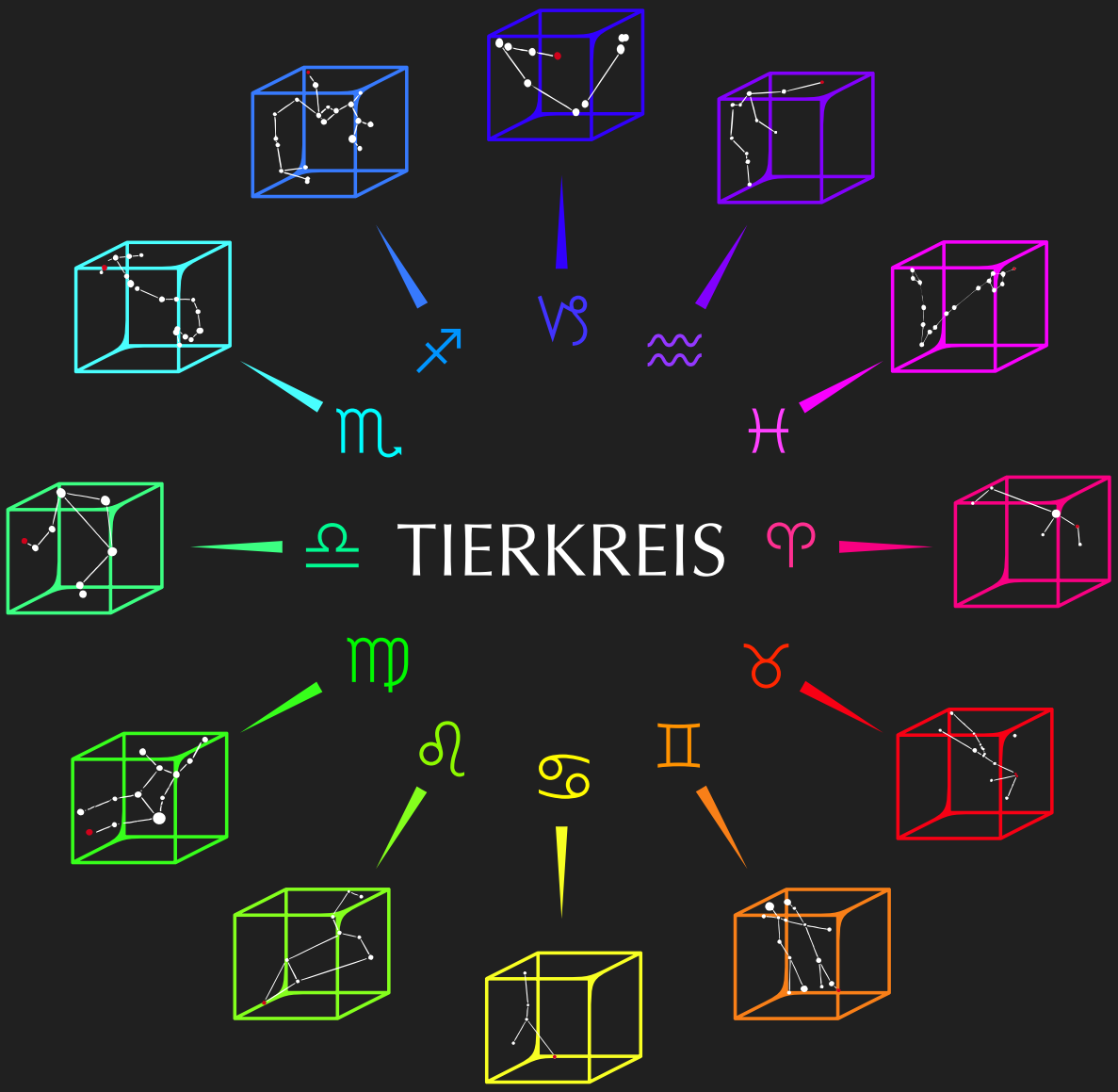
Karlheinz Stockhausen's



an arrangement for
electronic music,
instruments and voices

Omer Eilam

KARLHEINZ STOCKHAUSEN'S TIERKREIS: AN ARRANGEMENT FOR ELECTRONIC MUSIC, INSTRUMENTS AND VOICES

Omer Eilam

June 2017

"Art demands of us that we do not stand still”
- Ludwig van Beethoven.

This thesis is dedicated to Juan Verdaguer, mentor and friend.

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ABSTRACT

My work concerns the realization of an electronic music version of the piece TIERKREIS composed by Karlheinz Stockhausen in 1974. TIERKREIS is a collection of twelve short melodies belonging to the twelve zodiac signs wherein each melody possesses a unique melodic and rhythmic character. So far various arrangements of the composition were published, some by the composer himself, but none of them were made especially for electronic music. The nature of the melodies, namely their focus on a sequence of discreet pitches and rhythmical elements, makes them particularly susceptible to electronic music transformations such as timbral synthesis and spatial movements. The aesthetic choices for this realization were guided by and meant to convey the spirit of the composer.

TIERKREIS-GRUSS / TIERKREIS-GREETING

In 1974 Karlheinz Stockhausen composed TIERKREIS, a cycle of 12 melodies representing the 12 signs of the zodiac. Originally written for music boxes as a component part of a theater piece for percussion sextet titled MUSIK IM BAUCH TIERKREIS forms the basis to much of Stockhausen's later works, both directly as in the case of SIRIUS (1976) and in a broader sense by constructing entire pieces from a small melodic nucleus, a process which already started with MANTRA (1970) and reached its apex with the LICHT opera cycle (1978-2003).

The nature of TIERKREIS is unique in the sense that each melody on the one hand has its distinctive characteristics while on the other hand relates to the cycle as a whole, thus achieving a strong compositional unity. This relationship can be more easily understood when examining the diagram reproduced on the cover of the score of TIERKREIS (Figure 1.1). The first thing to notice is that each melody is based on one important note, called the **central tone** of the melody. These tones follow the chromatic 12 tones scale, beginning on D# (*Aquarius*) and ending with D (*Capricorn*). The tempi also follow a chromatic scale (this time not according to the order of the cycle), with *Libra* being the slowest at ♩ = 71 bpm and *Pisces* the fastest at ♩ = 134 bpm. The two smaller note-heads on each staff represent the highest and lowest tones of each melody, i.e. its range. The durations of each melody also form a 12-member series with a rather narrow range of durations, from 26.66 seconds for *Libra* to 30.4 seconds for *Pisces*.

Notably, because they were written for music boxes, which at that time could not have reproduced considerable differences in either timbres or dynamics, the pitch and rhythm dimensions of the melodies were utilized to the maximum and emphasized in their structures, as I will later discuss specifically for each melody.

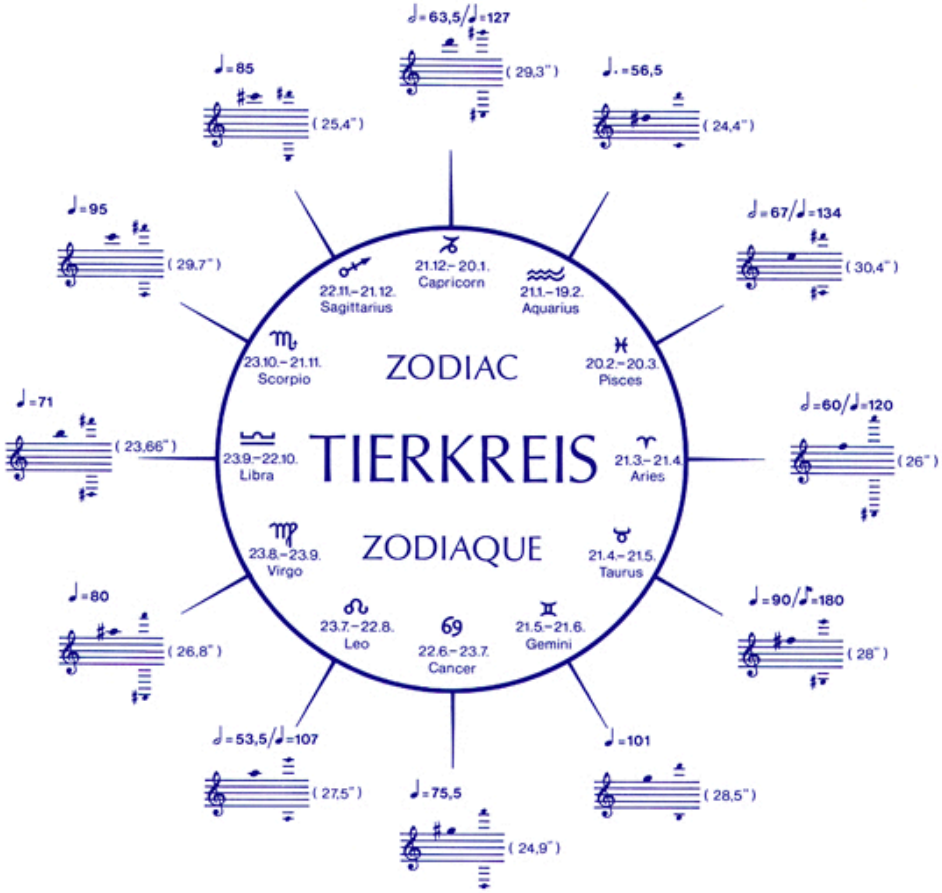

Figure 1.1. The cover of the score of TIERKREIS capturing its global characteristics.

Zooming in from the general diagram Figure 1.2 (Kohl, 1983) shows the series of notes that comprise each melody of TIERKREIS. The central tone is always the first in the series, while the others are called **main tones**. Each melody utilizes all 12 notes of the chromatic scale while some also include repetition of notes, making the series longer. By examining the different series one can already recognize differences in tendencies. For example, the series of *Aquarius* is first ascending and then descending in an almost chromatic fashion. On the other hand the melody of *Libra* begins in the middle range with small intervals that grow larger in the middle and smaller again towards the end.

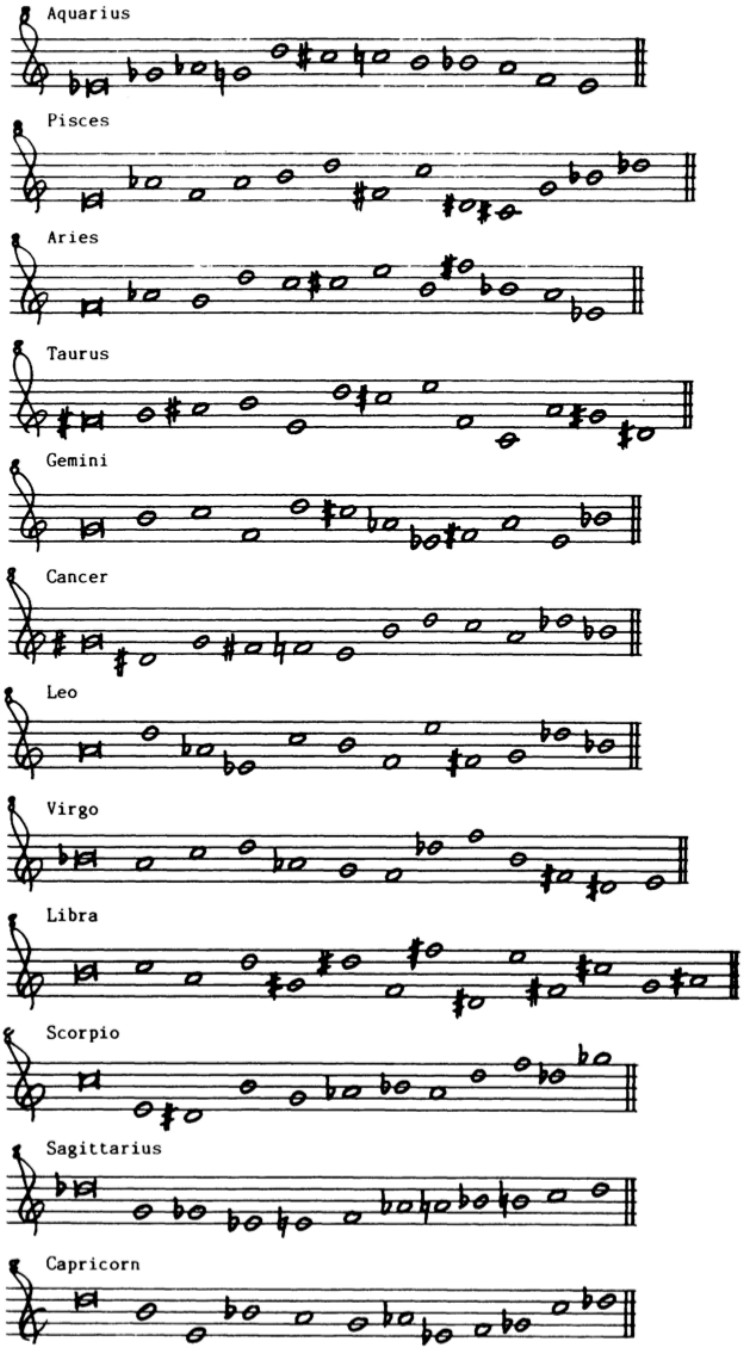

Figure 1.2. The series of notes comprising each melody of TIERKREIS.

In 1978 Christel Stockhausen (Karlheinz's daughter) published a short article (Stockhausen, 1978) in which she portrayed guidelines and examples for making a new version of the piece. These call for playing each melody several times, normally three or four times in succession, giving the interpreter many possibilities for variation. The following variations are possible:

- Dynamic nuances, either within a melody or from repetition to repetition.
- Changes of articulation (staccato, portato, legato).
- Use of various octave registers, either on the same instrument or on auxiliary instruments.
- Duet interpretation: when a chordal instrument accompanies a melody instrument or a singer, variation can be achieved by the arrangement of solos and duets.
- Rhythmic emphasis by playing only the rhythm on a central pitch.
- Dissection of melody: certain sections may be emphasized by leaving out others.

To maintain the special relationship discussed above I decided to come up with a few overarching elements that govern the construction of the entire piece. From the perspective of timbral synthesis I decided to limit myself to two synthesis methods which I termed *Octaver* and *Impulser,* that repeat in various forms throughout the cycle. I will discuss these two methods in detail in the following chapters. To complement these timbres each melody also contains unique sounds that are identified with it alone and do not occur elsewhere, as in the case of the Tuba in *Taurus* or the two singers in

Pisces. Finally, the sounds of the four classical elements (Air, Fire, Water and Earth) can be heard during several moments in the piece which represent the connections of the zodiac signs to the seasons and triplicities (Zodiac, 2017).

With respect to the spatial organization of the sounds a unity is achieved in the form of spatial trajectories within a cubical space, where each melody follows the geometrical path of its corresponding star constellation (as can be seen in Figure 1.3). This cube is then projected onto the space of the concert hall. As mentioned above, each of the twelve melodies has a central tone which corresponds to one note of the chromatic scale. This tone is mapped to one of the stars in the constellation and localised to the position of the constellation in the zodiac cycle. For example, the central tone for the *Pisces* melody is E, located at -30°. The central tone for the *Aries* melody is F, located at 0°, etc. (Figure 1.3). Once the central tone is localised the orientation of the other stars in the constellation is determined according to their geometrical relation to the chosen star.

What follows this introduction is an account of my work on each melody of TIERKREIS. This thesis should not be read as a musicological analysis of the piece but rather as a documentation of my attempt to make an electronic music realization of TIERKREIS in the spirit of the composer. This text complements the music which is the real essence of this work and hence makes little sense when viewed in isolation.

At the time of the writing of this document I completed the arrangement of 5 out of the 12 melodies using a diverse set of compositional methods which so far have

included recordings made in the analog studio of The Institute of Sonology, software based digital sound synthesis, composed vocal and instrumental parts, and field recordings. The order in which the chapters are placed does not follow their succession in the cycle but the chronological order in which I arranged them, starting with *Aries* in August 2016 and ending with *Gemini* in May 2017. I plan to continue this work and realize the entire cycle.

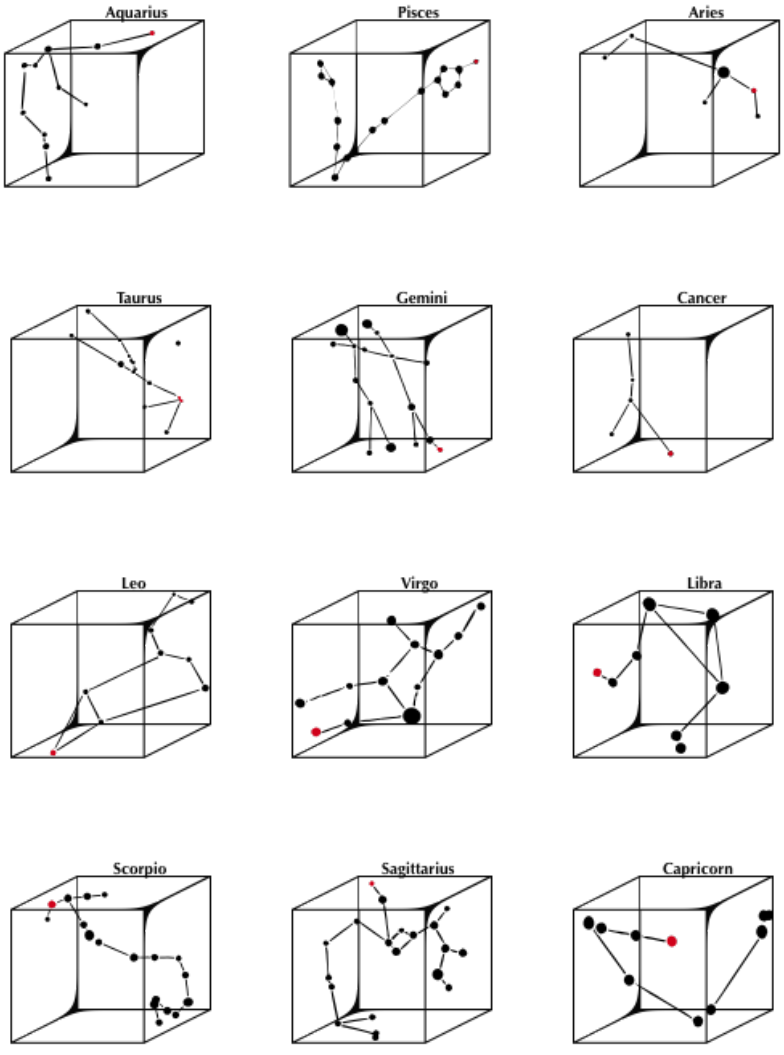

Figure 1.3. The Zodiac constellations with their chosen stars (red oval) inside a cub space.

WIDDER - ARIES

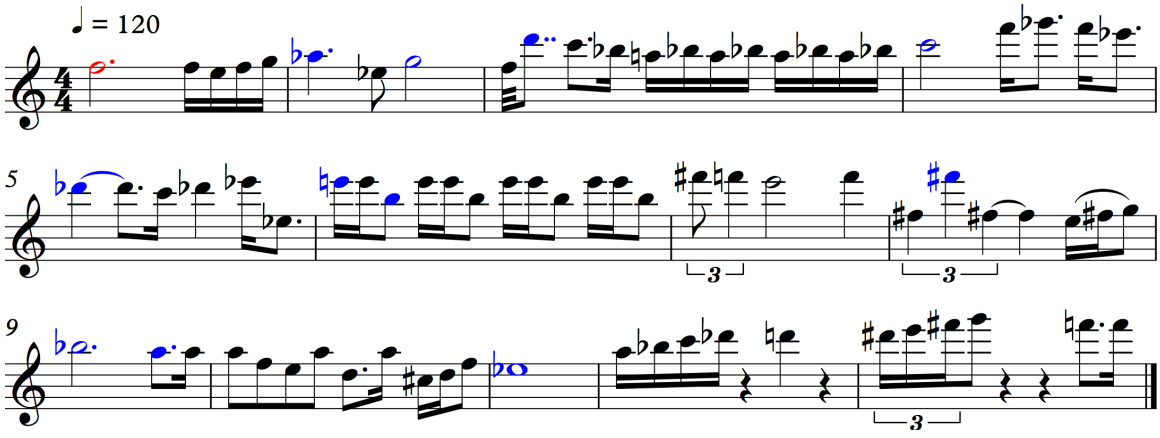

Figure 2.1. The *Aries* melody. Central tone is colored red, main tones are blue and accessory tones are black.

The material I used consists of two different synthesis methods. The first is a digital additive synthesis method I call *Octaver.* It is made up of nine sine waves on top of a fundamental tone, each one situated an octave higher than the previous one, thus encompassing the entire audible range. Each sine wave also has an envelope in the shape of a low frequency sawtooth wave. Because all of the sawtooth waves have the same frequency but different phases it follows that at certain time intervals a different octave is accentuated and heard louder than the rest (Figure 2.2). The second method is called *Impulser* which is basically a sampler composed of filtered impulses synthesized in the analog studio using an impulse generator passing through a tuneable filter (Abstimmbarer Anzeigeverstärker UBM) and a plate reverb (EMT 140).

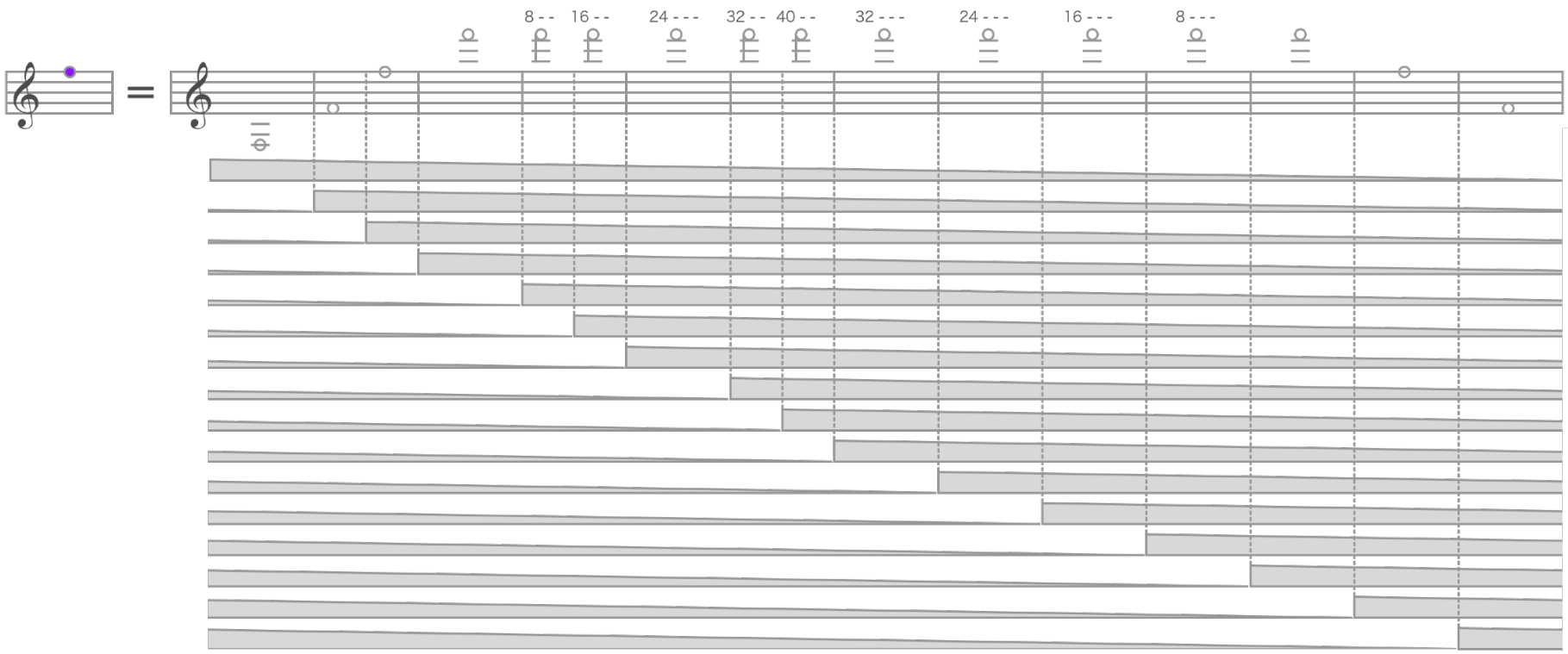

Figure 2.2. Graphical representation of the *Octaver* synthesis method.

