

chroai: tetrachords

string quartet

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Performance Notes

chroai: tetrachords is written in an 11-limit just intonation tuning system using Ben Johnston's extended just intonation notation. In this notation system, a 5-limit major scale is built from tonic C (1/1) where the subdominant, tonic, and dominant triads are tuned in the proportion 4:5:6. Ratios that deviate from these natural notes utilize symbols to denote comma adjustments.

Ratio Values of Natural Notes

F A C E G B D
 4 : 5 : 6
 4 : 5 : 6
 4 : 5 : 6

Comma Adjustment Symbols through Prime 11

Sign	Ratio	Cents Difference	Purpose	Sign	Ratio	Cents Difference
+	81/80	21.51¢	10/9 to 9/8	-	80/81	-21.51¢
#	25/24	70.67¢	6/5 to 5/4	b	24/25	-70.67¢
7	35/36	-48.77¢	9/5 to 7/4	∟	36/35	48.77¢
↑	33/32	53.27¢	4/3 to 11/8	↓	32/33	-53.27¢

The open strings of the string quartet are tuned in 3/2 fifths with the C string of the cello as 1/1.

Dynamics and tempo are denoted with descriptors and are left up to the discretion of the performers. In general, the quartet should strive to execute variations in tempo as a unit, and dynamics should be even and blended unless notated otherwise.

Below each natural harmonic is a combination of Roman and Arabic numerals, which indicate the string number (Roman) and partial number (Arabic) for the given pitch. For example, IV7 requests the player to produce the 7th partial on the fourth string of the instrument (strings are numbered I-IV from highest to lowest).

Cello multiphonics used:

IV [7, 8, 9]
 bow between left hand and nut for the 2nd position

III [7, 8, 9]
 bow between left hand and nut for the 2nd position

The three scales that comprise the tuning system for *chroai*: *tetrachords* were constructed using the three tetrachord *genera* (diatonic, chromatic, and enharmonic) distinguished by ancient Greek music theory. The two outer tones of each tetrachord span a $\frac{4}{3}$ fourth, while the two inner tones are mutable according to the *chroai* (shades, nuances) of the individual genera. Each scale is formed by stacking two tetrachords of the same genera separated by a $\frac{9}{8}$ whole tone.

The scales gradually transition from one to the next using common tones as pivot points, resulting in the following modulation that takes place over the course of the piece: Diatonic \rightarrow Chromatic \rightarrow Enharmonic.

SCALES (progression)

Diatonic

A	B ^b --	C-	D-	E	F-	G-	A
$\frac{27}{16}$	$\frac{16}{9}$	$\frac{1}{1}$	$\frac{9}{8}$	$\frac{81}{64}$	$\frac{4}{3}$	$\frac{3}{2}$	$\frac{27}{16}$

