Journey to the Heart of Music

Philip Perry

Example L
Josquin des Prez – Motet: Ave Maria

MUTABLE NUMBER ANALYSIS

In his lifetime and onward through the sixteenth century Josquin des Prez (circa 1445 - 1521) occupied a position of great influence and respect, similar to that which Beethoven was to acquire three hundred years later. Broadly speaking, Josquin melded together the French and Burgundian traditions of austere counterpoint and sweet harmony, into the synthesis now known as Franco-Flemish polyphony. Josquin with his contemporaries and successors in the Netherlands school forged the standard language of late renaissance polyphony which continued as the dominant mode of musical thought until well into the seventeenth century. Notwithstanding that the Netherlander's style embodied a strong contrapuntal element – which on occasions could gain the upper hand with extraordinary feats of counterpoint and canon – overall, the harmonic element in their music was rarely denied: And as the sixteenth century progressed, the older modal/melodic approach to composition among the Netherlanders was to gradually give ground to a more thoroughly harmonic conception; a trend particularly well marked in secular music.

Though modality hung on, as least as a theoretical concern right into the Baroque period, there was, as in medieval times, a disconnection between theory and practice. Mode or scale as a concept originated with ancient Greek music and passed into medieval Europe through the church's need to organise and codify liturgical plainchant. However the modes as understood in the fifteenth and sixteenth centuries, whether derived from the ecclesiastical tradition or re-learnt from newly available Greek texts, were essentially concerned with monophonic music and of limited application to polyphony. Polyphony, music in many parts, imposed its own rules and logic upon composers, which they intuitively grasped and developed while more or less ignoring or paying lip service to the rules of modality. Theorists of the sixteenth century attempted to reconcile modal theory and current practice with varying degrees of success; perhaps they would have better to start again from a blank slate. This is the approach pursued in a mutable number analysis: The harmonic component is placed foremost and the concept of a tonal center or key projected on to the composition. Though such concepts as key and harmonic progression properly belong to a later age, their genesis can be

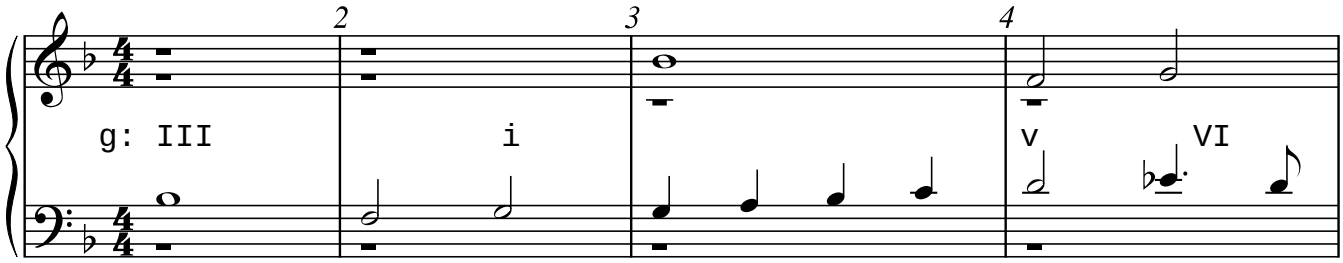
observed in music stretching right back to the dawn of the tonal era. This is not to deny the many stylistic differences between the music of different epochs, a rich substantive diversity in all aspects of composition – melody, rhythm, meter, instrumentation, form, etc. – held within an underlying harmonic unity present throughout the tonal tradition: A foundational unity explicated and charted by mutable numbers, stretching from tonality's early tentative beginings in the late medieval period, through the renaissance, to a long and glorious zenith centered on the music of the eighteenth century; and on through the romantic era to the vicissitudes of modernism and the triumph of popularism in the twentieth century and beyond.

