COLOR CIRCLE: AN ORIGINAL COMPOSITION FOR ORCHESTRA AND COMPUTER

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BY

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This dissertation represents not an ending, but rather a beginning. A beginning of a new chapter in my musical, professional, and academic career. During my second year as an undergraduate music student, I came to the firm conclusion that becoming a professor of music would be my career path, and I have taken few detours from that path in the past decade. Along the way have been a plethora of individuals who have contributed countless hours towards the advancement of my career, and I owe them more than words could ever express.

I wish to thank my committee co-chairs, Dr. Amelia Kaplan and Dr. Michael Pounds, as well as the entirety of the theory/composition faculty who served during my time at Ball State University. Special thanks must be given to Dr. Rob Brookey who was kind enough to accept me into the Digital Storytelling program for my secondary area of study and to serve on my committee. I would also like to thank my remaining committee members, Dr. Don Ester and Professor Douglas Droste.

My composition instructors from years past have proven immensely helpful and influential in the years after my time studying with them ended, and so I must give thanks to Elainie Lillios, Christopher Dietz, Daniel Breedon, and Steven Makela. The advice, both musical and professional, received from these individuals has proven useful beyond measure. I would not have made it this far without their continued support.

Lastly, I must thank my friends and family for their continued and unending support. Special mention must be given to my friend and former college roommate Scott Flancher. Without watching him give up on his musical dream, I might never have continued to pursue mine.

INTRODUCTION

The concept of circles and how they are important both physically and metaphysically in music, art, and acoustics has sparked inside me a creative energy. This avenue is populated with ruminations on the unit circle, sine tones, the harmonic series, and the fully-chromatic circle of fifths. In my time as a graduate assistant at Ball State University, I was fortunate enough to teach multiple sections of our class on acoustics. Becoming more familiar with how sound works, how vibrating strings and their modes of vibrations create harmonics, how two pure tones separated by a very small number of hertz will cause a period fluctuation of amplitude, and how acoustic phenomena in general are created, instilled in me a desire to incorporate such knowledge into my musical output. *Color Circle* is one of several pieces in a recent series that explore these fascinations.

When speaking to my friend and colleague Dr. Christopher Biggs of Western Michigan University, I was reminded of the importance of controlling pitch language in electroacoustic music. He shared with me that many of his fixed-media pieces use the circle of fifths, albeit beneath the surface, to help control harmonic content and generate momentum. Given my already present fascination with circular structures, I concluded that I would compose a piece that exploits this concept.

One of my previous pieces for orchestra, *Color Variations*, approaches the orchestra as a palette of instrumental colors. Each instrument family slowly introduces new timbres and new pitch classes as a singular thematic idea, that is continually varied, unfolds. *Color Circle* connects this approach, though it is driven by a more flexible motive instead of a clearly defined thematic idea, with my fascination of circles, acoustic phenomena, and the desire to include a fully-chromatic circle of fifths.

As a composer, I am interested in integrating instruments with fixed and live sounds that are generated electronically. Other works in my catalog have explored the relationship between live instruments and electronically generated sounds, but none have explored this relationship with an ensemble on the scale of an orchestra. Rather than weaken the presence of such a large group of performers, the electronically generated sounds reinforce the acoustically generated sounds in order to present a cohesive and gestural soundworld. Many of the acoustic phenomena that I aim to exploit are done so via a combination of the colors of the orchestra and the electronically generated material. While any number of interesting and unique sounds can be achieved by an orchestra with no assistance, certain phenomena, including beating, masking, and granulation, are more easily achieved via modern electronics and computing. The resultant combination yields the finished product that is *Color Circle*.

Chapter 1: Review of Literature

Electronic music, in a wide variety of genres, sub-genres, and technical configurations, has existed for well over a century, yet works for large ensemble and live electronics are still not commonplace in the concert hall. Thus, many examples from the literature are composed by young, relatively unknown musicians. To complicate matters further, many experimental or modernist works that have provided inspiration for *Color Circle* lack any sort of electronic component. Therefore, a common musical vernacular between acoustic and electronic terminology proves elusive.

Fortunately, there are select examples from the literature by both established and emerging composers that combine large ensembles (more often than not a wind ensemble) and electronics (though most involve fixed media files rather than a live component). Chief among these examples is Eli Fieldsteel's composition for wind ensemble and live electronics, *Singularity* (2015). Fieldsteel's technical configuration has served as a model for my own in that his work makes use of a dedicated musician operating a computer to trigger electronically generated sounds in real time.

