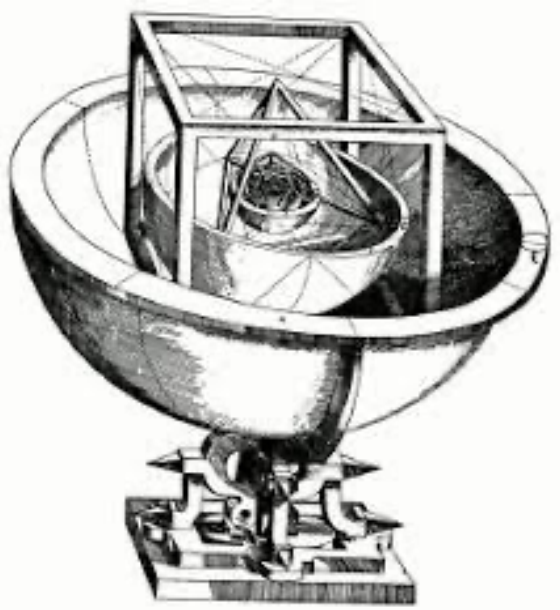
MOTET:
HARMONIES OF THE WORLD

MUSIC BY JOHANNES KEPLER (1619) / DAVE SOLDIER (2021)
LYRICS FROM PROCLUS "HYMN TO THE SUN" (C. 480 A.D.)



SOPRANO, 2 ALTOS, TENOR, BARITONE, BASS

DURATION ABOUT 15 MINUTES

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VERSION 1.29.22

FOR EKMELES

This four part motet is composed according to Johannes Kepler's *Harmonies of the World* (1619), in which he reports his discovery of the elliptical shape of the planets orbits around the sun and also derives a basis for the polyphonic music of the renaissance.

In *Book V*, Kepler describes the music of the planets, and while realizing that there is no air or sound in the cosmos, he conjectures that someone at the sun would perceive this music. He demonstrates that if the planets moved in circles around the sun as suggested by Copernicus, the sounds they produce would be dissonant. He felt that the "master artisan" would not design a system in which the planets did not revolve in consonance, and this was the stimulus for his discovery of how the planets genuinely orbit.

Kepler realized that the planets move in ellipses and so they would change in musical pitch according to their distance from the sun, like a lute's string dampened at different lengths on the neck. If this occurred, the planets would occasionally be in tune with each other.

His calculations of the shapes and speeds of the rotations and the planet's relative distances from the sun inspired Isaac Newton's efforts to describe force, acceleration and gravity, and so provided the foundation for contemporary mathematics and physics and virtually all contemporary technology.

In *Chapter 7* of *Book V*, Kepler asked that a composer write a motet based on the planetary motions he deduced.

"Shall I have committed a crime if I ask the single composers of this generation for some artistic motet instead of this epigraph? The Royal Psalter and the other Holy Books can supply a text suited for this. But alas for you! No more than six are in concord in the heavens. For the moon sings here monody separately, like a dog sitting on the Earth. Compose the melody; I, in order that the book may progress, promise that I will watch carefully over the six parts. To him who more properly expresses the celestial music described in this work, Clio will give a garland, and Urania will betroth Venus his bride."

He writes many pages on what the motet ought to be, including the harmonies, intonation and allowable intervals and scales.

To my knowledge, while there have been musical interpretations of a diagram of planetary intervals (see Part IV), the motet that Kepler requests has not been written. I therefore credit Kepler as a collaborator on this motet in four parts, the second of which is closest to his intent.

GENERAL GUIDE

In *Book V, Chapter 10*, the *Conjectural Epilogue on the Sun*, Kepler indicates that the music should be heard as if the listener were present on the Sun with singing from the planets orbiting the listener in ellipses. The six planets change pitches like strings that change in length between two

bridges, with the highest note closest to the sun, the *parahelion*, and the lowest when most distant from the sun, the *aphelion*.

In performance, if possible, the voices should rotate around the listeners.

The fundamental "DO" of Kepler's time was written as a "C", and the lowest available pitch corresponded to G2 (with middle C as C4), a note known as *Gamma*. These notes did not have an assigned frequency and can be anywhere comfortable for the singers, like the SA fundamental pitch in Indian classical raga.

Kepler defined the pitches of his 12 note per octave scale in Book III, Chapter 11: he wrote them as the length of a string, and for modern readers and performers, here I list his intonation expressed in frequency ratios: he did not specify the tritone, for which I use the square root of 2, the half-point of an octave. If we set G2 (gamma) at 98 Hz, close to the contemporary frequency for G2, C (C4) is 4/3*98 Hz*2 = 261.333 Hz and:

C4	C#4	D4	D#4	E4	F4	F#4	G4	G#4	A4	Bb4	B4	C5
1/1	17/16	9/8	6/5	5/4	4/3	^-2	3/2	19/12	27/16	9/5	15/8	2/1 ratios
261	276	294	318	327	349	374	392	413	441	470	490	523 Hz

The notes for the octave below are half the frequency values, and those above are doubled, e.g., the G above the soprano's top staff line (G5) is 2 * 392 Hz = 784 Hz.

This table is transposed if the fundamental is transposed, as detailed below.

One of Kepler's main challenges was what to do wotj Venus. Its orbit is very close to circular, and so always close to a single note. In Chapter 6, Kepler reports that it changes pitch only as a *diesis*, the smallest classical interval - it sings only a note a bit flat of E natural. In Chapter 7, to allow additional consonances for the motet, Kepler allows Venus to sing either the e or e-flat, which we do in Parts I, II, and III.

In Book V, Chapter 7, Kepler diagrams consonances that occur among the planets during points in their orbits. I strongly suspect that the reason that some consonances with the ranges of the planets, for example the Ab major triad, were not included because he used a keyboard tuned to the just intonation intervals in the table above, and some triads are too out of tune: but in a vocal piece like this one, we can retune the ratios to fundamentals other than C and so we obtain additional chords in harmony that still obey his rules.

I use key signatures that indicate the fundamental (not the mode), so that 3 sharps mean that the fundamental is A, whether the music is in A major, minor or phrygian modes. The motet uses fundamentals in C, Eb, E, G, Ab and A. This tuning table reports the tuning of the pitches for Kepler's just intonation scale for each of these key signatures using "cents" or 1/100th of a 12-equal interval scale semitone.

Differences from 12-equal tuning in cents

keys	C	Eb	E	G	Ab	A
C	-2	-2	-2	-2	-2	-2
B	-14	27	-14	-14	27	-14
Bb/A#	16	16	-16	16	16	-6
A	-18	14	-18	4	23	-18
G#/Ab	12	12	-29	12	12	-29
G	0	0	0	0	0	0
F#/Gb	-2	29	-12	-12	29	-33
F	-4	18	-4	18	-4	-4
E	-16	25	-16	-16	25	-16
D#/Eb	14	14	-27	14	14	-18
D	2	2	2	2	12	-20
C#/Db	10	31	-31	0	10	-31
C	-2	-2	-2	-2	-2	-2

For lyrics in Parts I II, and III, I chose the ***Eis Hēlion****, Hymn to the Sun* by Proclus, who Kepler strongly admired and quotes throughout his book. I thank Maria Combatti for transliteration from the Greek and recording the spoken text for singers to hear the pronunciation and the rhythm in dactylic hexameter in which it was composed.

Part 1 is based on the harmonies of the aphelions and parahelions. We proudly show how these chords are not at all consonant, but in my opinion, have their own sort of beauty.

To determine the tuning of these chords I use these values in minutes/seconds (60 seconds/minute) from Kepler's book, here converted to seconds.

aphelions:	106	270	1574	3428	5690	8821
parahelions:	135	330	2281	3678	5857	23040

Based on a G gamma of 98 Hz, the movement begins and returns to the word "Kluthi" ("hearken"), sung in chords tuned to the aphelions and parahelions. Transposed vocal ranges:

	Saturn	Jupiter	Mars	Earth	Venus	Mercury
aphelions:	98	125	182	198	329	255
parahelions:	125	152.5	264	213	338	666

Hearken, dispenser of light, you, o lord, who hold yourself
the key to the life-supporting source and channel off from above
a rich stream of harmony into the material worlds.

Kluthi, faous tamia, zōarkeos, ō ana, pēgēs
autos echōn klēida kai hulaiois eni kosmois
hupsothen harmoniēs ruma plousion exocheteuōn.

Part 2 is intended to evoke choral motets by Orlando Lassus, who Kepler mentions in the book to be exemplary composer of modern music that is rationally derived from the laws of the universe: I think this part is closest to what Kepler desired.

The planets, girded with your ever-blooming torches,
through unceasing and untiring dances,
always send life-producing drops down for earthlings.

Zōsamenoi de planētes aeithaleas seo pursous
aien hup' allēktoisi kai akamatoisi choreiais
zō(i)ogonous pempousin epichthoniois rathamiggas.

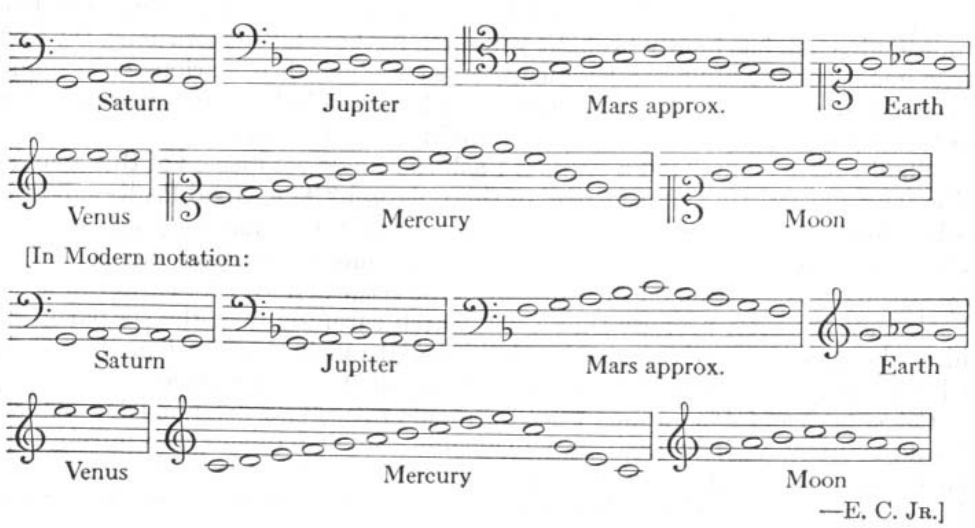
Part 3 has a novel phrasing based on hexameter, which lends itself to a 7 beat cycle.

From your chain the king of the song that obeys the divine,
Phoibos, sprung forth. Singing inspired songs to the accompaniment of the kithara,
he calms the great wave of deep-roaring becoming.

Seirēs d' humeterēs basileus theopeitheos oimēs
exethoren Phoibos; kitharē(i) d' hupo theskela melpōn
eunazei mega kuma barufloisboio genethlēs.

Part 4
In Book V, Chapter 6, Kepler's diagram indicates the musical ranges of the six planets and the Earth's moon, as shown below in a version prepared by Elliott Carter who rewrote the diagram into clefs familiar now. This diagram has been realized several times including excellent computer music versions by Willie Ruff and Laurie Spiegel.

Kepler does not ask for words for the planets to sing in this diagram except that he states "the Earth sings *mi* and *fa* as on our planet *mi*sery and *fa*mine obtain".



In this Figure, Kepler cheats on the range of Jupiter, which ought to sing from B to a note between D and Eb. Instead he transposes it down to Saturn's low note, G gamma, to make it more consonant with the others. I use that transposition and range for Part 4 only since it is based on Kepler's *Chapter 6*, but in Parts I, II and III, use Jupiter's correct range according to Tycho Brahe's measurements, as Kepler does in *Chapter 7*.

The asterisks above each planet's staff in the score mark the start of a rotation. The voices should rotate around the listener at the Sun, and the asterisks above the part show a repeated point in the rotation.

Part 4 works well with Kepler's just intonation tuning in C, and he asks for glissandos between pitches. While Earth sings the two syllables *mi* and *fa*, the others sounds are only suggestions, and soloists should develop their own different character or accent for their planet.

OPTIONAL INSTRUMENTS & ADDITIONAL VOICES

The octaves of the planet's vocal extend above that reached by human singers (see below). I use the voices Kepler specifies in *Book V, Chapter* 8: Mercury as a soprano, Earth and Venus as altos, Mars as a tenor, and Jupiter and Saturn as basses (I call Jupiter a baritone, and Venus can be a countertenor or a mezzo soprano).

While Kepler says that there can only be 6 parts, there is no reason that individual parts can't be sung by multiple singers, and so it is fine for a chorus to sing this music. Like motets of Kepler's time, the version of the piece has only vocal parts, but it is fine to add a continuo for additional instruments, and I have in alternate version of the piece for that.

Part 4 can use a drone instrument like a tambura or sruti box on the notes C and G, or drones by string instruments, and those players should be attentive to the music around them and adjust timbre and volume according to the overall sound. Part 4 can further use improvising instrumentalists to represent occasional celestial phenomena including comets, moons (Kepler, who corresponded with Galileo, knew there were moons of Saturn and Jupiter), meteors, stars and galaxies that transiently enter the listener's awareness.

MORE ON THE MATH (not required, for those interested…)

To determine the frequencies / pitches that the planets sing, Kepler considered each orbit to be like a fretted guitar string, When the vibrating string length between the fret and the bridge is twice as long, it sounds an octave lower.

Since Venus's orbit is nearly circular, the orbit is always nearly the same distance from the Sun and the parahelion and the aphelion are about the same. The "string" is at nearly the same length at all times, and so Venus always sings nearly the same note.

For the most elliptical orbit, Mercury's, Tycho Brahe, Kepler's mentor, made observations with his telescope that indicated that the planet moves at an angle of 384 "minutes" = 23040 "seconds" per day, at the parhelion and 147 "minutes" = 8821 "seconds" at the aphelion. This means that Mercury travels much faster relative to the Sun when the length of the "string" is shorter and plays a lower tone when it the string is longer.

A string which is stopped at 8821 seconds /23040 seconds = 0.38 of its full length, close to the ratio 5/12 (= 0.42), will sound a frequency that is 12/5 higher than the open note. For example, with contemporary tuning, 12/5 *260 Hz (C4) = 624 Hz (about Eb6), which means that Mercury has a range of about an octave and minor third: Kepler gives it an octave and major third, and also uses slightly different numbers for aphelions and parhelions within the book.

This process, derived from Kepler's interpretations of Tycho Brahe's recordings to deduce the aphelions and parahelions, provides the vocal ranges for each planet, approximately:

Mercury's range is 12/5, an octave and minor third
Venus is 25/24, far under a half-step and Kepler rounds down to a unison in Chapter 6 and rounds up to a half-step in Chapter 7. This small interval is a *diesis*.
Earth is 16/15, close to a half-step
Mars is 3/2, a fifth
Jupiter is 6/5, a minor third
Saturn is 5/4, a major third

The next question is how to decide that pitch the aphelion / low note should be for each planet. Kepler reasonably chose the lowest note he had available in his era for the aphelion of Saturn, the longest distance of any planet from the Sun. This note, now called G2, was called "gamma". Since the highest note available was C6, which was called UT, the "gamut" means the whole range of available notes. Therefore, Saturn's range is from G2 to B2 (see Kepler's diagram above). If we set Saturn's low note G2 at a quasi-contemporary value of 98 Hz, the B2 high note is 125 Hz.

To derive the fundamentals of the next planet, Jupiter, Kepler took its aphelion (270 seconds) and compared it to Jupiter's aphelion (106 seconds): since 270/106 = ~0.38, close to an octave and major third, and Saturn should start at B3. Repeating this for each planet:

Saturn's range is G2 to B2

Jupiter B3 to D/Eb4
Mars F#6 to C7
Earth G7 to Ab7
Venus E8
Mercury B8 to E 10

This assignment of voices for each planet presents issues for singing. The top note of a conventional soprano is about C6, and the top note of Mercury extends beyond the range of human hearing. To solve this, Kepler moved the planets by octaves into a singable range.

Another issue is how to realize the timing for Part IV. If we used the untransformed durations of the planets around the sun, each rotation of Mercury would be 88 Earth days, and a rotation of Saturn would take 10,789 days (122-times longer than the duration of Earth's). Kepler thinks that this is so slow that it is possible that a full consonance of a triad may show up only once, possibly at creation.

For one way to bring the timing as well as frequencies to a human scale, consider that musical octaves are $\log_2$ transofmations of note frequencies, in which each higher octave is double the frequency of the lower. For example, if middle C (called C4) is 260 Hz, the C an octave below (C3) is 130 Hz and the high C two octaves above (C6) is 1040 Hz. We can determine how distant these notes are from each other in octaves by calculating the $\log_2$ of a number, which means how many times the number 2 must be multiplied by itself to equal that number: for example, $\log_2(16) = 4$ because 2*2*2*2 = 16. For C6 and C3, their distance in octaves is calculated as 1120 Hz/ 130 Hz = 8, and since $\log_2(8) = 3$, they are 3 octaves distant.

I use this approach to transform the frequencies of the planet's rotations in Part IV. These are a lot slower than the frequencies of the notes used in music – the frequency of the Earth's rotation around the Sun is 1 / year = ~ 1/31 million seconds = ~ 30 millionth of a Hz - but frequencies nonetheless. The difference in octaves between the durations of a solar rotation by Saturn and Mars is about 7 octaves, since $\log_2$ (10,789 days/88 days) = ~7.

For Part IV, I calculate the rotation from the numbers of Earth days that each planet takes to rotate around the Sun. For Mercury, $\log_2$ (88 days) = 6.46, and for Saturn $\log_2$ (10,789 days) = 13.39. I then set one year of Mercury's $\log_2$ rotation as 20 quarter notes. In this way, the planet's durations for a rotation around the Sun are: Mercury 20, Venus 24, Earth 26, Mars 29, Jupiter 37 and Saturn 41 quarter notes. On the score, I mark an asterisk for each planet at the start of their yearly intervals, when rotation should return to the same angle around the audience listening from the Sun.

PRONUCIATION GUIDE

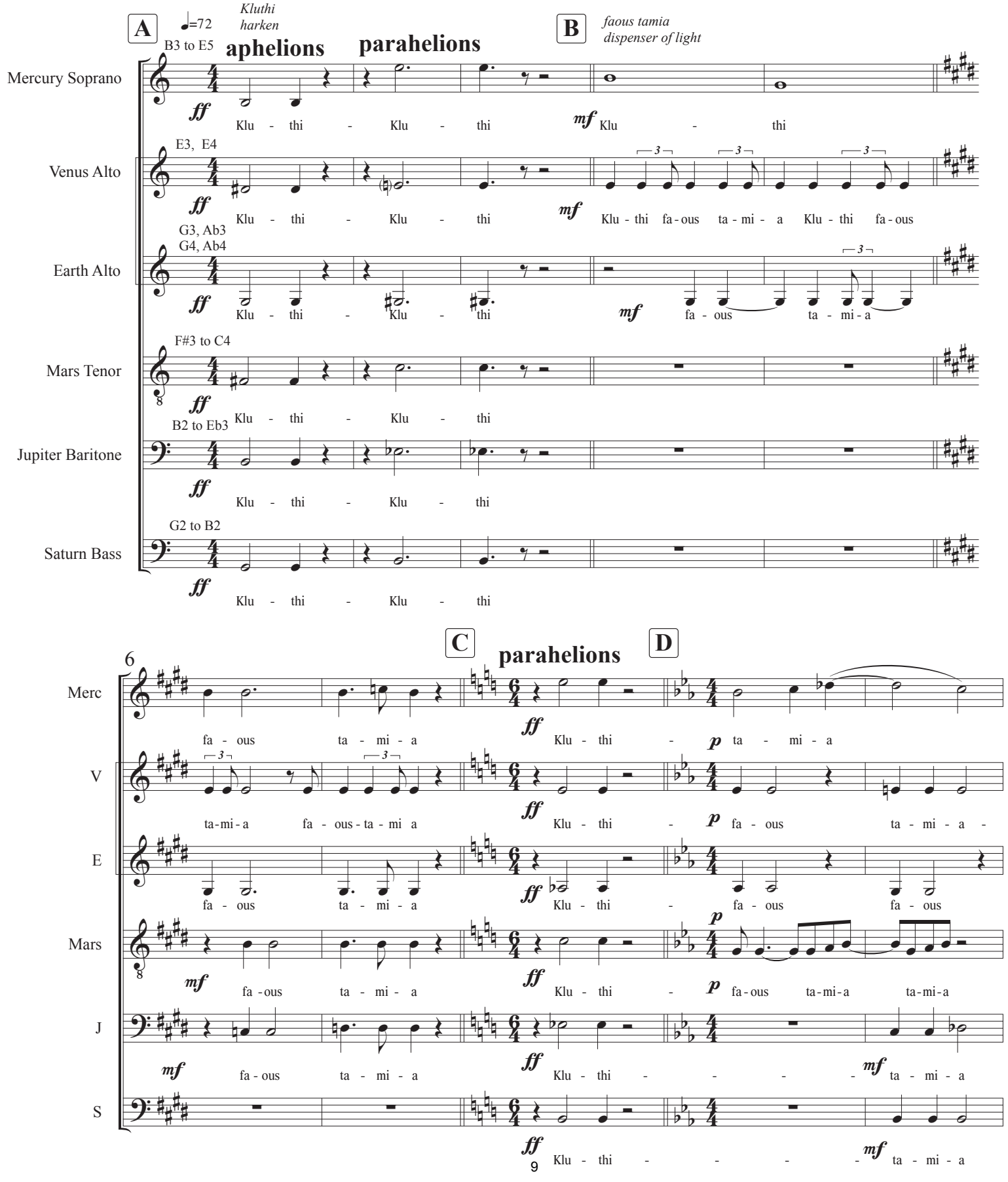
Dr. Maria (Marina) Combatti, a specialist in Greek poetry, kindly recorded recitations of the lyrics, one with the words stressed as spoken Greek and the other in dactylic hexameter, the rhythms of Proclus's hymn. This was also the rhythm used by Hesiod, Homer and in most of the epics.