The short extract presented below, the opening measures of Josquin's motet *Ave Maria*, provides something of a median example of the range of contrapuntal and harmonic thought in the sixteenth century. While the overriding impression is one of the motion of independent voices weaving their individual paths, the sum of all melodic paths taken together does not negate a sense of commensurable harmonic succession; and indeed, at cadences a clear sense of harmonic progression can emerge. For example at measures 11 and 12, a full close (V^7- i) is evident despite the antique Landini figuration and missing root note. (Interestingly the mutable number analysis provides a root note (D-h10) in the form of a difference tone as well as carrying over the conjunction (D-h30 --> D-h40) from the previous chord.)

One possible source of confusion to be guarded against in this analysis is the similarity between the value represented by a mutable number and the frequency of its conjunction measured in hertz (cycles per second). As the unit value of the absolute fundamental (D# H1) is set at 1.2 hertz (derived from middle C = 256 hertz) the mutable digit sequences built upon this foundational unit will produce numbers a little lower in value, but running roughly parallel to, the conjunction frequencies. Also the matter of the unit value introduces the related issue of the appropriate choice of fundamental nesting harmonic series for pieces in the minor mode/key. Although this foundational series is taken to embody some sense of tonal center or key, as the minor chord is embedded within a mid-level nested harmonic series built upon a fundamental frequency different from the root of the minor chord (usually the note-letter a major-third below the root plus two octaves) it is also logical and practical to choose the same note-letter series for the bottom level fundamental nesting series. Thus for compositions in a minor key/mode, the absolute fundamental harmonic series which forms a structure embodying the stability and continuity of the (minor) key/mode in the piece, will actually be a harmonic series built on a note-letter other than the minor tonic. Here in this motet the key/mode of 'g' (G-minor) is encapsulated by a fundamental series built on D# (Eflat), the note-letter a major-third below the perceived tonal center. Although this might appear at first sight surprising, a look through the mutable number analysis will confirm that for almost all occurrences of the G-minor chord a difference tone of D# is generated by the objective notes. (Difference tone are indicated by a diamond symbol.)

At the time Josquin wrote his music the temporal/durational aspects of compositions were governed by the concept of a tactus: a more or less steady pulse which continued in an unperturbed manner throughout the piece. Interestingly and perhaps unsurprisingly, the tactus pulsed at roughly the rate of the human heart beat at rest – which also places it in the vicinity of the fundamental frequency of typical MOS analyses. The tactus in the composition below (original note values halved) would be a simple duple meter pulse of approximately one halfnote equals metronome 50–60 (i.e. 1.2–1Hz). See also the metrical MOS, page 6.

L.3 - AVE MARIA - JOSQUIN DES PREZ



Value:	576-F (decimal)	576-F	480-D	480-D	480-D	480-D	960-D	960-D
Mutable	6	12	10	6	6	8	16	15
Digit	6	3	3	5	5	5	5	4
Sequence	16 Tonal	16	16	16	16	12	12	12
	1 Center g	1	1	1	1	1	1	1