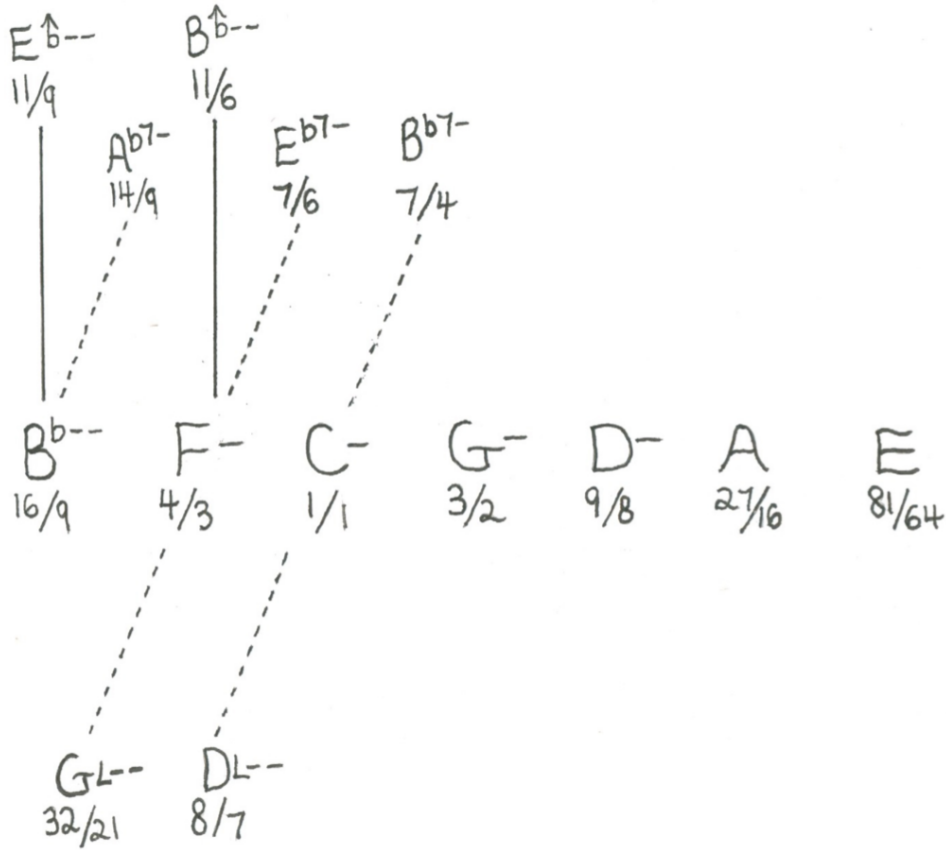
Chromatic

D-	E ^b -	E [♯] --	G-	A	B ^b -	B [♯] --	D-
$\frac{9}{8}$	$\frac{7}{6}$	$\frac{11}{9}$	$\frac{3}{2}$	$\frac{27}{16}$	$\frac{7}{4}$	$\frac{11}{6}$	$\frac{9}{8}$

Enharmonic

G-	G [♯] --	A ^b -	C-	D-	D [♯] --	E ^b -	G-
$\frac{3}{2}$	$\frac{32}{21}$	$\frac{14}{9}$	$\frac{1}{1}$	$\frac{9}{8}$	$\frac{8}{7}$	$\frac{7}{6}$	$\frac{3}{2}$

The following lattice shows all ratios used in the 11-limit just intonation tuning system for *chroai: tetrachords*



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light, brisk, flowing
moderate volume

Violin 1

Violin 2

Viola

Cello

5

A

2 9

tasto *pont*

IV² II² II⁴ II²

IV⁴ I² slow/jagged: fluctuate tempo slow/jagged: fluctuate tempo *tasto*

IV⁴ II² *tasto* *pont* 3 slow/jagged: fluctuate tempo

M M M

IV [7, 8, 9] quiet, unstable multiphonic blossoming stable multiphonic quiet, unstable multiphonic

bow between left hand and nut for 2nd position

13

tasto 3 slow/jagged: fluctuate tempo IV³ IV²

pont III⁴ III² *pont* 3 I² *pont* I²

III⁴ I² III⁴ slow/jagged: fluctuate tempo *pont* 3 *tasto* 3

III⁴ I² IV⁴ slow/jagged: fluctuate tempo M M IV [7, 8, 9] as quiet as possible

bow between left hand and nut for 2nd position

17 *pont* decelerate and decrescendo ----- *tasto* *pont* slow and quiet 3

IV 4 *pont* *tasto* *pont*

slow/jagged: fluctuate tempo

slow/jagged: fluctuate tempo

slow/jagged: fluctuate tempo

IV 4

slow/jagged: fluctuate tempo

II 2 II 4 IV 4

I 2 I 4

M

IV [7, 8, 9]
bow between left hand
and nut for 2nd position

21 *pont* accelerate and crescendo ----- a tempo

pont *tasto* ----- *pont* *tasto*

(> ... > ... >)

jagged tremolo: fluctuate tempo
intermittent addition of accents

IV 2
cue

(> ... > ... >)