- th (θ) pronounced with aspiration, as in English *think*, *Theodore*
- i (ι) pronounced like Italian -i, as in English *gin*, *sin*
- a (α) pronounced like Italian -a, as in English *alpha* (indeed)
- e (ε) pronounced like Italian -e, as in English *elegant*
- u (υ) pronounced like French -u (iu) or English *utility*, *ufo*
- ou (ου) pronounced like Italian -u, as in English *blooming*, *booming*
- ch (χ) hard, aspirate sound like in English *chiasm*, *chimera*
- ē (η), ō (ω) long vowels
- g (γ) hard sound as in English *god*
- hu (ὐ); ha (ἀ) pronounced with aspiration, as in English *hard*, *hi*, *hear*
- gg (γγ) to read like -ng- as in engagement
- (i), subscribed i (ῳ, ῃ) pronounced like Italian -i but very slightly almost silently
- Ph (Φ) pronounced as an aspirate -p more than -f
- (i) as above, subscribed i (ῃ) pronounced like Italian -i but very slightly almost silently

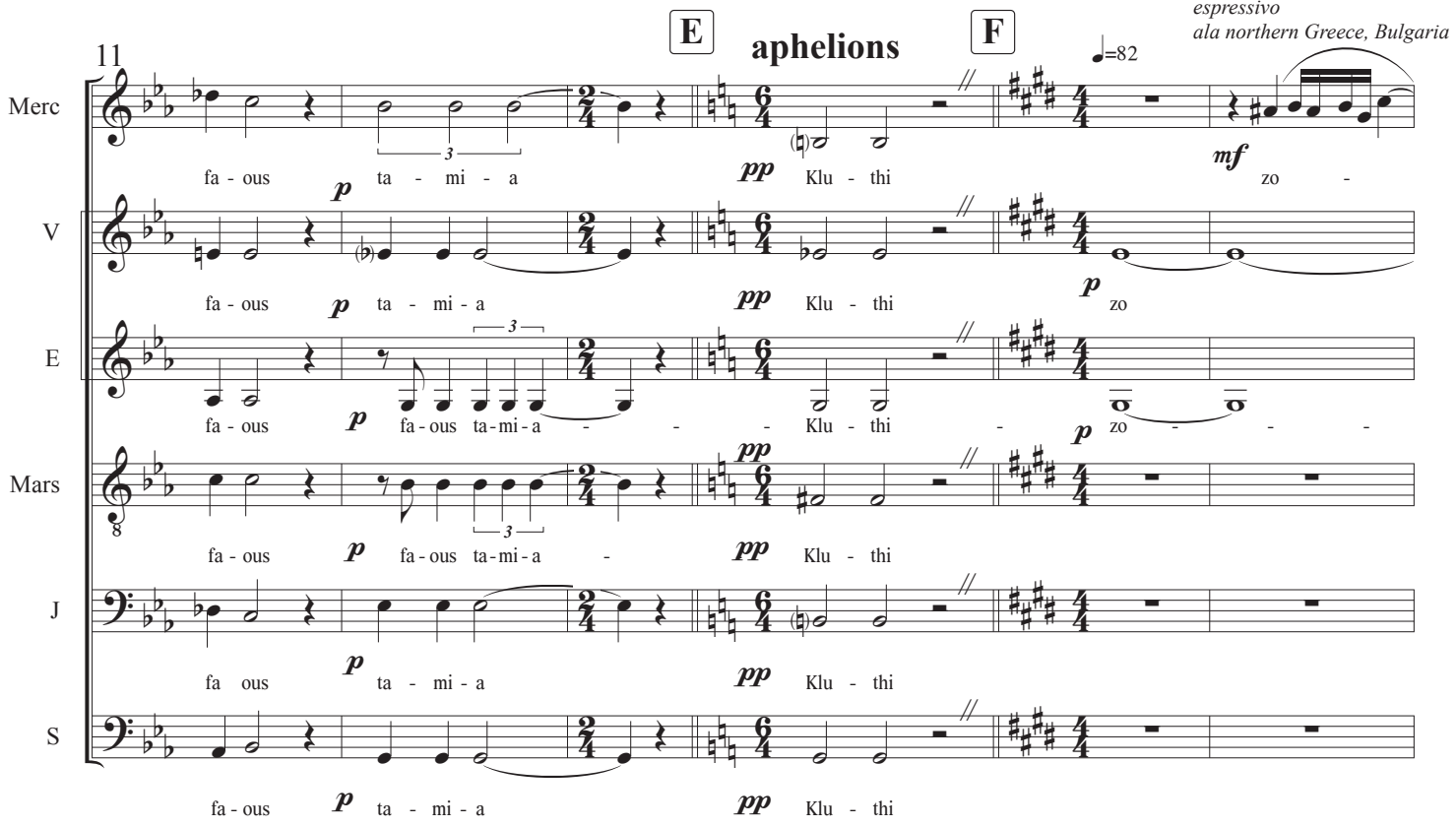
Part I Motet: Harmonies of the Worlds

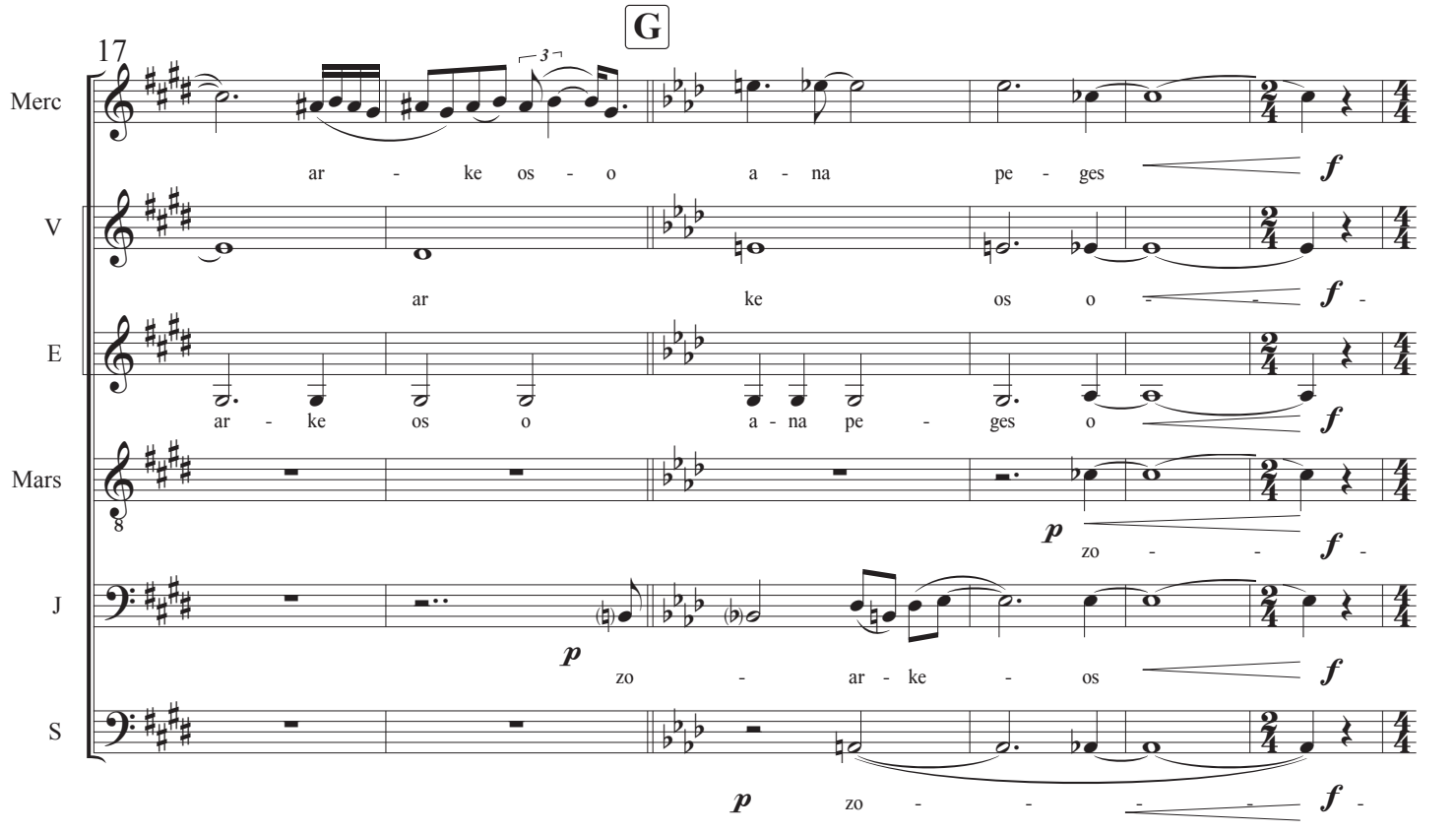
Johannes Kepler / Dave Soldier
text Proclus "Hymn to the Sun"

for aphelion and parhelion chords, use the tunings in the notes

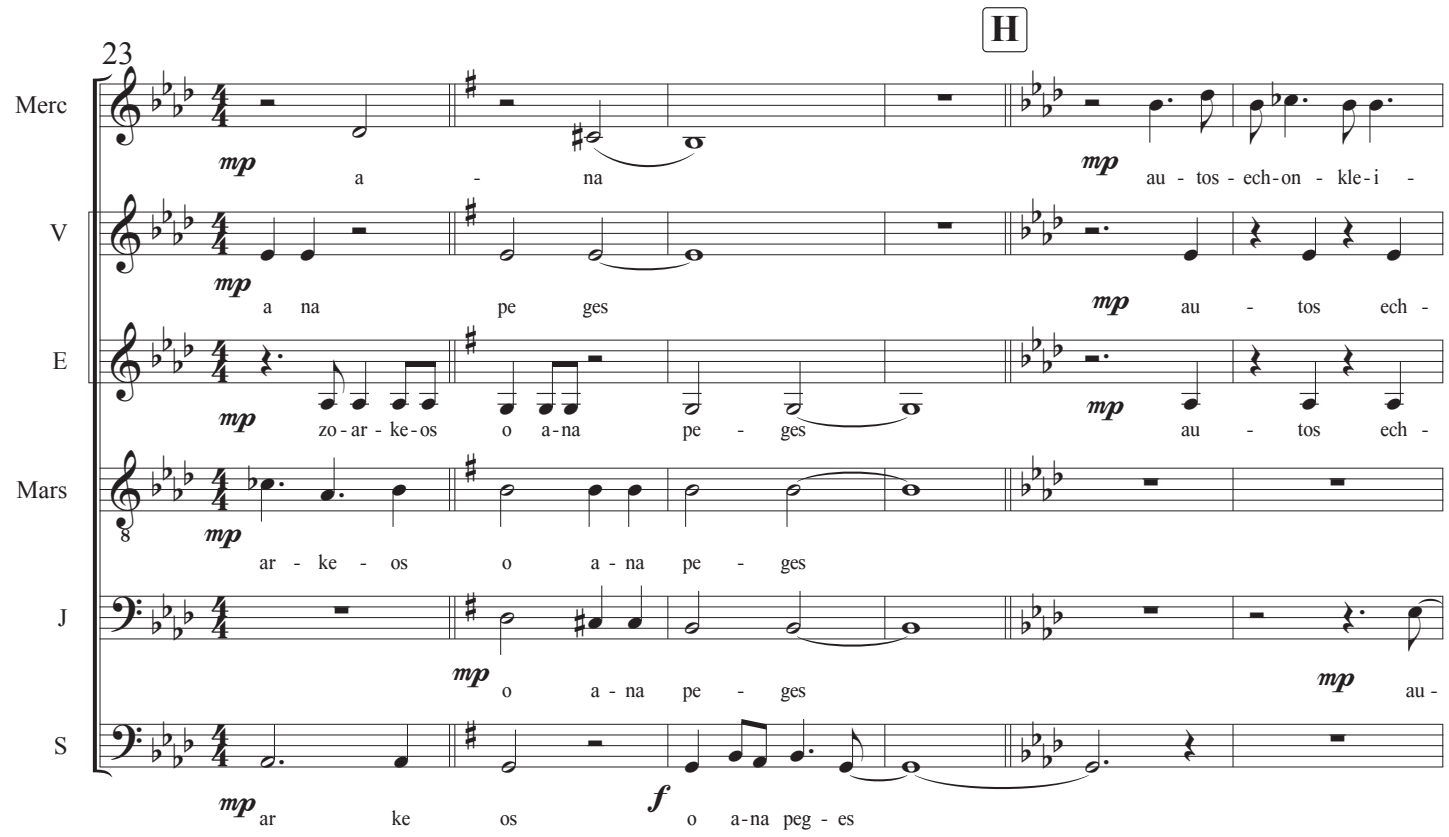


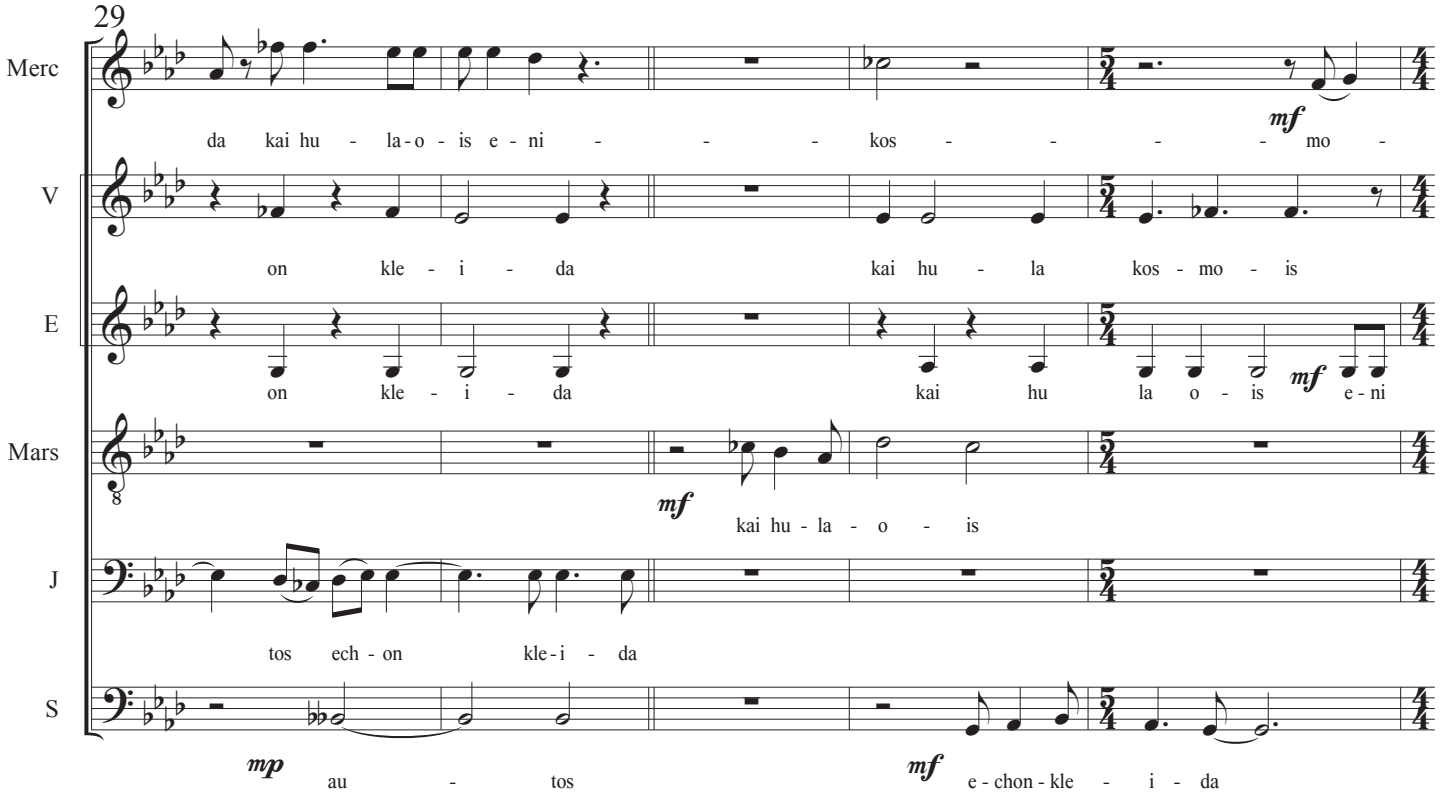
zoarkeos, o ana, peges
you, o lord, who hold yourself
espressivo
ala northern Greece, Bulgaria





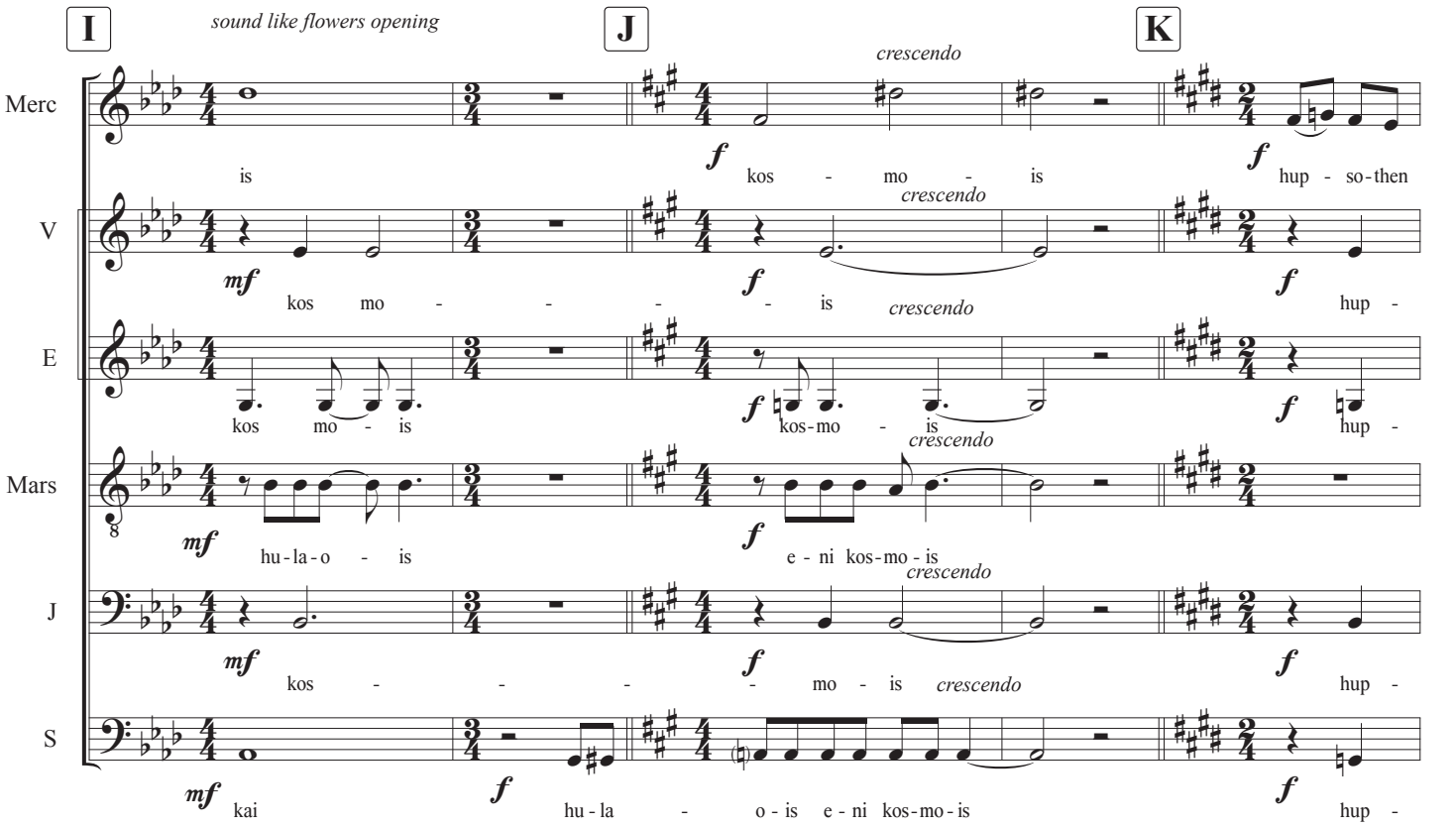
autos echōn klēida kai hulaiois eni kosmois
the key to the life-supporting source and channel from above