In the first repeat all the sounds come from the top speakers. The melody is heard in the front and the accompaniment in the back, both played by *Octaver*. To enhance the perception of the pitch range of the melodic line the lowest note of the melody is panned all the way to the left and the highest all the way to the right, while the notes in between acquire their place in the stereo field based on their relative pitch distance from the lowest and highest notes. The left and right signals slowly converge towards the middle thus becoming louder and less dispersed, ending in full mono by the end of the first repeat. A similar procedure takes place in the accompaniment.

The second repeat follows immediately and is composed entirely from *Impulser* playing the melody without accompaniment. The central and main tones of the melody (red and blue notes in Figure 2.1) are heard from the position of *Aries,* the star Sheratan (red circle in Figure 2.3) while the accessory tones are heard from all of the top speakers at an equal level.

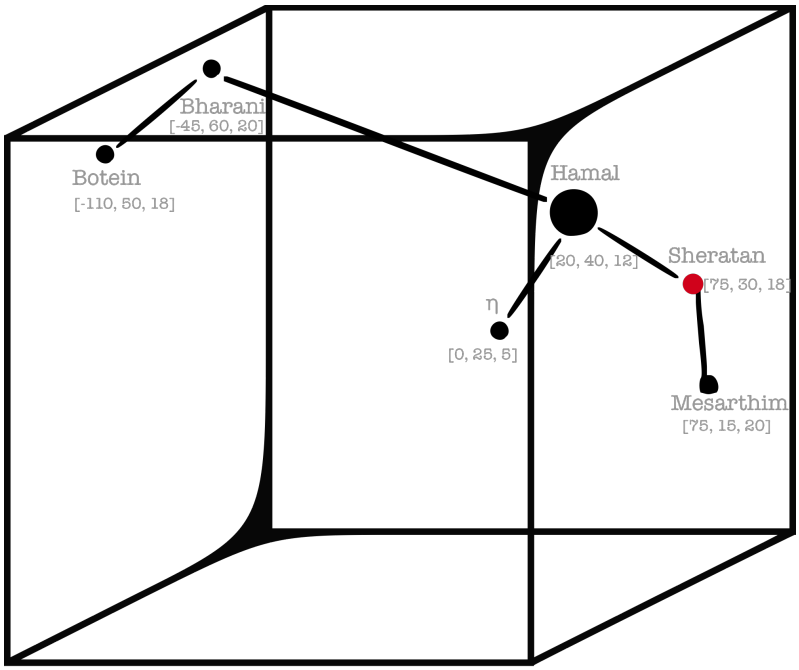

Figure 2.3. The *Aries* constellation, its chosen star (red oval) and spatial coordinates inside a cubical space.

The third and last repeat combines the previous two together. The filtered impulses take the part of the accompaniment (heard from the position of *Aries*) while *Octaver* plays the central and main tones of the melody (Figure 2.4). This happens 8 times slower than the original tempo in order to showcase the internal "octave-switching" process of *Octaver*. Moreover, whenever a new main tone is introduced it appears in a distinct spatial location. The *Aries* constellation consists of 3 upper stars (Sheratan, Hamal and Bharani), each connected to a lower star (Mesarthim, η and Botein, respectively). The first main tone switches between Sheratan and Mesarthim, the second switches between Hamal and η and the third between Bharani and Botein. The switching has an internal rhythmicity which follows the entire rhythm of the *Aries* melody. This way a perception of flickering stars is created, becoming denser towards the middle (where more and more tones are heard simultaneously) and then sparse again until it ends with the flicker of the last tone. In addition, because after three tones the entire stars of the constellation were represented the entire constellation is "shifted" upwards by 10 latitudinal degrees. This happens again and again after every 3 tones reaching a maximum of 40° latitudinal angle.

The full score of *Aries* is given as Appendix I. All dynamics were determined intuitively and controlled manually after the realization of the score. The premiere of *Aries* took place on November 30, 2016 as part of The Institute of Sonology Discussion Concert series in The Royal Conservatoire, Den Haag.

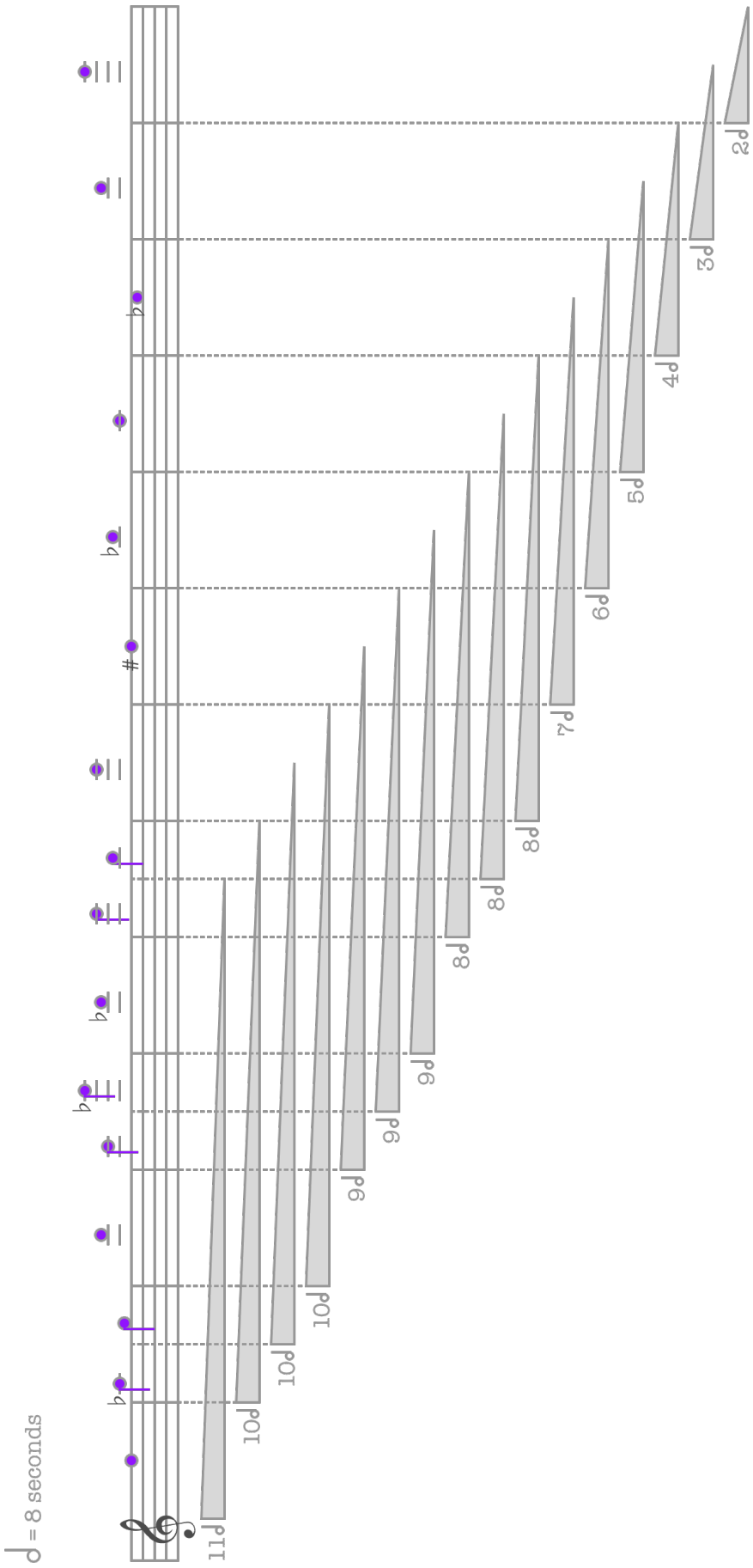

Figure 2.4. Form scheme for the 3rd repeat of *Aries*.

FISCHE - PISCES

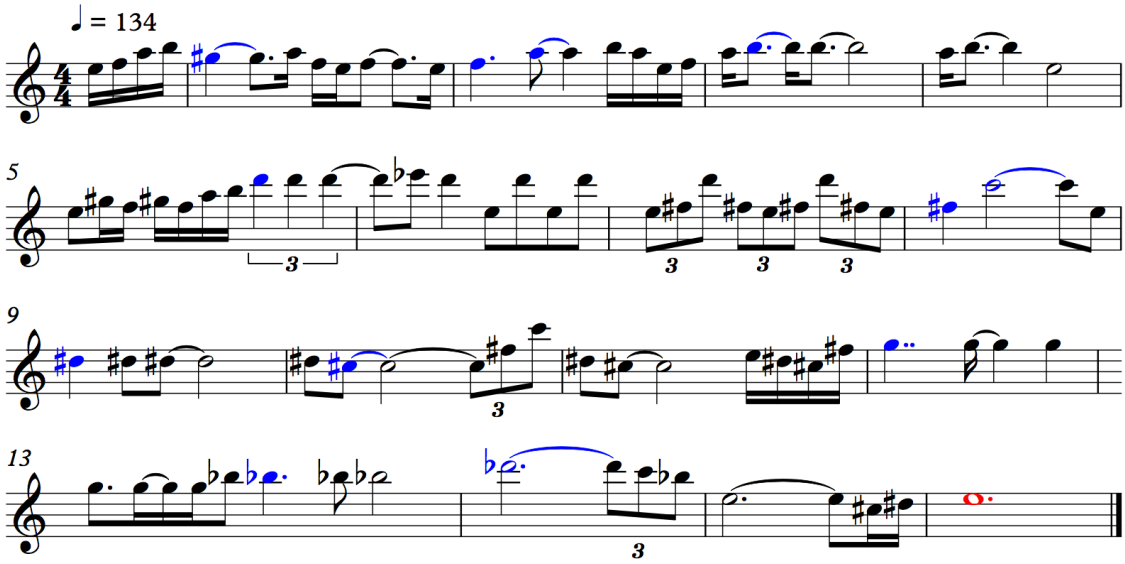

Figure 3.1. The *Pisces* melody. Central tone is colored red, main tones are blue and accessory tones are black.

For *Pisces* I decided to incorporate spoken and sung texts, in English and in German, both written by the composer (Figure 3.2), as well as the names of the stars in the constellation. The arrangement begins with the sound of a water stream heard from the position of its chosen star, Fum al Samakah (Figure 3.3) signifying the first fish. A few seconds later another water stream is heard from the position of Anunitum as the second fish. The first repetition starts at that point with a baritone whispering the English text. The voice is heard from the loudspeakers beginning from the position of Fum al Samakah and tracing the trajectory of the entire constellation until it reaches Anunitum at the end. At that moment more water streams gradually enter making the texture denser until eventually 16 individual streams are heard corresponding to the number of stars in

the constellation. The level of the streams was manually controlled to interact with the other musical layers.

Pisces -	Pisces -
zwei Fische in Bewegung	two fishes in movement
Planeten Jupiter Neptun	planets Jupiter Neptune
wasserweich anschmiegend	water softly clinging
formlos vorwärts rückwärts	formless forward backward
unentschieden	undecided dissolving
zerfließend	devoted gentle and kind
hingebungsvoll sanft und gütig	sudden willfulness
plötzlich Eigensinn	intuition dreams
Intuition Träume	wisdom innocence
Weisheit Kindlichkeit	

Figure 3.2. The text of *Pisces* in German and English, written by Karlheinz Stockhausen.

The second repetition begins with the baritone whispering the German version of the text, this time beginning in Anunitum and finishing in Fum al Samakah. As he traverses the constellation, his movement is controlled so that he always reaches the position of a new star at the same time of the main tones of the melody. For example, the G# in bar 1 of the melody is heard from the position of Al Pherg, the F in bar 2 is heard from the position of Torcularis Septentrionalis, etc. At the exact same moments and sounding from the same spatial locations a tenor announces the names of the stars using the pitches of the main tones (each time a single pitch) and fragments of the rhythmical motif that appears in bars 12-13 of the melody (the length of the fragment depending on

the number of syllables that make up the name of the star). Accompanying the tenor, playing the same notes and following the same spatial trajectory is *Octaver*.

For the third and last repetition the two singers sing the English version of the text in an interleaved manner. The tenor starts at the position of Fum al Samakah while the baritone starts at Anunitum. They both move slowly in space and sing the last phrase in unison at the position of Alrisha. Throughout the repetition *Octaver* can be heard playing a low E (the central tone of *Pisces*) as a drone from the position of Alrisha. Following the unison is a big crescendo of all the water streams indicating the transition to *Aries*.

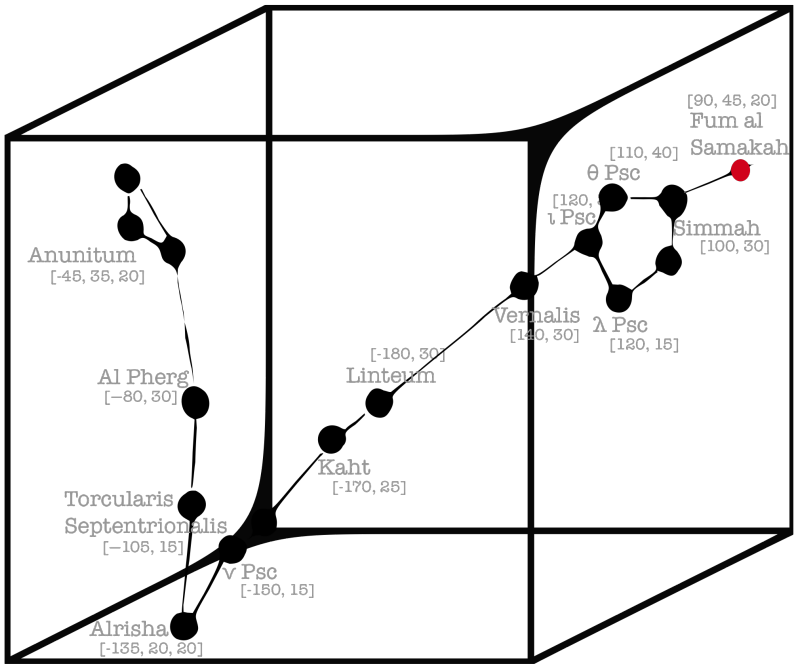

Figure 3.3. The *Pisces* constellation, its chosen star (red oval) and spatial coordinates inside a cubical space.

The full score of *Pisces* is given as Appendix II. The recording of the singers took place in November 2016 in The Royal Conservatoire, with Jake Gramit as baritone, Tigran Matinyan as tenor, Rengert Eggink as recording engineer and Omer Eilam as musical director. The premiere of *Pisces* took place on November 30, 2016 as part of The Institute of Sonology Discussion Concerts series in The Royal Conservatoire, Den Haag.

WASSERMANN - AQUARIUS

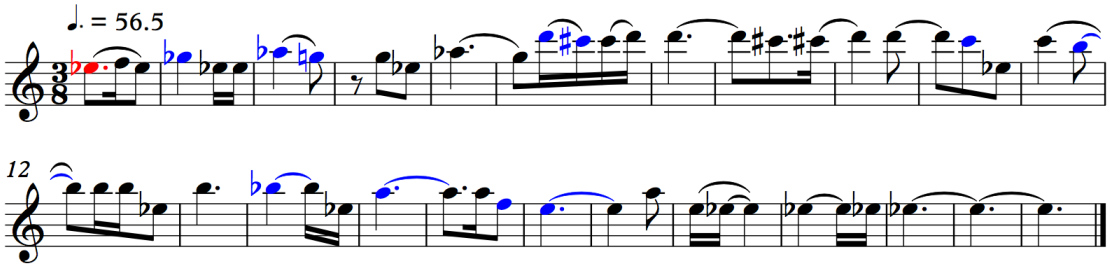

Figure 4.1. The *Aquarius* melody. The Central tone is colored in red, main tones in blue and accessory tones in black.

The scene of *Aquarius* consists of a boy playing with a music box. In the first repeat only the music box is sounding, playing the melody and accompaniment. The final chord is sustained while a light shines on a young boy who starts singing the melody together with the first version of the English text as the second repeat. After he finishes he turns the handle of the music box as if to trigger the third repeat which consists of a conversation between a single music box in the location of *Aquarius* (red oval in the Figure 4.2) and 10 other music boxes located in the positions of the other stars of the constellation. The first music box plays the melody in the original pitch and rhythm while the other music boxes are playing transposed versions based on the intervals between the main note and the accompanying chord in each bar. For example, the main note of the second bar is G ♭ and the chord comprises of the notes C-F-B ♭ ; therefore the intervals for the transposition of the first three music boxes in the second bar will be -6, -1 and +3, correspondingly. The intervals for the transposition of the next three music boxes will be

the same but an octave higher and the ones for the next three music boxes will be the same but an octave lower. The tenth music box is transposed by the first interval two octaves higher. Furthermore, each of the 10 music boxes is playing in one constant rhythmical motif taken from the melody (Figure 4.1). An exception to this rule happens whenever one of the music boxes is playing an identical rhythmical motif to the current one of the melody; in that case it is not transposed but remains in its original pitch, thus making the melody apparent in its original form while shifting between the different music boxes and therefore between different points in space.

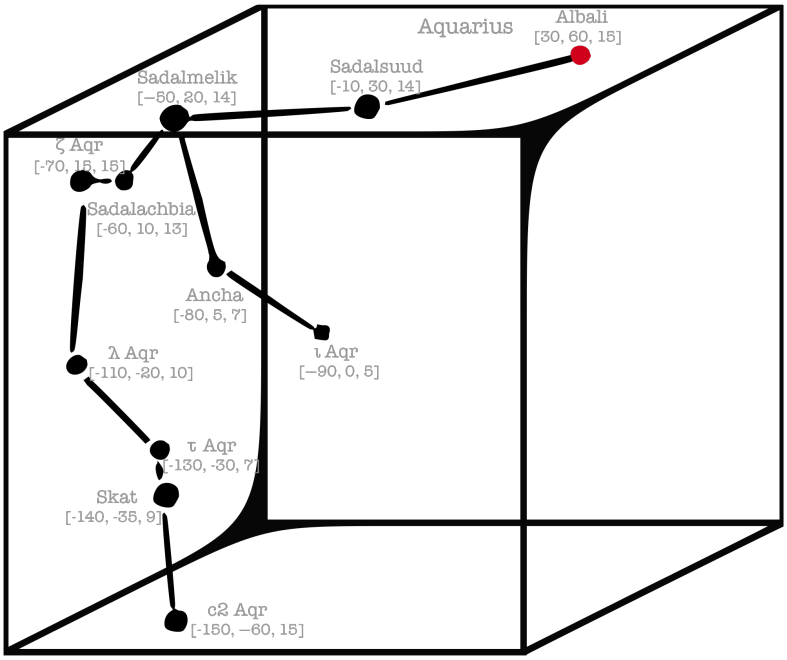

Figure 4.2. The *Aquarius* constellation, its chosen star (red oval) and spatial coordinates inside a cubical space.

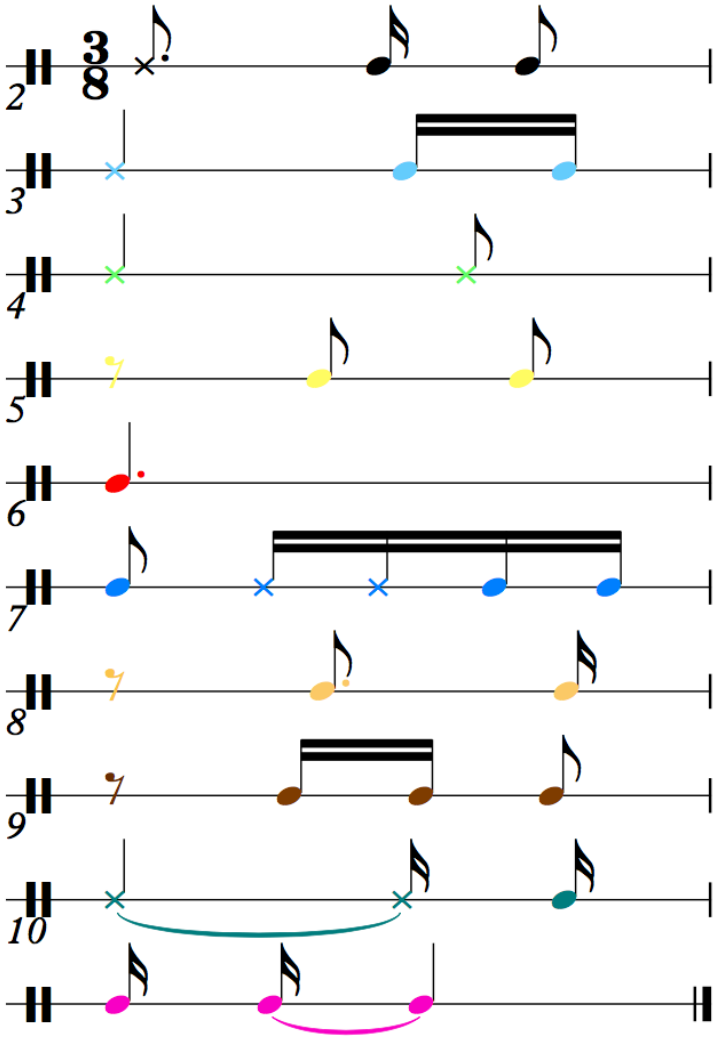

Figure 4.3. *Aquarius* rhythmical motifs taken from the melody and played by the 10 music boxes in the 3rd repeat.

The last repeat is entitled “Memories”. The tempo slows down to 1/3 time and the music box is playing individual notes from the melody traversing the constellation as flickering stars momentarily lighting up the sky (the names of the stars appear next to the notes to denote their momentary position in space). The boy sings fragments of the second version of the English text, namely mentioning Janus, the god with two faces that sees into the past and the future at the same time. Added to these are short segments taken from the arrangement of the other melodies, such as the footsteps from *Taurus* or the “KATHINKAs GESANG sound” from *Gemini.* I plan to revisit this last repeat once the arrangement of the cycle is complete to incorporate elements from every other melody, thus encapsulating the spirit of the entire cycle in this short fragment.

The full score of *Aquarius* is given as Appendix III. The recording took place in March 2017 in The Royal Conservatoire, with Domonkos Hegyi as the boy singer and Omer Eilam as recording engineer and musical director. The premiere of *Aquarius* took place on March 9, 2017 as part of the CASS Concerts series in The Royal Conservatoire, Den Haag.

STIER - TAURUS

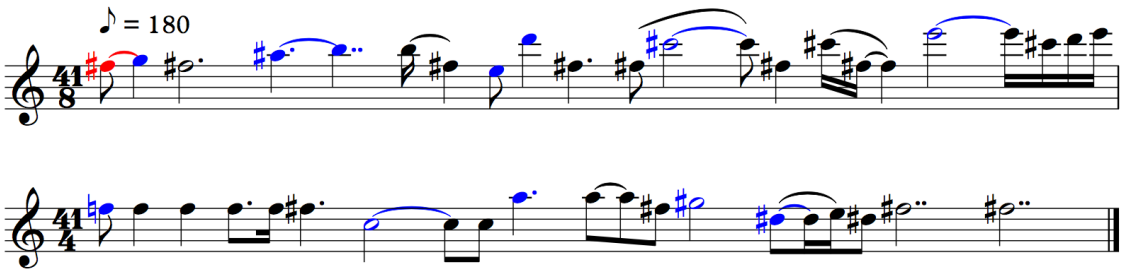

Figure 5.1. The *Taurus* melody. The Central tone is colored in red, main tones in blue and accessory tones in black.