jagged tremolo: fluctuate tempo
intermittent addition of accents

M M

blossoming,
fluctuate stability < >

as quiet
as possible

I 2 I 4

4 24

slow/jagged:
fluctuate tempo

tasto

pont

III⁴

IV⁴

II⁴

decelerate and decrescendo ----- slow and quiet

27

pont

I 2

III⁴

tasto

II²

slow/jagged:
fluctuate tempo

II⁴

slow/jagged:
fluctuate tempo

B *freely, interpreted spatially*
quiet with subtle swells throughout

31 5

III 4

ponte

tasto

ord.

ponte

II/III/IV sweeping, fluctuate tempo.....gradually to slow but steady tempo

III 4

II 2

I 2

decelerate ----- a tempo

33

back and forth, steady tempo

sim.

ponte

II 2

III 2

III4/II

steady tempo, in your own time

6

II/III/IV

steady tempo, in your own time

ponte

5

5

II/III/IV

cue

tasto

7

IV 4

IV [7, 8, 9] quiet, unstable multiphonic

III 4

I 2

IV 7

IV [7, 8, 9] *quiet, unstable multiphonic*
 bow between left hand and nut for 2nd position

6 35 *accelerate* -----

tasto

pont

tasto

II²

IV⁴

I²

III⁴

I²

IV⁷

II⁴

37 *decelerate* -----

tasto

pont

tasto

III⁴

II²

III⁴

I²

II²

II/III/IV sweeping, fluctuate tempo

5

C delicate, gradual expansion to m. 45
 m. 40, 42, 44 nearly inaudible

39

pont ($> \dots > \dots >$)

I²

jagged tremolo: fluctuate tempo
intermittent addition of accents

III⁴

I² jagged tremolo: fluctuate tempo
intermittent addition of accents

II⁴ jagged tremolo: fluctuate tempo
intermittent addition of accents

I³ I⁴ ($> \dots > \dots >$)

jagged tremolo: fluctuate tempo
intermittent addition of accents

I² *tasto*

II⁴ IV⁴ I⁴

42

III⁴ *sim.*

tasto ($> \dots > \dots >$)

I⁴ *sim.*

IV⁴ *sim.*

sim.

II²

43

pont ($> \dots > \dots >$)

IV⁷ *sim.*

IV⁴ *sim.*

IV⁴ *sim.*

44

sim.

II/III² back and forth, III⁴
steady tempo

II/III/IV
sweeping, fluctuate tempo

45

IV⁴ *sim.*

8 46

decelerate

D

*freely, interpreted spatially
rhythms interpreted individually
repeats ad libitum*

accelerate

50

m. 52 - 53 subtle undulating accents

52 9

heavy vib. pont pizz. ric. (-) (-)

IV⁴ IV⁴

7^b - 7^b IV⁷ I² IV⁷ heavy vib. pont pizz. ric. (-) (-)

IV⁴ II² IV⁴

decelerate and descrescendo -----

53 ord ----- very pont

ord ----- very pont

(-) (-) very pont

ord ----- very pont

II² M

III⁴ IV⁴ IV [7, 8, 9]

IV [7, 8, 9]
bow between left hand
and nut for 2nd position

loose hoquet in order with dove-tailing
delicate, gradual expansion to E
repeat ad libitum

E

freely, slowly, interpreted spatially
slow portamenti between each note
all stopped notes *tasto*

10
54

pont
L
slow/jagged:
fluctuate tempo
ric.
III 2
IV 2
III/IV
M
III [7, 8, 9]
bow between left hand
and nut for 2nd position
cue: E
M
IV 7
quiet, unstable
multiphonic

decelerate and descrecendo -----

56

L
L
L
M
III [7, 8, 9]
bow between left hand
and nut for 2nd position
IV 7
IV [7, 8, 9]
bow between left hand
and nut for 2nd position
quiet, unstable
multiphonic