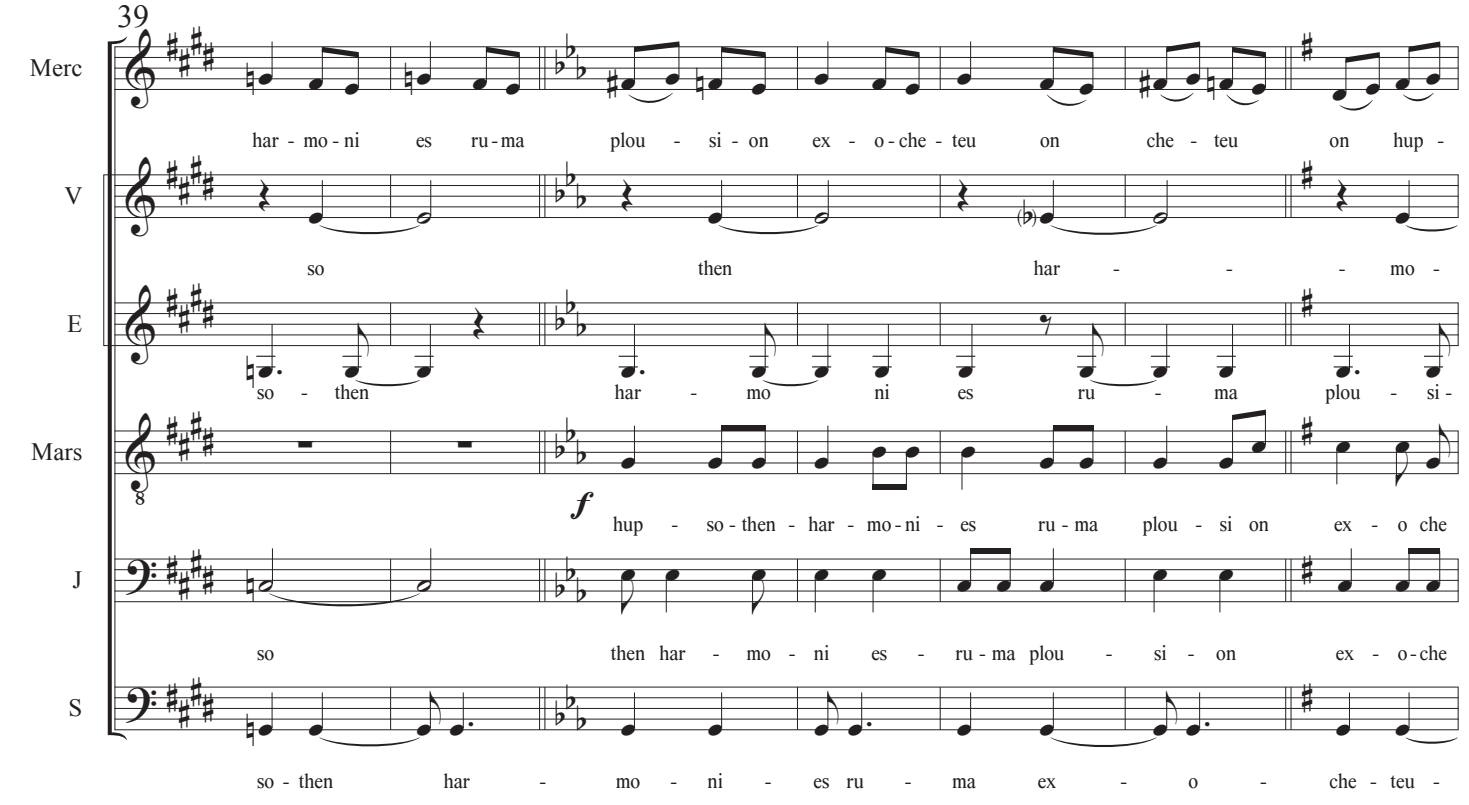


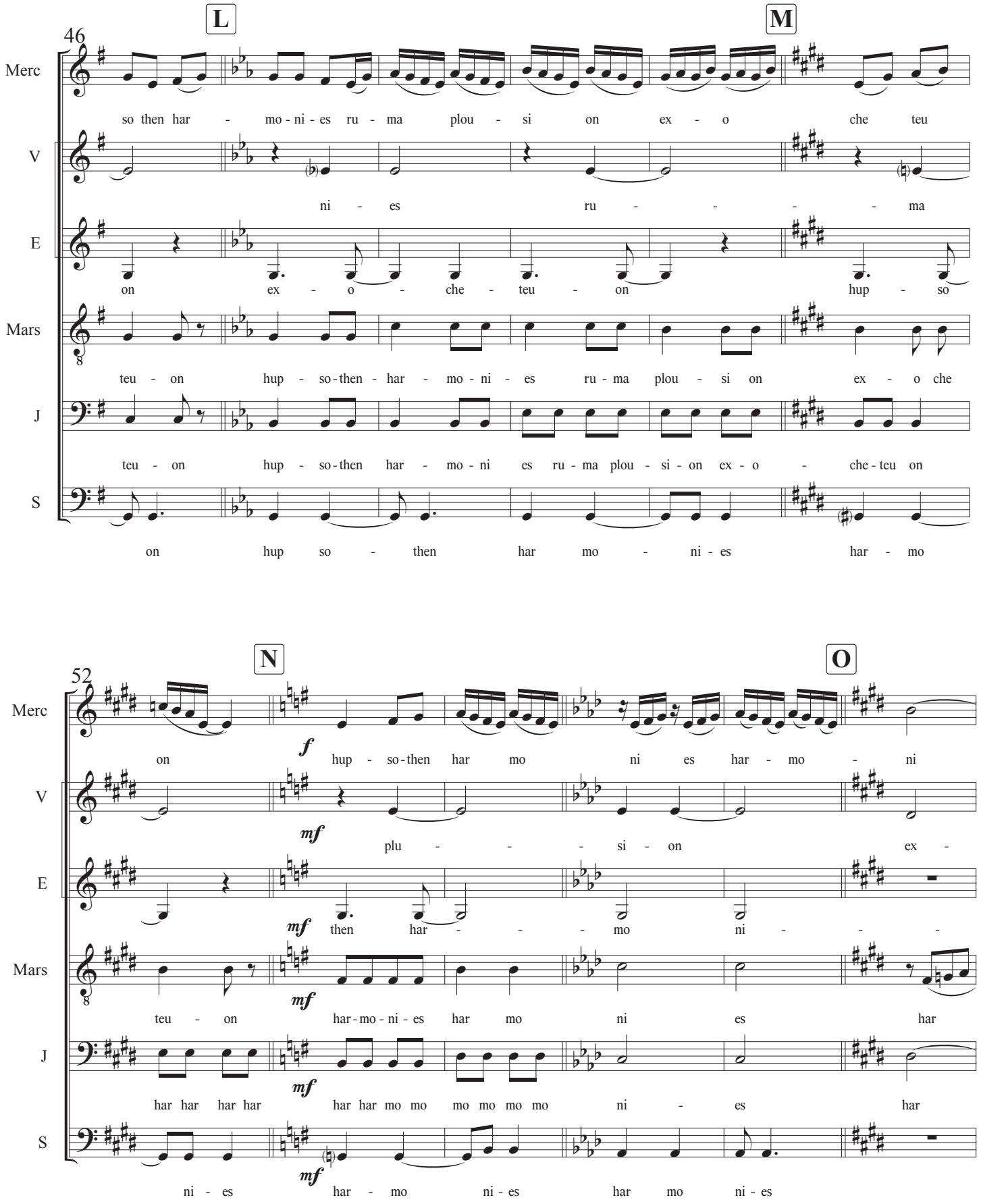


4

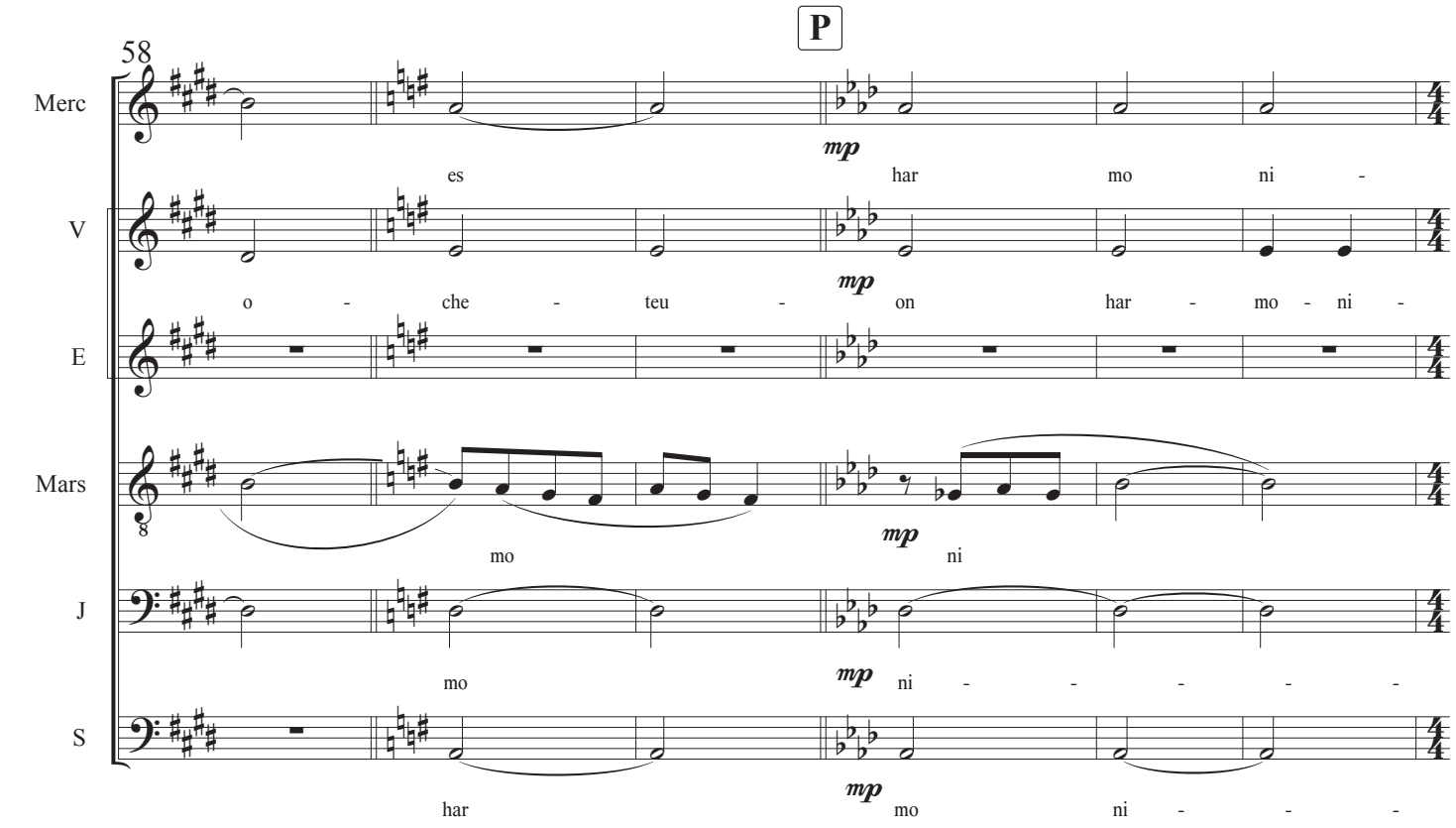
hupsothen harmoniēs ruma plousion exocheteuōn
a rich stream of harmony into the material worlds

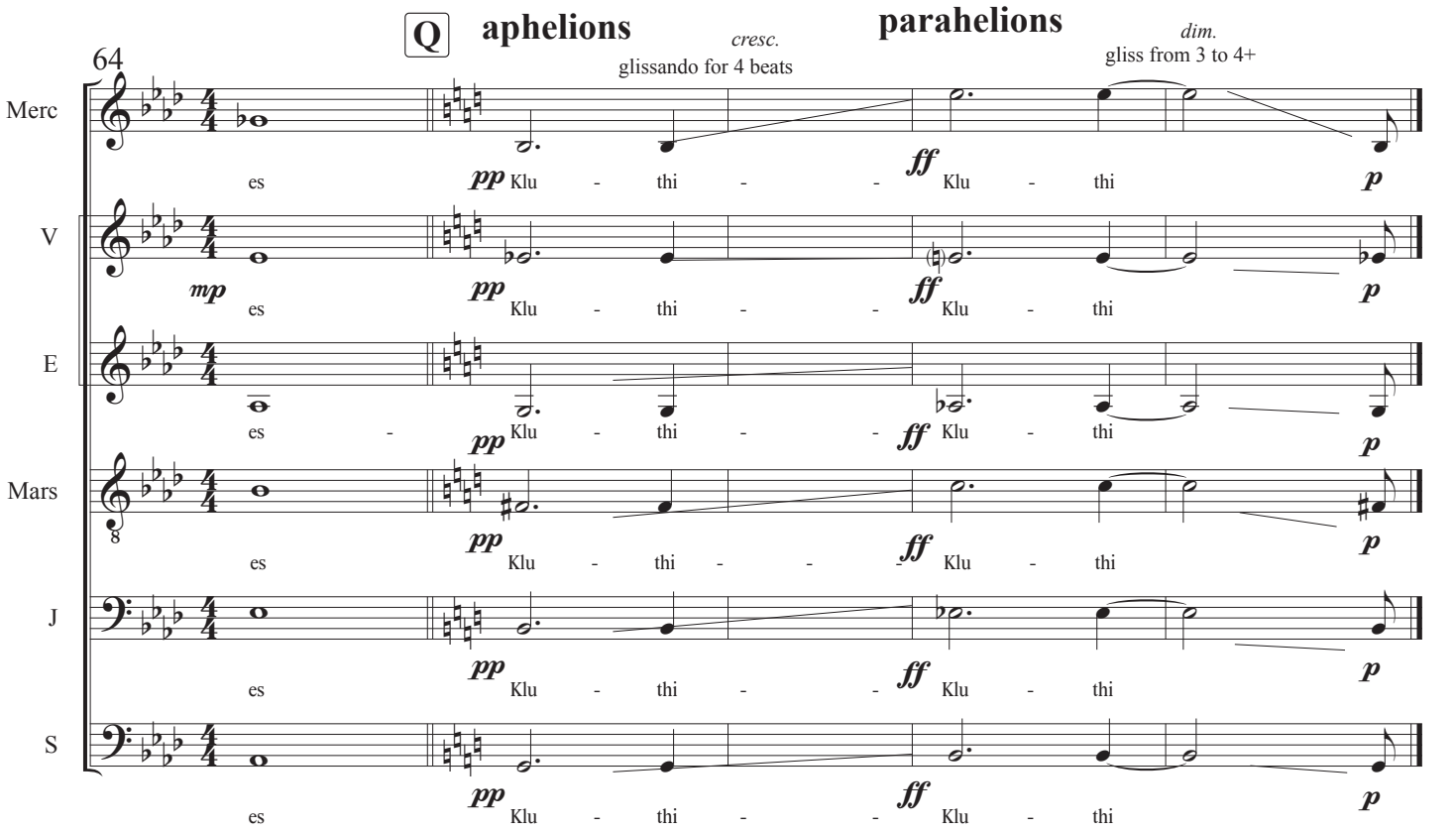





L
M
46
Merc
so then har - mo - ni - es ru - ma plou - si on ex - o che teu
V
ni - es ru - - - - ma
E
on ex - o - che - teu - on hup - so
Mars
teu - on hup - so - then - har - mo - ni - es ru - ma plou - si on ex - o che
J
teu - on hup - so - then har - mo - ni es ru - ma plou - si - on ex - o - che - teu on
S
on hup so - then har mo - ni - es har - mo
N
O
52
Merc
f
on hup - so - then har mo ni es har - mo - ni
V
mf
plu - - - si - on ex -
E
mf
then har - - - mo ni - - -
Mars
mf
teu - on har - mo - ni - es har mo ni es har
J
mf
har har har har har har mo mo mo mo mo mo ni - es har
S
mf
ni - es har - mo ni - es har mo ni - es

6


P
58
Merc
V
E
Mars
J
S
mp
es har mo ni -
o - che - teu - on har - mo - ni -
mo ni
mo ni - - - - -
har mo ni - - -


Q
aphelions
parahelions
cresc.
glissando for 4 beats
dim.
gliss from 3 to 4+
64
Merc
V
E
Mars
J
S
pp
ff
p
es Klu - thi - - Klu - thi

Pars II Motet: Harmonies of the Worlds

Johannes Kepler / Dave Soldier
text Proclus "Hymn to the Sun"

Pars II

A ♩ = 60

Zosasmenoi de planetes
The plantets, girded

Mercury Soprano: *mf* Zo - sa me - noi de pla - ne tes de pla -

Venus Alto: *mf* Zo - sa me - noi de pla - ne tes

Earth Alto: *mf* Zo - - - - sa - me - noi de pla ne -

Mars Tenor: *mf* Zo - sa - me - noi de pla-ne - tes Zo-sa - me - noi de pla-ne - tes

Jupiter Baritone: *mf* Zo - sa me-noi de pla - ne - tes

Saturn Bass: *mf* Zo - sa - me - noi de pla - ne - tes

NB m4 and 5, C naturals are lowered to match G#

aeithaleas seo pursous
with your ever-blooming torches

7

Merc: ne - tes ae - ith - a - le - as se - o pur - sous ai - en

V: ae-ith-a-le - as se - o pur - sous

E: tes ae - ith-a - le - as se - o pur-sous

Mars: ae - ith - a - le as se - o pur - sous ai - en

J: ae - ith a - le as seo pur - sous ai - en

S: ae - ith - a le as se - o pur - sous

2

12

aien hup' allektoisi kai
throuigh unceasing and

Merc: hup al - lek - toi - i si - - - kai - - - - a -

V: ai-en hup al - lek - to - i si kai - - - - a -

E: ai-en hup' al - lek - to - i si kai - - - - a -

Mars: hup al - lek - to - i - si kai - - - - a -

J: hup al - lek to - i - si kai - - - - a -

S: ai-en hup al - lek - to - i - si kai - - - - a -

NB, m 17 beat 4, tune Saturn A to E

B

akamatoisi choreiais
untiring dances

cresc.

Merc: ka - ma - to - i - si - cho - rei - ais a - ka - ma - to - i - si - cho - rei

V: ka - ma - to - i - si - cho - rei - ais a ka - ma - to - i -

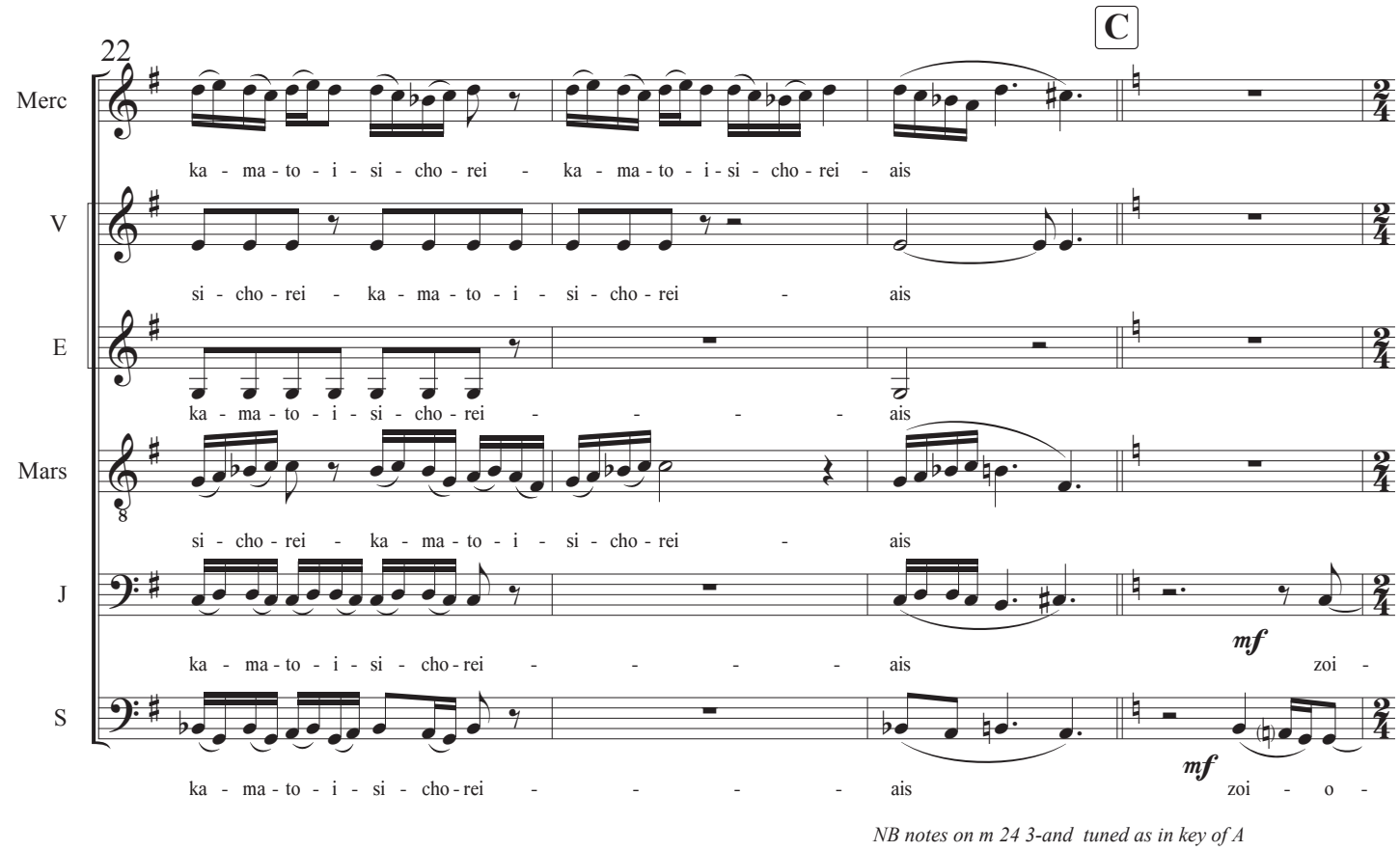
E: ka - ma - to - i - si - cho - rei - ais a ka - ma - to - i - si - cho - rei -