The scene of *Taurus* is marked by a dialogue between the electronic music and a Tuba soloist. The electronic music consists of Impulser-based synthesized sounds of shooting stars and falling meteors as well as recorded sounds of foot stomps symbolizing marching soldiers.

As an introduction the Tuba player steps in from the left side of the stage and stands firmly in the location of *Taurus*. After a bull shout is heard the Tuba starts playing the melody in its middle register while stomping in place to the same rhythm. This is accentuated by similar sounds in the tape, with each new main tone introducing another voice ("soldier"). After a brief interlude of feet stomping only the second repeat starts with the Tuba player playing an arpeggiated version of the accompaniment in its lowest register while Impulser plays the melody in a higher one. The stomping continues in steady 1/4 notes while spreading in space: each soldier "walks" to a position of one of the stars in the constellation, getting there one by one at the same time that a new main tone

is heard in the melody. Each time a soldier reaches his/her place they (and the ones that preceded them) switch from 1/4 to 1/8 notes momentarily for the duration of the main tone, thus accentuating the double series of approximate retrograde

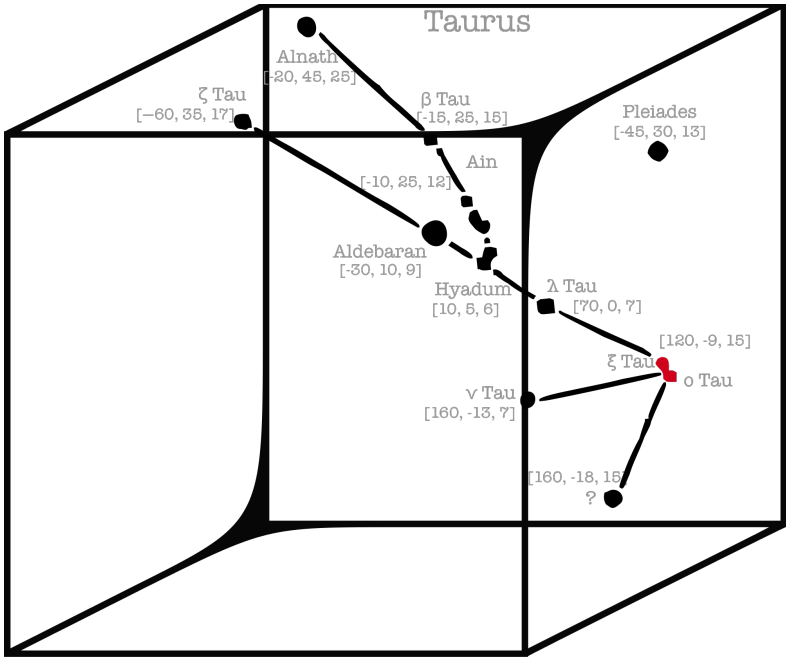

Figure 5.2. The *Taurus* constellation, its chosen star (red oval) and spatial coordinates inside a cubical space.

symmetry of these durations (Kohl, 1983). The music seems to continue smoothly to the 3rd repeat but as soon as it happens it is suddenly interrupted by the sound of a falling meteor augmented by a full range Tuba glissando. The soldiers immediately disperse in reaction. The Tuba continues to play the melody, now in its highest register, with fast, repeating note ornaments reminiscent of a war signal, while the sounds of shooting stars play a simplified version of the accompaniment, starting from the outer stars of the constellation and drawing inwards. At the end of this repeat the soldiers quickly return to their positions for the beginning of the last one. This time they are heard one by one, each playing a rhythmical motif from the Tuba part of the previous repeat. The electronic music changes from high squeaking shooting stars to extremely low meteor blasts now

playing the full version of the accompaniment. The Tuba plays an identical solo to the extremely virtuosic one which appears in the last repeat of the *Taurus* arrangement of FÜNF WEITERE STERNZEICHEN, ending on a very high F# note in complete synchronicity with the last foot stomp of the final rhythmical pattern of the soldiers and the last meteor blast.

The full score of *Taurus* is given as Appendix IV. The recording took place in March 2017 in The Royal Conservatoire, with Giedrius Steponaitis as the tuba player, Rengert Eggink as recording engineer and Omer Eilam as musical director. The premiere of *Aquarius* took place on March 9, 2017 as part of the CASS Concerts series in The Royal Conservatoire, Den Haag.

ZWILLINGE - GEMINI

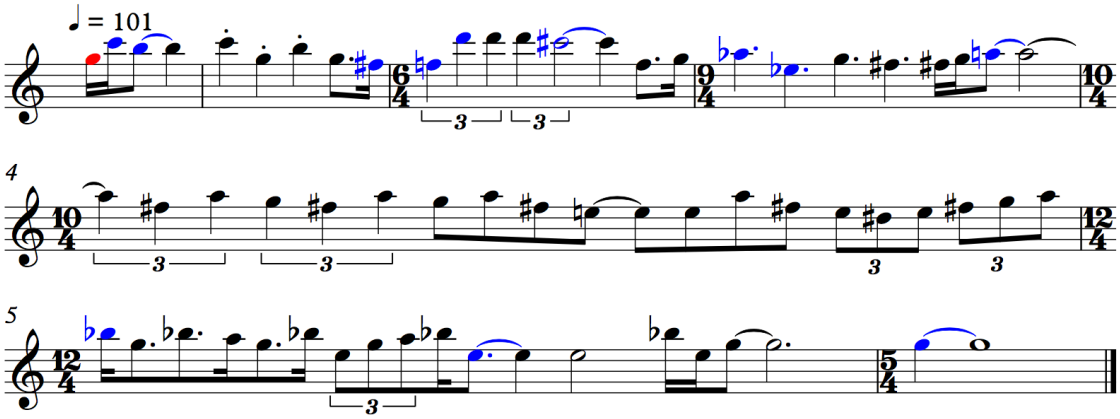

Figure 6.1. The *Gemini* melody. The Central tone is colored in red, main tones in blue and accessory tones in black.

For *Gemini* I decided to rearrange the version that Stockhausen himself composed for orchestra in 2007. It is a part of the larger FÜNF WEITERE STERNZEICHEN and the last piece he composed before he died.

I started by analyzing the orchestration which consists of the following three main sections: strings, winds and harp & vibraphone. An additional solo trumpet plays the series of main tones of the melody in "accelerating" four repetitions: the first repeat is the slowest and lasts 47 bars (1-47). The second repeat lasts 28 bars (48-76). The third repeat lasts 13 bars (77-90). The fourth repeat lasts 5 bars (91-96). The strings section consists of 8 violins, 3 violas and 3 violoncelli. One by one, each instrument plays the first 3-note motif of GEMINI starting on G and continuing, similar to the trumpet, according to the series of main tones (i.e. G-C-B, C-F-E, B-E-D#, etc.). The third note of each motif is sustained until another motif is played by the same instrument. Notice that there are 14

string instruments but only 13 main tones (the central tone G appears at the beginning and the end of the melody) so in practice each instrument plays between 3 to 5 motifs in total, as can be seen in Table 6.1.

Instrument	1st Repeat (Note/Starting Bar/Ending Bar)	2nd Repeat (Note/Starting Bar/Ending Bar)	3rd Repeat (Note/Starting Bar/Ending Bar)	4th Repeat (Note/Starting Bar/ Ending Bar)
V I 1	G5 / 1 / 52.5	B5 / 53 / 87	D5 / 87 / 95	A4 / 95.5 / 96.75
V I 2	D6 / 21 / 63	C#6 / 63 / 88.5	A6 / 89 / 96.75	
V I 3	A6 / 35.5 / 72.5	E5 / 73 / 91		C5 / 91.5 / 96.75
V I 4	E4 / 43 / 78.5		C6 / 79 / 93	D6 / 93.5 / 96.75
V II 1	B4 / 9 / 57.5	F5 / 58 / 87.75	A ♭ 5 / 88 / 96.5	E5 / 96.5 / 96.75
V II 2	A ♭ 4 / 28.5 / 68.5	A5 / 69 / 89.5	E4 / 90 / 96.75	
V II 3	G6 / 45.5 / 74.5	G4 / 75 / 92		F#6 / 92.5 / 96.75
V II 4		C4 / 50.5 / 82.5	F#5 / 83 / 94	A ♭ 6 / 94.5 / 96.75
Va I	F3 / 17 / 55	F#4 / 55.5 / 88	E ♭ 3 / 88.5 / 93.5	C#4 / 94 / 96.75
Va II	E ♭ 3 / 32 / 64	A ♭ 3 / 65 / 90	G5 / 90.5 / 95.75	B ♭ 3 / 96 / 96.75
Va III	B ♭ 3 / 39 / 70.5	B ♭ 4 / 71 / 91.5		B3 / 92 / 96.75
Vc I	C3 / 5 / 48	G3 / 49 / 76.5	G2 / 77 / 87.5 & C#3 / 87.5 / 92.5	F4 / 93 / 96.75
Vc II	F#2 / 13 / 60	D3 / 60.5 / 80.5	B2 / 81 / 89 & B ♭ 2 / 89.5 / 94.5	E ♭ 4 / 95 / 96.75
Vc III	C#2 / 25 / 67	E ♭ 2 / 67 / 84.5	F3 / 85 / 91	G2 / 91 / 96.75

Table 6.1. Analysis of the string instruments parts in *Gemini* from FÜNF WEITERE STERNZEICHEN. Each line represents a single instrument and each column a single repetition of the series of main tones.

When looking at the density of the motifs the aforementioned acceleration is not conducted in between repetitions but "within" them: in bars 1- 24 there is 1 motif every 4 bars. In bars 25 - 42[1] there is 1 motif every 3.5 bars. In bars 43 - 62 there is 1 motif every 2.5 bars. In bars 63 - 86 there is 1 motif every 2 bars. In bars 87 - 95 there are 2 motifs per bar, and in bar 96 there are 3 motifs.

Because of the "drone-like" nature of the sustained pianissimo of the strings I decided to resynthesize each part with Octaver. Specifically, I synthesized each motif from three sine waves that are jumping up one octave at a time and after six octaves jumping down again to the base frequencies in the duration of the motif according to the table above. I transposed all pitches down one octave to encompass almost entire audio range from C#1 (34.65 Hz) to E♭10 (19912 Hz), and frequencies above E♭10 were shifted down by another octave to avoid aliasing. For example, the first motif begins on G5 and lasts 51.5 bars which equal 122.38 seconds in the tempo of GEMINI (♩ = 101). Table 6.2 shows the frequency values of the sine waves that make up this motif. Additionally a low frequency sine wave (LFO) was used as a VCA to maintain a relationship between pitch and rhythm as well as to mimic the vibrato of the strings. The frequency of that oscillator corresponded to the frequency of the note itself but transposed 10 octaves lower. For example, for G5 (392 Hz) the frequency of the LFO was G-5 (0.382 Hz).

---

[1] Bars 39 - 42 contain one note but are unique because of the crescendo in the strings.

Note Octave	G	C	B
5	392.00 (0.38)	523.25 (0.51)	493.88 (0.48)
6	783.99 (0.77)	1046.50 (1.02)	987.77 (0.96)
7	1567.98 (1.53)	2093.00 (2.04)	1975.53 (1.93)
8	3135.96 (3.06)	4186.01 (4.09)	3951.07 (3.86)
9	6271.93 (6.12)	8372.02 (8.18)	7902.13 (7.72)
10	12543.85 (12.25)	16744.04 (16.35)	15804.27 (15.43)

Table 6.2. The sine wave frequencies that make up the first G-C-B motif of violin I 1 in bars 1 - 52.5. The frequencies of the LFOs are given in brackets.

The acceleration process is also captured by the spatialization of the sounds. At the onset all the string instruments are projected onto a plane at the front left of the space that represents one "twin" of the *Gemini* constellation (see Figure 6.2). Then the constellation starts rotating counter-

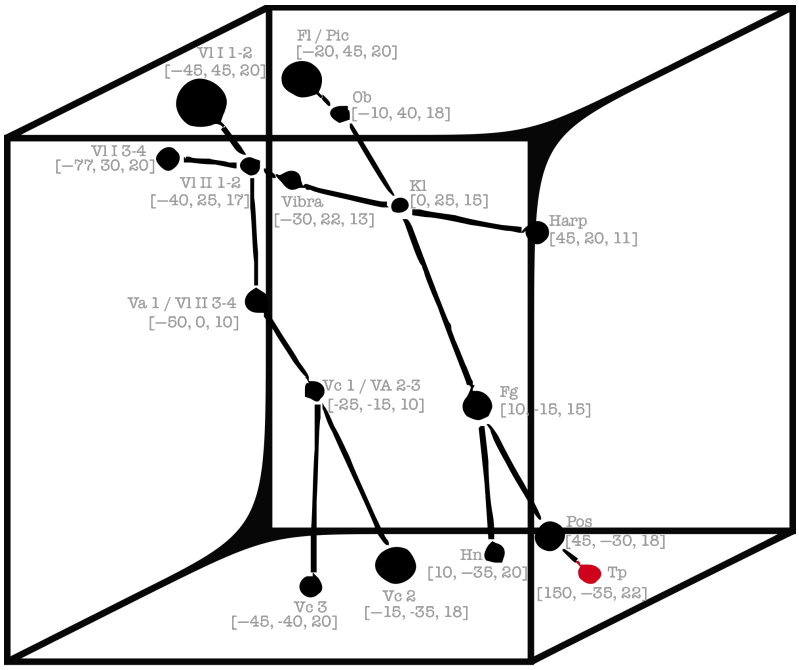

Figure 6.2. The *Gemini* constellation, its chosen star (red oval), spatial coordinates and location of instruments inside a cubical space. Vl=Violin. Va=Viola. Vc=Violoncello. Pic=Piccolo. Fl=Flute. Ob=Oboe. Kl=Clarinet. Fg=Bassoon. Hn=Horn. Pos=Trombone. Tp=Trumpet. Vibra=Vibraphone.

clockwise. The speed of rotation of each motif is determined so that the sound will complete one or more full circles in its duration. During the first repeat the sound complete one circle, during the second repeat the sound completes two circles, etc. Therefore, as more motives appear the stars go out of phase with each other and the shape of the constellation is gradually distorted (see Figure 6.3).

The winds section plays the rest of the melody (i.e. the entire melody without the initial 3-note motif). The section is further divided into two: Flute (and Piccolo), Oboe and Clarinet as higher voices, and Bassoon, Horn and Trombone as lower voices. Instead of repeating the entire series 4 times like the other instruments this section plays the melody once from beginning to end, dividing it into 5 segments and repeating each segment several times (see Table 6.3), sometimes in original tempo (fast) and sometimes in half time (slow).

Segment # Section	I (bar 1)	II (bar 2)	III (bar 3)	IV (bar 4)	V (bar 5)
High winds	2 fast, 2 slow	2 fast, 1 slow	1 fast, 1 slow	2 fast	2 fast, 1 slow
Low winds	3 fast	1 fast, 1 slow	1 fast, 1 slow	2 fast, 1 slow	2 fast, 1 slow

Table 6.3. *Gemini* segments played by the wind instruments in FÜNF WEITERE STERNZEICHEN.

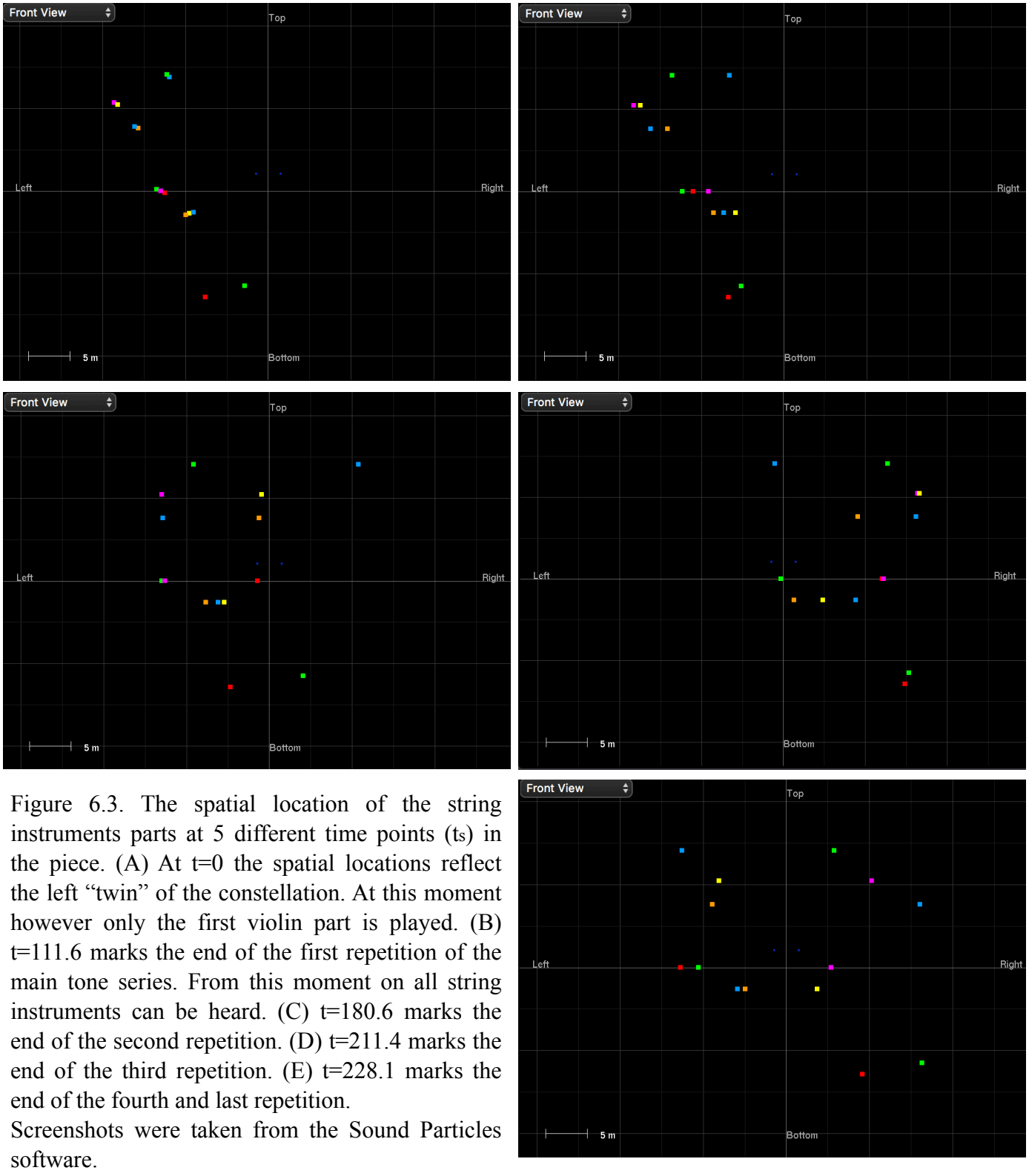

Figure 6.3. The spatial location of the string instruments parts at 5 different time points (ts) in the piece. (A) At t=0 the spatial locations reflect the left "twin" of the constellation. At this moment however only the first violin part is played. (B) t=111.6 marks the end of the first repetition of the main tone series. From this moment on all string instruments can be heard. (C) t=180.6 marks the end of the second repetition. (D) t=211.4 marks the end of the third repetition. (E) t=228.1 marks the end of the fourth and last repetition.
Screenshots were taken from the Sound Particles software.

To resynthesize the winds section I wanted to use Impulser. However, not wanting to lose the “human breathing” aspect I decided to combine the original parts as well using cross-modulation with Impulser as the carrier and the wind instruments as modulators. The initial spatial location of the wind instruments can be seen in Figure 2. The rotation of these parts is done in a similar fashion to the strings but this time in the clockwise direction, thus again reflecting the twin aspect of the melody. The acceleration process was done in four steps relating to the four repetitions of the main tone series mentioned above. During the first repetition all of the winds complete one full circle, during the second repetition they complete two full circles and so forth. Unlike the strings all of the wind instruments undergo the same acceleration so the shape of the constellation is not distorted.

The harp and vibraphone provide the chordal part of the accompaniment. I resynthesized these parts with a similar timbre to the one which Stockhausen used in KATHINKAs GESANG als LUZIFERs REQUIEM (Version für Flöte und Elektronische Musik). Beyond merely aesthetic reasons I sought to utilize a sound which, similar to Octaver, has an inner rhythmical structure that reflects its duration (I refer the reader to the score of the aforementioned piece for further explanations. The initial spatial location of these parts can be seen in Figure 6.2. The rotation process was similar to the one mentioned above for the wind instruments, counter-clockwise for the vibraphone (accommodating the strings), and clockwise for the harp (accommodating the winds).

Finally for the trumpet part I again used cross-modulation of the original part with the sound of wind as carrier. Both trumpet and wind are symbols of spring, the season of which Gemini is the concluding star sign. This part is the only one with a static position from beginning to end, the position of Gemini in the Zodiac circle.

A transcription of *Gemini* taken from the score of FÜNF WEITERE STERNZEICHEN is given as Appendix V. The premiere of *Gemini* is yet to take place.

TIERKREIS-ABSCHIED / TIERKREIS-FAREWELL

I would like to conclude this document with an interim summary, a reflection on the work already conceived and prospects for the fulfillment of the rest of cycle.

First are some reservations regarding the arrangements. In *Pisces* I did not use the accompaniment material. I now recognize that it was intended to be the “second fish" so I would like to change the last repeat to feature the tenor singing the melody (in English) while the baritone sings the accompaniment (in German). Furthermore, since at the time I did not intend for the arrangement to feature live musicians I recorded the two singers and realized the spatialization on tape. An alternative option would be to have live singers moving through space tracing the trajectories of the constellation. Ideally the audience can be seated in a circle surrounded by the performers standing in the positions of their respected star signs as well as the loudspeakers.

With respect to the spatialization of sounds everything described in this document cannot be perceived in stereo for obvious reasons, but its perception is quite limited in an octophonic system setup as well. The reason for that is that the Vector Based Amplitude Panning method (VBAP) (Pulkki, 1997) which I used must have a greater number of loudspeakers placed in a sphere in order to faithfully capture subtle movements with higher resolution. To test this notion I have prepared an arrangement of *Gemini* specifically for the Wave Field Synthesis (WFS) system (Berkhout, 1991) which will be premiered in June 2017. The WFS system is exceptional in its ability to localize sounds

in the horizontal axis due to its high density of speakers (192 speakers on the perimeter of a square), but it lacks the possibility of altering the vertical position of sounds. I would like to be able to further experiment with other spatial audio systems such as the 4DSOUND located at the Spatial Sound Institute in Budapest or the Sound Dome located at the ZKM in Karlsruhe.

Finally I would like to draw the reader's attention to the main motivations behind my work. All the tools and methods mentioned above I regard as means to an end which is the internal coherence in form between the different melodies. This coherence is achieved by adhering to the guidelines provided by the composer, the usage of the same sound material in different ways for each melody and the strict scheme of spatial organization. In that sense the last repeat of *Aquarius* which presents short segments taken from the arrangements of the other melodies is meant to encapsulate the spirit of the entire cycle.

The second motivation is to draw many connections between this arrangement and Stockhausen's ideas. This ability is something that I especially value in the LICHT opera cycle where the composer achieves an integration of many of his past ideas and experiments. For example, the tam-tam from MIKROPHONIE and the ring-modulated piano from MANTRA reappear in MICHAELS REISE. The systematic approach to overtone singing in STIMMUNG and all of his early electronic music influenced the timbral and noise material of the super-formula. The usage of anthems as familiar material to be presented in different forms, the so called "apple on the moon", can be

thought of as a precursor to the super-formula as the sole basic material for LICHT, and so forth. In the same way the music boxes in my arrangement of *Aquarius* can be traced back to the original version of TIERKREIS with the last repeat signaling a departure from that world and into the world of electronic music. The tuba solo from *Taurus* is meant as a clear reference to the orchestral version but with an entirely different accompaniment ("apple on the moon"). The recollection of past and future melodies in *Aquarius* can be traced back to VISION. The introduction to *Aries* which includes fragments of the melody can be traced back to SIRIUS, and so forth.

