5-fingered passage. Pno3's part has a melodic line in the right hand with a 7:5 interval marking. Dynamics include *p* (piano) and *pp* (pianissimo). The score is written for three pianos, with each piano having its own set of staves.

Pavane for a Dead Planet

33 $\text{♩} = 33$

Pno1

Pno2

Pno3

33 $\text{♩} = 33$

Pno1

Pno2

Pno3

p

pp

5

7

5

5

Musical score for two piano parts, Pno1 and Pno3, measures 36-38. The score is in 3/2 time and features a key signature of one flat (B-flat major or D minor). Measure 36 starts with a tempo marking of quarter note = 35. Measure 37 has a tempo marking of quarter note = 32. Pno1 (measures 36-37) has dynamics *p* and *pp*, and includes a triplet of eighth notes. Pno3 (measures 36-37) has dynamics *pp* and *pp*. Measure 38 shows a change in dynamics and includes a quintuplet in the Pno1 treble staff and a triplet in the Pno3 treble staff.

Pavane for a Dead Planet

39

$\text{♩} = 30$ $\text{♩} = 28$

Pno1

pp

Pno2

Pno3

Detailed description of the musical score: The score is for three pianos (Pno1, Pno2, Pno3) in 2/2 time. It consists of three systems of music. The first system (measures 39-42) starts with Pno1 and Pno2. Pno1 has a triplet in the right hand (measures 40-41) and a melodic line in the left hand. Pno2 has a triplet in the right hand (measures 40-41) and a melodic line in the left hand. Pno3 has a melodic line in the right hand and a bass line in the left hand. The second system (measures 43-46) continues the melodic lines for Pno1 and Pno2, while Pno3 remains mostly static. The third system (measures 47-50) shows Pno1 and Pno2 with melodic lines, and Pno3 with a bass line. The score includes dynamic markings like 'pp' and various musical notations such as triplets, slurs, and rests.

14 48

Pno1

Pno2

Pno3

mf 9 9-3 9 *mf* 9

mf 11 11 11 11

pp

pp

pp

9 11 11 11 *mf* 9 *mf*

pp *pp*

mf 9-3 9 *pp* 11 9

Pavane for a Dead Planet

Pno1

Musical score for Pno1, measures 53-56. The score consists of four staves. The top staff contains a series of chords, each marked with a bracket and the number '9'. The second staff contains a melodic line with various ornaments, including a trill (marked '11') and triplets (marked '3'). The third and fourth staves provide harmonic support with sustained notes and moving lines.

Pno2

Musical score for Pno2, measures 53-56. The score consists of four staves. The top staff features chords marked with '9'. The second staff has a melodic line with trills ('11') and triplets ('3'). The third and fourth staves contain sustained notes and moving lines, with some notes marked with a sharp sign (#).

Pno3

Musical score for Pno3, measures 53-56. The score consists of two staves. The top staff has chords marked with '11' and '9', with a dynamic marking of 'mf' (mezzo-forte) appearing in the fourth measure. The bottom staff features sustained notes and moving lines, with some notes marked with a sharp sign (#).

16 57

Pno1

Pno2

Pno3

mf

pp

pp

pp

pp

Pavane for a Dead Planet

62

Pno1

Pno3

p *11*

p *9*

5 *3*

5:4 *pp* *mp*

5:4 *pp* *3:2* *mp*

5:4 *3:2* *mp*

9 *11* *p* *9*

mp

Pavane for a Dead Planet

Pno1

Musical score for Pno1, measures 67-70. The score consists of five staves. The top staff is in treble clef with a key signature of one sharp (F#) and contains a whole note chord with a fermata and a dynamic marking of *ff*. The bottom four staves are in bass clef. The second staff has a bracketed group of notes with a 5:4 ratio. The third staff has a bracketed group of notes with a 6:4 ratio. The fourth staff has two bracketed groups of notes, each with a 6:4 ratio. The fifth staff has a single note with a vibrato marking.

Pno2

Musical score for Pno2, measures 67-70. The score consists of five staves. The top staff is in treble clef and contains a whole note chord with a fermata and a dynamic marking of *p*. The bottom four staves are in bass clef. The second staff has a bracketed group of notes with a 5:4 ratio. The third staff has two bracketed groups of notes, each with a 6:4 ratio. The fifth staff has a single note with a vibrato marking.