Mars: ka - ma - to - i - si - cho - rei - ais a ka - ma - to - i -

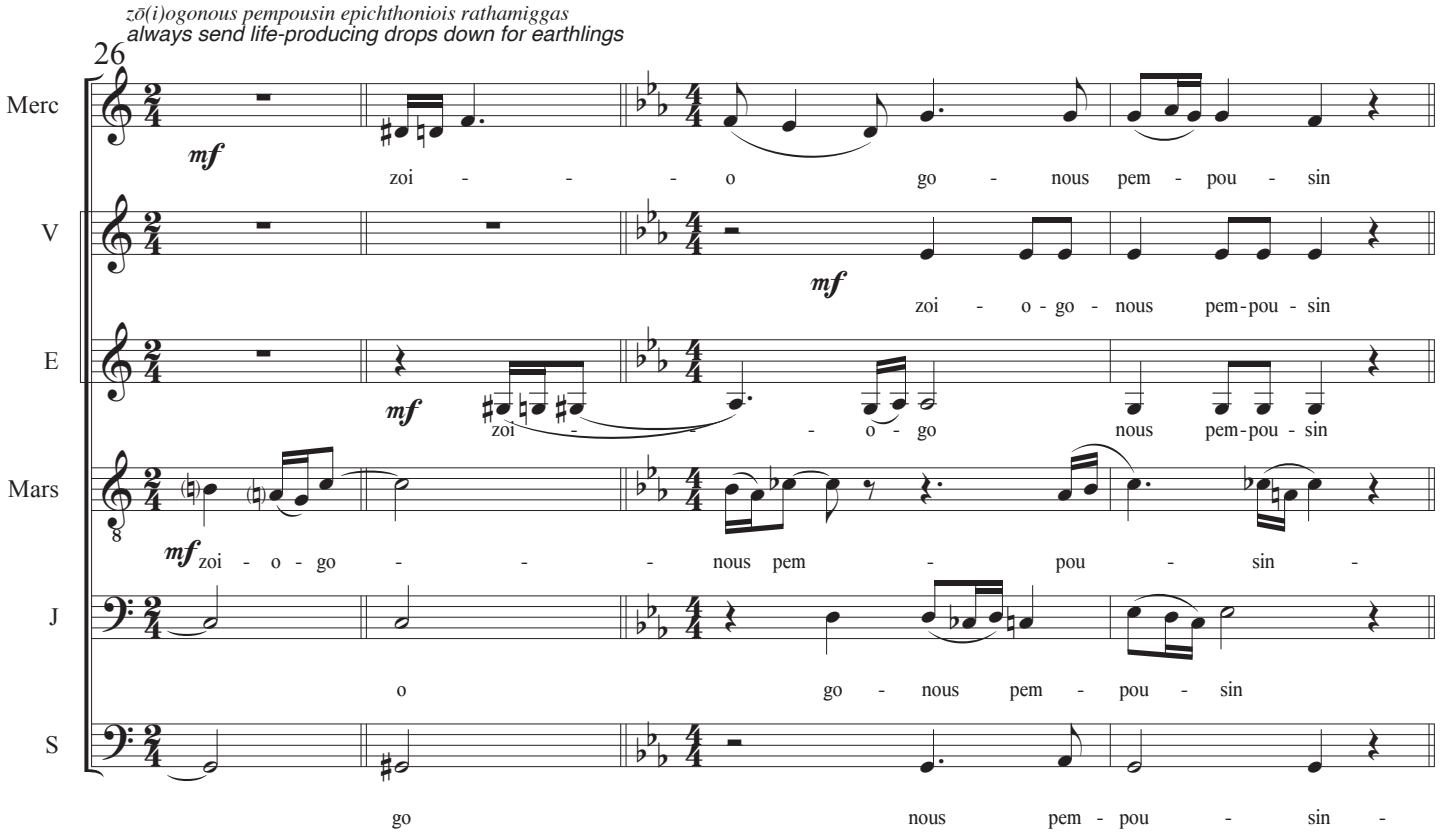
J: ka - ma - to - i - si - cho - rei - ais a ka - ma - to - i - si - cho - rei -

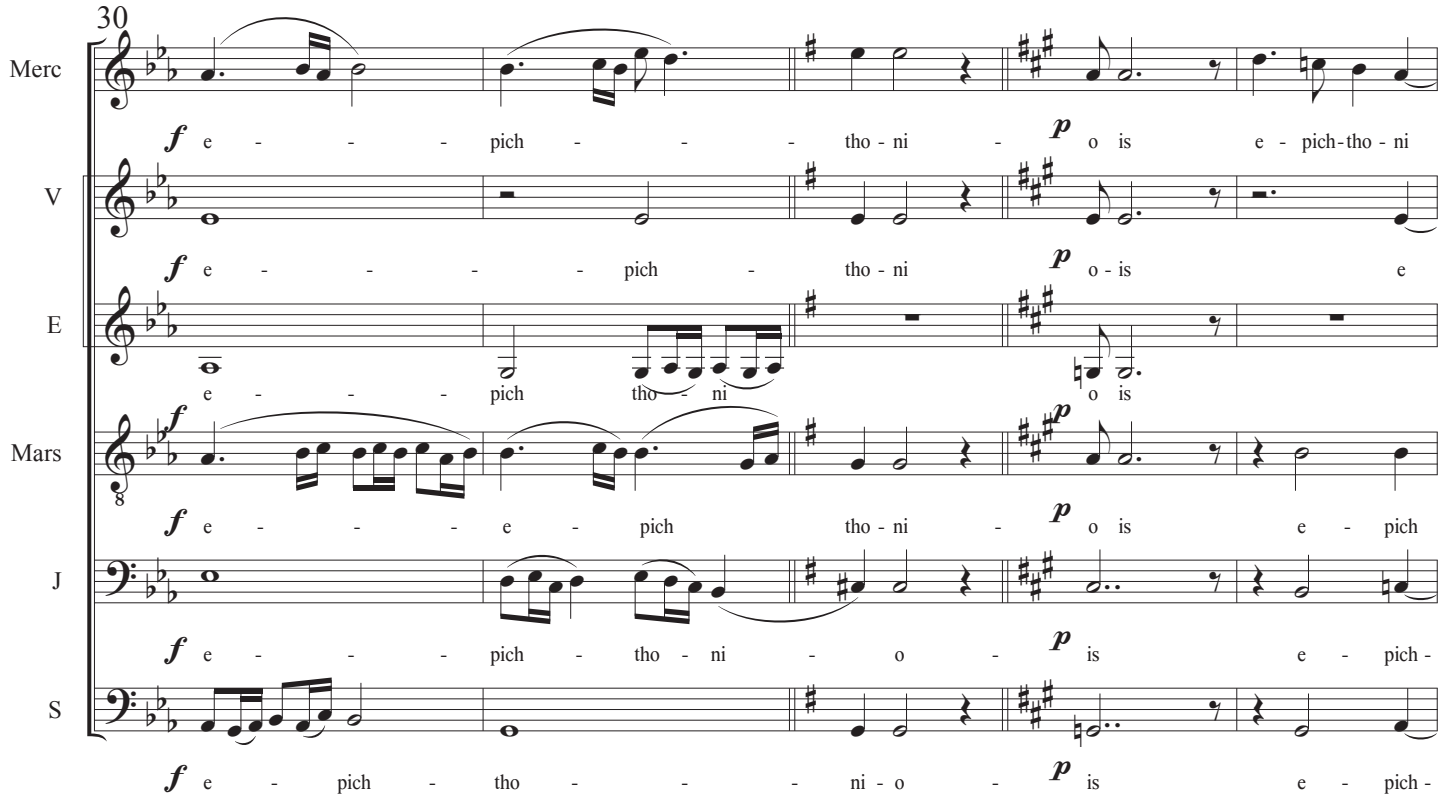
S: ka - ma - to - i - si - cho - rei - ais a ka - ma - to - i - si - cho - rei -

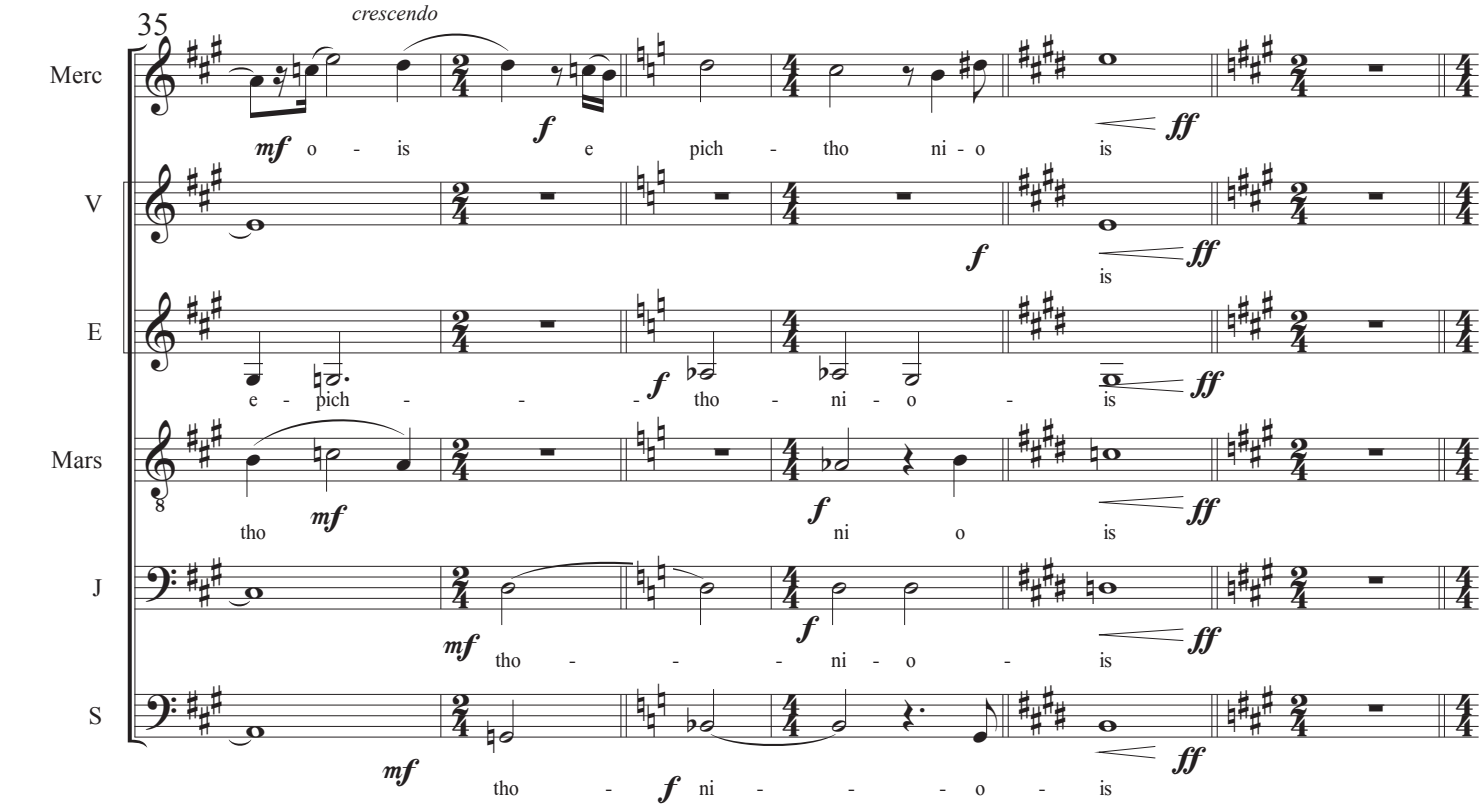
NB, m20 like m 17



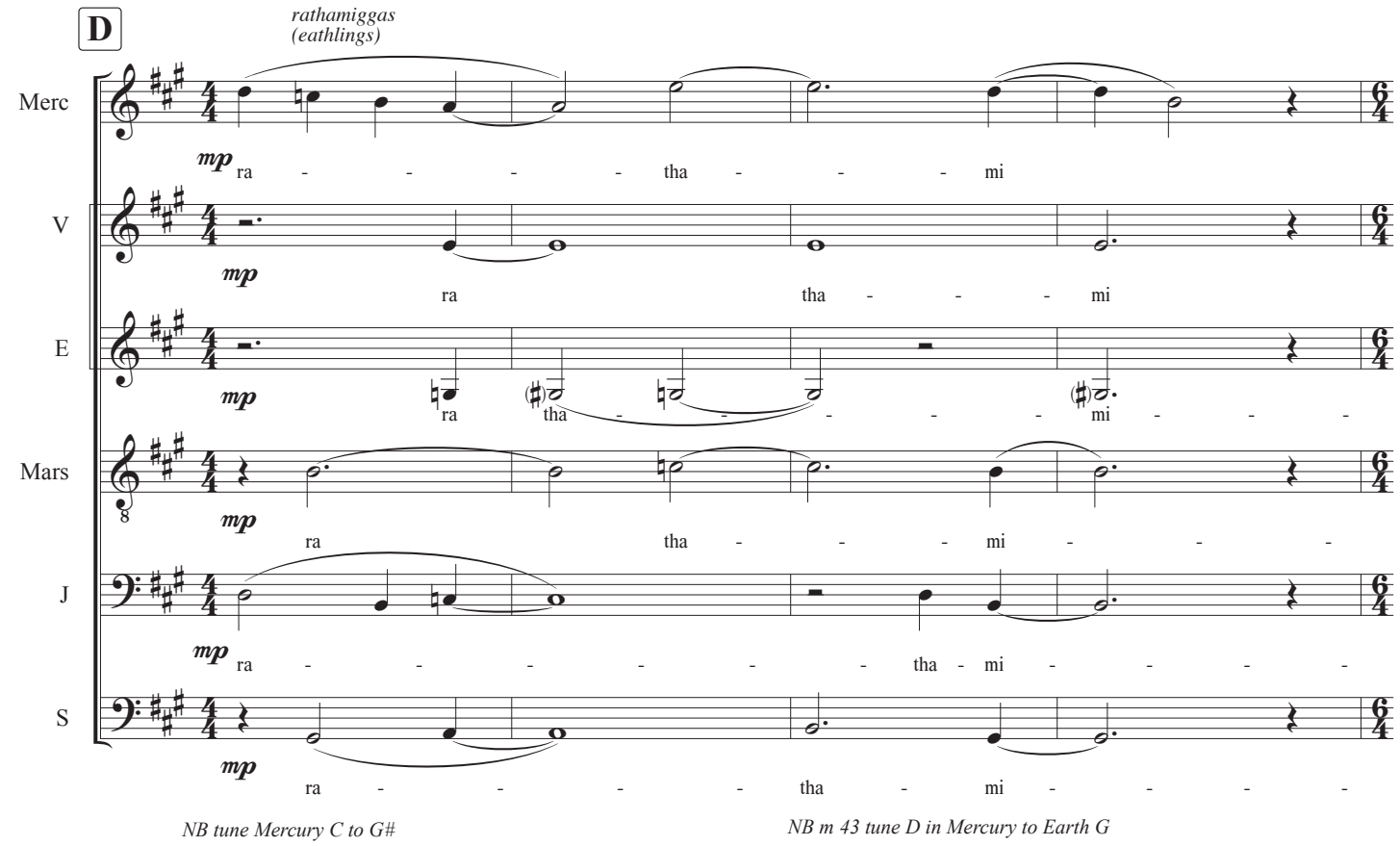
NB notes on m 24 3-and tuned as in key of A

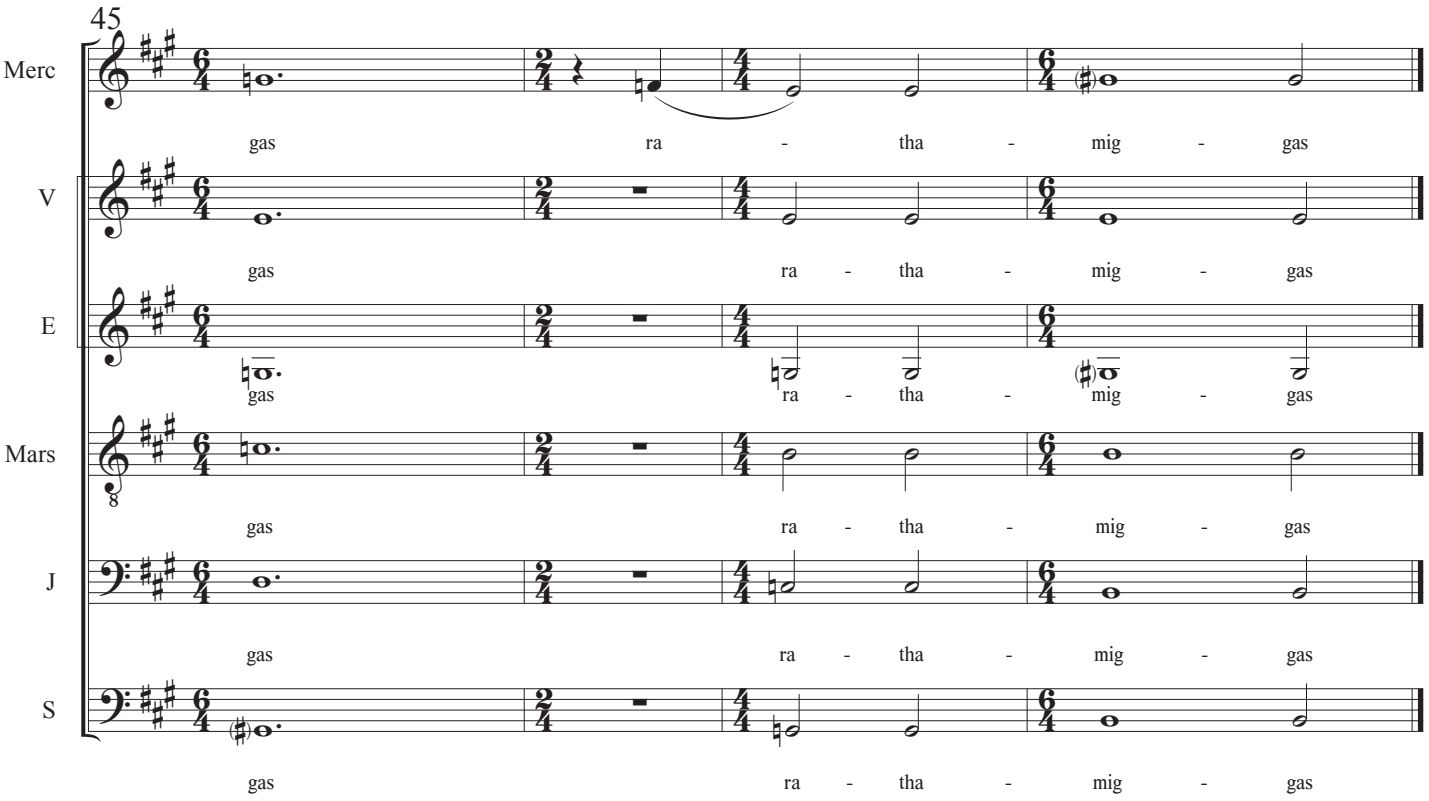






NB, tune Mercury D in m35 and Jupiter D in m36 to G by Earth


D
rathamiggas
(eathlings)
Merc
V
E
Mars
J
S
mp
ra - - - - tha - - - mi
ra tha - - - mi
ra tha - - - - - - mi - - -
ra tha - - - mi - - -
ra - - - - - - tha - mi - - - -
ra - - - - tha - mi - - - -
NB tune Mercury C to G#
NB m 43 tune D in Mercury to Earth G


45
Merc
V
E
Mars
J
S
gas ra - tha - mig - gas

Pars III Motet: Harmonies of the Worlds

Johannes Kepler / Dave Soldier
text Proclus "Hymn to the Sun"

Pars III

A

♩=72

Seirēs d' humeterēs basileus theopeitheos oimēs
From your chain the king of the song that obeys the divine

Mercury Soprano
Venus Alto
Earth Alto
Mars Tenor
Jupiter Baritone
Saturn Bass

mf Sei - res d'hum - e - te - res bas - si - le - us theo - pei theos oi - mes - Sei - res d'hum - e - te - res bas - si -