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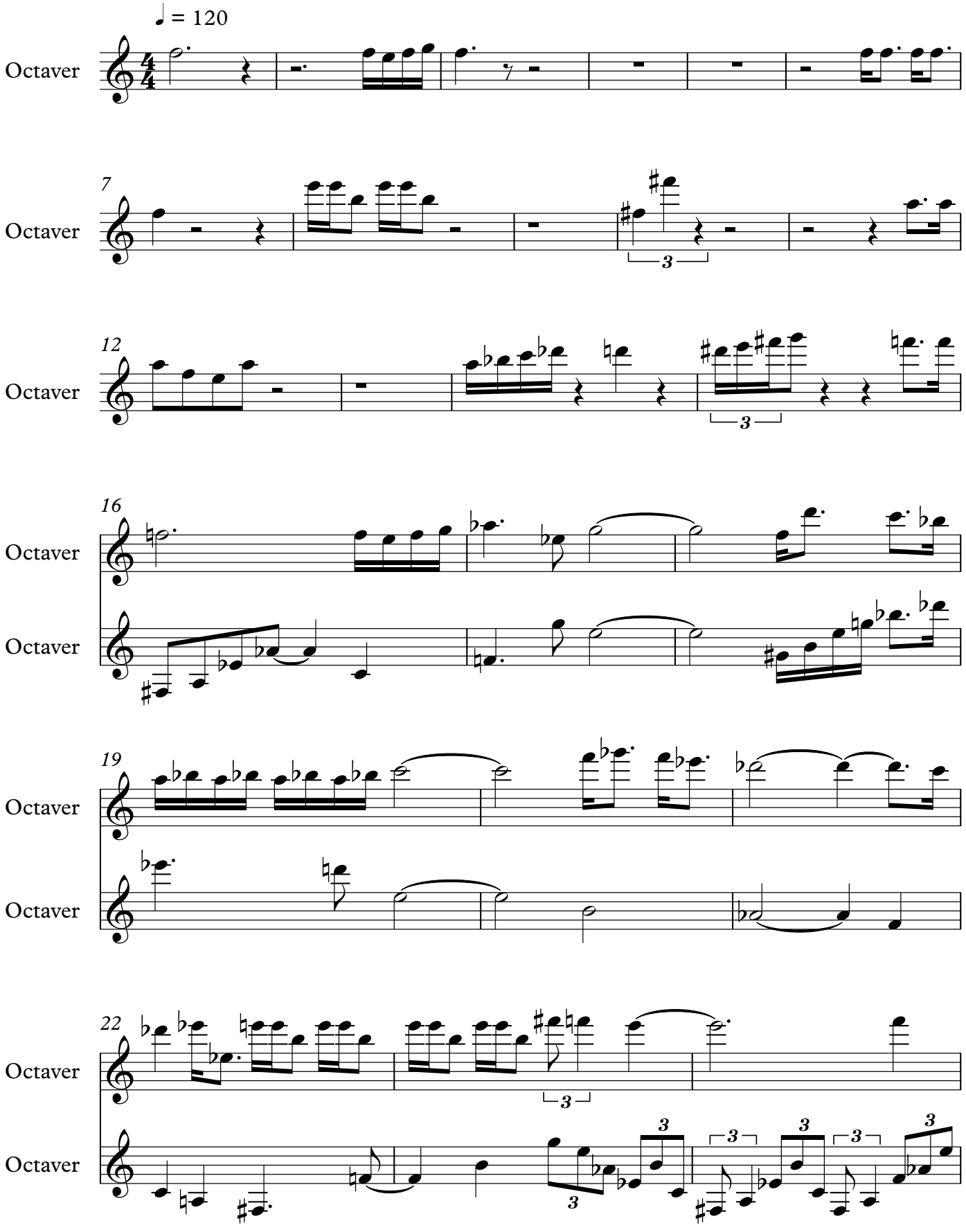
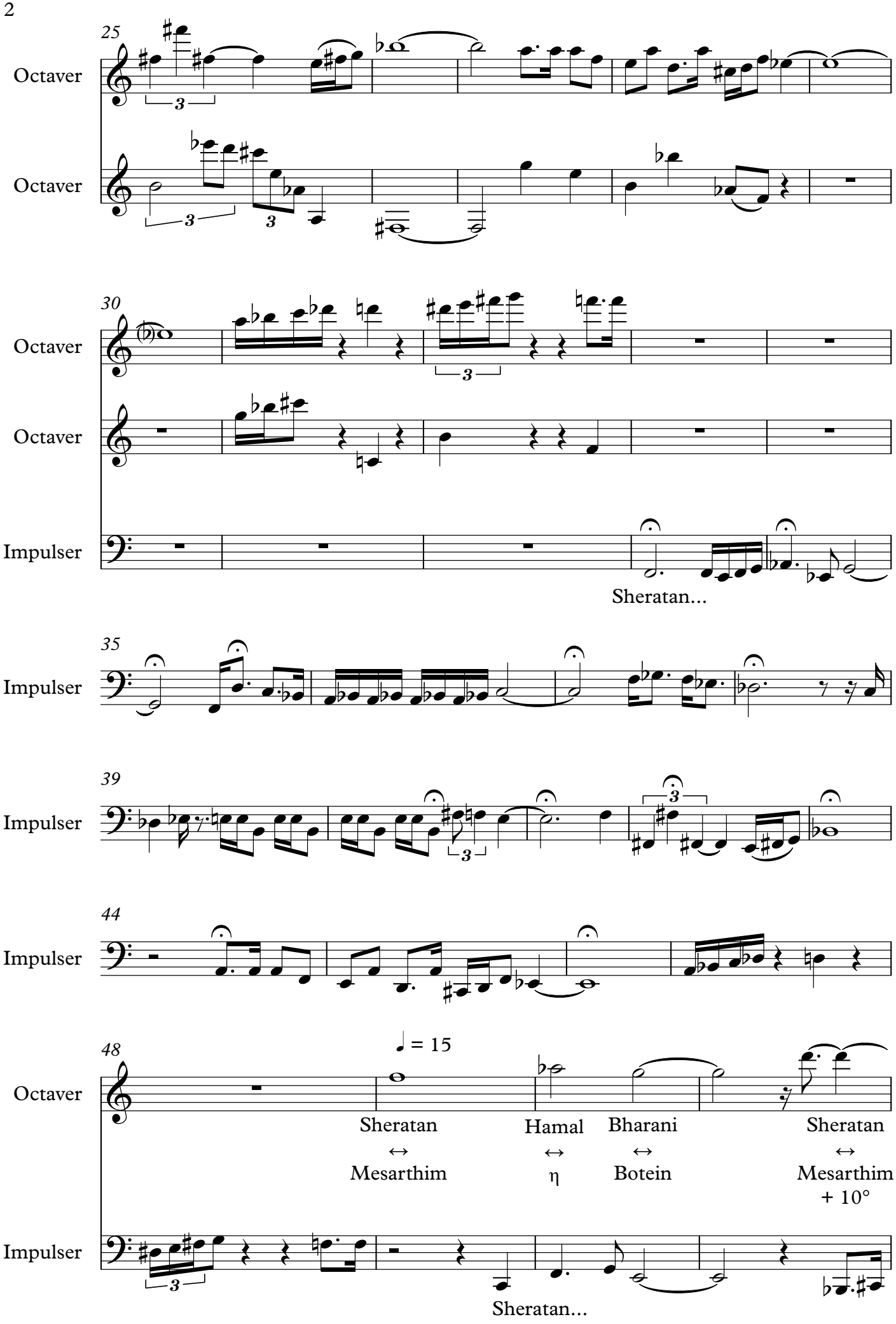
APPENDICES

WIDDER - ARIES

For Electronic Music




25
Octaver
Octaver
30
Octaver
Octaver
Impulser
Sheratan...
35
Impulser
39
Impulser
44
Impulser
48
♩ = 15
Octaver
Sheratan
↔
Mesarthim
Hamal
↔
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Botein
Sheratan
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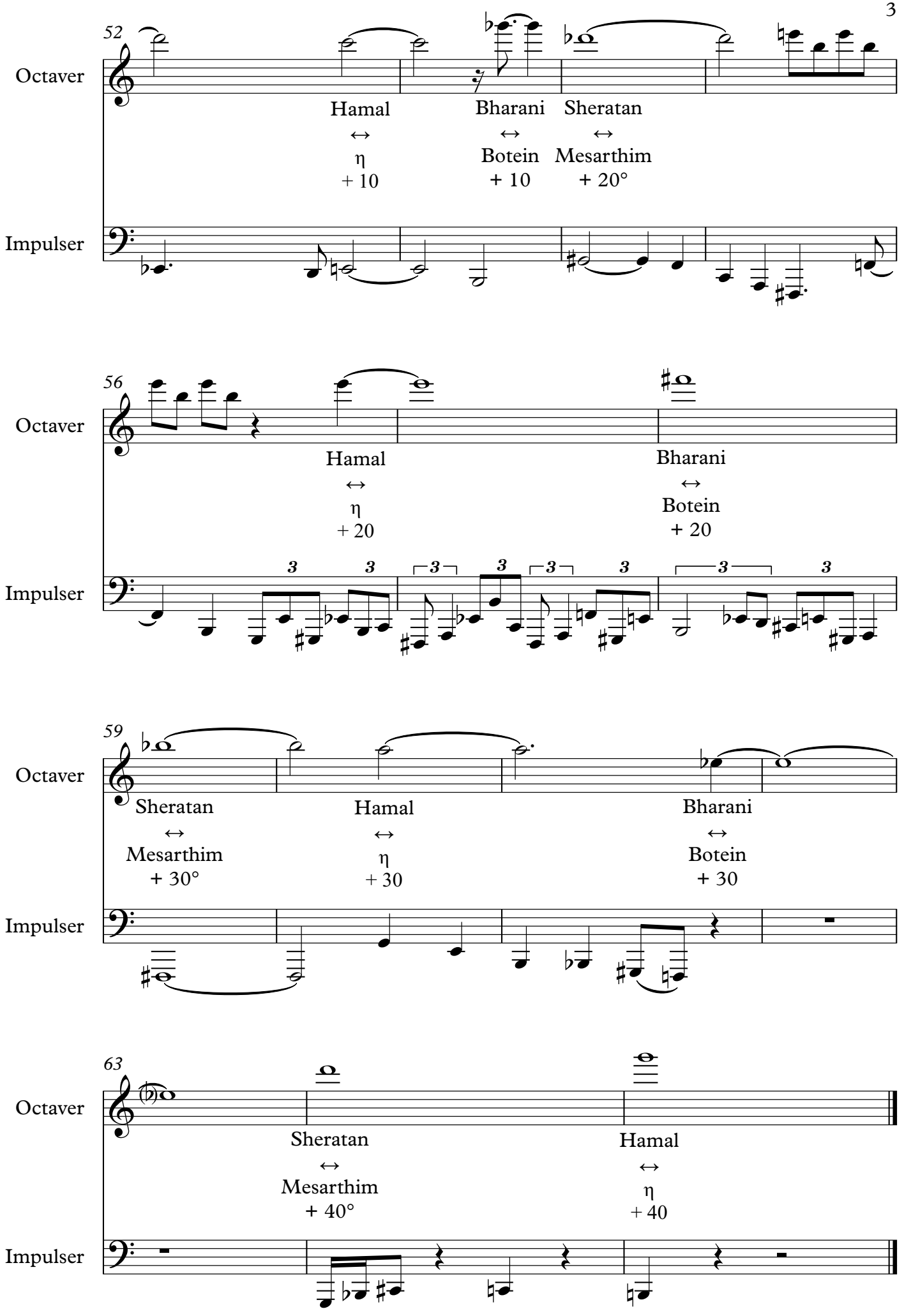
Mesarthim
+ 10°
Impulser
Sheratan...


52
Octaver
Hamal
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η
+ 10
Bharani
↔
Botein
+ 10
Sheratan
↔
Mesarthim
+ 20°
Impulser
56
Octaver
Hamal
↔
η
+ 20
Bharani
↔
Botein
+ 20
Impulser
3
59
Octaver
Sheratan
↔
Mesarthim
+ 30°
Hamal
↔
η
+ 30
Bharani
↔
Botein
+ 30
Impulser
63
Octaver
Sheratan
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+ 40°
Hamal
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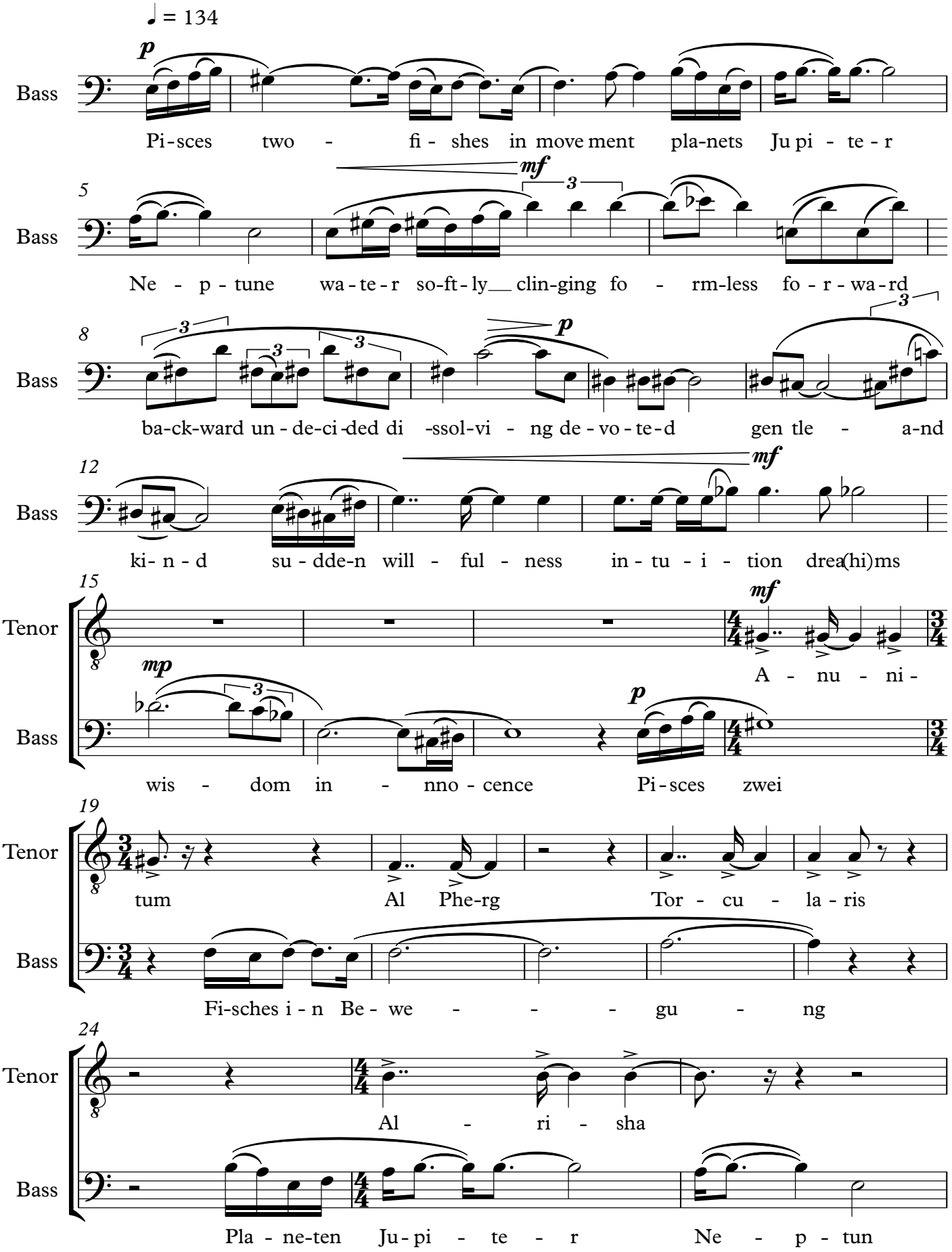
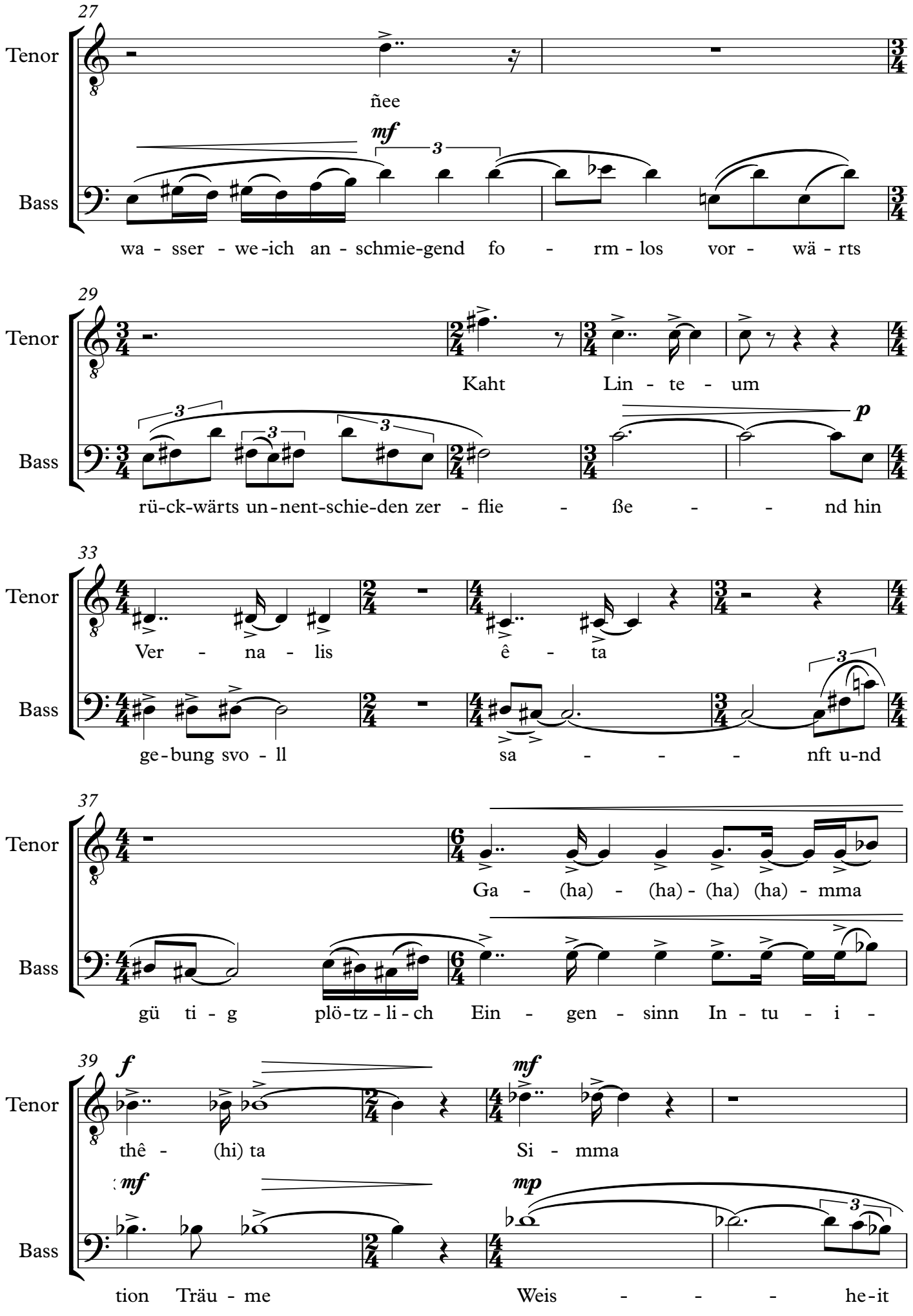
η
+ 40
Impulser