D# H1 = 1.2 Hz

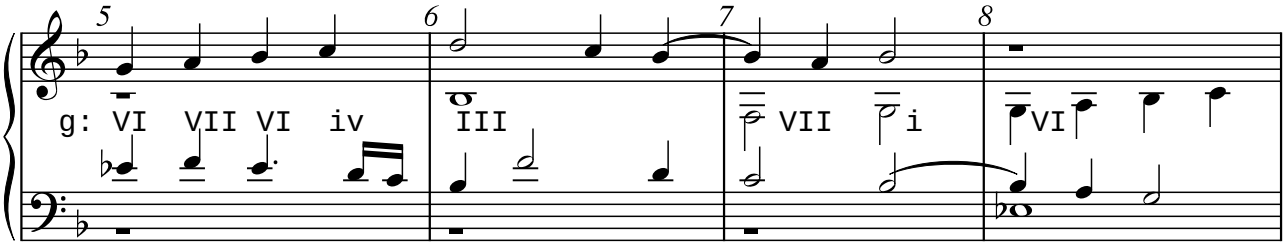
					1152.0Hz	D-h80*>	D-h60*>
						- h75*	C-h56*
						- h70*	A#h48*
						- h65*	G-h40*
						A-h60*	F-h36*
						- h55	D#h32*
	F-h72**	F-h72*	F-h70*	F-h70*		F#h50*	C#h28*
691.2Hz	F-h36**>	F-h36*	- h35*	- h35*		- h45*	B-h25
	D-h30**	D-h30*>	D-h30*>	D-h30*>		D-h40*	A#h24*
	- h29	- h29	- h29	- h29		- h35*	- h23
	C#h28	C#h28	C#h28	C#h28		A-h30*>	A-h22
	- h27*	- h27*	- h27	- h27		F#h25*	G#h21
	C-h26	C-h26	C-h26	C-h26		F-h24	G-h20*
	B-h25	B-h25	B-h25*	B-h25*		- h23	F#h19
	A#h24**	A#h24*	A#h24	A#h24		E-h22	F-h18
	- h23	- h23	- h23	- h23		D#h21	E-h17
	A-h22	A-h22	A-h22	A-h22		D-h20*	D#h16*
	G#h21*	G#h21*	G#h21	G#h21		C#h19	D-h15
	G-h20	G-h20	G-h20*	G-h20*		C-h18	C#h14
	F#h19	F#h19	F#h19	F#h19		B-h17	C-h13
	F-h18**	F-h18*	F-h18	F-h18		A#h16	A#h12*
	E-h17	E-h17	E-h17	E-h17		A-h15*	A-h11
	D#h16	D#h16	D#h16	D#h16		G#h14	G-h10
	D-h15*	D-h15*	D-h15*	D-h15*		G-h13	F- h9
	C#h14	C#h14	C#h14	C#h14		F-h12	D# h8*
	C-h13	C-h13	C-h13	C-h13		E-h11	C# h7
	A#h12**	A#h12*	A#h12	A#h12		D-h10*	A# h6
	A-h11	A-h11	A-h11	A-h11		C- h9	G- h5
	G-h10	G-h10	G-h10*	G-h10*		A# h8	D# h4*R
	F- h9*	F- h9*	F- h9	F- h9		G# h7	A# h3
	D# h8	D# h8	D# h8	D# h8		F- h6	D# h2
	C# h7	C# h7	C# h7	C# h7		D- h5*R	D#h1/H16
	A# h6**	A# h6*	A# h6	A# h6		A# h4	(19.200Hz)
	G- h5	G- h5	G- h5*R	G- h5*R		F- h3	
	D# h4	D# h4	D# h4	D# h4		A# h2	
	A# h3*R	A# h3*R	A# h3	A# h3		A# h1/H12	
	D# h2	D# h2	D# h2	D# h2		(14.400Hz)	
	D#h1/H16	D#h1/H16	D#h1/H16	D#h1/H16			
	(19.200Hz)	(19.200Hz)	(19.200Hz)	(19.200Hz)			

Summation/ Overtone: □
Objective Notes: ○
Aggregates: *
Mid.C=256Hz
Conjunction:>
Root: R
Dif. Tone: ◇

Aggregated
Series: (6 groups of 6) 2:1 (12 groups of 3)
(-2 groups of 3)
(10 groups of 3) -3:5-> (6 groups of 5) ----------3:4--------> (8 groups of 5)
(+8 groups of 5)
(16 groups of 5) 15:16 (15 groups of 4)

Nested
Series: (12 x three) -----> (-6 x one) -----> (10 x three) ----------4:3--------> (10 x four)
(+40 x one)
(20 x four) --3:4--> (20 x three) -->