4

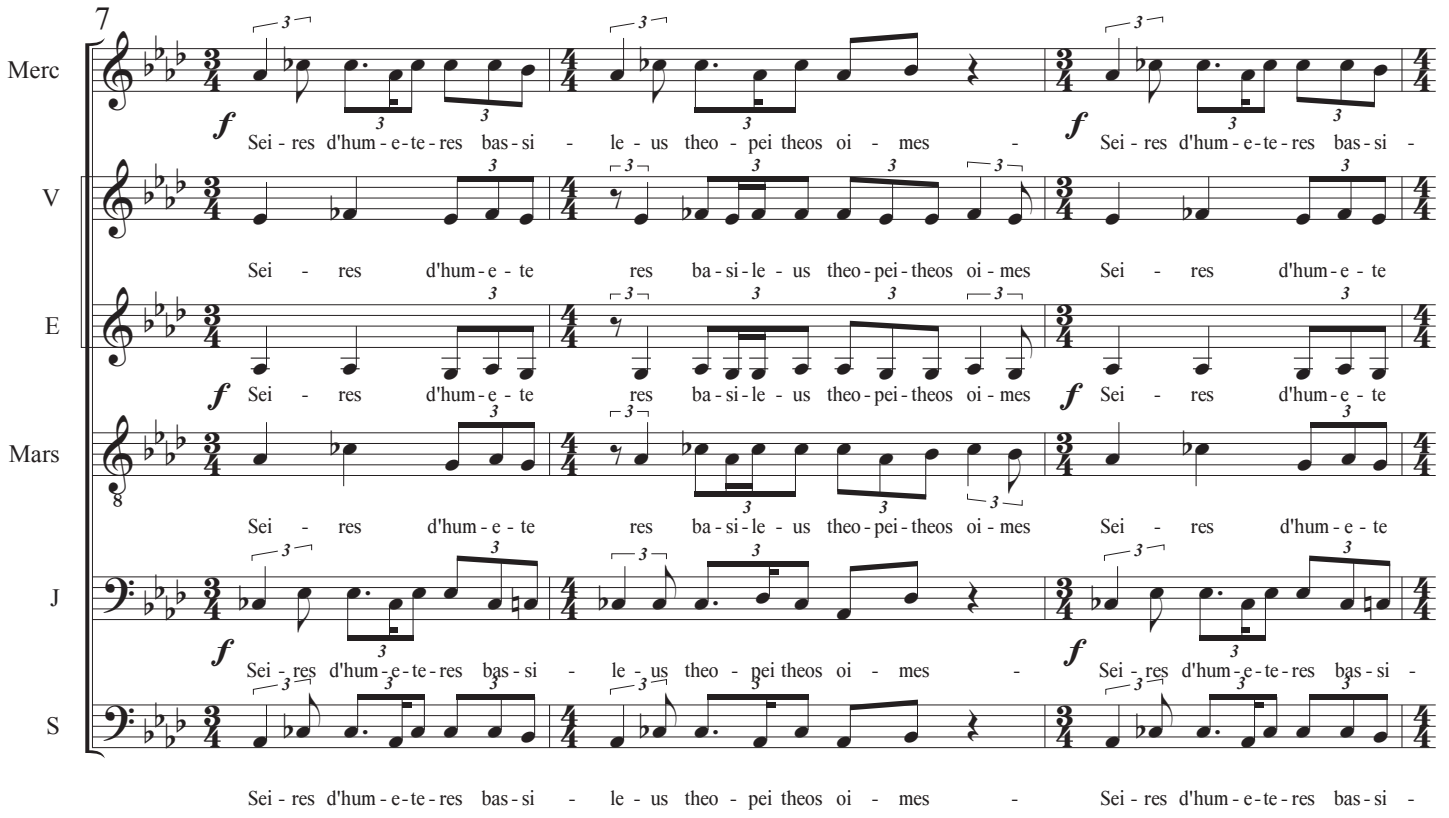
Merc
V
E
Mars
J
S

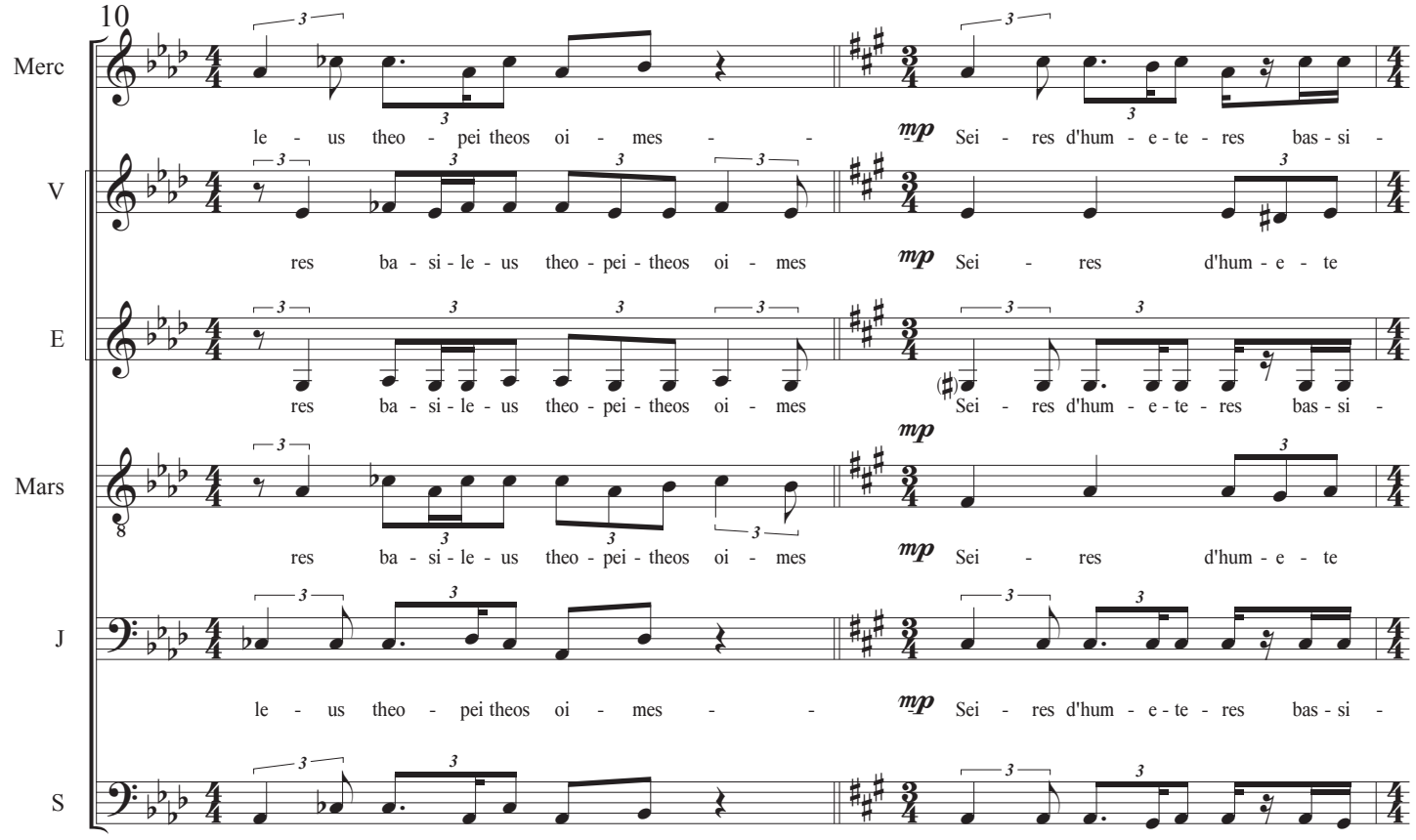
f Sei - res d'hum - e - te res ba - si - le - us theo - pei - theos oi - mes

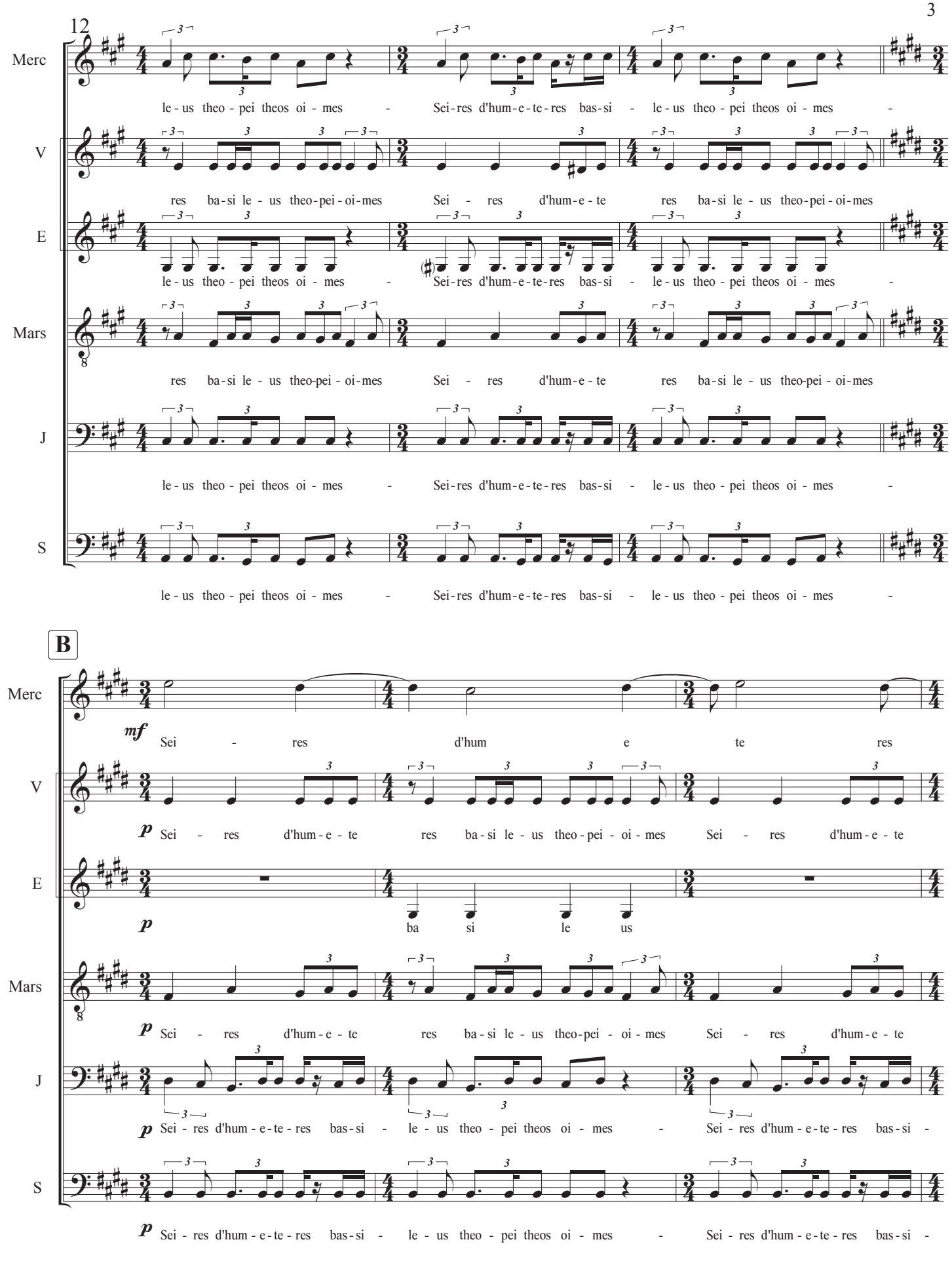
le - us theo - pei theos oi - mes *f* Sei - res d'hum - e - te - res bas - si - le - us theo - pei theos oi - mes

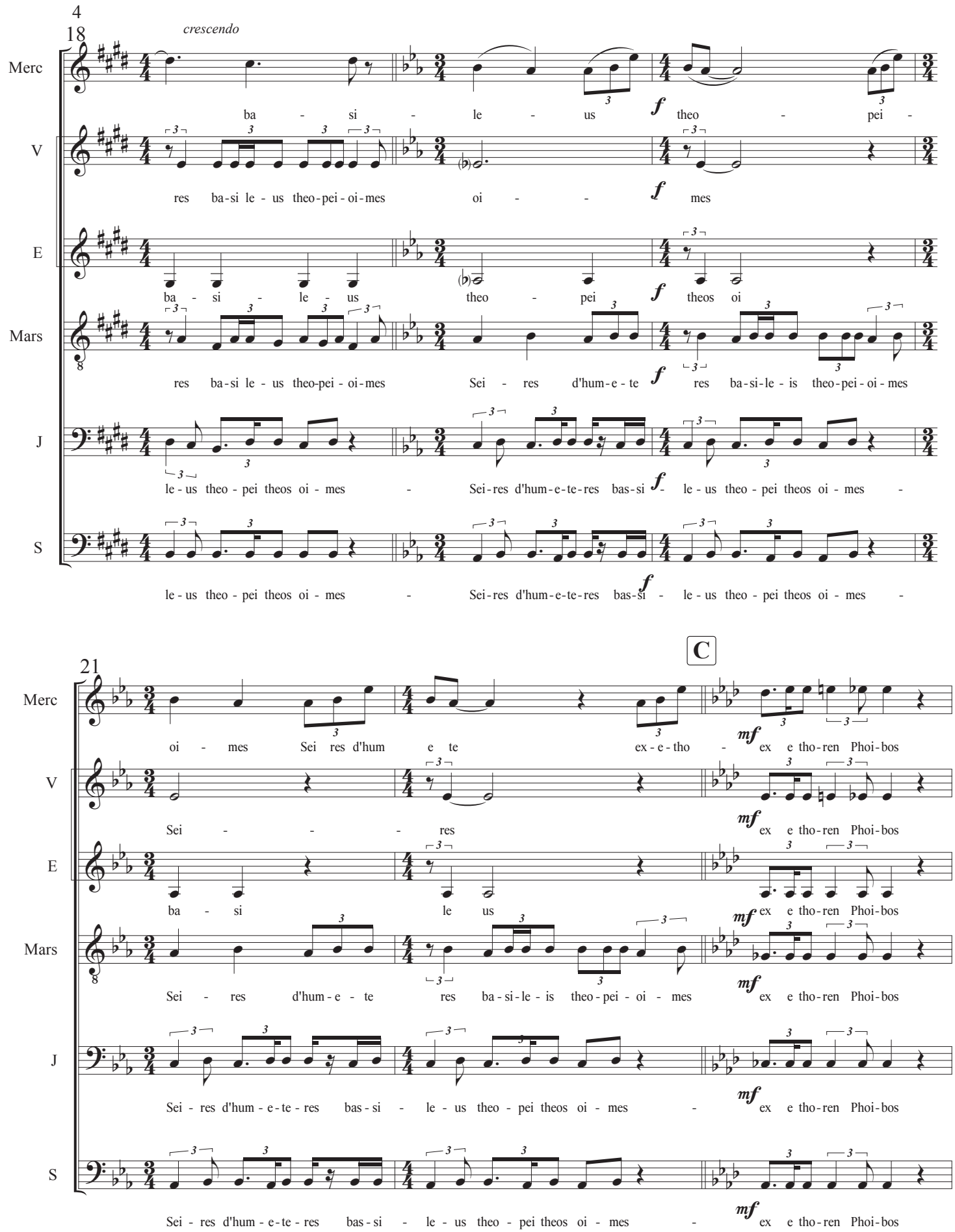
le - us theo - pei theos oi - mes *f* Sei - res d'hum - e - te - res bas - si - le - us theo - pei theos oi - mes

2

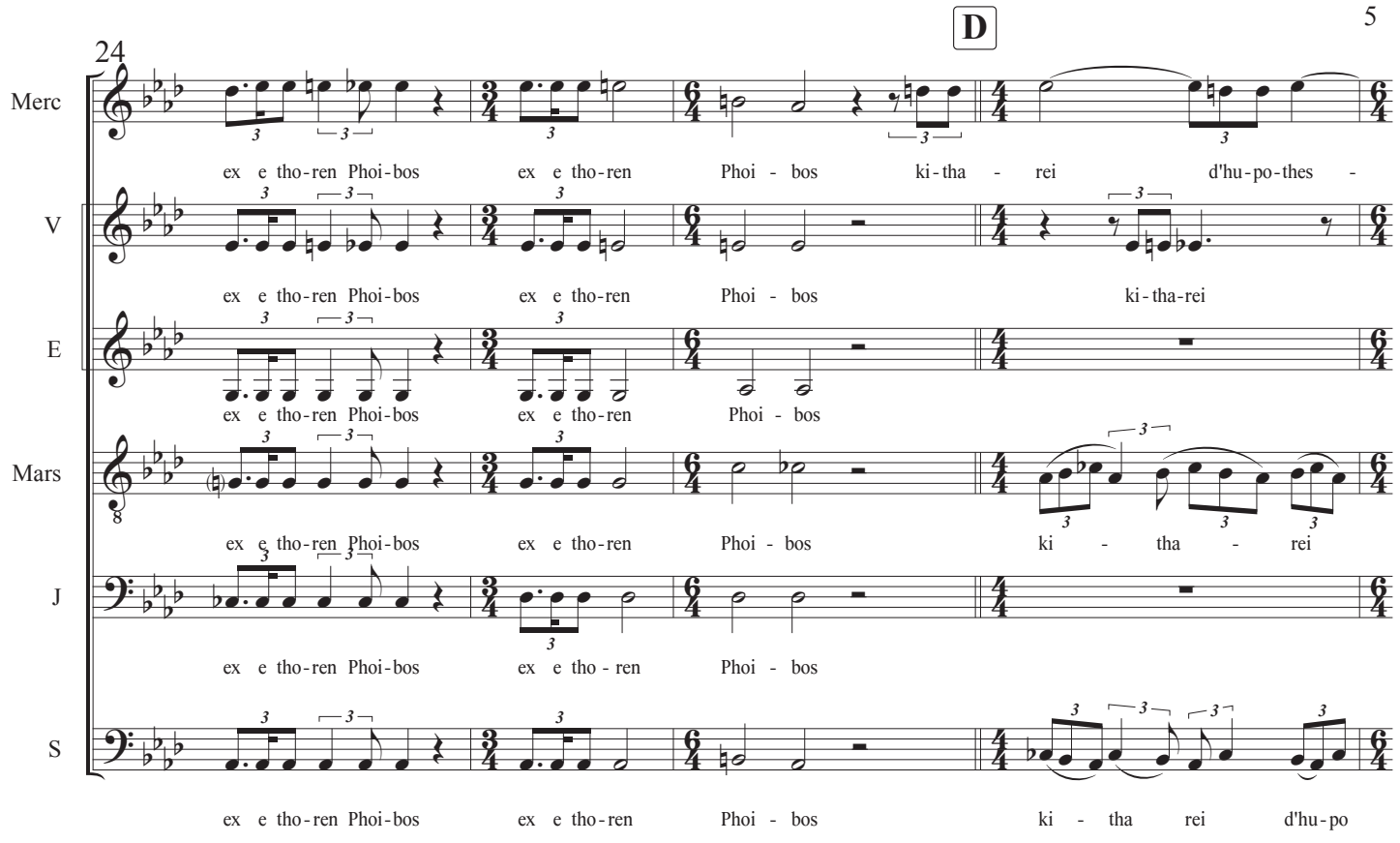

7
Merc
V
E
Mars
J
S
f
Sei - res d'hum - e - te - res bas - si - le - us theo - pei theos oi - mes
Sei - res d'hum - e - te res ba - si - le - us theo - pei - theos oi - mes


10
Merc
V
E
Mars
J
S
mp
Sei - res d'hum - e - te - res bas - si - le - us theo - pei theos oi - mes
Sei - res d'hum - e - te res ba - si - le - us theo - pei - theos oi - mes

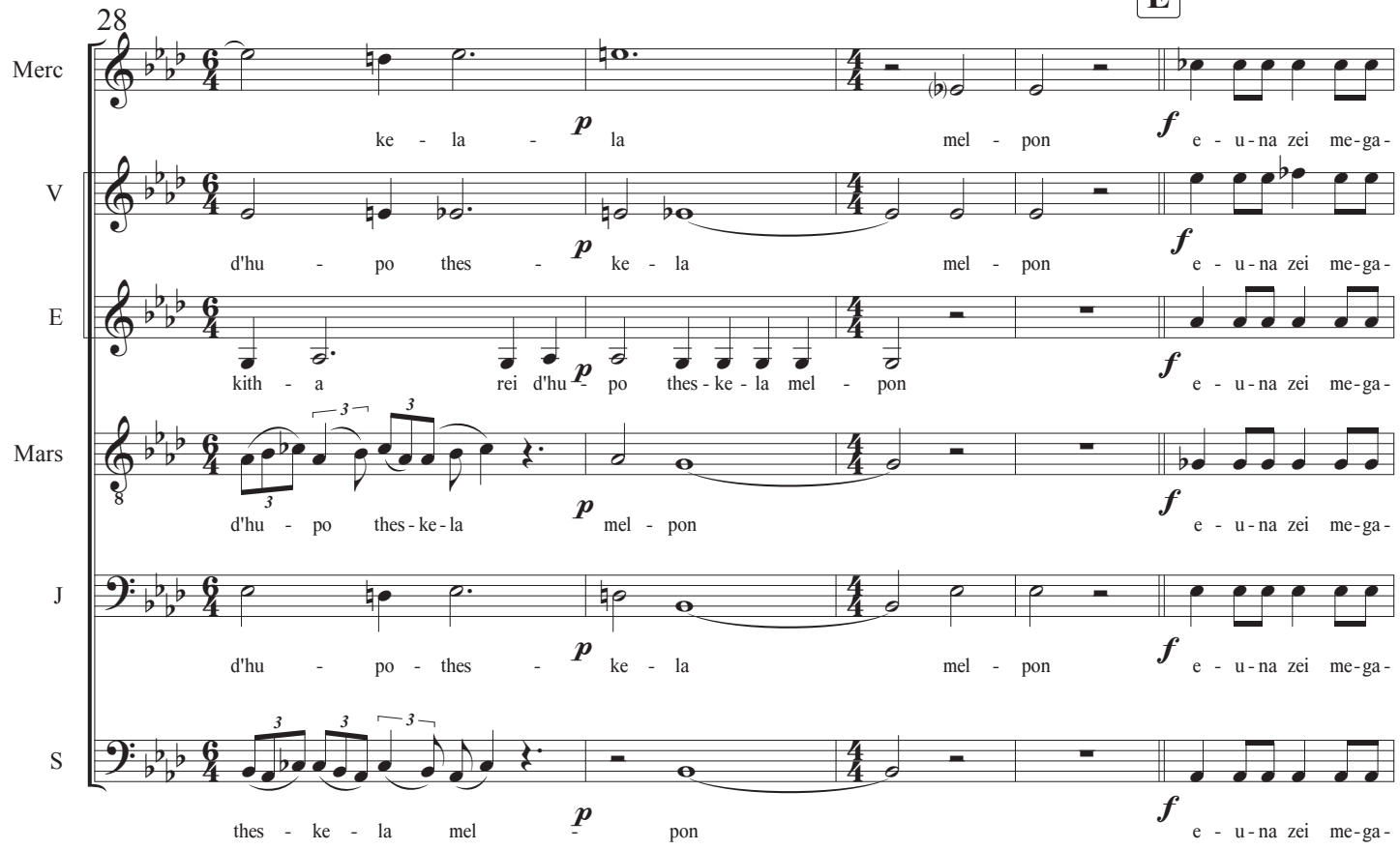

12
Merc
le - us theo - pei theos oi - mes - Sei-res d'hum-e-te-res bas-si - le-us theo - pei theos oi - mes -
V
res ba-si le - us theo-pei - oi-mes Sei - res d'hum-e - te res ba-si le - us theo-pei - oi-mes
E
le - us theo - pei theos oi - mes - Sei-res d'hum-e-te-res bas-si - le-us theo - pei theos oi - mes -
Mars
res ba-si le - us theo-pei - oi-mes Sei - res d'hum-e - te res ba-si le - us theo-pei - oi-mes
J
le - us theo - pei theos oi - mes - Sei-res d'hum-e-te-res bas-si - le-us theo - pei theos oi - mes -
S
le - us theo - pei theos oi - mes - Sei-res d'hum-e-te-res bas-si - le-us theo - pei theos oi - mes -
B
Merc
mf Sei - res d'hum e te res
V
p Sei - res d'hum - e - te res ba - si le - us theo - pei - oi - mes Sei - res d'hum - e - te
E
p ba si le us
Mars
p Sei - res d'hum - e - te res ba - si le - us theo-pei - oi - mes Sei - res d'hum - e - te
J
p Sei - res d'hum - e - te - res bas - si - le - us theo - pei theos oi - mes - Sei - res d'hum - e - te - res bas - si -
S
p Sei - res d'hum - e - te - res bas - si - le - us theo - pei theos oi - mes - Sei - res d'hum - e - te - res bas - si -