FISCHE - PISCES

For Tenor & Bass Singers and Electronic Music




27
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Tenor
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Bass
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33
Tenor
Ver - na - lis ê - ta
Bass
ge-bung svo - ll sa - - - nft u-nd
3
37
Tenor
Ga - (ha) - (ha) - (ha) (ha) - mma
Bass
gü ti - g plö-tz - li - ch Ein - gen - sinn In - tu - i -
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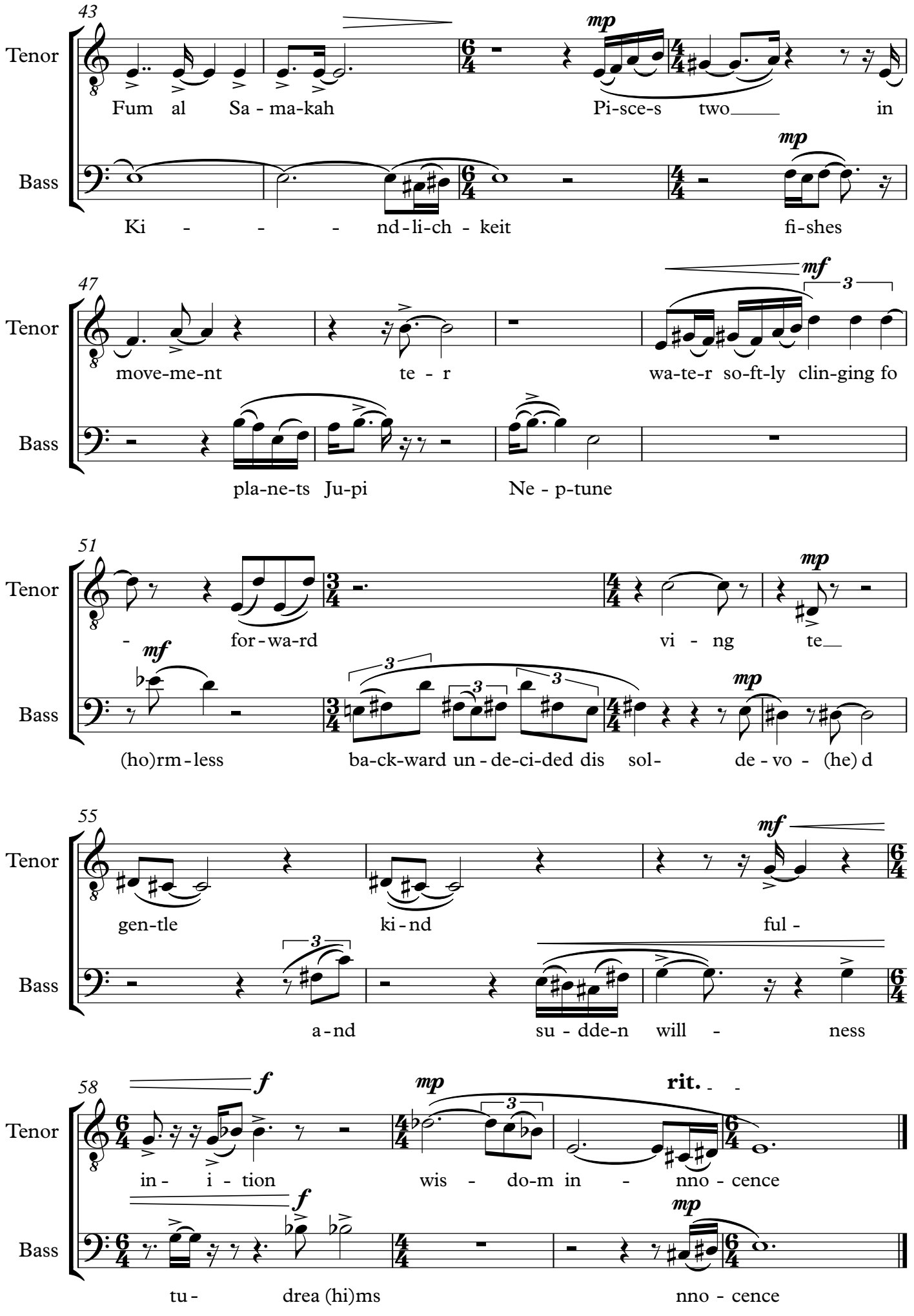
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Tenor
Fum al Sa - ma-kah
Pi-sce-s two in
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Bass
Ki - - - nd-li-ch - keit
fi-shes
mp
47
Tenor
move-me-nt
te - r
wa-te-r so-ft-ly clin-ging fo
mf
3
Bass
pla-ne-ts Ju-pi
Ne - p-tune
51
Tenor
- for-wa-rd
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Bass
(ho)rm-less
ba-ck-ward un-de-ci-ded dis sol-
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mf
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55
Tenor
gen-tle
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Bass
a-nd
su - dde-n will - ness
3
58
Tenor
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wis - do-m in - nno - cence
f
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Bass
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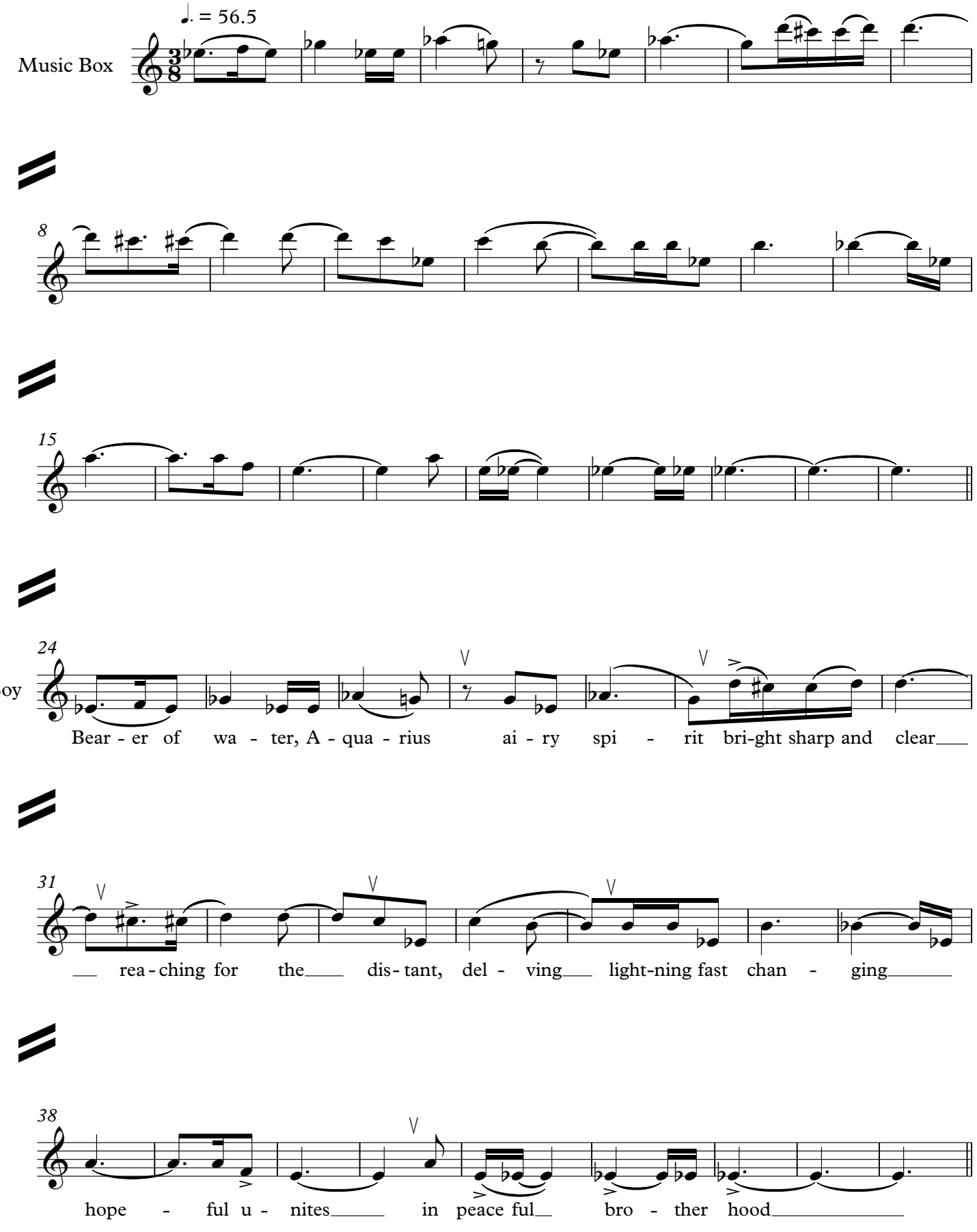
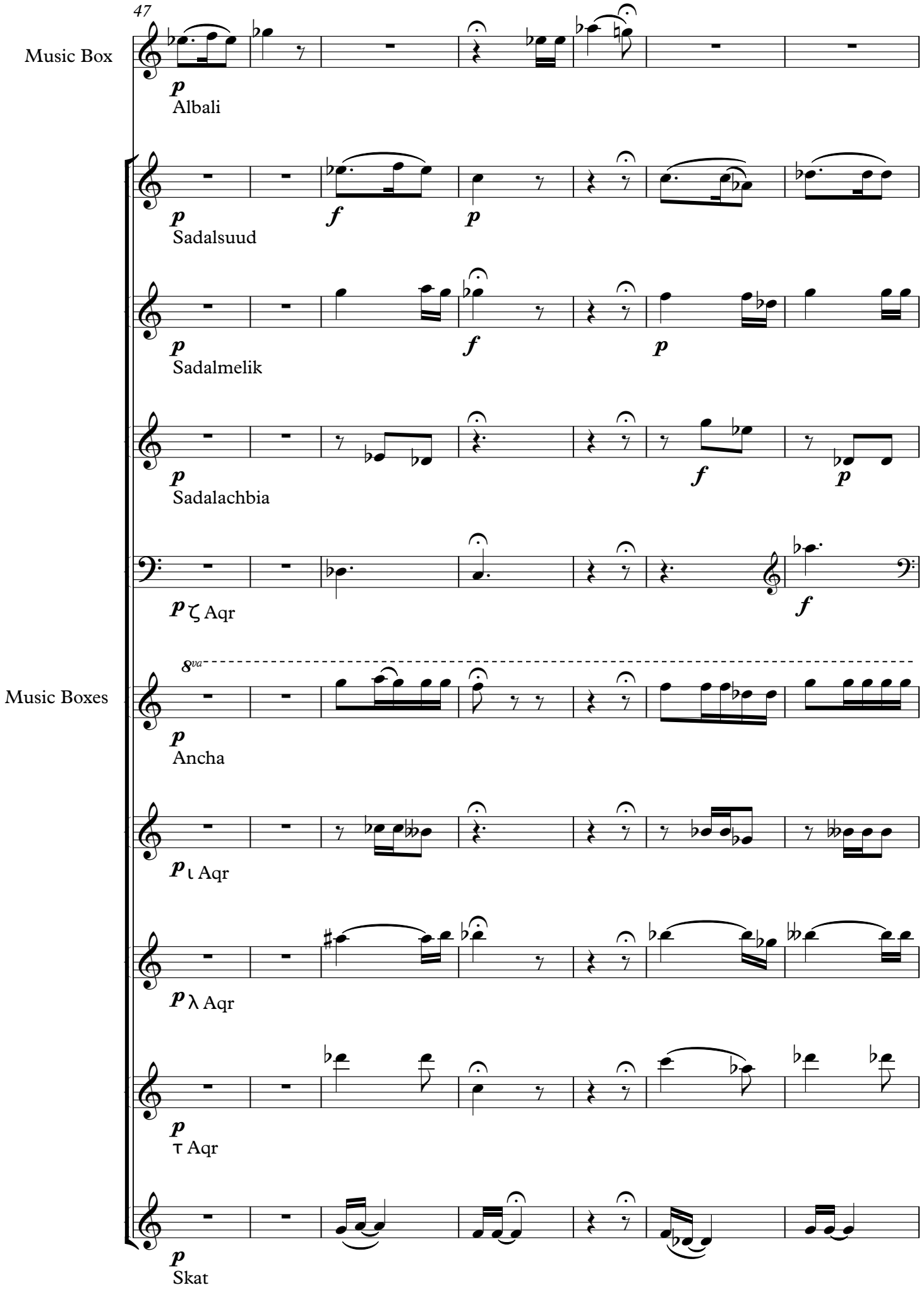
WASSERMANN - AQUARIUS

For a Boy Singer and Electronic Music

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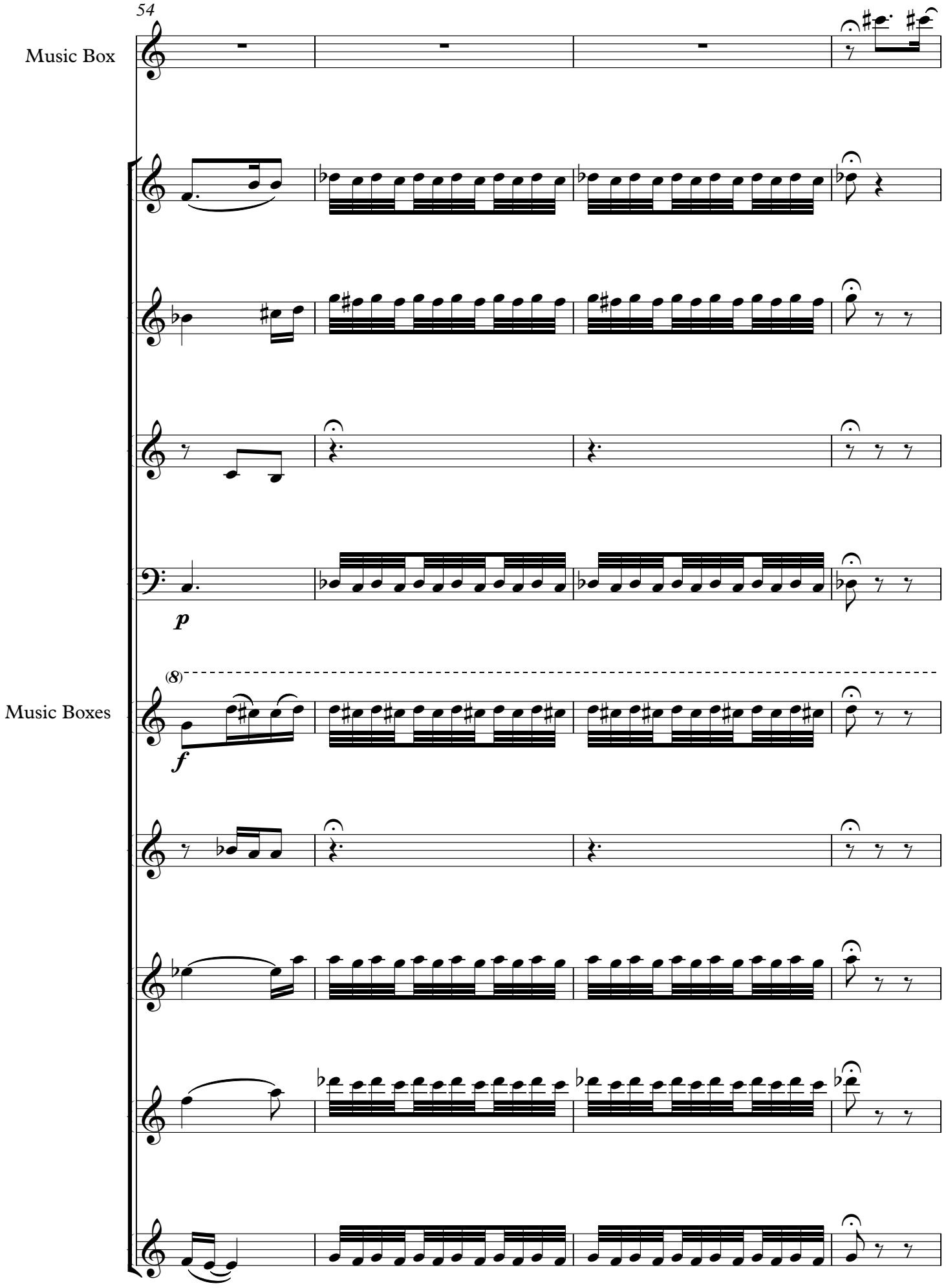
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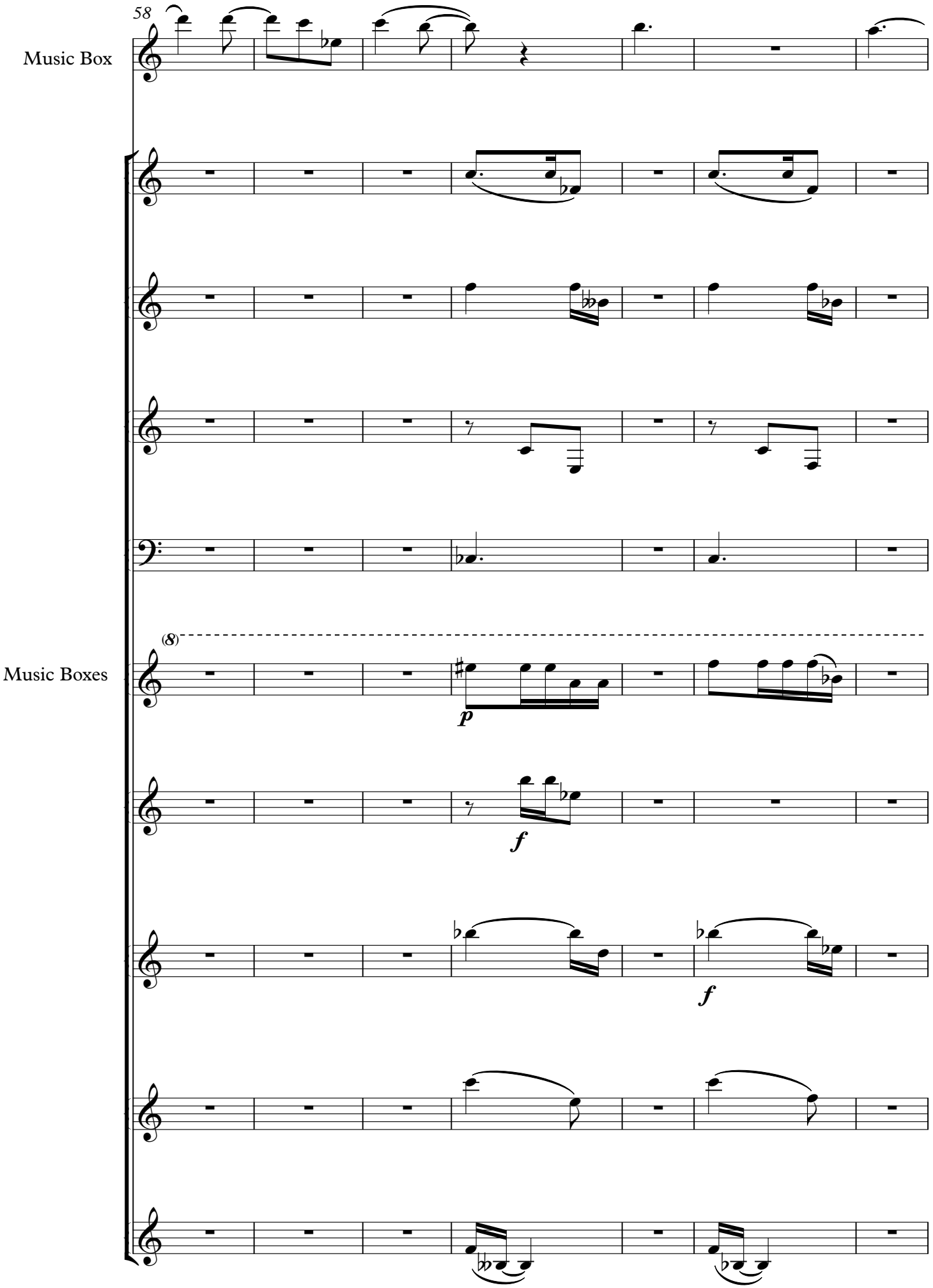
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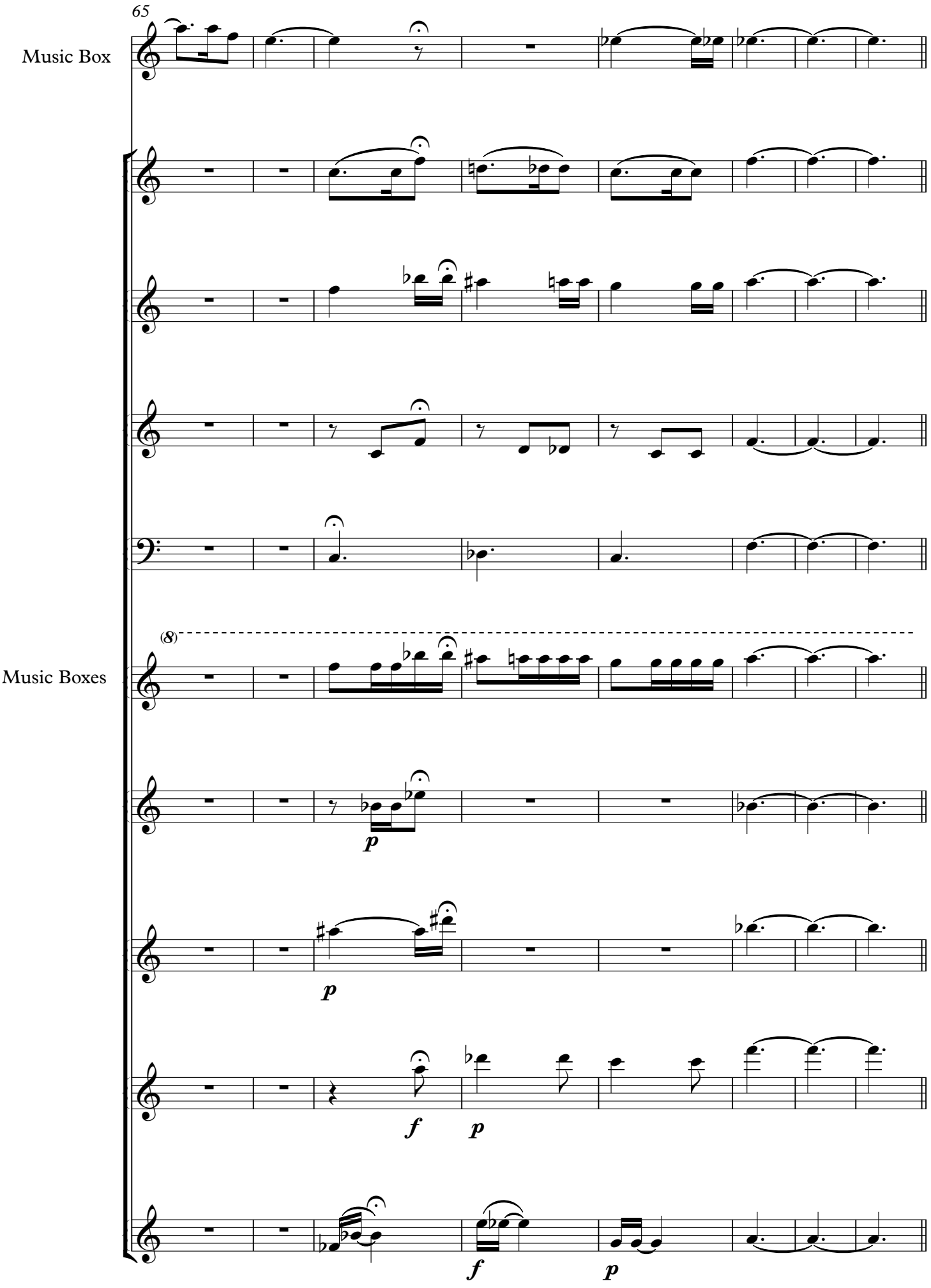
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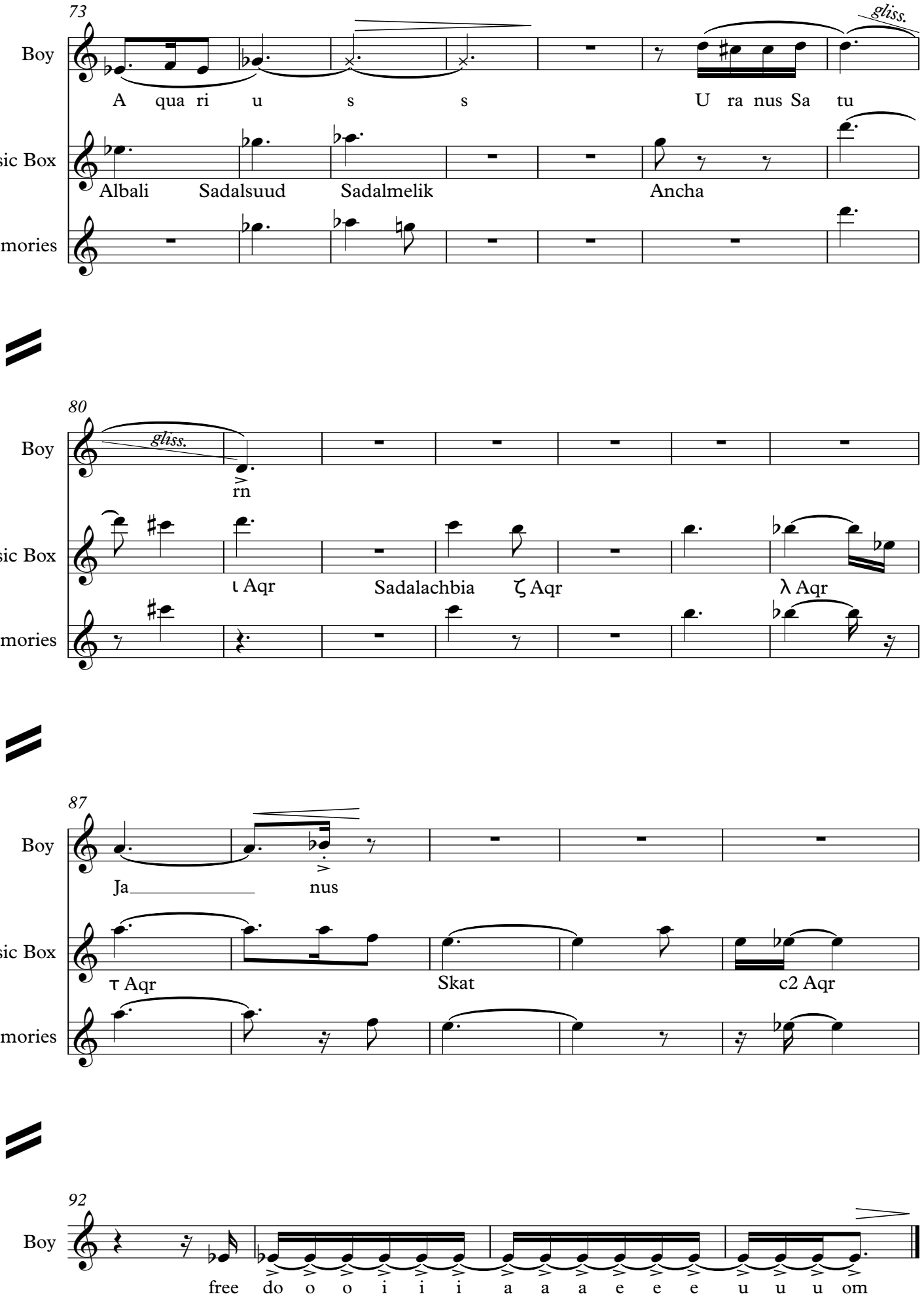
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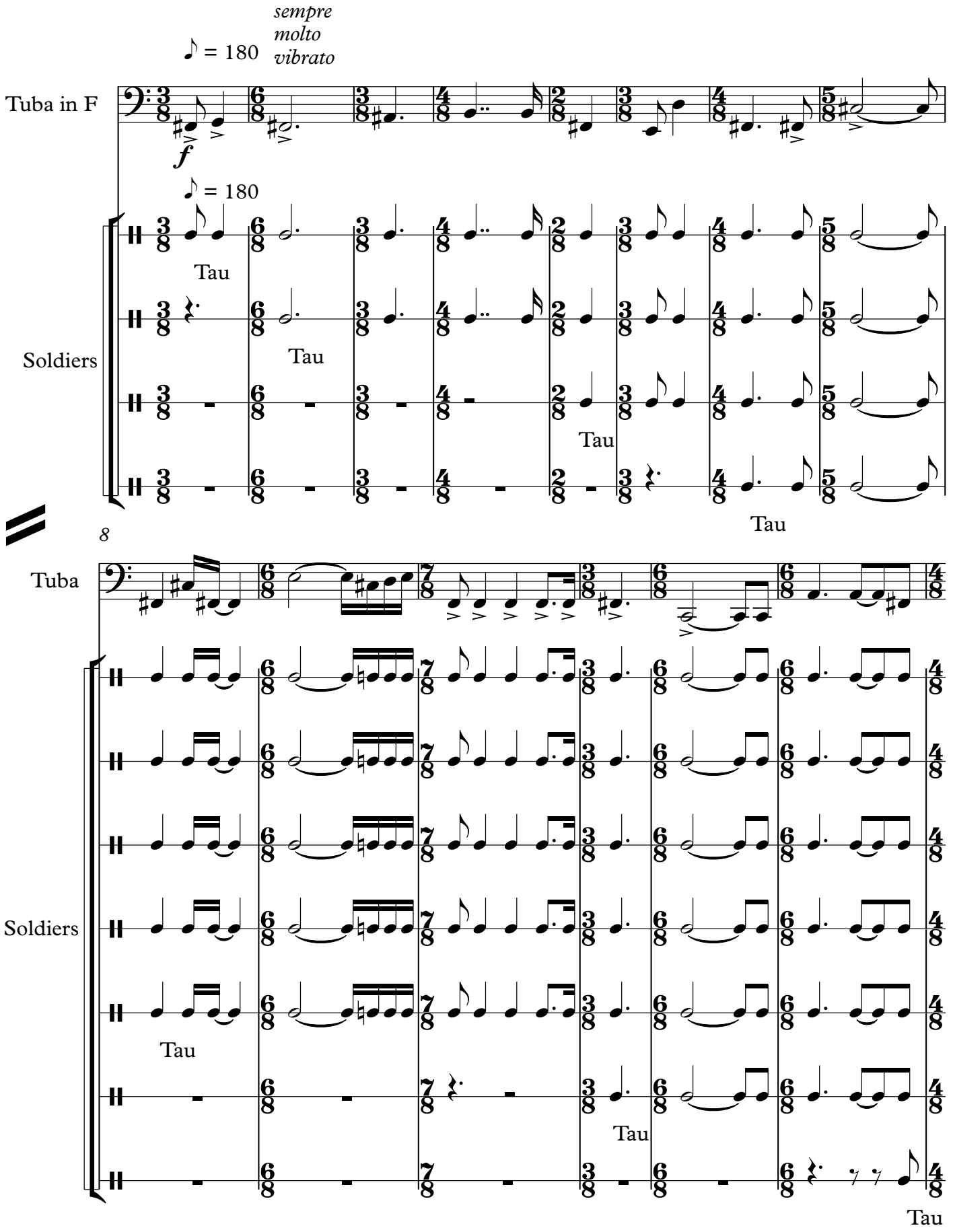
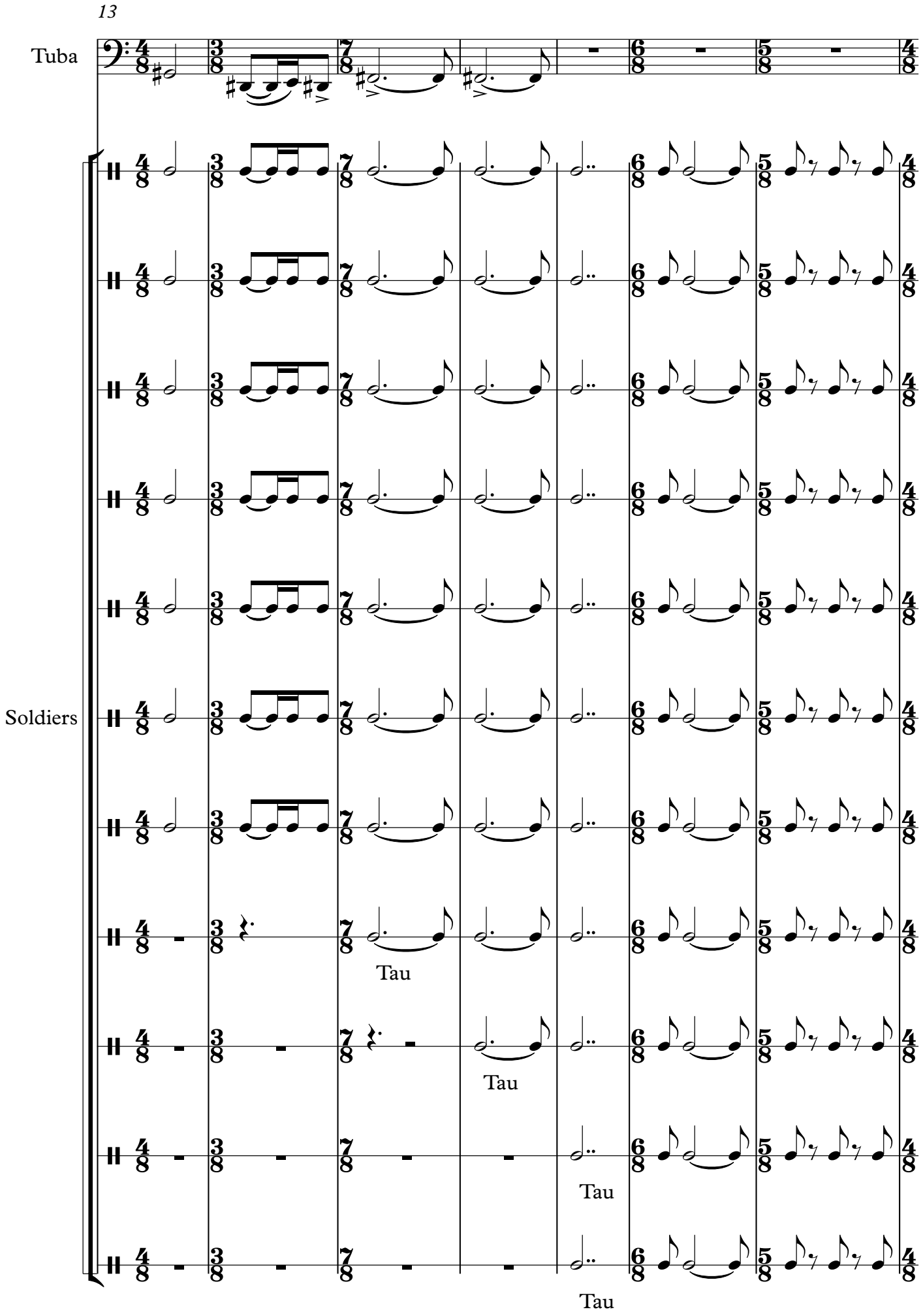
STIER - TAURUS