L.4 - AVE MARIA - JOSQUIN DES PREZ



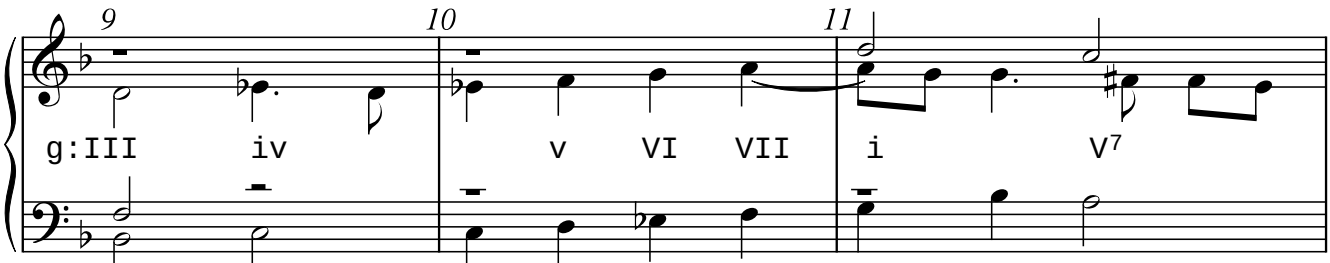
960-D	1152-F	1280-G	1280-G	960-D	960-D	1152-F	1152-F	1280-G	1280-G	640-G	640-G	384A#
15	18 16 18	20	12	9	10	12	16	18	16	8	10	6
4	4 4 4	4	5	5	4	4	4	4	5	5	4	4
16	16 18 16	16	21	21	24	24	18	18	16	16	16	16
1	1 1 1	1	1.016	1.016	1	1	1	0.988	1	1	1	1

1382.4Hz

F-h72*>	G-h72*	G-h80**>	G-h60* 1536.0Hz			G-h72*>1555.2Hz	G-h80*			
E-h68*	F-h64*>	F-h72**	F-h52	F-h48*>1382.4Hz		F-h64*	F~h70*			
D-h60*	D#h56*	D#h64**	D~h45*>	D-h40* 1152.0Hz		D#h56*	G-h40*>	G-h40* 777.6Hz		
C-h56*	C-h48*	D-h60*	C-h40*	A#h32*		C-h48*	D-h30*	F-h36*		
A#h48*	A-h40*	C-h56**	- h35*	F#h25		A-h40*	- h29	D#h32*		
G-h40*	F-h32*	A#h48**	G-h30*	F-h24*		F-h32*	C#h28	C#h28*		
F-h36*	D#h28*	G-h40**	E-h25*	- h23		D#h28*	- h27	B-h25		
D#h32*	D-h26	F-h36*	D#h24	E-h22		D-h26	C-h26	A#h24*> 466.6Hz		
C#h28*	C#h25	D#h32**	- h23	D#h21		C#h25	B-h25*	- h23		
B-h25	C-h24*	C-h26	D-h22	D-h20*		C-h24*	A#h24	A-h22		
A#h24*	- h23	B-h25	C#h21	C#h19		- h23	- h23	G#h21		
- h23	B-h22	A#h24**	C-h20*	C-h18		B-h22	A-h22	G-h20*		
A-h22	A#h21	- h23	B-h19	B-h17		A#h21	G#h21	F#h19		
G#h21	A-h20*	A-h22	A#h18	A#h16*		A-h20*	G-h20*	F-h18		
G-h20*	G#h19	G#h21	A-h17	A-h15		G#h19	F#h19	E-h17		
F#h19	G-h18	G-h20*	G#h16	G#h14		G-h18	F-h18	D#h16*		
F-h18	F#h17	F#h19	G-h15*	G-h13		F#h17	E-h17	D-h15		
E-h17	F-h16*	F-h18	F#h14	F-h12*		F-h16*	D#h16	C#h14		
D#h16*	E-h15	E-h17	F-h13	E-h11		E-h15	D-h15*	C-h13		
D-h15	D#h14	D#h16**	D#h12	D-h10		D#h14	C#h14	A#h12*		
C#h14	D-h13	D-h15	D-h11	C- h9		D-h13	C-h13	A-h11		
C-h13	C-h12*	C#h14	C-h10*	A# h8*		C-h12*	A#h12	G-h10		
A#h12*	B-h11	C-h13	A# h9	G# h7		B-h11	A-h11	F- h9		
A-h11	A-h10	A#h12*	G# h8	F- h6		A-h10	G-h10*	D# h8*		
G-h10	G- h9	A-h11	F# h7	D- h5		G- h9	F- h9	C# h7		
F- h9	F- h8*	G-h10	D# h6	A# h4*R		F- h8*	D# h8	A# h6		
D# h8*	D# h7	F- h9	C- h5*R	F- h3		D# h7	C# h7	G- h5		
C# h7	C- h6	D# h8**	G# h4	A# h2		C- h6	A# h6	D# h4*R		
A# h6	A- h5	C# h7	D# h3	A# h1/H24		A- h5	G- h5*R	A# h3		
G- h5	F- h4*R	A# h6	G# h2	(28.800Hz)		F- h4*R	D# h4	D# h2		
D# h4*R	C- h3	G- h5	G# h1/H21			C- h3	A# h3	D#h1/H16		
A# h3	F- h2	D# h4*R	(25.600Hz)			F- h2	D# h2	(19.440Hz)		
D# h2	F- h1/H18	A# h3				F- h1/H18	D#h1/H16			
D#h1/H16	(21.600Hz)	D# h2				(21.600Hz)	(19.440Hz)			
(19.200Hz)		D#h1/H16								
		(19.200Hz)								