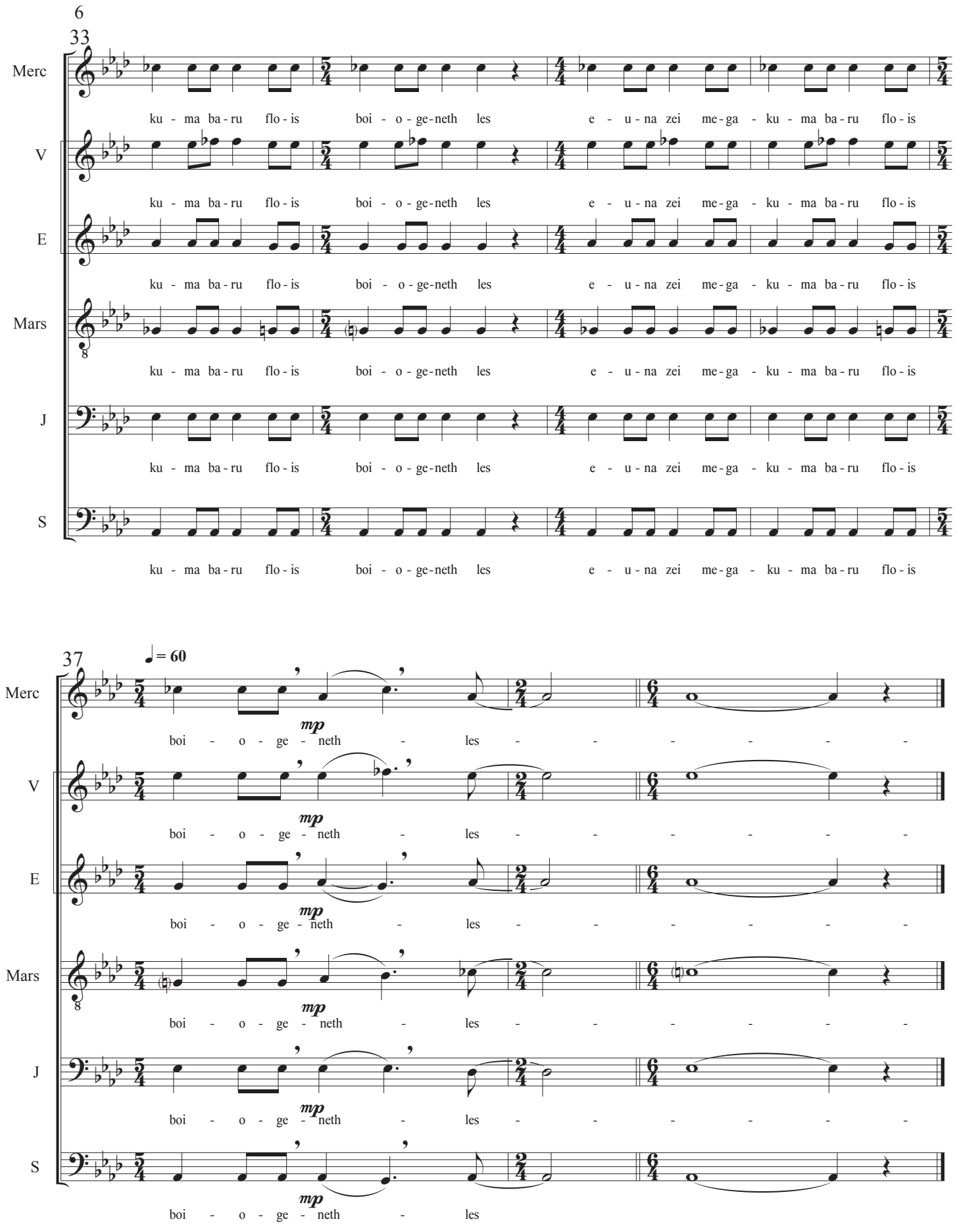


exethoren Phoibos; kitharē(i) d' hupo theskela melpōn
Phoibos, sprung forth. Singing inspired songs to the accompaniment of the kithara



eunazei mega kuma barufloisboio genethlēs
he calms the great wave of deep-roaring becoming



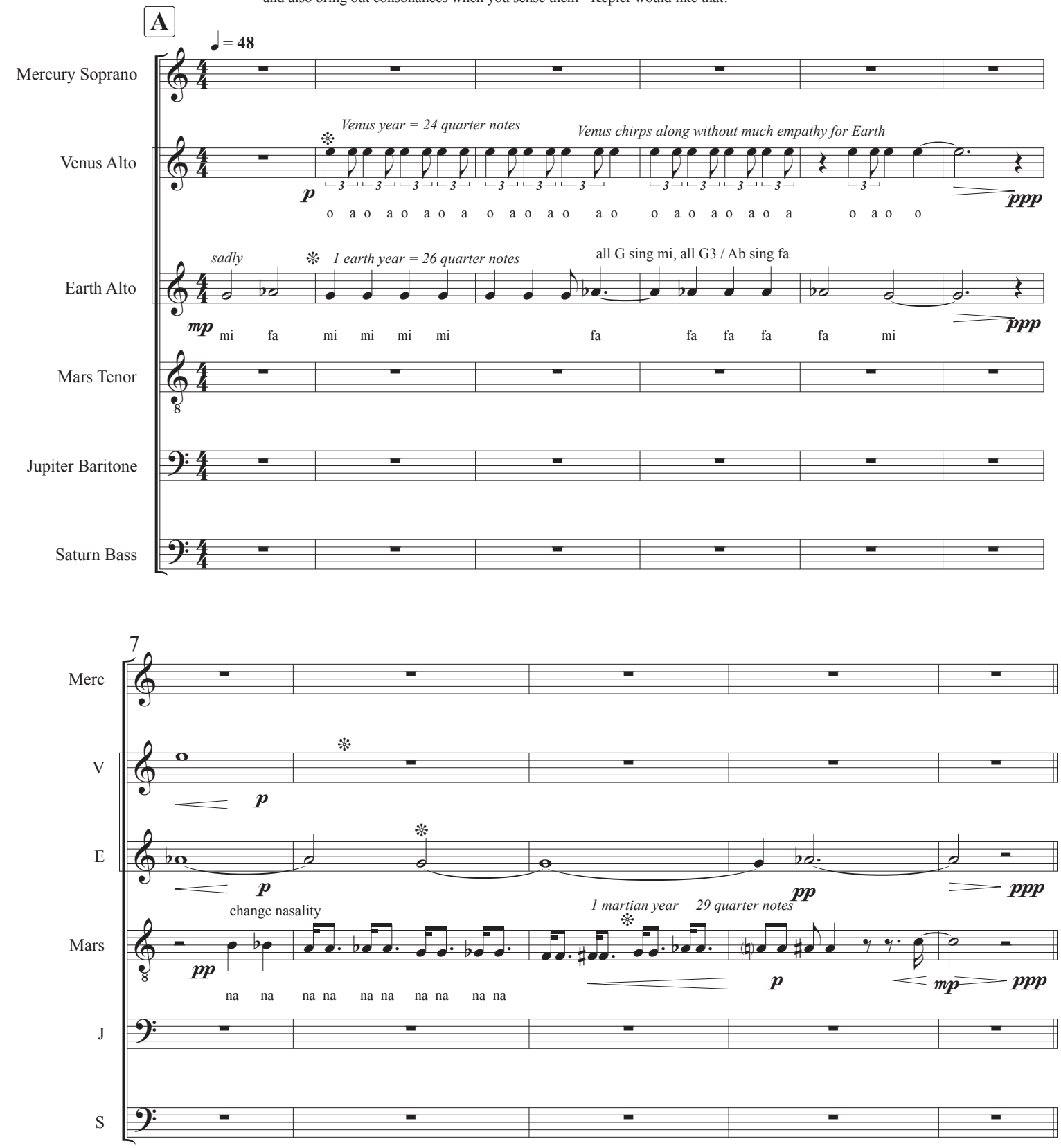

6
33
Merc
V
E
Mars
J
S
ku - ma ba - ru flo - is boi - o - ge-neth les e - u - na zei me - ga - ku - ma ba - ru flo - is
37
♩ = 60
mp
boi - o - ge - neth - les - - - - - -

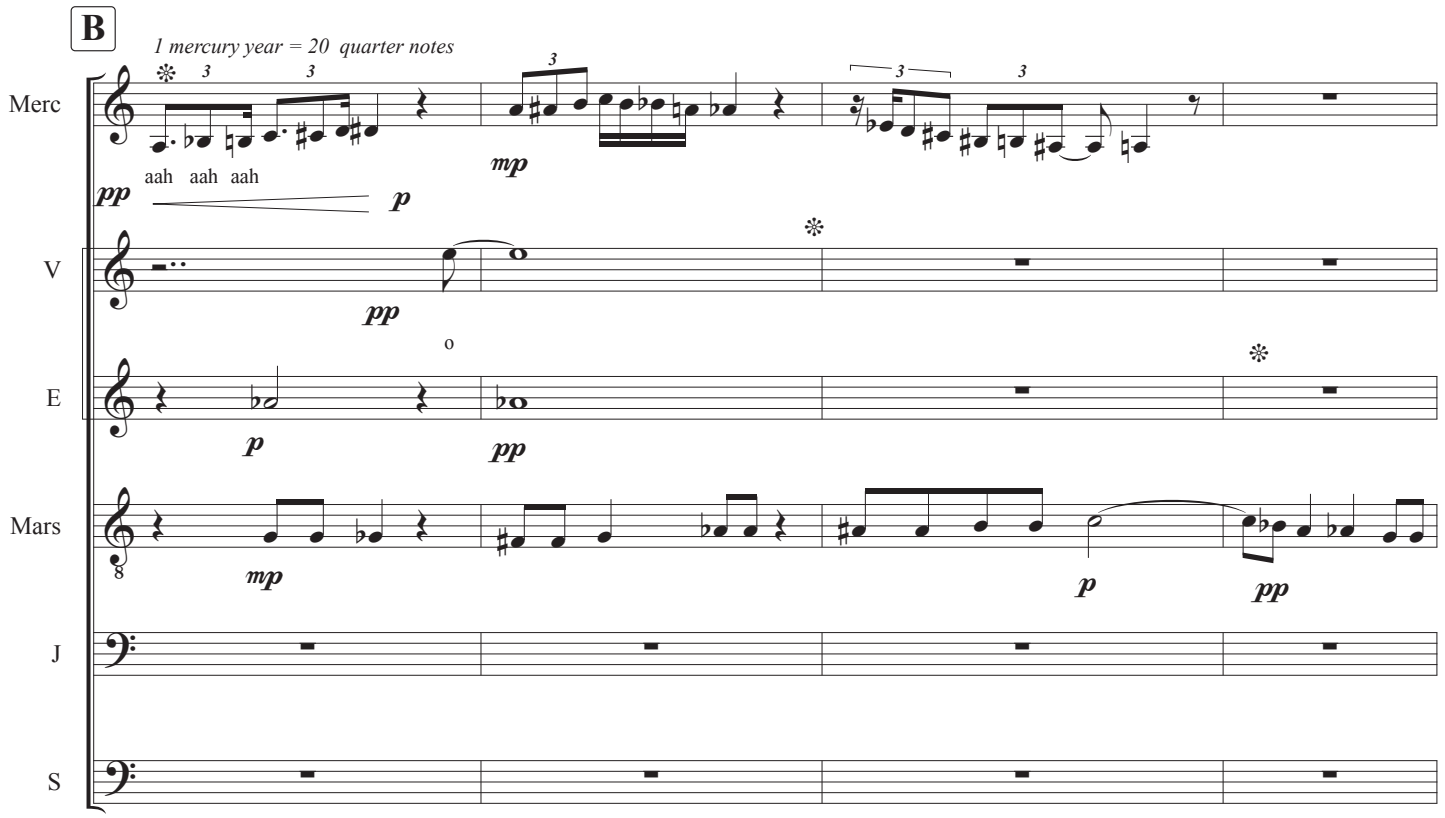
Pars IV Motet: Harmonies of the Worlds

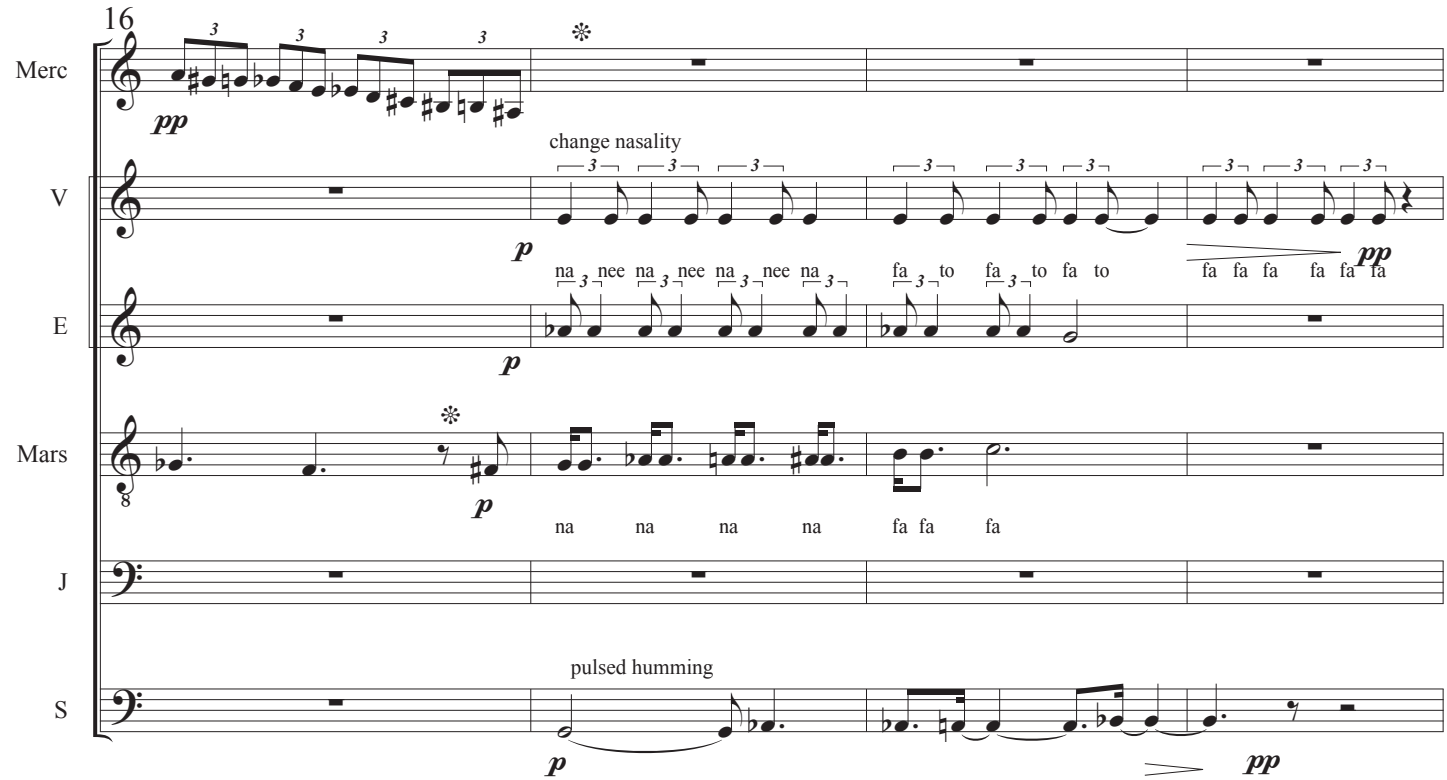
Johannes Kepler / Dave Soldier
text Proclus "Hymn to the Sun"