For Tuba and Electronic Music

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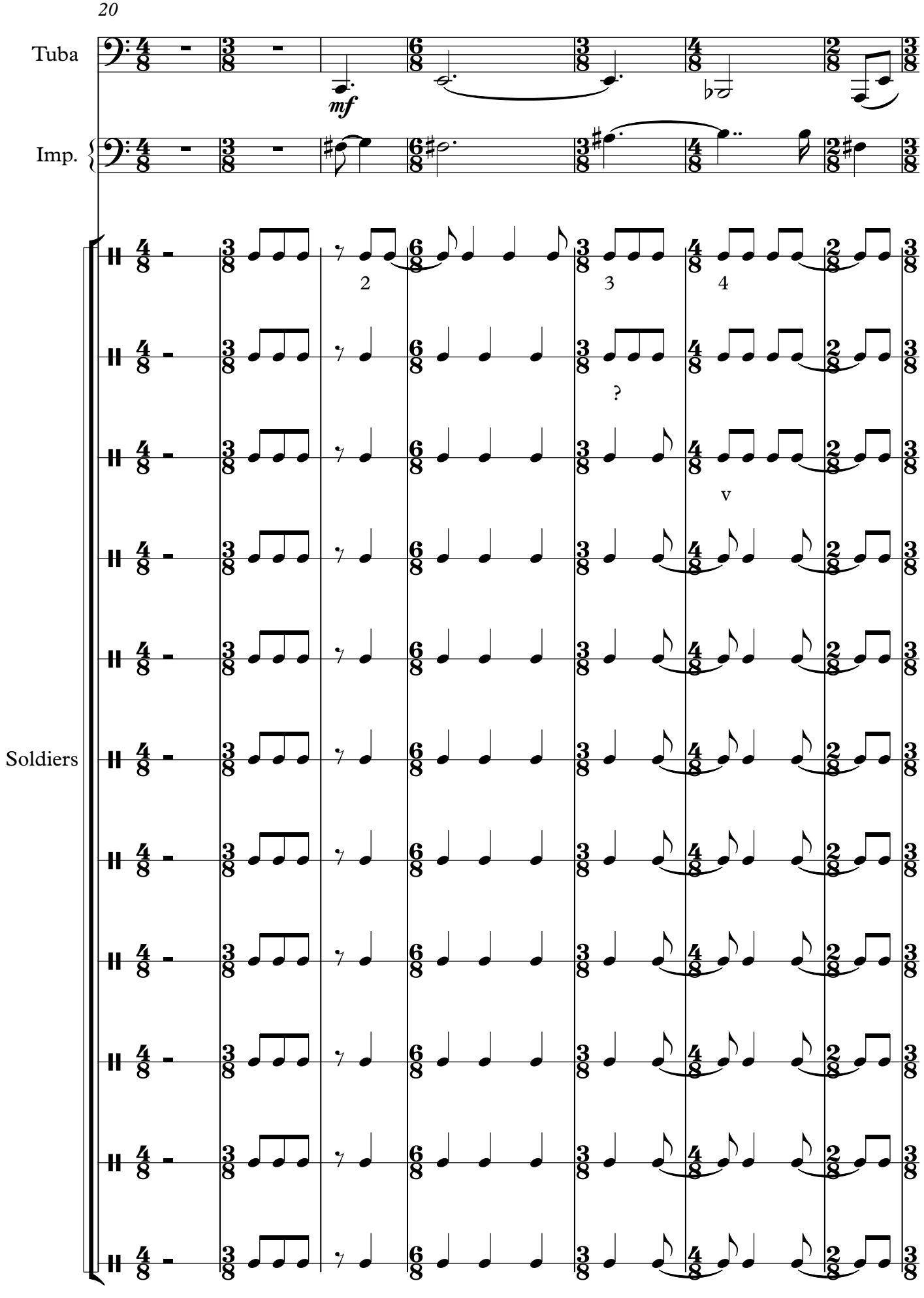
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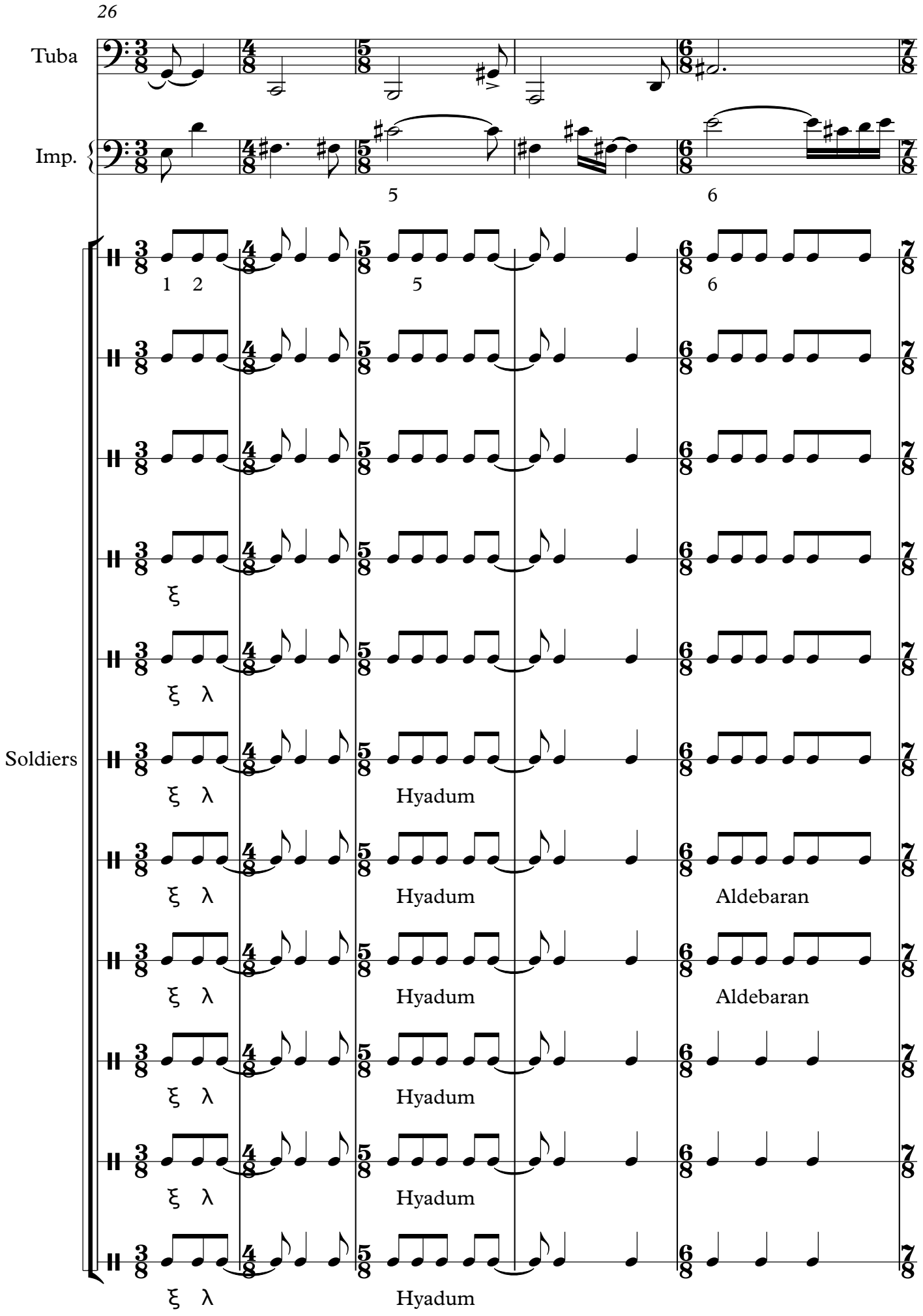
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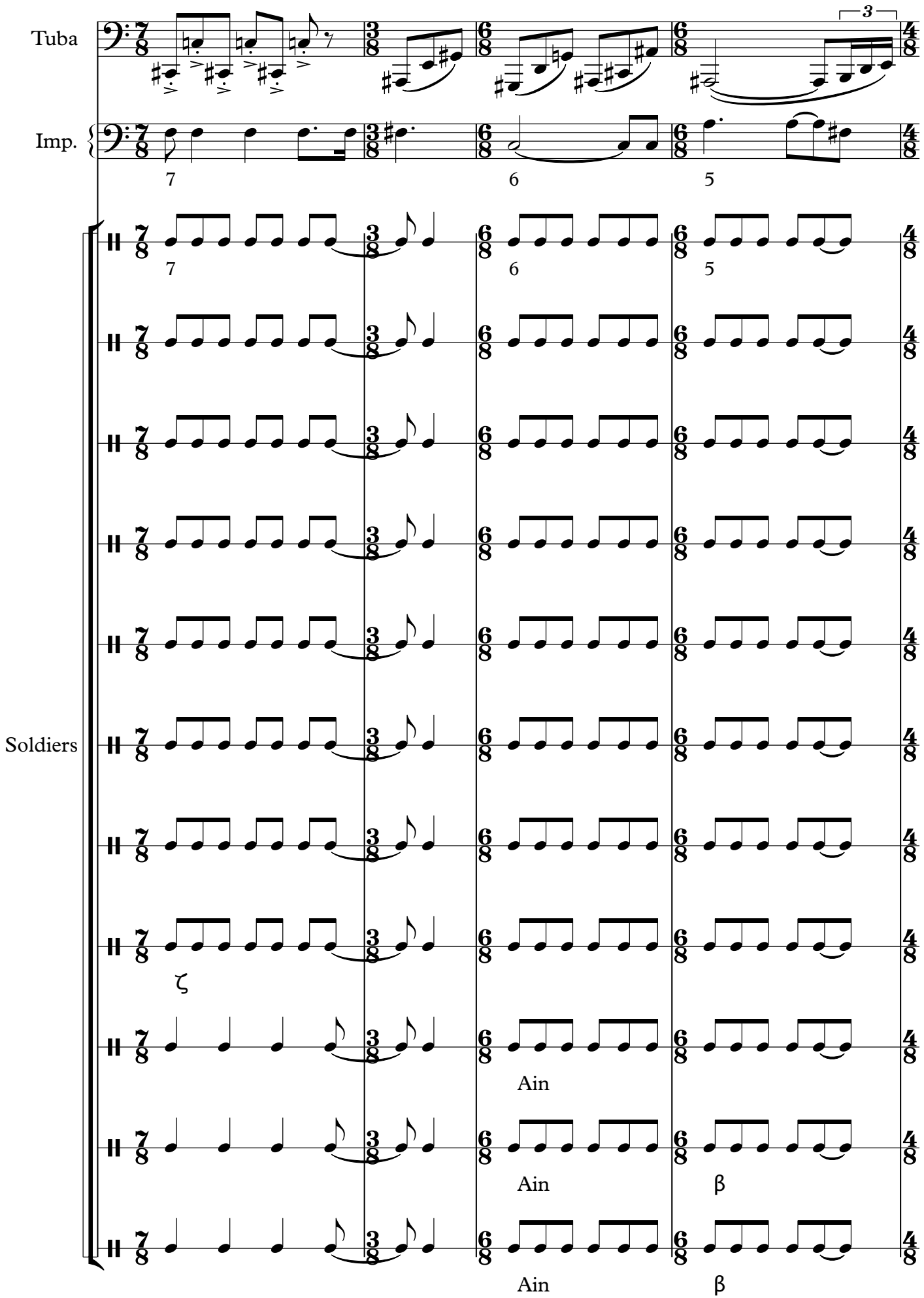
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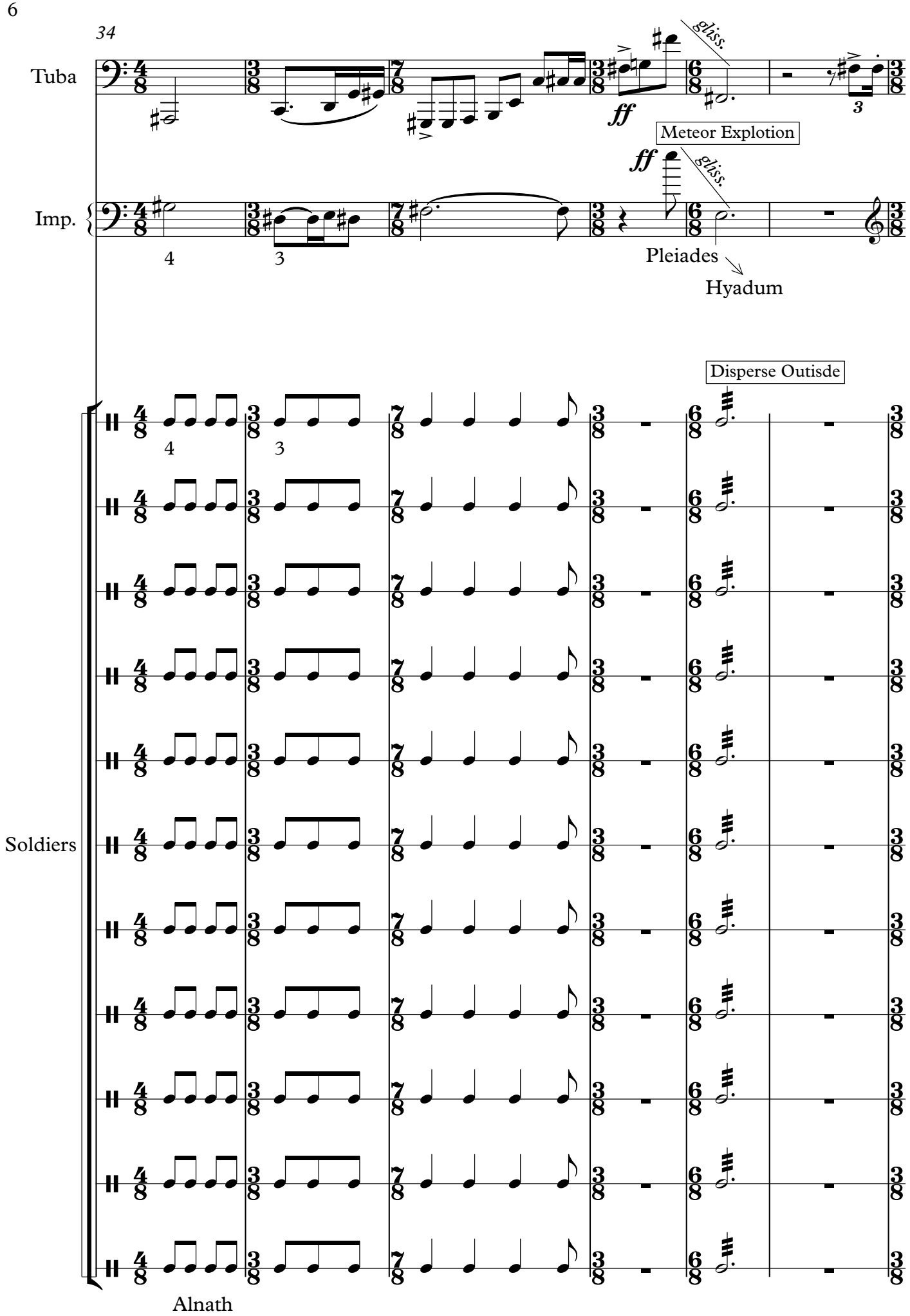