Pno3

Musical score for Pno3, measures 67-70. The score consists of three staves, all in bass clef. The top staff has a bracketed group of notes with a 5:4 ratio. The middle staff has a bracketed group of notes with a 5:4 ratio. The bottom staff has two bracketed groups of notes, each with a 6:4 ratio.

20 68

Pno1

Pno2

Pno3

f

f

f

f

f

f

11:8 9:8 9:7 7:6 5:4

7

5 7

7:6 5:4

11:8 9:8 9:7

7

5 7

11:8 9:8 9:7 7:6 5:4

7

5 7

69 $\text{♩} = 35$ 21

Pno1

Pno2

Pno3

The musical score is for three pianos (Pno1, Pno2, Pno3) in 3/2 time. The tempo is marked as quarter note = 35. Measure 69 shows Pno1 with a treble clef and a 5:4 interval. Pno2 has a grand staff with a 5:4 interval and a triplet. Pno3 has a grand staff with sixths, fifths, and a complex bass line. Measure 21 shows Pno1 with a treble clef and a 5:4 interval. Pno2 has a grand staff with a 5:4 interval and a triplet. Pno3 has a grand staff with sixths, fifths, and a complex bass line.

Pno2

f 6 6 6

mf 19:12

fff

Pno3

f 6 6 6

f 5 5 5

71

Pno1

19:12 *mf*

Pno2

19:12 *mf*

f 6

6

6

19:12

Pno3

f

5:4

f 6

6

6

f 5

5

5

Pavane for a Dead Planet

Pno2

3:2

6

6

6

Pno3

19:12

5

5

3:2

6

6

6

5

5

5

f

>

f

f

>

$\text{♩} = 33$

Pno1

Pno2

Pno3

The musical score is organized into three systems, each containing staves for three pianos (Pno1, Pno2, Pno3).
 - **System 1 (Measures 73-82):** Pno1 has a melodic line starting with a triplet of eighth notes, followed by a 19-measure rest. Pno2 and Pno3 have rhythmic accompaniment with sixteenth-note patterns and rests. Fingering numbers 3, 5, and 6 are indicated.
 - **System 2 (Measures 83-92):** Pno1 continues with melodic fragments and rests. Pno2 and Pno3 feature more complex sixteenth-note textures. Fingering numbers 5, 6, and 9:10 are present.
 - **System 3 (Measures 93-102):** Pno1 has a melodic line with a 19-measure rest. Pno2 and Pno3 continue with rhythmic accompaniment. Fingering numbers 3, 5, 6, and 9:10 are used.

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26 74

Pno1

Pno2

Pno3

19:12

6 5

Pavane for a Dead Planet

75 27

Pno1

19:12

Pno2

19:12

5:4

Pno3

19:12

Pno1

Pno2

Pno3

The musical score is for three pianos (Pno1, Pno2, Pno3) and is set in 19:12 time. The tempo is marked as $\text{♩} = 36$. The key signature has one flat (B-flat). The score is divided into three systems, each with four staves. The first system (Pno1) features a long melodic line in the upper staves and rhythmic accompaniment in the lower staves, including sixteenth-note patterns and triplets. The second system (Pno2) continues the melodic and rhythmic themes. The third system (Pno3) concludes the piece with similar textures. The score includes various musical notations such as slurs, ties, and dynamic markings.

Pno2

Musical score for Pno2, measures 77-96. The score consists of five staves. The top staff is a treble clef with a 3-measure rest, followed by a 19-measure rest. The second staff is a treble clef with a melodic line. The third staff is a treble clef with complex chords and arpeggios, including a 6:4 interval and a 5-measure rest. The fourth and fifth staves are bass clefs with rhythmic patterns, including 6-measure and 5-measure rests.

Pno3

Musical score for Pno3, measures 77-96. The score consists of two staves. The top staff is a treble clef with a 19-measure rest. The bottom staff is a bass clef with rhythmic patterns, including 6-measure rests.