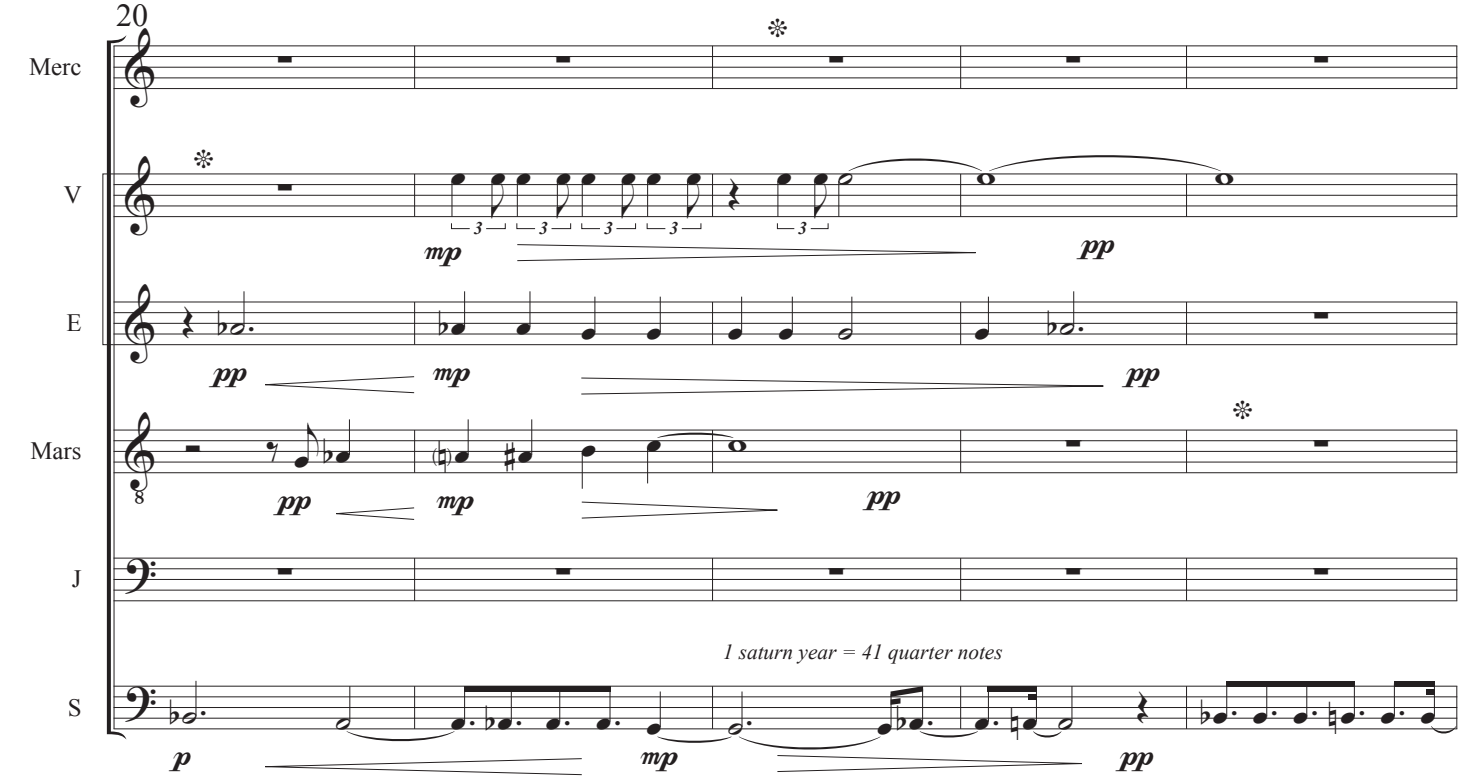
connect pitch changes by glissandos

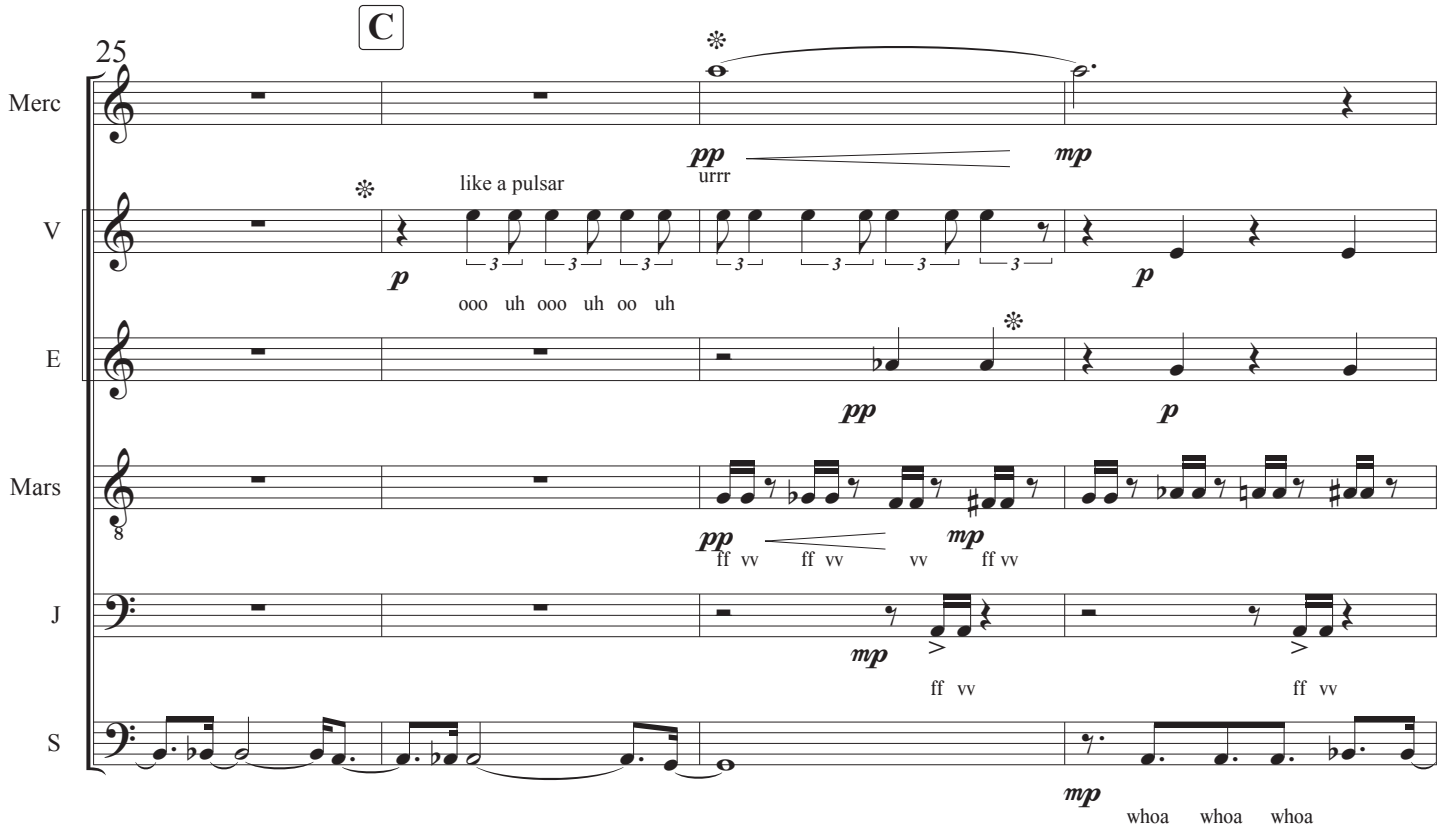
and also bring out consonances when you sense them - Kepler would like that!

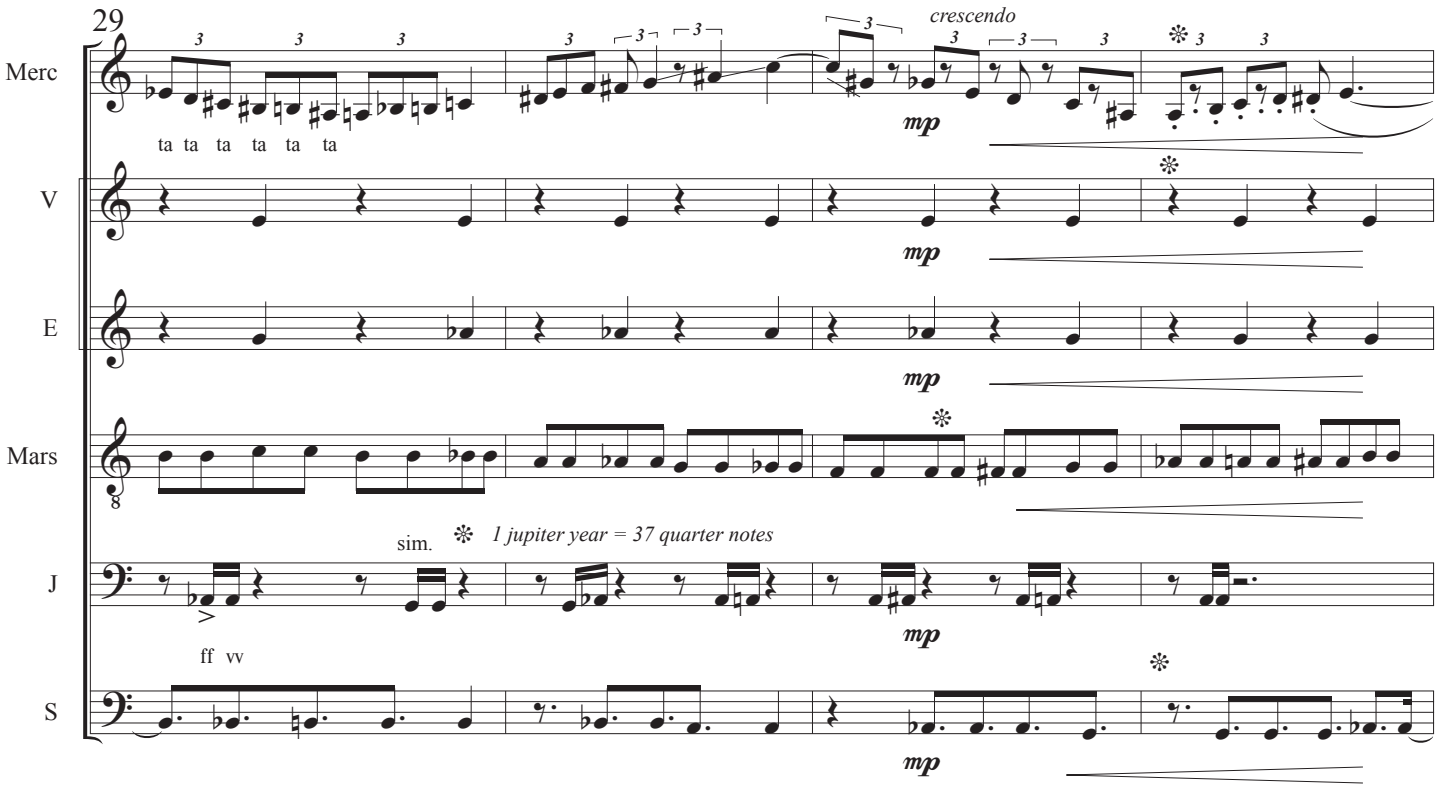


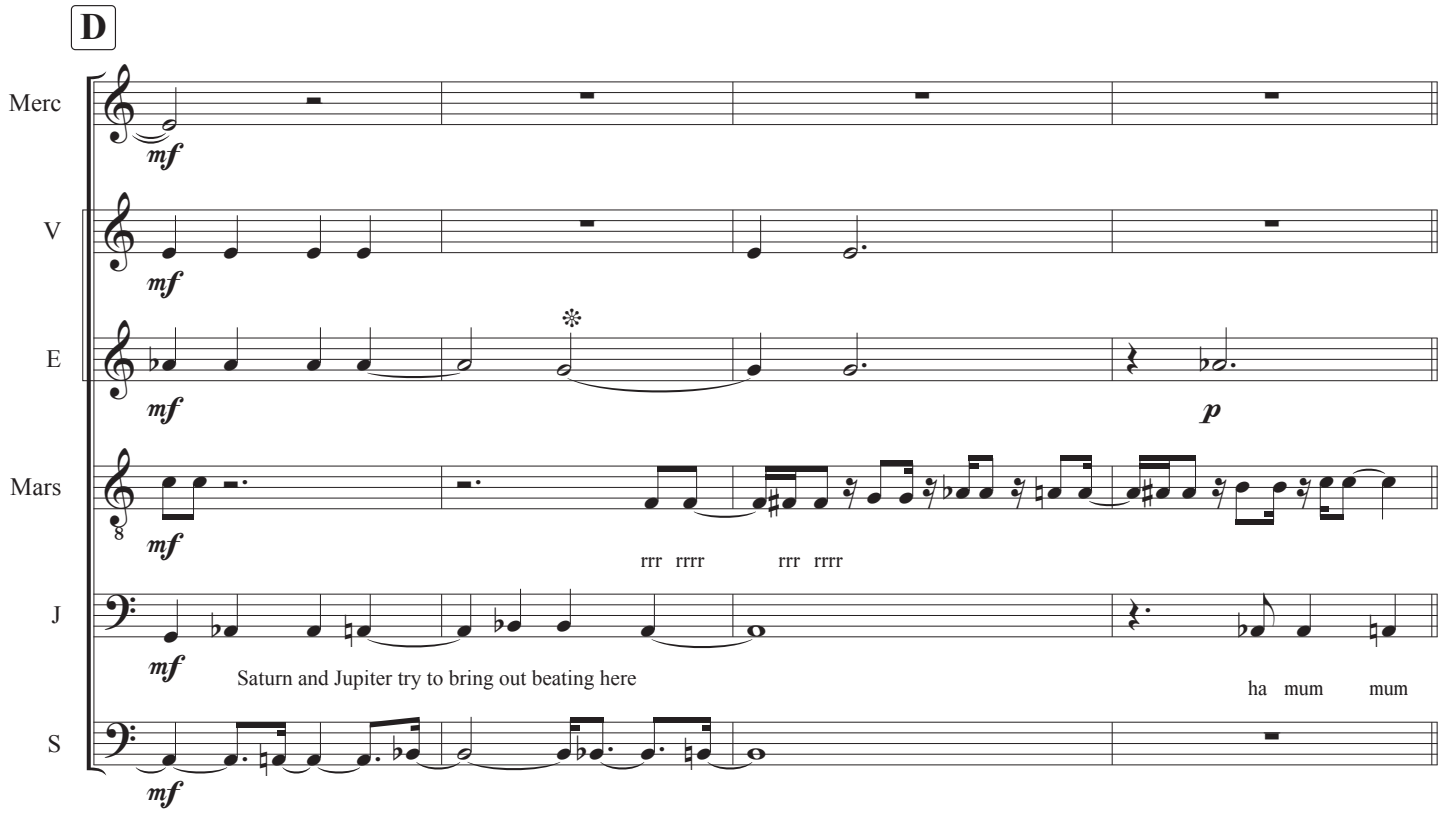

B
1 mercury year = 20 quarter notes
Merc
V
E
Mars
J
S
aah aah aah
pp
p
mp
pp
o
p
pp
mp
p
pp

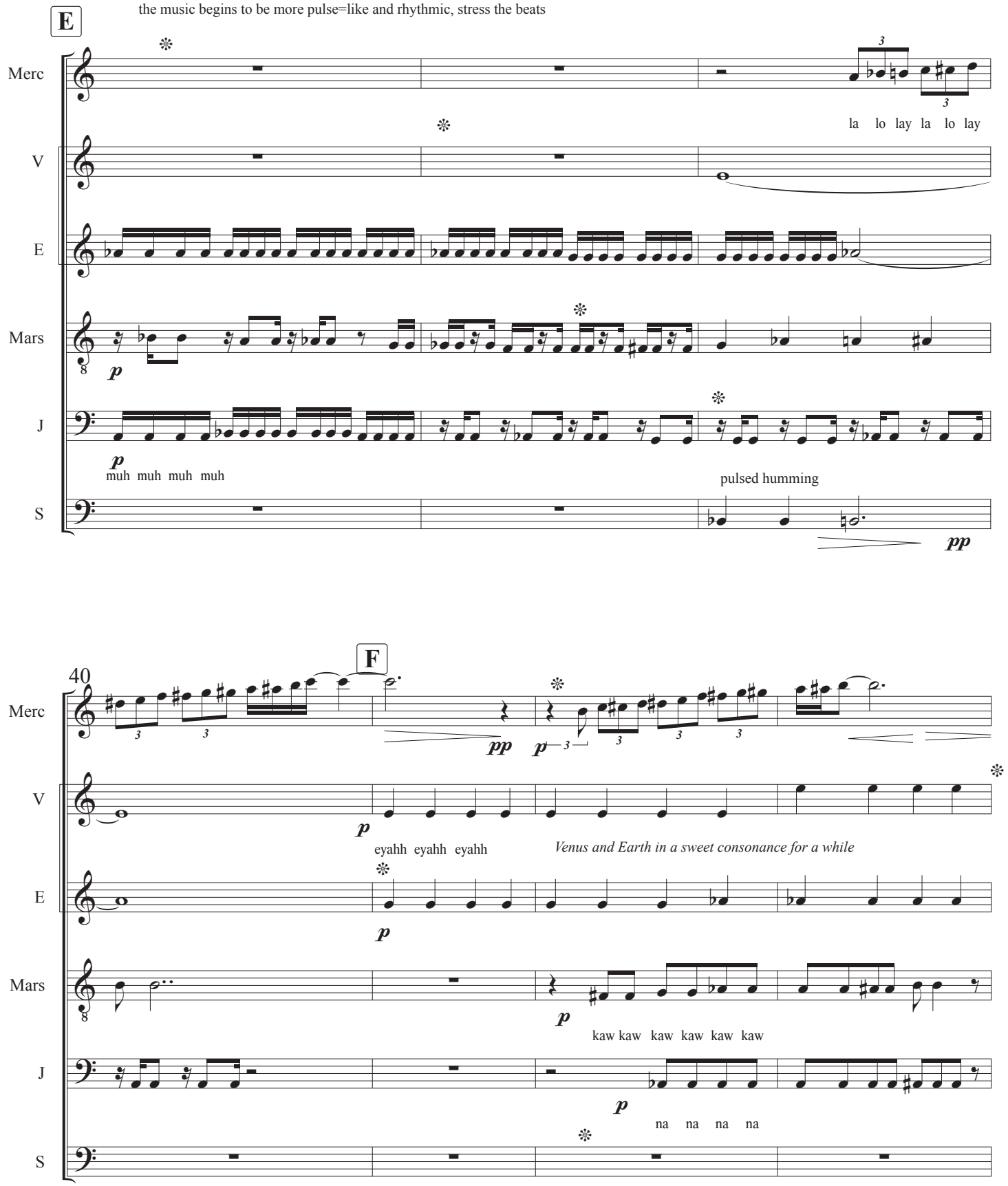

16
Merc
V
E
Mars
J
S
pp
change nasality
p
na nee na nee na nee na nee
fa to fa to fa to
fa fa fa fa fa fa
pp
p
p
na na na na fa fa fa
pulsed humming
p
pp


20
Merc
V
E
Mars
J
S
1 saturn year = 41 quarter notes

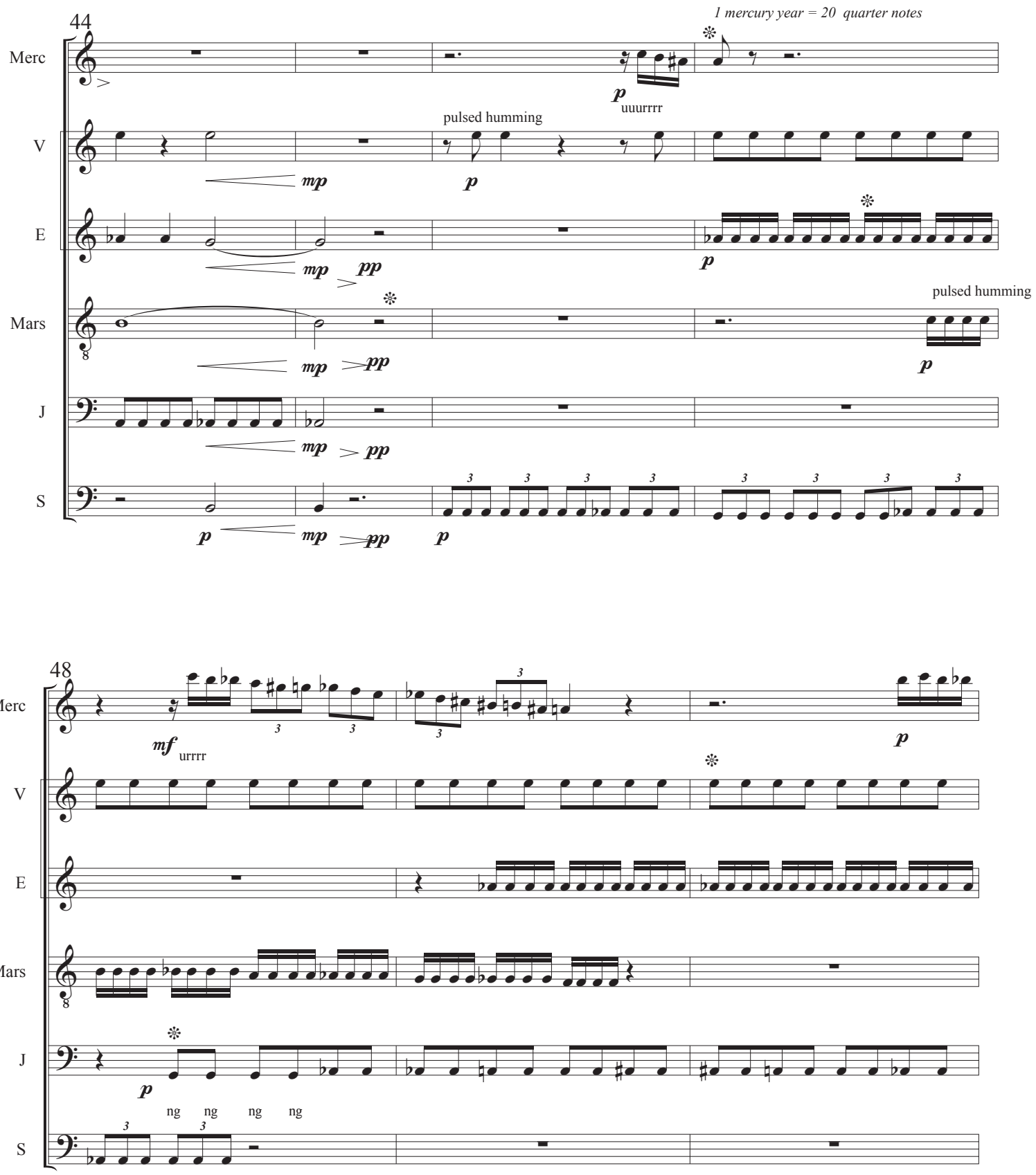

C
25
Merc
V
E
Mars
J
S
like a pulsar
urrr
ooo uh ooo uh oo uh
ff vv ff vv vv ff vv
ff vv
ff vv
whoa whoa whoa