Other recent works by composers who may not yet be commonly known in the concert hall, but have nonetheless proved influential in my own compositional practice, include Chris Biggs' multiple works for wind ensemble and electronics such as *Object Metamorphosis* (2010), *Object Metamorphosis II* (2011), and *Extinction* (2015), Steven Bryant's work for symphonic band and electronics *Ecstatic Waters* (2008), and Michael James Olson's uniquely configured work for chamber ensemble, electronics, and video *Arcadia* (2013). Mason Bates' recent work for orchestra and live electronics, *Mothership* (2011), deserves special mention as it has been performed by professional ensembles including the London Symphony Orchestra.

Unsuk Chin, a more established and venerated composer, proves influential with her composition *Xi* (1998). As was the goal with *Color Circle*, *Xi* combines the acoustic qualities of the orchestra with the electronically generated sounds of the computer in a sumptuously organic fashion. It is often difficult to determine whether the heard sounds are acoustic or electronic. The musical gestures of the piece appear to be at a structural level that transcends the inherent duality of acoustic and electronic sounds, and the two are combined with immense craftsmanship so as to prevent the listener from extricating one from the other.

Any review of this literature would be remiss without at least an acknowledgement of compositions by the most successful of the early electroacoustic composers, the likes of whom include, among others, Karlheinz Stockhausen, Edgard Varèse, Mario Davidovsky, György Ligeti, Tristan Murail, and Iannis Xenakis. While these composers contributed substantial and momentous works towards the genre, among them Davidovsky's Pulitzer Prize winning piece for piano and tape *Synchronisms No. 6* (1970) and Varese's forward looking *Déserts* (1950-54) for mixed ensemble and tape, *Color Circle* draws little aesthetic inspiration from these works. In addition, given that *Color Circle* does not rely on a fixed media configuration such as magnetic tape, it will exist in a separate sub-category of electroacoustic music. Yet a historical influence is undeniable, and the final result of *Color Circle* owes much to the pioneering work of these composers.

Beyond compositions for large or small ensemble and electronics, various books and articles by established composers of electronic music discuss the techniques, design, and aesthetics of recent electroacoustic music. In fact, within the very recent past, two notable composers of electroacoustic music have each published treatises on electronic music. American composer Curtis Roads, well known for quite literally writing the books on both computer music and granular synthesis—*The Computer Music Tutorial* (1999) and *Microsound* (2004)—has released *Composing Electronic Music* (2015). While this book is geared almost exclusively toward composition for fixed media, Roads discusses the current technologies, trends, and styles common in the United States and Europe amongst composers of electronic music. Even more recent is Adrian Moore's contribution to the literature, *Sonic Art* (2016). With an emphasis placed on the flow of time and the nature of sound itself, this text lends itself quite well towards compositions involving both acoustic instruments and electronics.

Other works that have influenced the compositional process of *Color Circle* are strictly acoustic in nature. Perhaps the single most significant work in providing inspiration is Anders Hillborg's orchestral overture, *King Tide* (1999). Anders Hillborg, one of Sweden's leading contemporary composers, presents a gestural, timbral, and registral journey in this single movement work. His musical influences include composers ranging from Terry Riley to Ligeti, and *King Tide* serves as a unique combination of the repetition and rhythmic regularity found in minimalist and post-minimalist composers with the sound masses and slowly shifting registers of composers including Xenakis and Ligeti.

Ligeti himself serves as an inspiration in my work. And while he did venture into electroacoustic composition for two important works, his pieces for large orchestra serve as my inspiration. His approach to treating the orchestra as he might an electronic instrument—an approach he adopted from his time studying electronic music during an internship at the electronic music studio of Westdeutscher Rundfunk (WDR) in Cologne—is particularly noteworthy. In fact, Ligeti's third electronic piece (which he unfortunately never completed) was originally titled "Atmospheres," and the finished orchestral work of the same name begins almost identically to the sketches for the electronic precursor (Iverson 2011, 67). Pieces by Ligeti, including both *Atmospheres* and *Lontano,* propel themselves forward with a sense of static yet tense timelessness that slowly moves from one register to another, one instrument family to another, or from a confined register to a more expansive one. These slow and deliberate changes yield an organic sense of progression, a sense that Ligeti and Hillborg alike control with great mastery.