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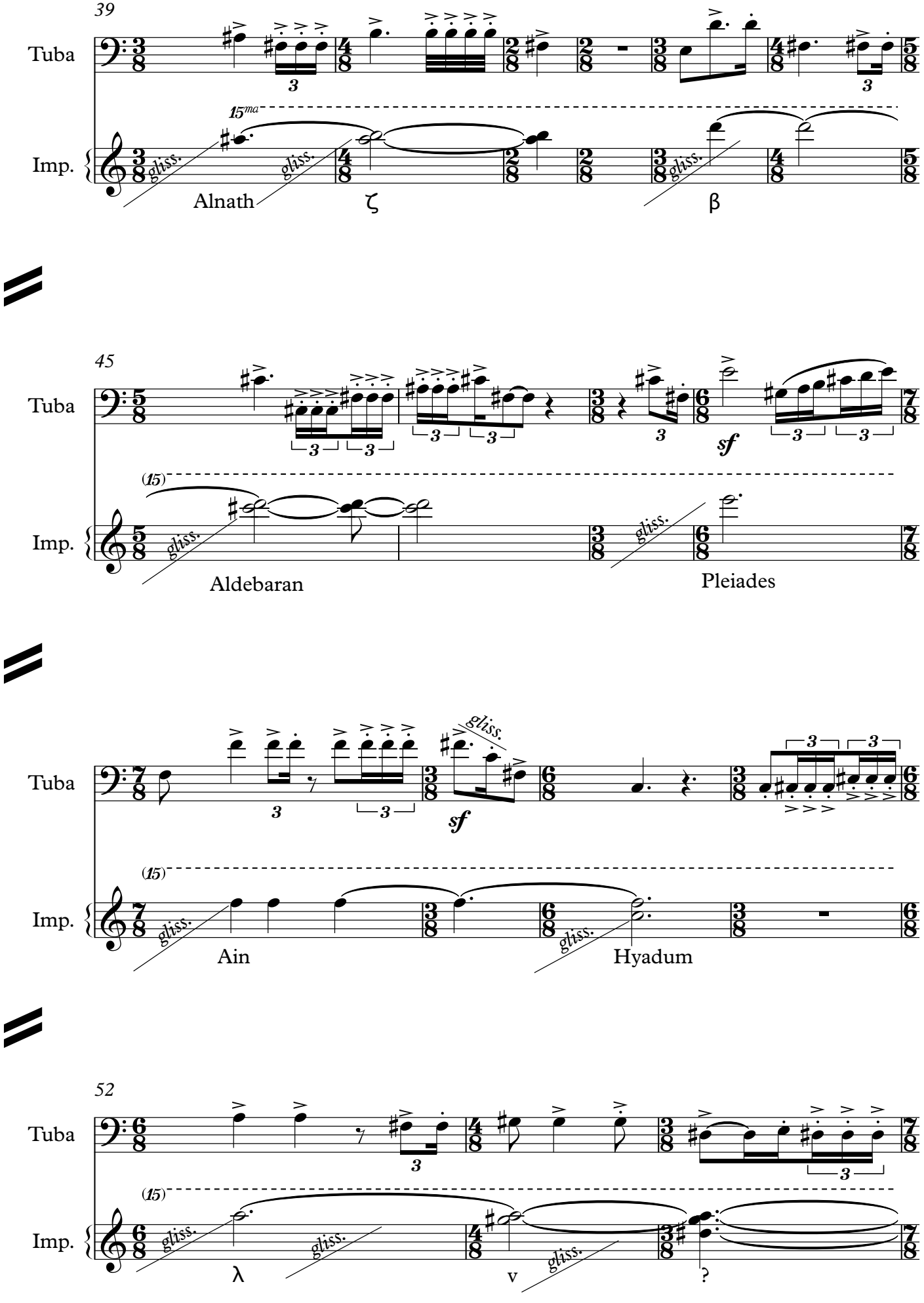
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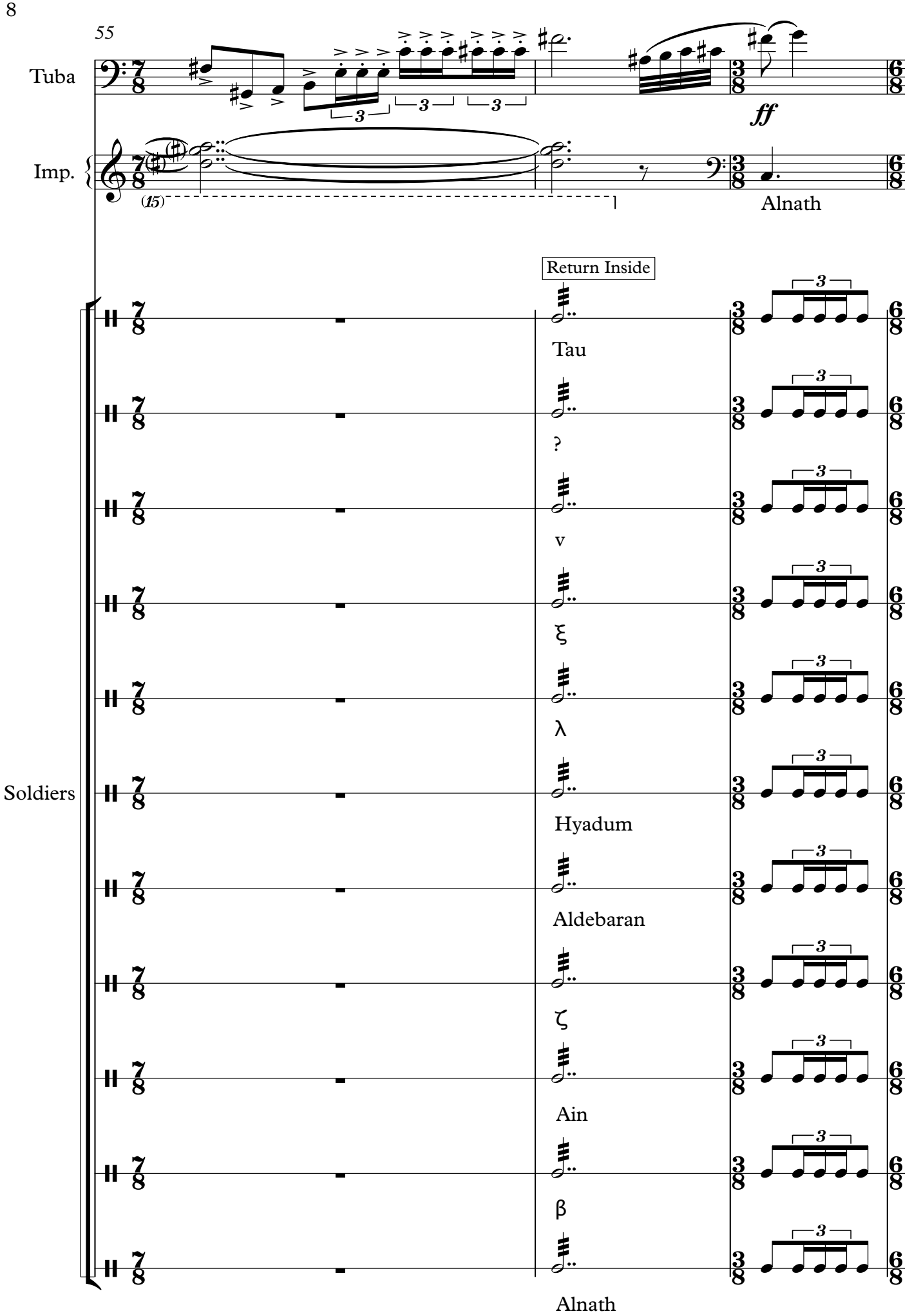
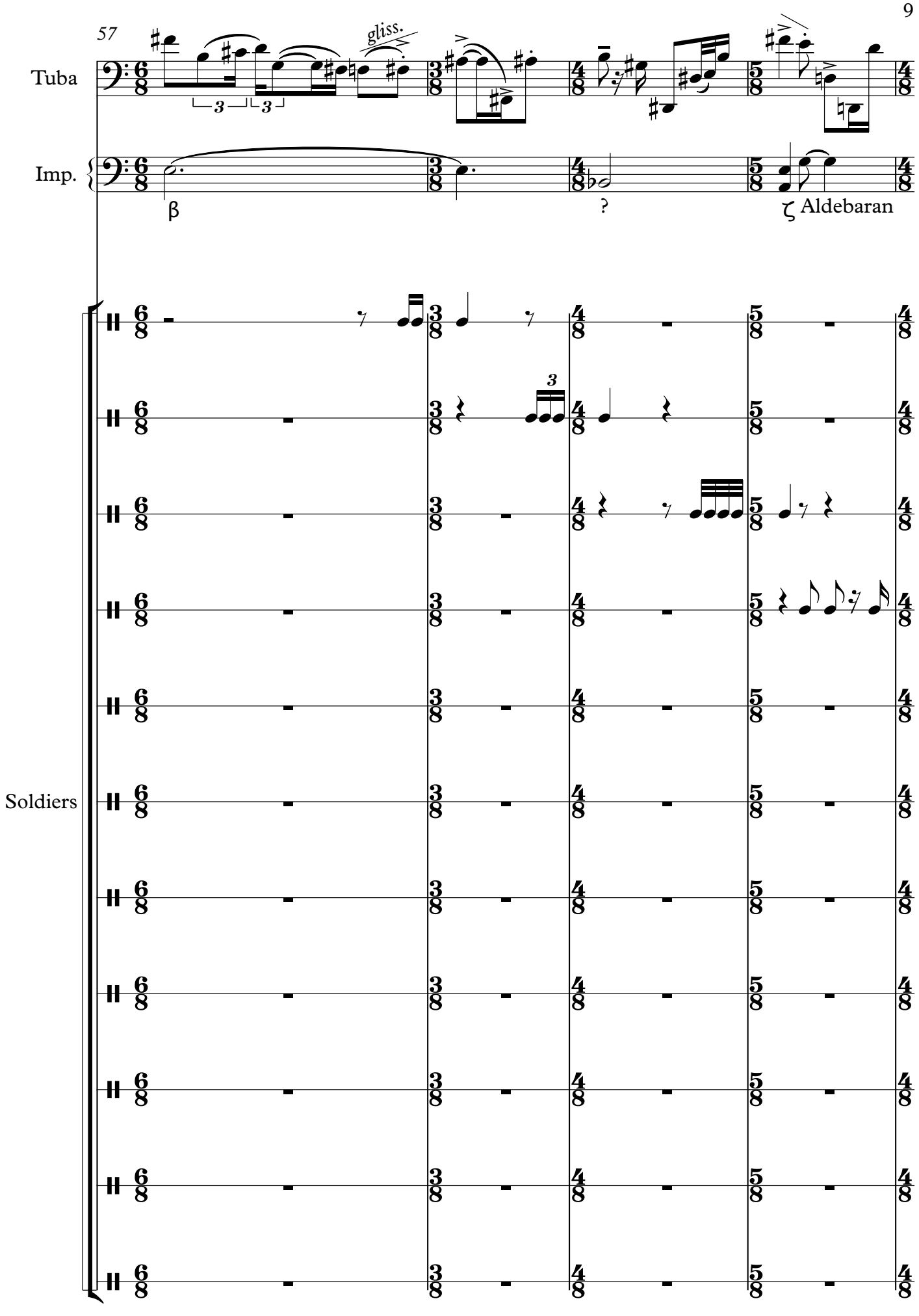
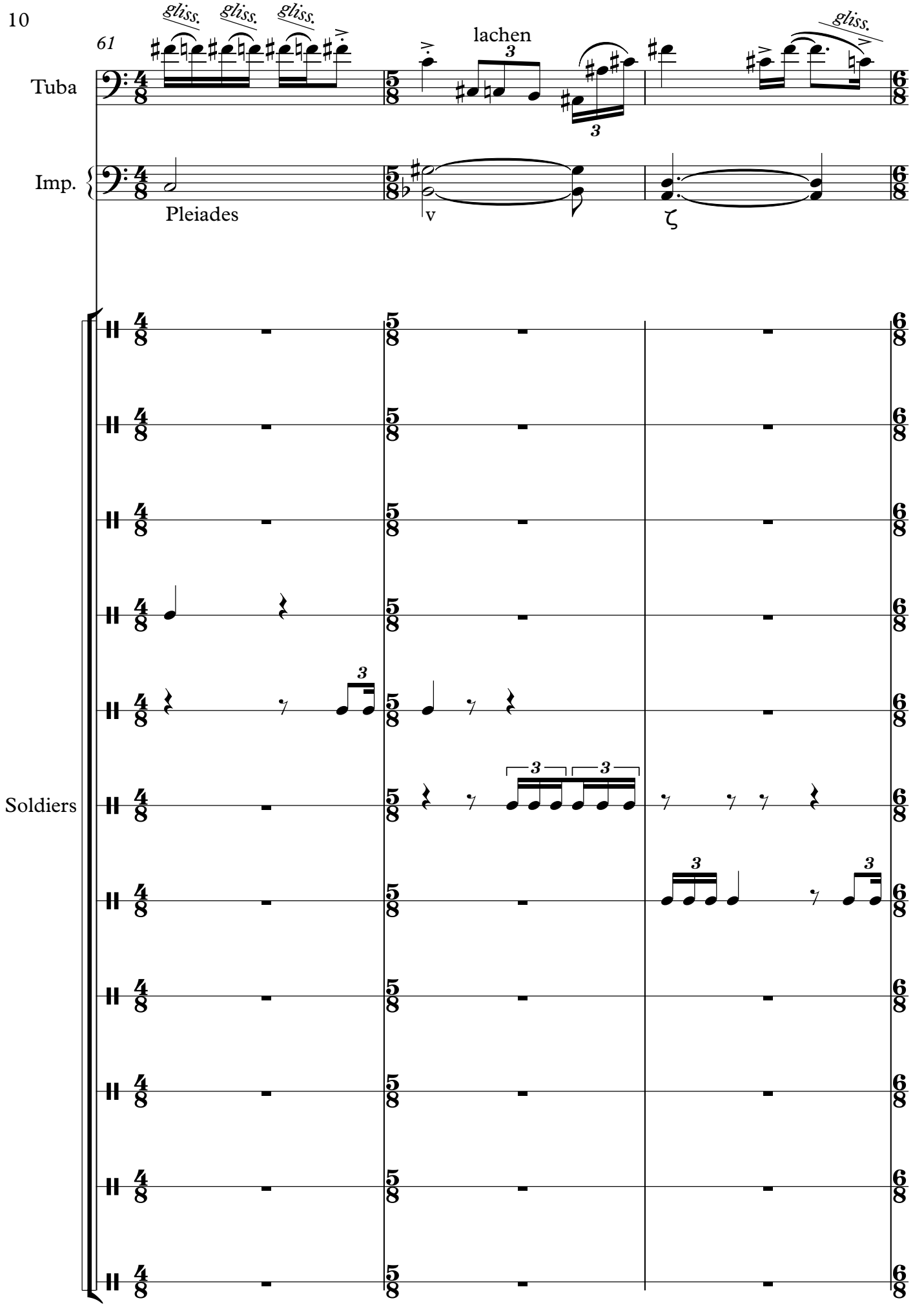
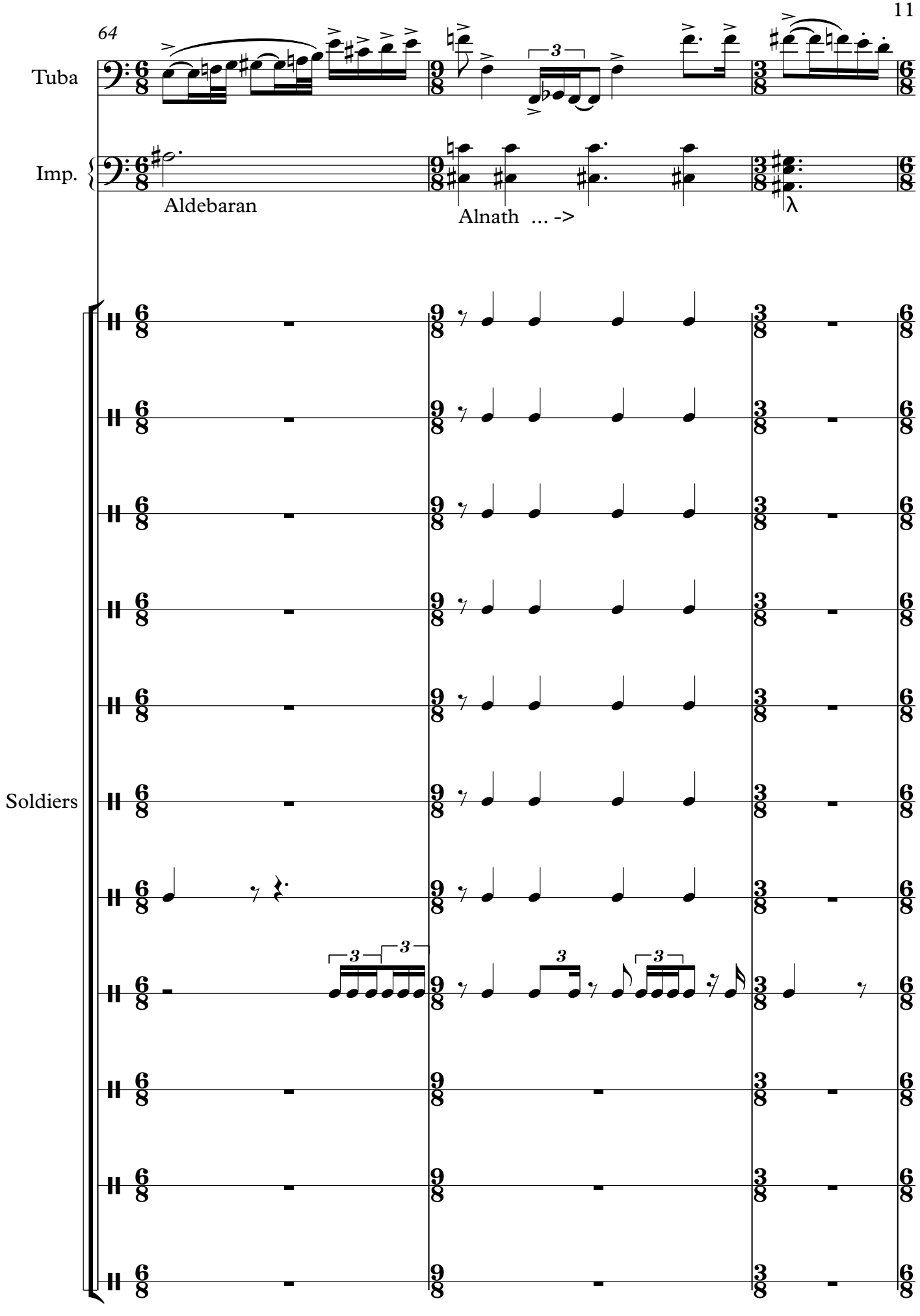
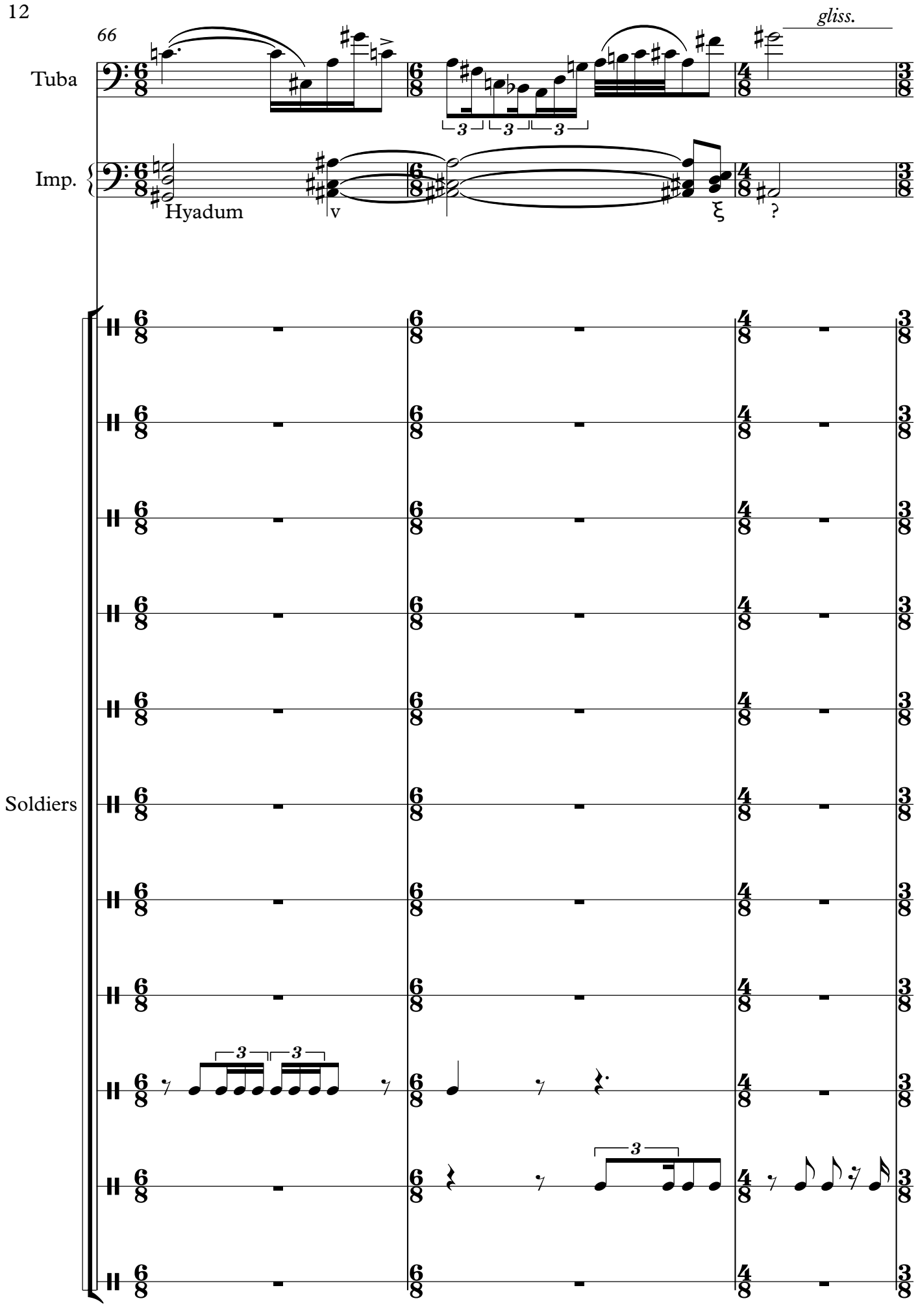
45
Tuba
Imp.
(15)
sf
Aldebaran
Pleiades
Tuba
Imp.
(15)
sf
gliss.
Ain
Hyadum
52
Tuba
Imp.
(15)
λ
ν
?