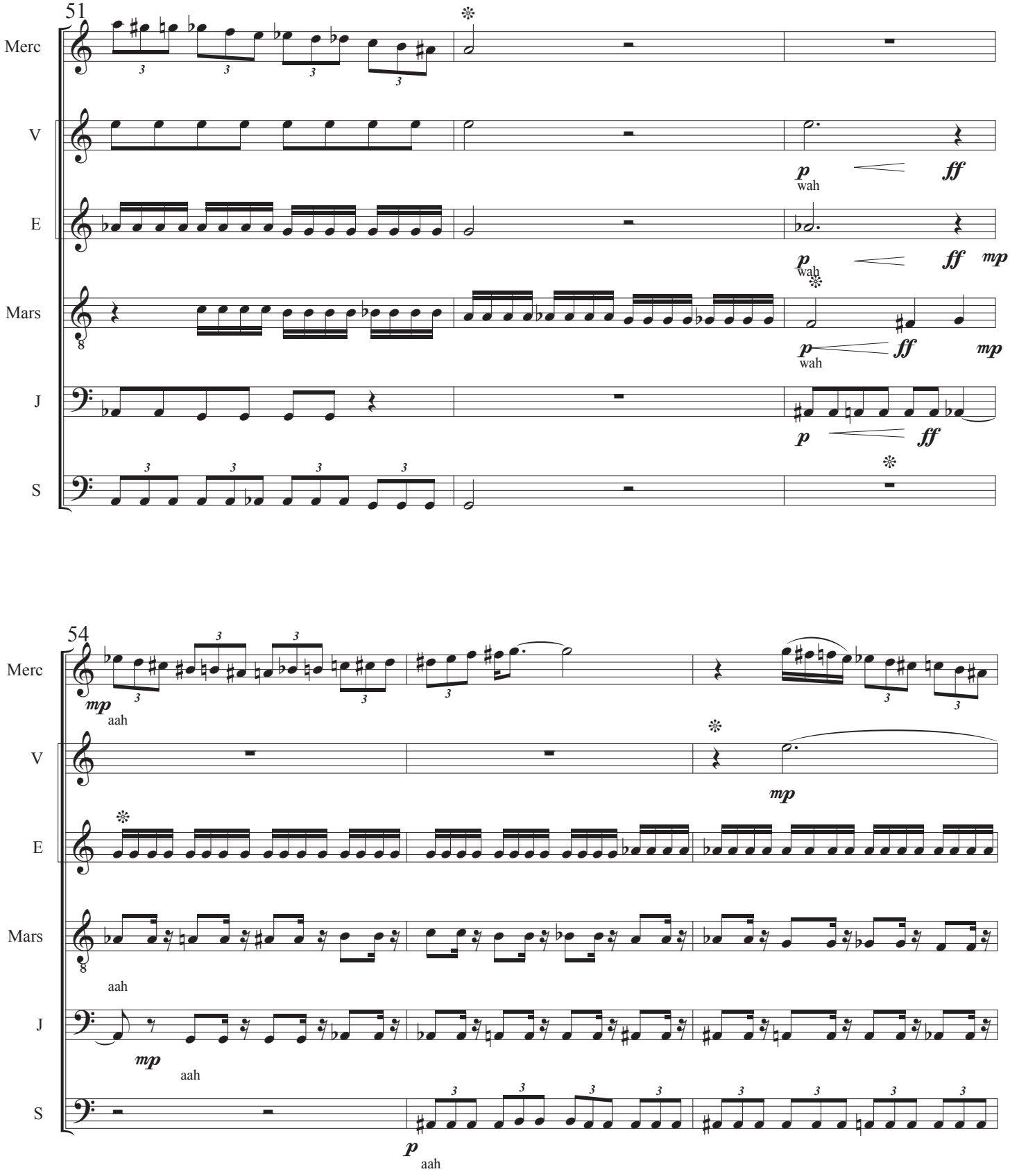

29
Merc
V
E
Mars
J
S
crescendo
mp
ta ta ta ta ta ta
sim.
1 jupiter year = 37 quarter notes
ff vv

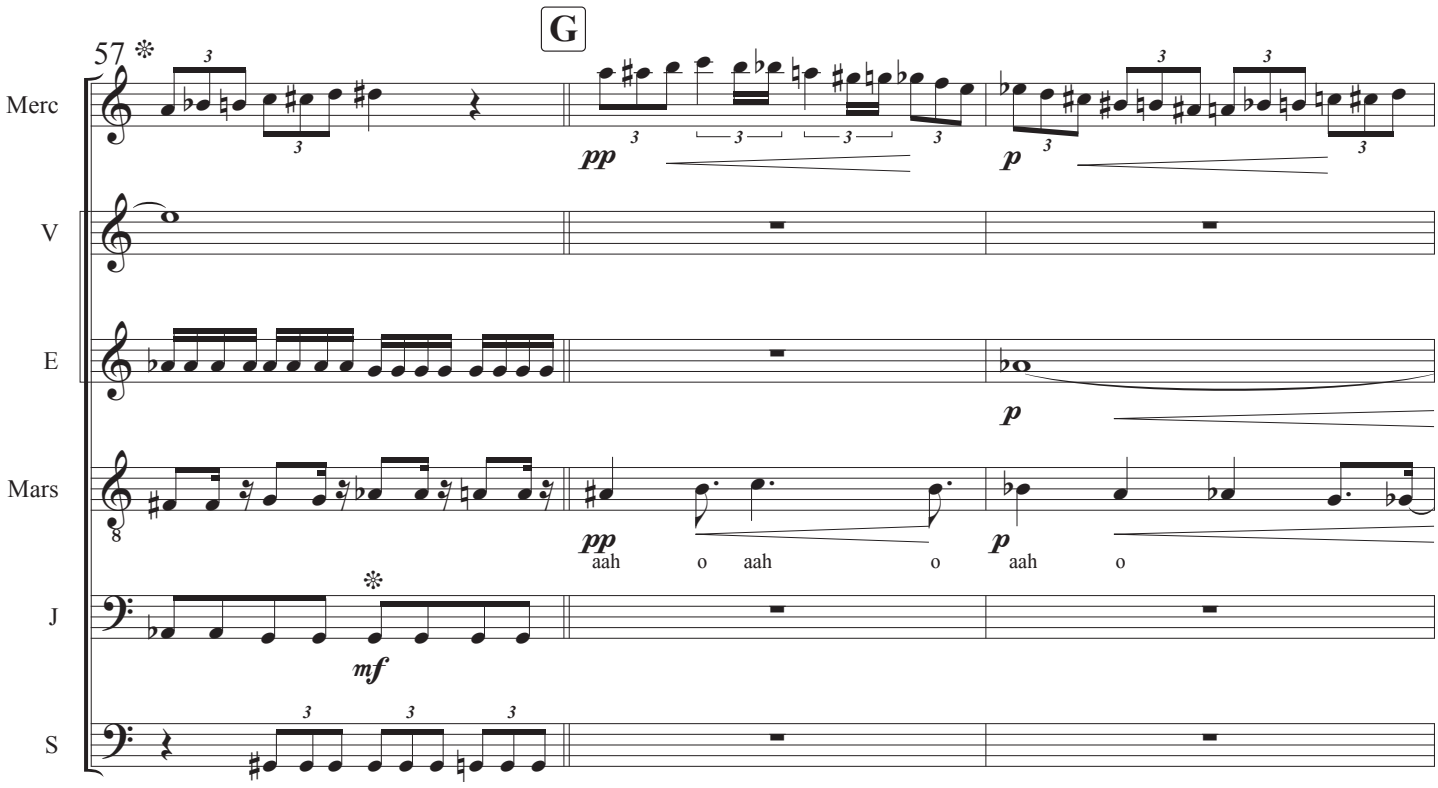

D
Merc
V
E
Mars
J
S
mf
p
rrr rrrr
rrr rrrr
Saturn and Jupiter try to bring out beating here
ha mum mum

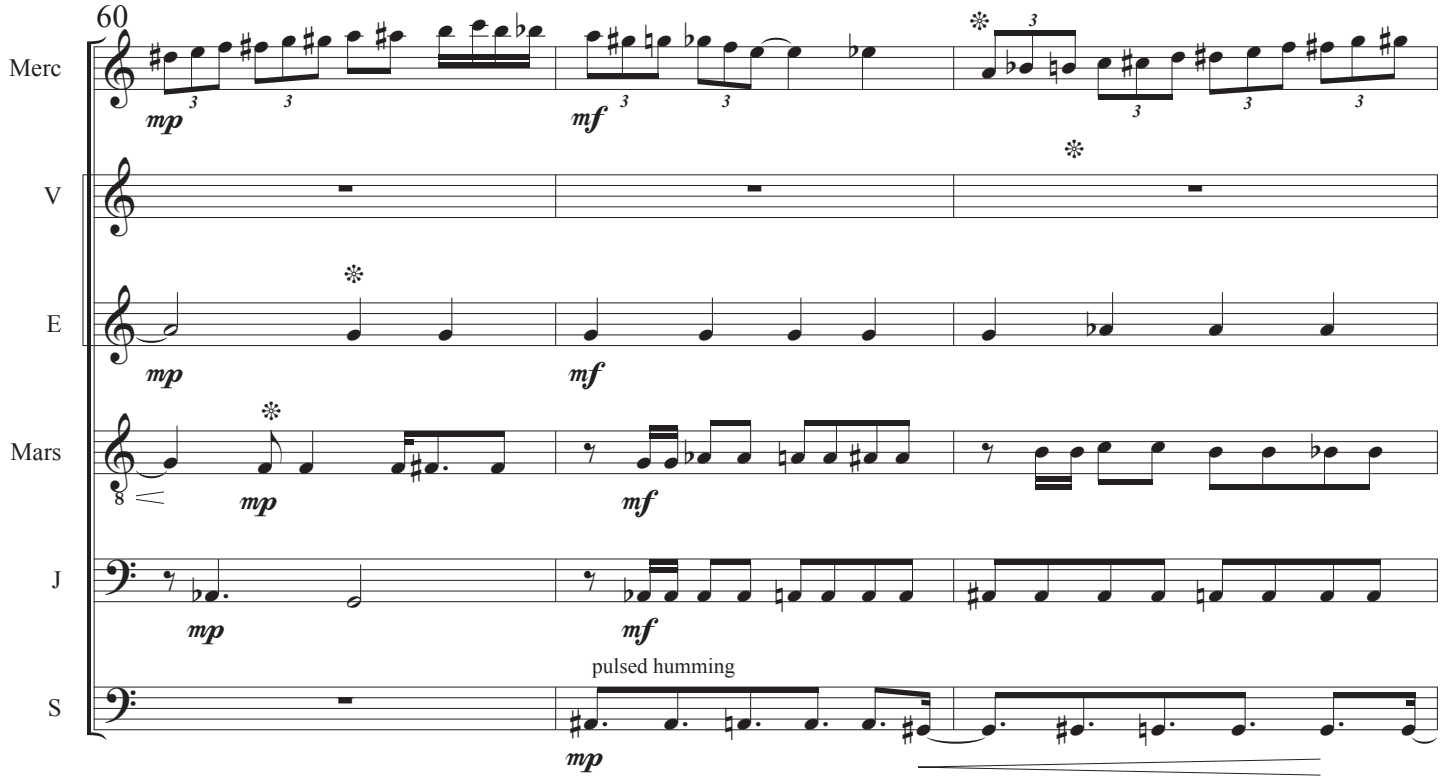

E
the music begins to be more pulse=like and rhythmic, stress the beats
Merc
V
E
Mars
J
S
la lo lay la lo lay
muh muh muh muh
pulsed humming
F
40
eyahh eyahh eyahh
Venus and Earth in a sweet consonance for a while
kaw kaw kaw kaw kaw kaw
na na na na

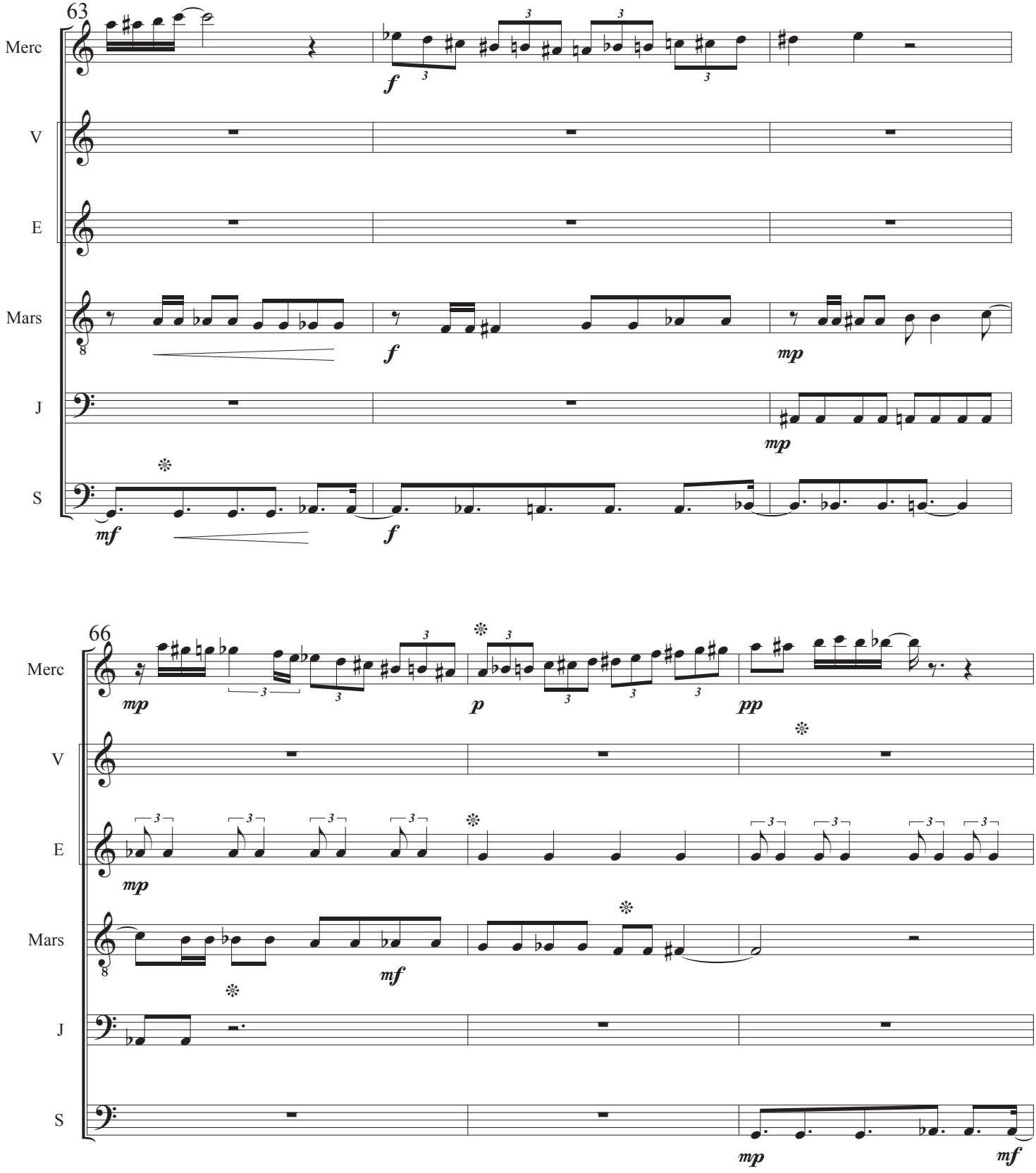
6


44
1 mercury year = 20 quarter notes
Merc
V
E
Mars
J
S
p
uuurrrr
pulsed humming
mp
pp
48
mf
urrrr
ng ng ng ng

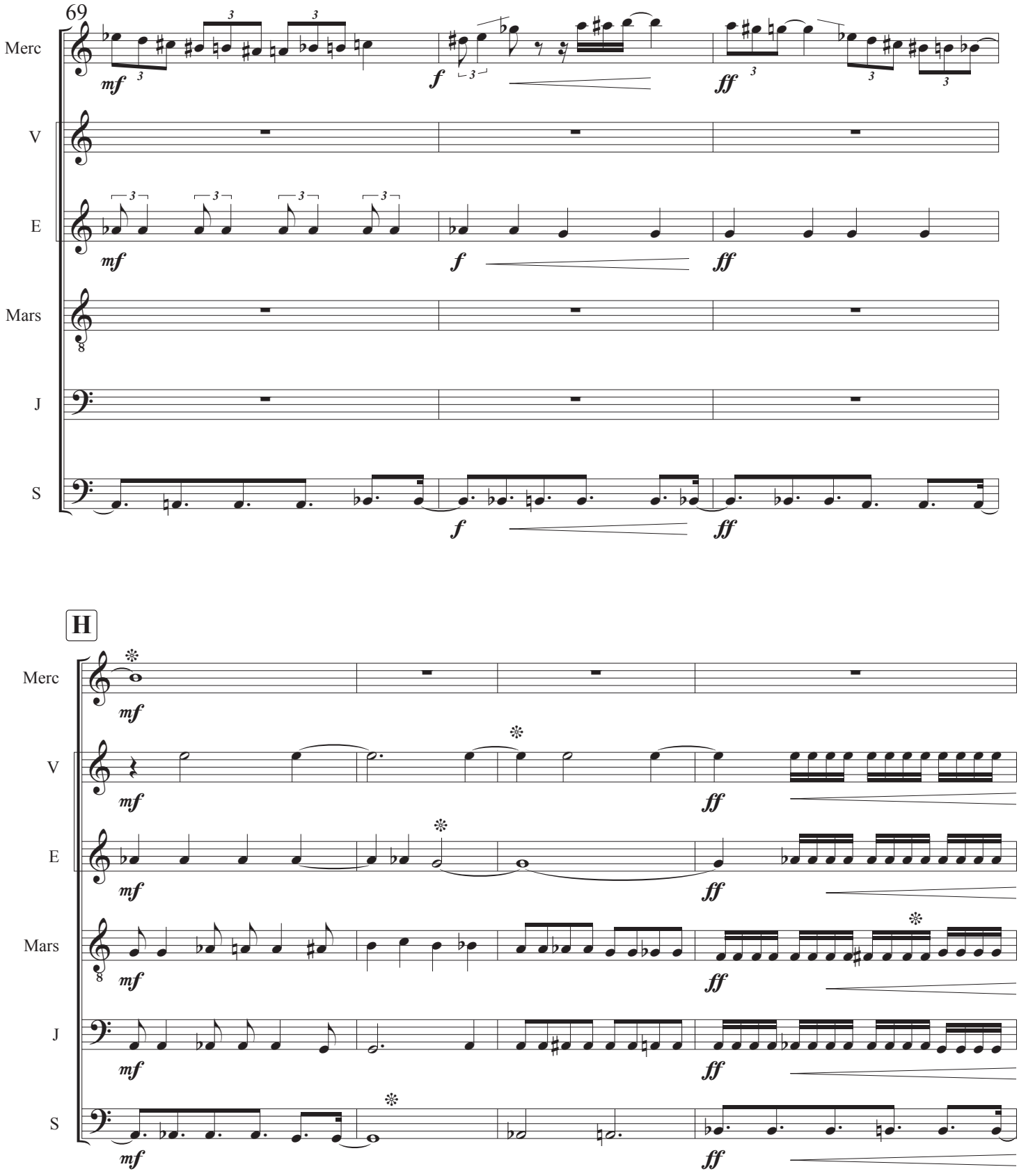

51
Merc
V
E
Mars
J
S
p
wah
ff
mp
54
aah

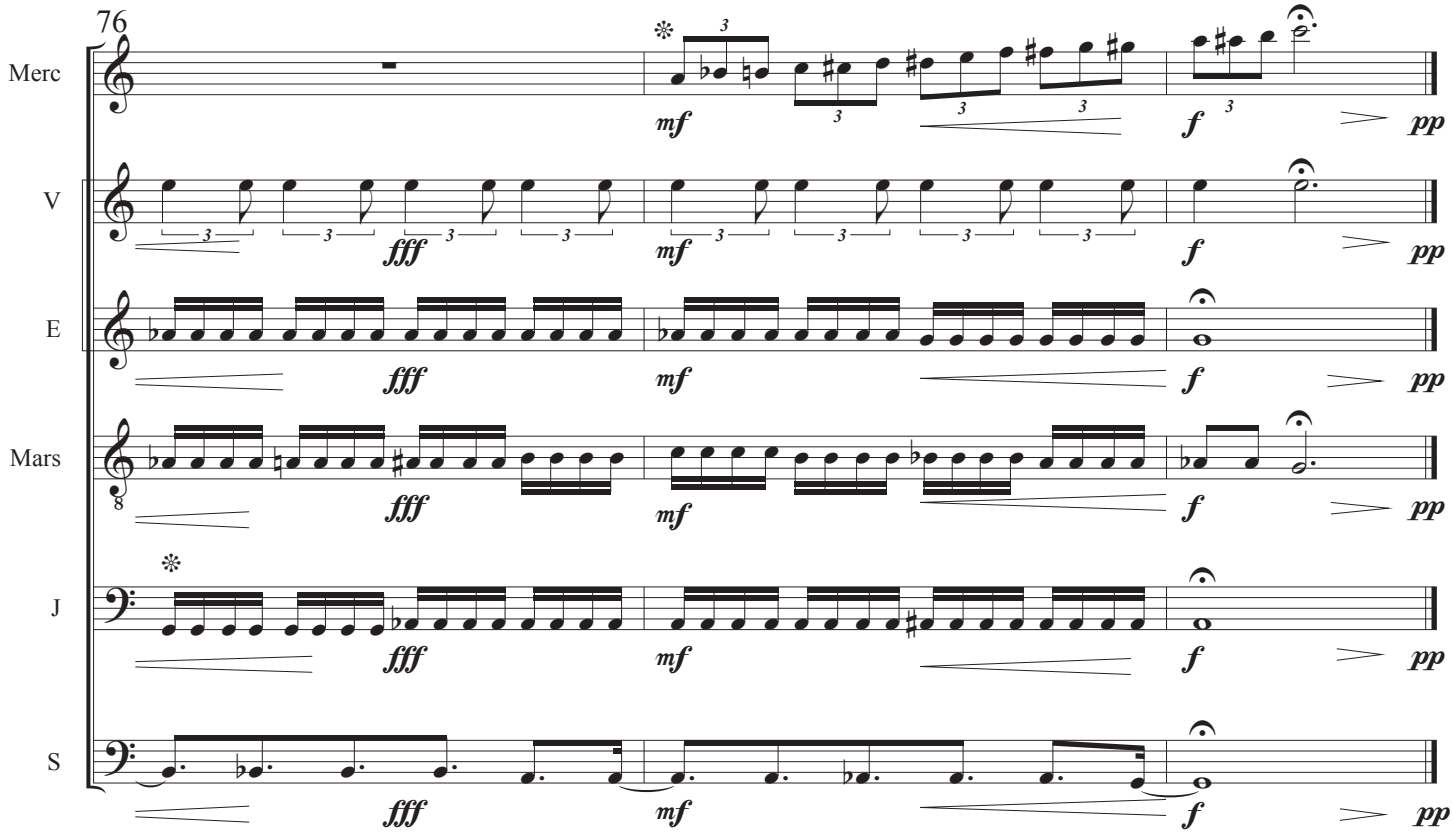

G
57
Merc
V
E
Mars
J
S
pp
p
aah
o
aah
o
aah
o
mf


60
Merc
V
E
Mars
J
S
mp
mf
pulsed humming


63
Merc
V
E
Mars
J
S
f
mp
mf
66
p
pp

10




76
Merc
V
E
Mars
J
S
mf
f
pp
fff