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Pno2

Pno3

Pno1

Musical score for Pno1, measures 79-81. The score consists of four staves: two treble clefs and two bass clefs. The first staff has a melodic line with notes and rests, with a bracketed measure range from 79 to 81. The second staff has a similar melodic line. The third and fourth staves have a rhythmic accompaniment with notes and rests, with a bracketed measure range from 79 to 81. The tempo is marked as ♩ = 34.

Pno2

Musical score for Pno2, measures 79-81. The score consists of four staves: two treble clefs and two bass clefs. The first staff has a melodic line with notes and rests, with a bracketed measure range from 79 to 81. The second staff has a similar melodic line. The third and fourth staves have a rhythmic accompaniment with notes and rests, with a bracketed measure range from 79 to 81. The tempo is marked as ♩ = 34.

Pno3

Musical score for Pno3, measures 79-81. The score consists of one staff with a treble clef. The staff has a melodic line with notes and rests, with a bracketed measure range from 79 to 81. The tempo is marked as ♩ = 34.

32 80

Pno1

13

6

5

Pno2

13

5:4

6

5

Pavane for a Dead Planet

81 33

Pno1

f

19:12

6

Pno2

f

19:12

6

5

Pno3

19:12

Pavane for a Dead Planet

82

34

Pno1

19:12

6

3

19:12

Pno2

5:4

6

5

5

5

19:12

Pno3

Pavane for a Dead Planet

83 $\text{♩} = 32$

Pno2

19:12

6

6

6

3

19:12

Pno3

f

f

f

6

6

6

5

5

5

Pavane for a Dead Planet

Pno1

Musical score for Pno1, consisting of five staves. The top staff is a treble clef with a 19:12 ratio. The second staff is a treble clef with a 5:1 ratio. The third staff is a bass clef. The fourth and fifth staves are bass clefs with a 6:5 ratio and a *ff* dynamic marking.

Pno2

Musical score for Pno2, consisting of three staves. The top staff is a treble clef with a 19:12 ratio. The middle staff is a bass clef with a 6:5 ratio. The bottom staff is a bass clef with a 5:1 ratio and a *ff* dynamic marking.

Pno3

Musical score for Pno3, consisting of four staves. The top staff is a treble clef with a 19:12 ratio. The second staff is a treble clef. The third staff is a bass clef with a 6:5 ratio and a *ff* dynamic marking. The bottom staff is a bass clef with a 5:1 ratio and a *ff* dynamic marking.

40

91 $\text{♩} = 34$ $\text{♩} = 32$ $\text{♩} = 28$ $\text{♩} = 30$

Pno1

Pno3

94 $\text{♩} = 32$

The musical score is for three pianos, labeled Pno1, Pno2, and Pno3. It begins at measure 94 with a tempo marking of quarter note = 32. The key signature has one flat (B-flat). Pno1 has a treble and bass staff with dynamics *pp* and a fingering of 5. Pno2 has a treble and bass staff with dynamics *p* and *pp*, and a fingering of 5. Pno3 has a treble and bass staff with a fingering of 5. The score includes various musical notations such as slurs, ties, and accidentals.

Pavane for a Dead Planet

98

$d = 29$

$d = 32$

p

Pno1

5

3:2

5

3:2

Pno2

5

3:2

pp

p

pp

pp

Pno3

5

102 $\text{♩} = 31$ $\text{♩} = 30$

Pno1

Pno2

Pno3

Pavane for a Dead Planet

109 $\text{♩} = 30$
p.

Pno2

Pno3

The image shows two systems of musical notation for piano parts. The first system, labeled 'Pno2', consists of four staves (treble and bass clefs). It begins at measure 109 with a tempo marking of quarter note = 30 and a dynamic marking of piano (p.). The melody in the upper staves features a slur over a sequence of notes, followed by a fermata. The lower staves provide harmonic accompaniment. The second system, labeled 'Pno3', also consists of four staves. It continues the piece with a more intricate melodic line in the upper staves, including a slur, a bracket indicating a 5-measure phrase, and another bracket indicating a 3:2 ratio. The bass line continues with accompaniment.

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112 rit. ♩ = 18

Pno1

Pno2

pp

ppp

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