One can reach even further back, however, to a composer that by today's standards might be shrouded, incorrectly in my view, in antiquity. Yet this composer's influence is heard in the work *Exquisite Corpse* (2002) by Anders Hillborg when he quotes, at length, his 7th Symphony. The composer in question is Jean Sibelius, a composer whose work has proven immensely influential on *Color Circle.* Richard Steinitz, in his biography on the life of Ligeti, recognizes the influence of Sibelius on both Ligeti and the spectral composers that were soon to follow in the late twentieth and early twenty first centuries (Steinitz 2003, 153). Steinitz compares Ligeti's *Atmospheres* to Sibelius' tone poem *Tapiola* (1926), despite being composed over 30 years later. Steinitz is not the only musician to recognize the forward-looking qualities of Sibelius' music. Magnus Lindberg studied the works of Sibelius and described his music as having a resonant, "almost spectral quality" (Auner 2013, 246). The influence of Sibelius on Ligeti, Lindberg, and the spectral composers of the late twentieth century is indirectly present in *Color Circle*, particularly with regards to Sibelius' approach to organically unfolding material and subversion of common forms.

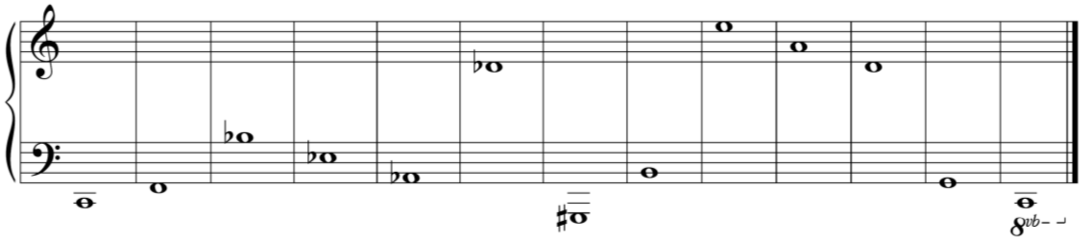
Lastly, Williams Caplin's recent treatise "Classical Form: A Theory of Functions in the Music of Haydn, Mozart, and Beethoven" (1998) serves as a generative template in pre-compositional activities. Caplin emphasizes the role of function in each phrase of music found in the classical era, yet his theories have been applied to music across western history. Common functions for themes, phrases, or entire sections of music might include continuation, interruption, extension, presentation, instigation, contrasting repetition, and others. In my compositional process, I have applied functions to each formal unit within *Color Circle*, often drawing on Caplin's vocabulary directly, but not limiting myself to his terminology.

Chapter 2: Compositional Approaches

Color Circle draws inspiration from my previously composed work for orchestra titled *Color Variations* (2010). *Color Variations* draws structural inspiration from the different timbres and colors of the orchestra. As such, the work has an underlying structure that is guided by particular groupings of instruments pitted against each other, and reserves the use of the entire ensemble for select moments. *Color Circle* has a similar premise, but with a much faster rate of change of instrument groupings, and a more interwoven and overlapping arrangement of their usage.

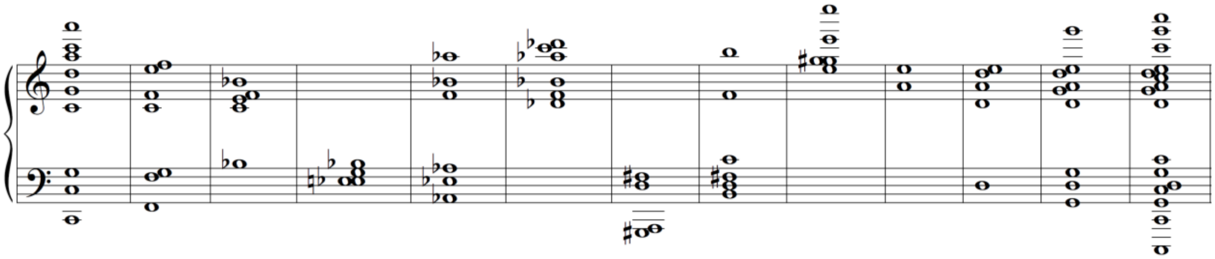
Color Circle is guided primarily by texture and gesture rather than by melody or motive. Material unfolds over time with regards to register, instrument family, technique, and spectral quality. Pitch material is guided by a fully chromatic circle of fifths, with sonorities of varying consonance and dissonance built above the root notes. See figure 1 for the fully chromatic circle of fifths without the additional sonorities built upward from the bass pitches.

