

# *Spacecat*

*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.

to Larry Polansky

# Spacecat

Kyle Gann  
2017

♩ = 100

Piano 1

*mp* *pp* *pp* *mp*

Piano 2

*mp*

Piano 3

♩ = 100

*mp*



4

Pno1

*mp* *pp* *mp* *pp*

Pno2

Pno3

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8

Pno1

Pno2

Pno3

3 3 3

pp

pp

pp



11

Pno1

Pno2

Pno3

mp

p

3

3

pp

pp

13

Pno1

Pno2

Pno3

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

Detailed description: This system contains measures 13 through 16. Pno1 (Grand Piano) starts with a whole note chord in measure 13, followed by a melodic line in the right hand and a complex bass line in the left hand. Dynamics range from *mp* to *pp*. Pno2 (Piano) has a melodic line in the right hand starting in measure 14, with a *pp* chord in the left hand in measure 16. Pno3 (Piano) has a melodic line in the right hand starting in measure 14, with a *pp* chord in the left hand in measure 16.



17

Pno1

Pno2

*mp* *6:5* *6:5* *6:5*

Detailed description: This system contains measures 17 through 20. Pno1 (Grand Piano) features a melodic line in the right hand and a bass line in the left hand, with several *6:5* intervals marked. Dynamics include *mp*. Pno2 (Piano) has a melodic line in the right hand with a *6:5* interval marked, and a bass line in the left hand.







31

Pno1

Pno2

Pno3

*mp* *f* *mf*

*mp* *f* *mp*

*mf*



33

Pno1

Pno2

Pno3

*5* *10:7* *3:2* *pp*

*5* *10:7*

*10:7*

35 7

Pno1

*mp* *pp*

Pno2

*mp* *pp*

Pno3

*mp* *pp*



37

Pno1

*f* *mf*

Pno2

*pp* *mf*

Pno3

8 40

Pno1

Pno2

Pno3

41

Pno1

Pno2

Pno3

*mf*

*mf*

43

Pno1

Pno2

Pno3

*mp* *p* *mf* *f*

*mf*

*ff*

46

Pno1

Pno3

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

*ff*

48

Pno1

Pno2

Pno3

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

*mp*

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51

Pno1

Pno2

Pno3

*mp* *f* *ff* *mf*

5 3

5 3

5 3



53

Pno1

Pno2

*p* *mp* *f* *ff*

*f* *ff*

55

Pno1

*mp* 6:5

*mp*

*ff*

*f* 3

Pno2

*mp* 6:5

*f*

*ff*

*f* 3:2

Pno3

*mp* 6:5

Detailed description: The image shows a musical score for three piano parts, labeled Pno1, Pno2, and Pno3. The score is written in treble and bass clefs. Pno1 has a treble staff with a melodic line and a bass staff with accompaniment. Pno2 has a treble staff with a melodic line and a bass staff with accompaniment. Pno3 has a treble staff with a melodic line. Dynamics include *mp* (mezzo-piano), *f* (forte), and *ff* (fortissimo). Articulations include slurs, accents, and a triplet in Pno1. A 6:5 ratio is indicated for the first measure of each part. A 3:2 ratio is indicated for a triplet in Pno2. The page number 55 is at the top left.

57

Pno1

Pno2

Pno3

mf

p

p

mf

p

p

60

Pno1

Pno2

p

mf

p



63 13

Pno1

Pno2

Pno3

66

Pno1

Pno2

Pno3

The musical score consists of three systems, each for a different piano (Pno1, Pno2, Pno3). The first system covers measures 63 to 65. Pno1 has a dense, rhythmic texture with many sixteenth notes and slurs. Pno2 and Pno3 have more sparse, chordal accompaniment. Dynamics include piano (p) and fortissimo (ff). The second system covers measures 66 to 68. Pno1 continues with its complex rhythmic pattern. Pno2 and Pno3 have more sparse, chordal accompaniment. Dynamics include piano (p) and fortissimo (ff). The third system covers measures 69 to 71. Pno1 has a complex rhythmic pattern with many sixteenth notes and slurs. Pno2 and Pno3 have more sparse, chordal accompaniment. Dynamics include piano (p) and fortissimo (ff). Measure numbers 63, 66, and 13 are indicated.

69

Pno1

Pno2

Pno3

The musical score consists of three systems, each for a different piano (Pno1, Pno2, Pno3). Each system contains a grand staff with a treble clef and a bass clef. Pno1's bass clef has a key signature of one flat (B-flat). Pno2's bass clef has a key signature of one sharp (F-sharp). Pno3's bass clef has a key signature of one sharp (F-sharp). The score begins at measure 69. Pno1 features a complex rhythmic pattern in the bass clef, including a triplet of eighth notes and several sixteenth notes. Pno2 and Pno3 have more sparse parts, with Pno2 featuring a triplet of eighth notes and Pno3 featuring a series of chords. The score includes various musical notations such as slurs, ties, and dynamic markings like '11'.

72

Pno1

Pno2

Pno3

*mp* *f*



73

Pno1

Pno2

Pno3

*ff* *5* *11* *ff* *11*

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74

Pno1

Pno2

Pno3



75

Pno1

Pno2

Pno3

*mp*

*p*

11:6

11:6

11:6

77

Pno1

Pno2

Pno3

*mp* *f* *ff*

13 11 11

78

Pno1

Pno2

Pno3

*ff* *ff* *ff*

13 13 13 13

79

Pno1

Pno2

Pno3

80

Pno1

Pno2

Pno3

Pno1

Pno2

Pno3

mp

f

p

pp



Pno1

Pno2

Pno3

101/64

f

f

f

86

Pno1

Pno2

Pno3

*ff* *ff* *mf* *mp* *p*

*ff* *mf* *mp* *p*

*ff* *mf* *mp* *p*

*ff* *mf* *mp* *p*



88

Pno1

Pno2

Pno3

*pp*



91

Pno1

*mp* *p*

Pno2

*mp*

Pno3

*mp*

94

Pno1

*pp* *mp*

Pno2

*mp*

Pno3

*mp*

96

Pno1

*pp* *mp*

22 97

Pno1

3:2

6:5

*f*

3

*p*

7:4

*p*

*pp*

Pno2

7:4

Pno3

7:4

99

Pno1

Pno2

3

Pno3

3

101

Piano score for measures 101-103. The score is divided into three systems for Pno1, Pno2, and Pno3. Pno1 has a treble and bass staff. Pno2 has a treble and bass staff. Pno3 has a treble and bass staff. Dynamics include *mp*, *f*, and *p*. Measure 101 shows Pno1 starting with a *mp* dynamic, Pno2 with a *f* dynamic, and Pno3 with a *f* dynamic. Measure 102 shows Pno1 with a *p* dynamic. Measure 103 shows Pno1 with a *mp* dynamic and Pno3 with a *mp* dynamic.



104

Piano score for measures 104-107. The score is divided into three systems for Pno1, Pno2, and Pno3. Pno1 has a treble and bass staff. Pno2 has a bass staff. Pno3 has a treble and bass staff. Dynamics include *f*, *p*, and *pp*. Measure 104 shows Pno1 with a *f* dynamic, Pno2 with a *pp* dynamic, and Pno3 with a *p* dynamic. Measure 105 shows Pno1 with a *p* dynamic and Pno3 with a *p* dynamic. Measure 106 shows Pno1 with a *p* dynamic and Pno3 with a *p* dynamic. Measure 107 shows Pno1 with a *p* dynamic and Pno3 with a *p* dynamic.

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