(15 grps 4)
(+3 grps 4)
(18 grps 4) 8:9 (16 g 4) 9:8 (18 g 4)
(+2 grps 4)
(10 grps 8) 6:5 (12 grps 5)
(-3 grps 5)
(20 x three)
(9 grps 5) 10:9 (10 grps 4)
(+12 x one)
(+2 grps 4)
(8 x nine) 8:9 (8 x eight) 9:8 (8 x nine)
(12 grps 4) 4:3 (16 groups of 4)
(+8 x one)
(+2 groups of 4)
(20 x four) 3:4 (20 x three)
(18 groups of 4) 8:9 (16 groups of 5)
(-15 x one)
(-8 groups of 5)
(5 x nine) 8:9 (5 x eight)
(8 groups of 5) 5:4 (10 groups of 4)
(+8 x one)
(-4 groups of 4)
(16 x three) -4:3-> (16 x four)
(6 groups of 4) 4:3->
(+8 x one)
(8 x nine) 10:9 (8 x ten)
(-40 x one) --------> (10 x four)
(-16 x one)
(8 x three) --4:3-->

L.5 - AVE MARIA - JOSQUIN DES PREZ



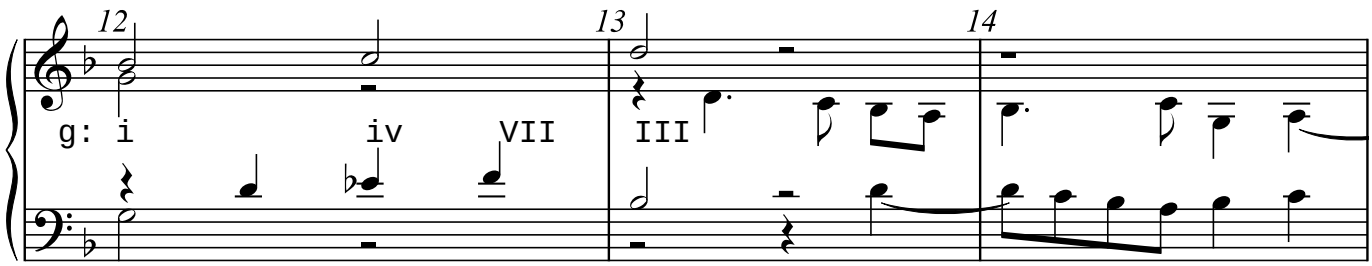
384A#	416-C	416-C	1088-E	1088-E	960-D	960-D	1152-F	1152-F	1280-G	1280-G	480-D	480-D
8	9	8	20	18	16	15	18	16	18	16	6	8
4	4	6	6	5	5	4	4	4	4	5	5	5
12	12	9	9	12	12	16	16	18	18	16	16	12
1	0.963	0.963	1.007	1.007	1	1	1	1	0.988	1	1	1