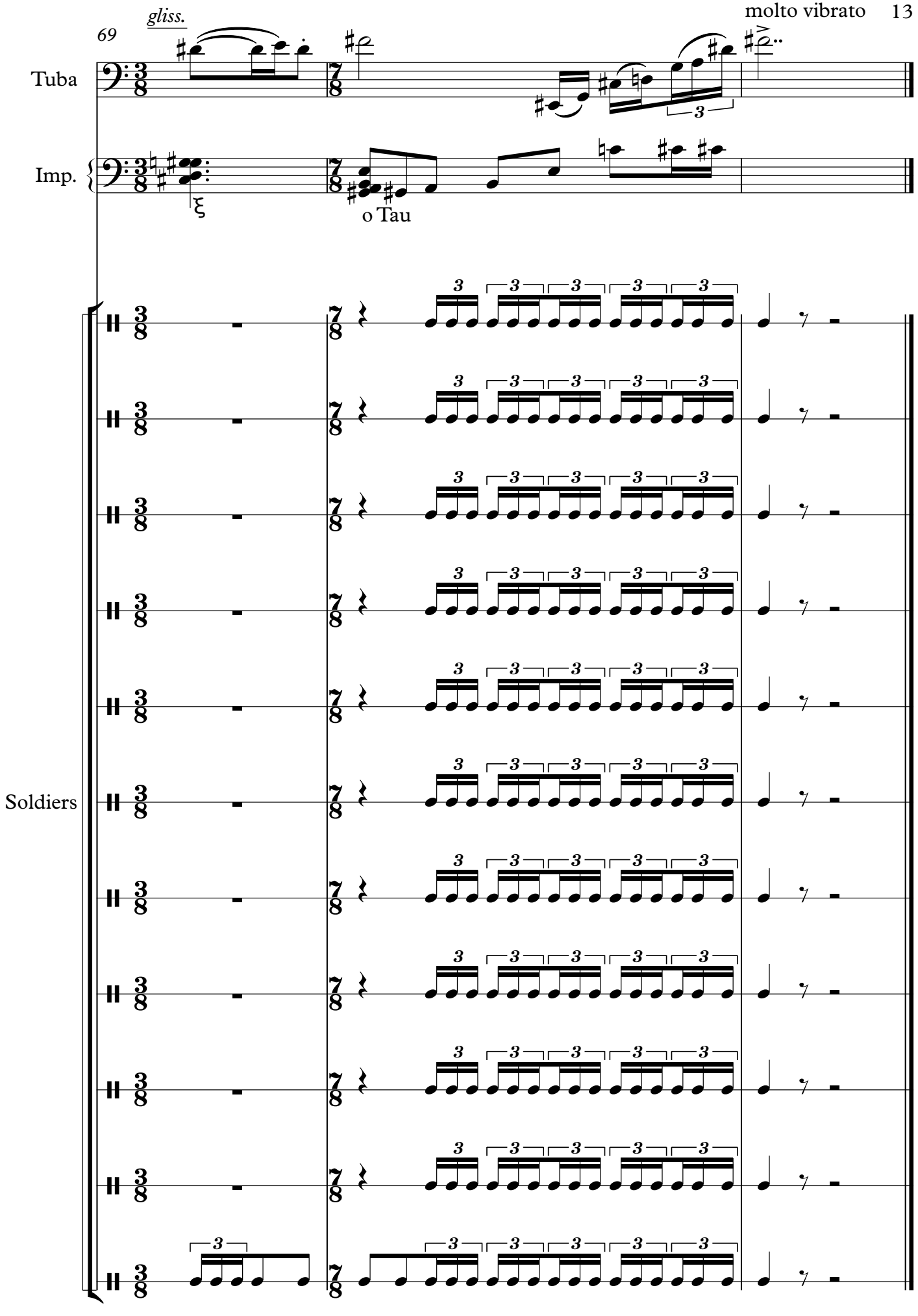

55
Tuba
Imp.
(15)
ff
Alnath
Return Inside
Tau
?
v
ξ
λ
Soldiers
Hyadum
Aldebaran
ζ
Ain
β
Alnath


57
gliss.
Tuba
Imp.
β
?
ζ Aldebaran
Soldiers


61
gliss.
gliss.
gliss.
lachen
gliss.
Tuba
Imp.
Pleiades
v
ζ
Soldiers


64
Tuba
Imp.
Aldebaran
Alnath ... ->
λ
Soldiers


66
gliss.
Tuba
Imp.
Hyadum
v
Soldiers


gliss.
69
Tuba
Imp.
o Tau
Soldiers

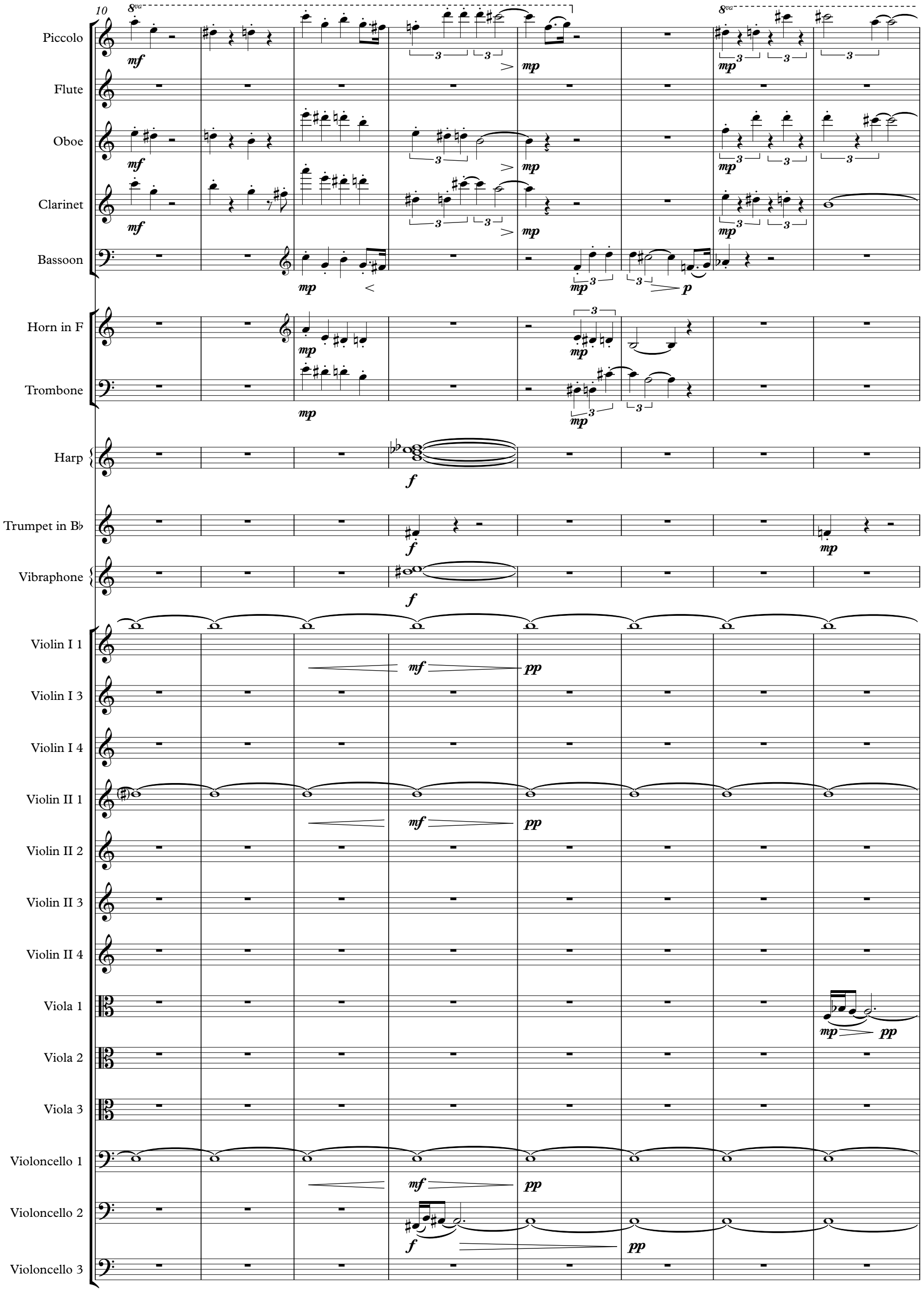
ZWILLINGE - GEMINI

Transcribed from FÜNF WEITERE STERNZEICHEN

Karlheinz Stockhausen

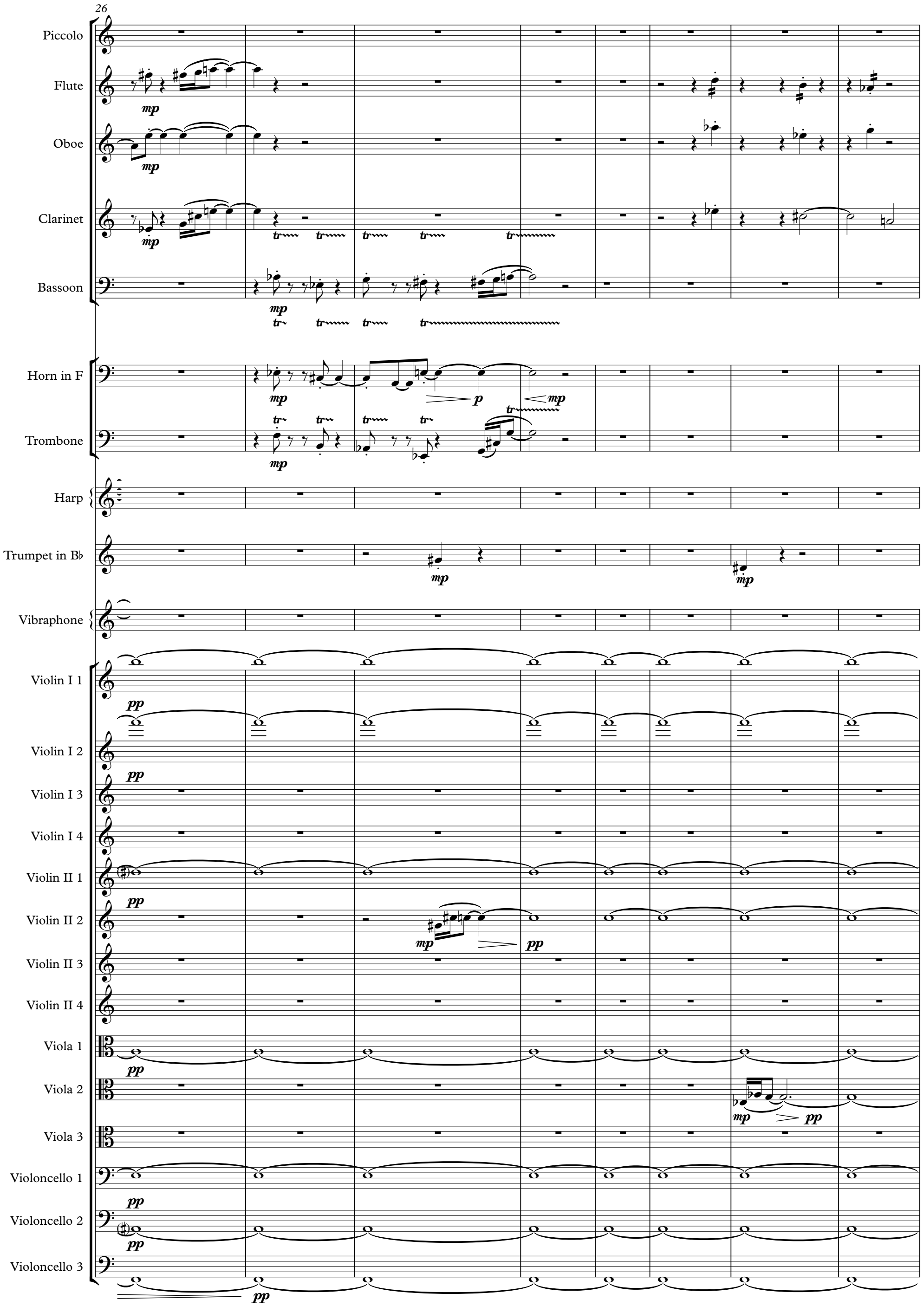
♩ = 101

Piccolo
Flute
Oboe
Clarinet
Bassoon
Horn in F
Trombone
Harp
Trumpet in B♭
Vibraphone
Violin I 1
Violin I 3
Violin I 4
Violin II 1
Violin II 2
Violin II 3
Violin II 4
Viola 1
Viola 2
Viola 3
Violoncello 1
Violoncello 2
Violoncello 3


10
8va
8va
Piccolo
Flute
Oboe
Clarinet
Bassoon
Horn in F
Trombone
Harp
Trumpet in B♭
Vibraphone
Violin I 1
Violin I 3
Violin I 4
Violin II 1
Violin II 2
Violin II 3
Violin II 4
Viola 1
Viola 2
Viola 3
Violoncello 1
Violoncello 2
Violoncello 3
mf
mp
p
pp
f

18

Piccolo
Flute
Oboe
Clarinet
Bassoon
Horn in F
Trombone
Harp
Trumpet in B♭
Vibraphone
Violin I 1
Violin I 2
Violin I 3
Violin I 4
Violin II 1
Violin II 2
Violin II 3
Violin II 4
Viola 1
Viola 2
Viola 3
Violoncello 1
Violoncello 2
Violoncello 3


26
Piccolo
Flute
Oboe
Clarinet
Bassoon
Horn in F
Trombone
Harp
Trumpet in B♭
Vibraphone
Violin I 1
Violin I 2
Violin I 3
Violin I 4
Violin II 1
Violin II 2
Violin II 3
Violin II 4
Viola 1
Viola 2
Viola 3
Violoncello 1
Violoncello 2
Violoncello 3
mp
p
pp
tr

34

Piccolo
Flute
Oboe
Clarinet
Bassoon
Horn in F
Trombone
Harp
Trumpet in B♭
Vibraphone
Violin I 1
Violin I 2
Violin I 3
Violin I 4
Violin II 1
Violin II 2
Violin II 3
Violin II 4
Viola 1
Viola 2
Viola 3
Violoncello 1
Violoncello 2
Violoncello 3

pp
pp
pp
mp
mp
mp
mp
mp
8va
mp
pp
mp
pp

43

Piccolo
Flute
Oboe
Clarinet
Bassoon
Horn in F
Trombone
Harp
Trumpet in B♭
Vibraphone
Violin I 1
Violin I 2
Violin I 3
Violin I 4
Violin II 1
Violin II 2
Violin II 3
Violin II 4
Viola 1
Viola 2
Viola 3
Violoncello 1
Violoncello 2
Violoncello 3

50

Piccolo
Flute
Oboe
Clarinet
Bassoon
Horn in F
Trombone
Harp
Trumpet in B♭
Vibraphone
Violin I 1
Violin I 2
Violin I 3
Violin I 4
Violin II 1
Violin II 2
Violin II 3
Violin II 4
Viola 1
Viola 2
Viola 3
Violoncello 1
Violoncello 2
Violoncello 3

57

Piccolo
Flute
Oboe
Clarinet
Bassoon
Horn in F
Trombone
Harp
Trumpet in B♭
Vibraphone
Violin I 1
Violin I 2
Violin I 3
Violin I 4
Violin II 1
Violin II 2
Violin II 3
Violin II 4
Viola 1
Viola 2
Viola 3
Violoncello 1
Violoncello 2
Violoncello 3

64

Piccolo
Flute
Oboe
Clarinet
Bassoon
Horn in F
Trombone
Harp
Trumpet in B♭
Vibraphone
Violin I 1
Violin I 2
Violin I 3
Violin I 4
Violin II 1
Violin II 2
Violin II 3
Violin II 4
Viola 1
Viola 2
Viola 3
Violoncello 1
Violoncello 2
Violoncello 3

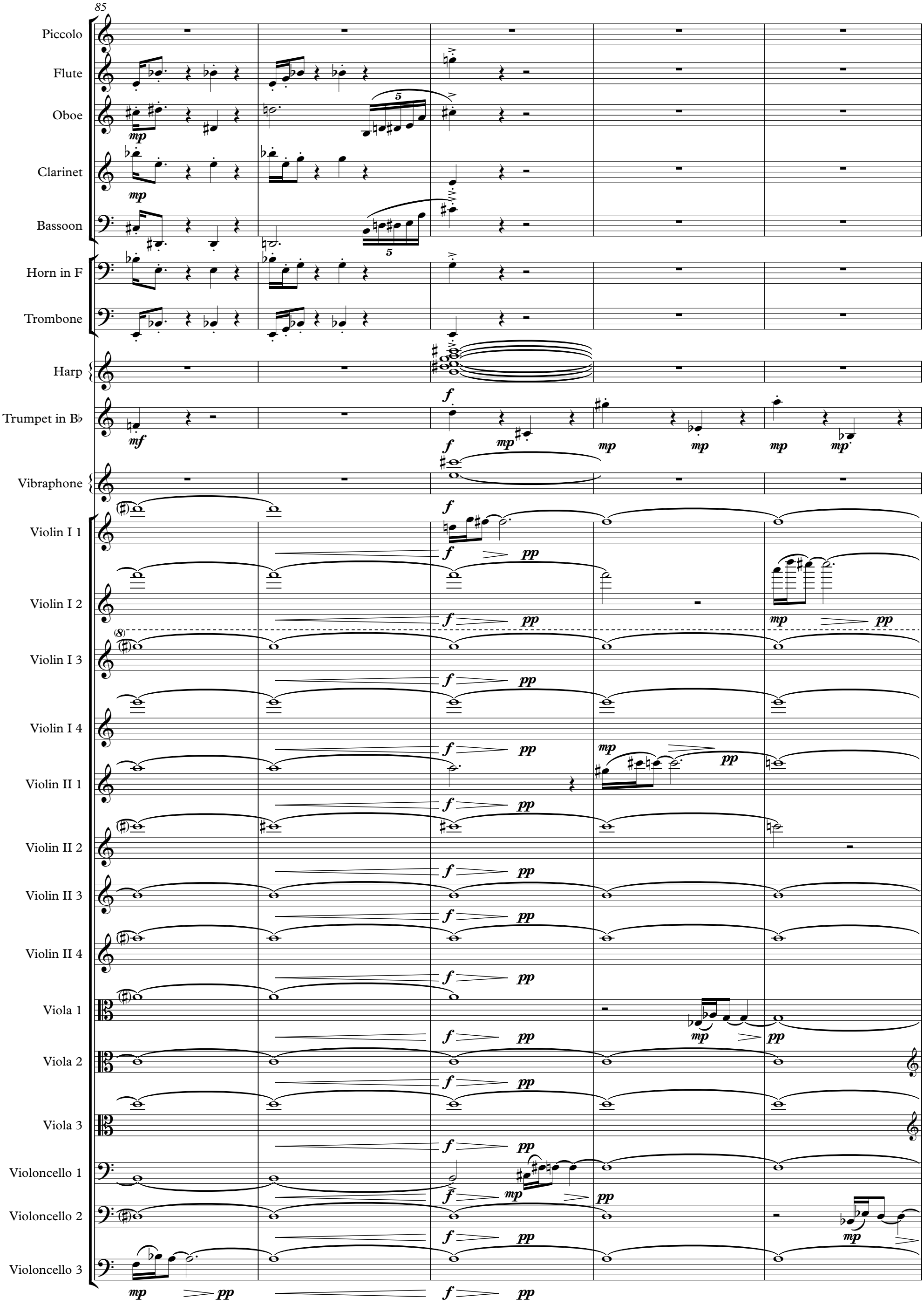
70

Piccolo
Flute
Oboe
Clarinet
Bassoon
Horn in F
Trombone
Harp
Trumpet in B♭
Vibraphone
Violin I 1
Violin I 2
Violin I 3
Violin I 4
Violin II 1
Violin II 2
Violin II 3
Violin II 4
Viola 1
Viola 2
Viola 3
Violoncello 1
Violoncello 2
Violoncello 3

gliss.
tr
5
3
3
mp
mp
mp
mp
mp
pp
mp
pp
mp
pp
mp
pp

78

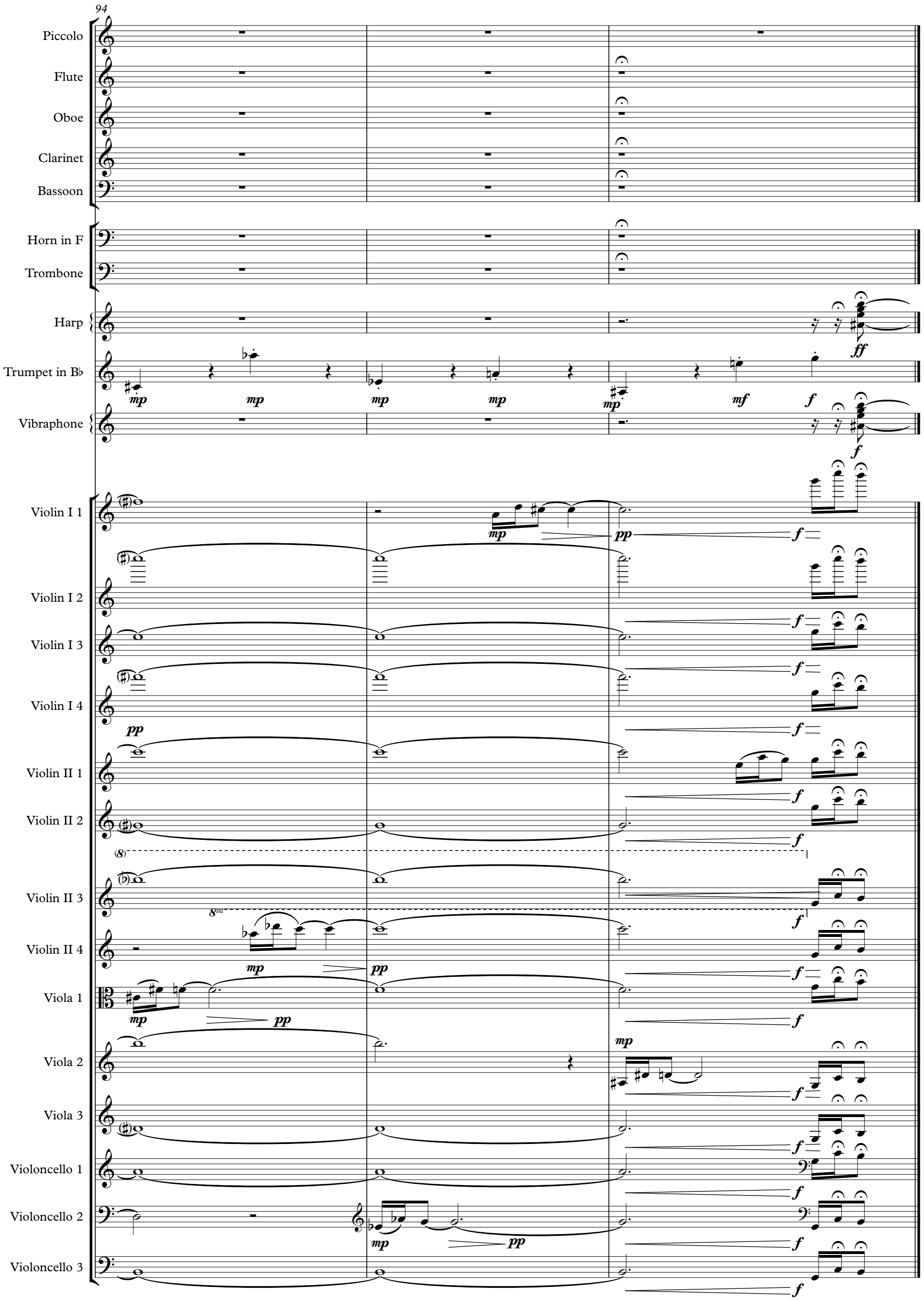
Piccolo
Flute
Oboe
Clarinet
Bassoon
Horn in F
Trombone
Harp
Trumpet in B♭
Vibraphone
Violin I 1
Violin I 2
Violin I 3
Violin I 4
Violin II 1
Violin II 2
Violin II 3
Violin II 4
Viola 1
Viola 2
Viola 3
Violoncello 1
Violoncello 2
Violoncello 3


85
Piccolo
Flute
Oboe
Clarinet
Bassoon
Horn in F
Trombone
Harp
Trumpet in B♭
Vibraphone
Violin I 1
Violin I 2
Violin I 3
Violin I 4
Violin II 1
Violin II 2
Violin II 3
Violin II 4
Viola 1
Viola 2
Viola 3
Violoncello 1
Violoncello 2
Violoncello 3
mp
mf
f
pp
5
(8)

90

Piccolo
Flute
Oboe
Clarinet
Bassoon
Horn in F
Trombone
Harp
Trumpet in B♭
Vibraphone
Violin I 1
Violin I 2
Violin I 3
Violin I 4
Violin II 1
Violin II 2
Violin II 3
Violin II 4
Viola 1
Viola 2
Viola 3
Violoncello 1
Violoncello 2
Violoncello 3

mp *pp* 8va


94
Piccolo
Flute
Oboe
Clarinet
Bassoon
Horn in F
Trombone
Harp
Trumpet in B♭
Vibraphone
Violin I 1
Violin I 2
Violin I 3
Violin I 4
Violin II 1
Violin II 2
Violin II 3
Violin II 4
Viola 1
Viola 2
Viola 3
Violoncello 1
Violoncello 2
Violoncello 3
8va
mp
pp
f
ff
mf