Figure 1: *Color Circle’s* fully chromatic, register-specific circle of fifths.



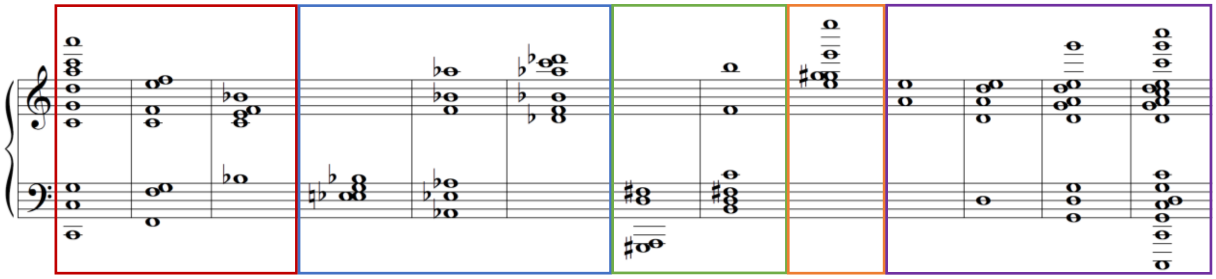
To aid in creating a sense of organic, unfolding of material, certain important pitches from one sonority carry into the next. Figure 2 demonstrates the individual sonorities built above each bass note from the circle of fifths. There are five formal sections of the work, each of which traverses between one and four sonorities, in order, until the final sonority is reached.

Figure 2: *Color Circle’s* fully chromatic circle of fifths with structural sonorities.



This circle of fifths also controls the overall register of the piece, with the root note serving as the lowest pitch heard during each formal section. This allows the listener to progress through a registral journey that ensures a wide variety of frequency content in multiple combinations.

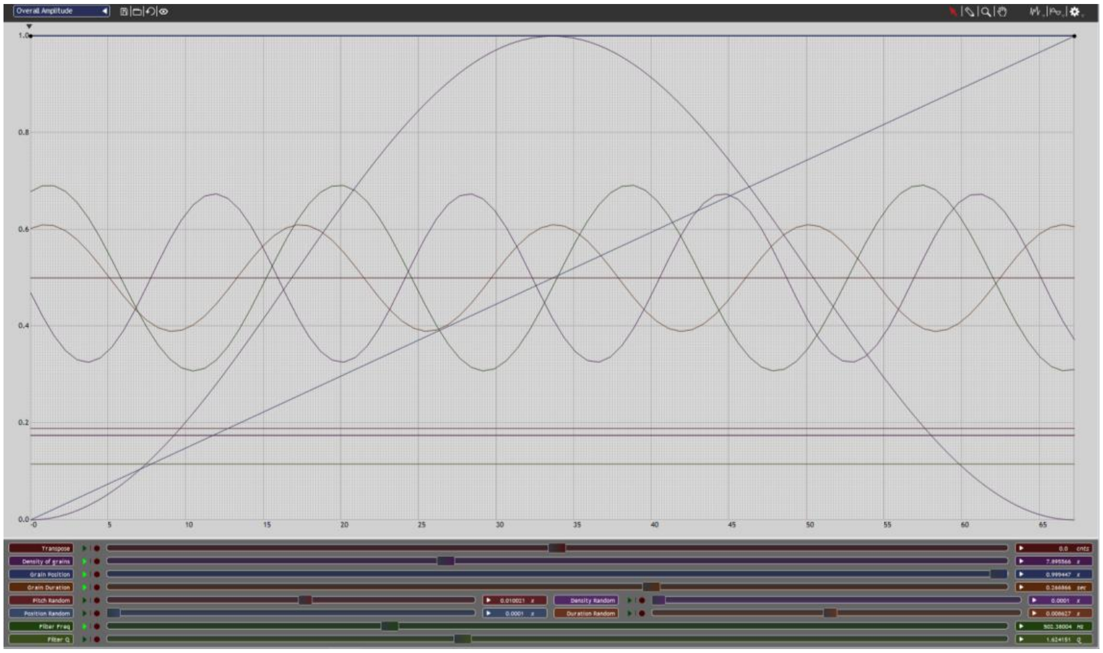
Figure 3: Formal divisions *Color Circle*, Parts I-V.