						1399.7Hz	F-h72*>	G-h72*>		G-h80* 1574.6Hz		
		E-h120**> 1312.2Hz		E-h90*		E-h68*	F-h64*	F-h56*		F-h70*		
F-h48*		C-h96**	1166.4Hz	D-h80*>		D-h60*	C-h56*	C-h48*		- h35*		
C-h36*> 524.9Hz		C-h48**		- h35*		C-h56*	A#h48*	A-h40*		D-h30*> 590.5Hz		D-h40*>
A#h32*		A#h42**		A-h30*>		G-h40*	F-h36*	F-h32*		- h29		C-h35*
F#h25		G-h36**		F#h25*		F-h36*	D#h32*	D#h28*		C#h28		A-h30*
F-h24*		E-h30**		F-h24		D#h32*	C-h26	D-h26		- h27		F#h25*
- h23		D#h28		- h23		C-h26	B-h25	C#h25		C-h26		F-h24
E-h22		D-h26		E-h22		B-h25	A#h24*>	C-h24*		B-h25*		- h23
D#h21		C#h25		D#h21		A#h24*>	- h23	- h23		A#h24		E-h22
D-h20*		C-h24**		D-h20*		- h23	A-h22	B-h22		- h23		D#h21
C#h19		- h23		C#h19		A-h22	G#h21	A#h21		A-h22		D-h20*
C-h18		B-h22		C-h18		G#h21	G-h20*	A-h20*		G#h21		C#h19
B-h17		A#h21*		B-h17		G-h20*	F#h19	G#h19		G-h20*		C-h18
A#h16*		A-h20		A#h16		F#h19	F-h18	G-h18		F#h19		B-h17
A-h15		G#h19		A-h15*		F-h18	E-h17	F#h17		F-h18		A#h16
G#h14		G-h18**		G#h14		E-h17	D#h16*	F-h16*		E-h17		A-h15*
G-h13		F#h17		G-h13		D#h16*	D-h15	E-h15		D#h16		G#h14
F-h12*		F-h16		F-h12		D-h15	C#h14	D#h14		D-h15*		G-h13
E-h11		E-h15*		E-h11		C#h14	C-h13	D-h13		C#h14		F-h12
D-h10		D#h14		D-h10*		C-h13	A#h12*	C-h12*		C-h13		E-h11
C- h9		D-h13		C- h9		A-h11	G-h10	B-h11		A#h12		D-h10*
A# h8*		C-h12**		A# h8		G-h10	F- h9	A-h10		A-h11		C- h9
G# h7		B-h11		G# h7		F- h9	D# h8*	G- h9		G-h10*		A# h8
F- h6		A-h10		F- h6		D# h8*	C# h7	F- h8*		F- h9		G# h7
D- h5		G- h9*		D- h5*R		C# h7	A# h6	D# h7		D# h8		F- h6
A# h4*R		F- h8		A# h4		A# h6	G- h5	C- h6		C# h7		D- h5*R
F- h3		D# h7		F- h3		G- h5	D# h4*R	A- h5		A# h6		A# h4
A# h2		C- h6**		A# h2		D# h4*R	A# h3	F- h4*R		G- h5*R		F- h3
A# h1/H12		A- h5		A# h1/H12		A# h3	D# h2	C- h3		D# h4		A# h2
(14.580Hz)		F- h4		(14.580Hz)		D# h2	D#h1/H16	F- h2		A# h3		A# h1/H21
		C- h3*R				D#h1/H16	(19.440Hz)	F- h1/H18		D# h2		(14.762Hz)
		F- h2				(19.440Hz)		(21.870Hz)		D#h1/H16		
		F- h1/H9								(19.683Hz)		
		(10.935Hz)										

4:3 (8 groups of 4)
(+1 group of 4)
(9 groups of 4) 8:9 (8 groups of 6)
(+12 groups of 6)
(20 groups of 6) 9:10 (18 groups of 5)
(-2 groups of 5)
(16 grps 5) 15:16 (15 grps 4)
(+3 grps 4)
(18 grps 4) 8:9 (16 grps 4)
(+3 grps 4)
(18 grps 4) 8:9 (16 grps of 5)
(-10 grps of 5)
(6 groups of 5) -4:3-> (8 groups of 5) 3:4

4:3-> (8 x four)
(+4 x one)
(12 x three) 4:3 (12 x four)
(+72 x one)
(30 x four) ---3:4--> (30 x three)
(-10 x one)
(20 x four) -3:4-> (20 x three)
(+12 x one)
(8 x nine) 8:9 (8 x eight)
(+12 x one)
(8 x nine) 10:9 (8 x ten)
(-50 x one)
(10 x three) ---4:3---> (10 x four) -3:4->

L.6 - AVE MARIA - JOSQUIN DES PREZ



480-D	1280-G	1280-G	832-C	832-C	576-F	576-F
6	16	12	8	12	8	6
5	5	6	6	4	4	4
16	16	18	18	18	18	24
1	1	0.988	0.963	0.963	1	1

	G-h80*> 1574.6Hz	G-h72**		
	F-h70*	D#h56		
	- h35*	C-h48**>	C-h48* 1049.8Hz	
590.5Hz D-h30*		A#h42**	A-h40*	
	- h29	G-h36**	G-h36*	
	C#h28	E-h30**	F-h32*> 699.8Hz	F-h24*
	- h27	- h27*	D#h28*	- h23
	C-h26	D-h26	D-h26	E-h22
	B-h25*	C#h25	C#h25	D#h21
	A#h24	C-h24**	C-h24*	D-h20*
	- h23	- h23	- h23	C#h19
	A-h22	B-h22	B-h22	C-h18
	G#h21	A#h21*	A#h21	B-h17
	G-h20*	A-h20	A-h20*	A#h16*
	F#h19	G#h19	G#h19	A-h15
	F-h18	G-h18**	G-h18	G#h14
	E-h17	F#h17	F#h17	G-h13
	D#h16	F-h16	F-h16*	F-h12*
	D-h15*	E-h15*	E-h15	E-h11
	C#h14	D#h14	D#h14	D-h10
	C-h13	D-h13	D-h13	C- h9
	A#h12	C-h12**	C-h12*	A# h8*
	A-h11	B-h11	B-h11	G# h7
	G-h10*	A-h10	A-h10	F- h6
	F- h9	G- h9*	G- h9	D- h5
	D# h8	F- h8	F- h8*	A# h4*R
	C# h7	D# h7	D# h7	F- h3
	A# h6	C- h6**	C- h6	A# h2
	G- h5*R	A- h5	A- h5	A# h1/H24
	D# h4	F- h4	F- h4*R	(29.160Hz)
	A# h3	C- h3*R	C- h3	
	D# h2	F- h2	F- h2	
	D#h1/H16	F- h1/H18	F- h1/H18	
	(19.683Hz)	(21.870Hz)	(21.870Hz)	

--> (6 groups of 5)
(+10 groups of 5)
(16 groups of 5) 3:4 (12 groups of 6)
(-4 groups of 6)
(8 groups of 6) 3:2 (12 groups of 4)
(-4 groups of 4)
(8 groups of 4) 3:4 (6 groups of 4)

--> (10 x three)
(+50 x one)
(8 x ten) ---9:10---> (8 x nine)
(-24 x one) ---> (-16 x one)
(8 x four) ----3:4---> (8 x three)

meter
(Metrical MOS)

MBN: $4_2 0_1$

```
h4...:sixteenthnote figuration
h3
h2...:eighthnote figuration
h1/H2:quarternote beat
   H1:meter duple halfnote tactus
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Measures 1 through 12

Note: Later in the piece there is a short triple time section which would involve the metrical MOS scheme in a sesquitertia 4:3 exchange and back again. Hopefully in time this analysis will be extended so as to include this feature.