Pitch and rhythmic material draws inspiration from the shape of a circle itself, or rather from circular motion projected on a single axis, which generates a sinusoidal wave over time. This wave-like structure is applied to pitches to create melodic content that undulates above and below a central pitch. Rhythmic values are treated similarly: the greater distance the pitch moves above or below the central pitch, the faster the rhythmic subdivision is. This allows for a great array of shapes, gestures, and textures, each of which is still fundamentally derived from the shape of a circle in a meaningful fashion. The depth of the wave (how high and low it goes above or below the central note) is shifted to create tension, and the frequency of the wave (how quickly over time it moves through a range of motion) increases and decreases to propel the work forward and generate momentum or suggest the immediacy of an arrival point.

The shapes of these underlying waves also shift from that of a sine wave to other common waveforms, including square waves, rectangle waves, triangle waves, and sawtooth waves. These shifts, whether sudden or slow, work in tandem with the overall structure of the work with respect to consonance and dissonance. Sine waves are the underlying wave during relatively consonant passages, while more angular waves, such as square waves, underpin the more dissonant passages. These wave-like gestures also apply to the sound generated by the computer. Figure 4, a screen capture taken from the software Cecilia 5 developed by Ajax Audio, demonstrates the wave-like shapes given to various parameters of soundfile granulation. Parameters, including grain density, grain depth, and the cut-off frequency of a high pass filter, undulate upwards and downwards along the contours of a sine wave over time.

Figure 4: Wave shapes of computer generated sounds in Cecilia 5.


Overall Amplitude
1.0
0.8
0.6
0.4
0.2
0.0
0
5
10
15
20
25
30
35
40
45
50
55
60
65
Transpose
Density of grains
Grain Position
Grain Duration
Pitch Random
Position Random
Density Random
Duration Random
Filter Freq
Filter Q

The electronically generated sounds were primarily created by performing audio manipulation techniques on samples of orchestral sounds. This technique allowed for a spectral analysis of the various voices in play and the creation of a connection between the electronically generated sounds and the acoustic ensemble. Consequently, the electronic portion can work with or against the acoustic ensemble as desired. The electronic portion often serves a stitching function between individual chords, lengthy sonorities, or entire formal functions by means of spectral overlap.

The electronic component consists primarily of sustained, textural clouds of sounds that are rarely heard unaccompanied. Unlike Davidovsky's *Sychronisms*, which make use of rapid interplay between acoustic sounds generated by the performer and electronic sounds controlled by the tape component, *Color Circle* presents these sounds together with intentional spectral effects. The electronic sounds exist with the orchestra, not against it.

This is not to say that the electronic sounds work to constantly reinforce the acoustic material. Rather, there are select moments, particularly those of the greatest dissonance, where detailed spectral analysis of the acoustically generated sounds is used to create similar sounds in the electronic component that are intentionally offset by very small amounts (often by only a few hertz). This approach allows for subtle amounts of beating and other acoustic phenomena to slowly fade in and out, and it creates timbres that are grounded in reality yet adopt a surrealistic character.

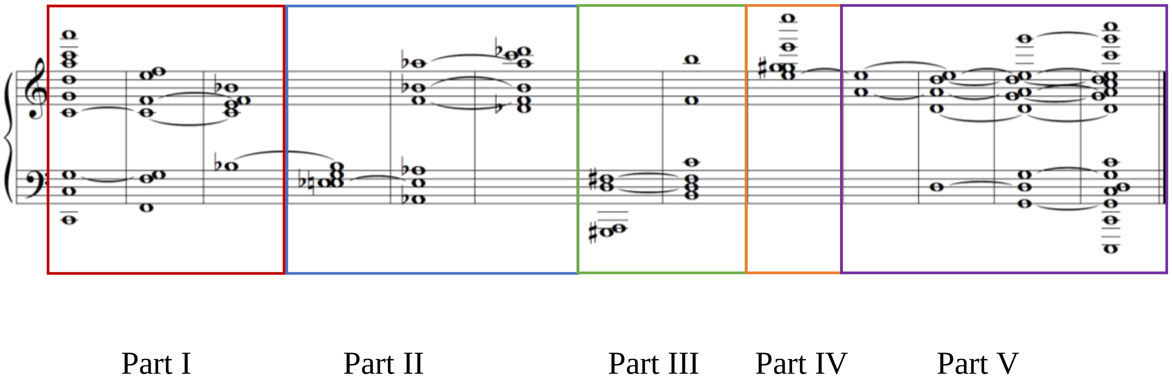
The electronics are triggered, controlled, and adjusted in real time by a member of the orchestra who operates a laptop running an application built in Cycling 74's Max. This allows the conductor the ability to rehearse the piece out of order. A simple graphical interface is presented in the application and includes controls for volume, cues, and other basic functions. By giving control of the volume of the electronics to a member of the orchestra, the conductor can shape dynamics in a similar fashion to how he or she can control the dynamics of a purely acoustic ensemble. The conductor is also able to control the balance between the electronic sounds and the rest of the ensemble.

The accompanying sounds do not require strict tempo synchronization with the orchestra. Given their primarily textural quality, these sounds will sustain and smoothly loop as long as is necessary before the conductor signifies that the next cue is to begin. Tempi given in the score are intended as suggestions more than as absolute rules, thus allowing the conductor to move within an acceptable margin of variability. If these tempi are approximately realized, no issues with remaining in time with any electronic cues should present themselves. A few gestures require a more refined level of synchronicity, and are notated in the score and provided with exact timing and tempo information. A small number of gestures are notated with traditional rhythmic figures, and cue notes are provided in the individual instrument parts to assist in reading.

Chapter 3: Analysis of Color Circle

Color Circle is divided into five formal sections. Part I consists of measures 1-42, Part II measures 43-78, Part III measures 79-100, Part IV measures 101-121, and Part V measures 122-154. As shown in figure 5, specific pitches remain constant between various sections to help create an organic sense of momentum that stitches sections together. Notable exceptions include the movement from the sixth to the seventh sonority, which coincides with the movement from the second to the third formal section of the work, and from the eighth to the ninth sonority, which coincides with the transition from the third to the fourth formal section of the work.

Figure 5: The circle of fifths with ties designating the pitches held across varying sonorities.



The movement from any single collection of pitches to another poses only two options: keeping one or more pitches in common or none at all. *Color Circle* exploits both of these options by including two harmonic shifts in which no pitches remain in common. These shifts are also accompanied by structural, timbral, and instrumental divisions, thus creating two moments of intense drama.

The movements between other sonorities are intentionally less dramatic. For example, the movement from the first sonority to the second retains two common pitches (G3 and C4), and the movement from the second to the third sonority also retains two common pitches (C4 and F4). Notice that C4 (which is the first pitch heard in the piece) remains common across all three sonorities that combine to create Part I of the work. This pitch remains constant during the entirety of Part I to aid in creating a sense of cohesion, and it does not stop sounding until Part II.

The movement from the third to the fourth sonority coincides with the movement from Part I to Part II. This movement retains only a single pitch: Bb3. The arrival of Part II is also heralded by the second most dissonant sonority of the entire work. This sonority is built as an Eb major triad with the addition of an E natural.

Each sonority in *Color Circle* is constructed to achieve varying degrees of consonance and dissonance. This is achieved by a scoring system in which individual interval classes are given a dissonance value between 0 and 10. Octaves/unisons are scored at 0, perfect fourths at 1, major thirds at 2, minor thirds at 3, major seconds at 5, minor seconds at 8, and tritones at 10. Note that this system assumes an inherent dissonance in intervals such as the minor second and tritone and an inherent consonance in intervals such as the perfect fifth and the octave. The presence of each interval class within a sonority, easily viewed by finding the interval class vector of each sonority, adds the assigned value to the total dissonance score. For example, sonority 1 has an interval class vector of [021030]. Tallying the assigned value of each interval yields a total dissonance score of 16 (2 values of 5, 1 value of 3, and 3 values of 1). In contrast, sonority 4 has an interval class vector of [103011]. This sums to a total dissonance score of 28.

Much like Part I, Part II of *Color Circle* is built from three unique sonorities. These three sonorities each retain at least a single pitch in common between them, once again assisting to create a sense of cohesion as they progress. While Part I moves from a very wide registral range (one that encompasses over four octaves) to a much smaller one (which is confined to a single octave), Part II begins with an extremely limited register of only a perfect fifth and proceeds to expand outward and upward to span two octaves in a much higher range.

The movement from Part II to Part III coincides with the most dramatic shift of harmonic content yet heard in the work. No pitches remain in common, and the register shifts downward by nearly three octaves. The beginning of Part III contains the lowest pitch material from the entire work. Part III is built from only two sonorities as opposed to three, and these two sonorities share two pitches between them (D3 and F#3). While retaining a generally low registral space in both sonorities of Part III, there begins a movement upward to approach the first sonority of Part IV. Part III also contains the most dissonant sonorities from the entirety of the work, consisting of both minor seconds and tritones (when reduced to interval class).

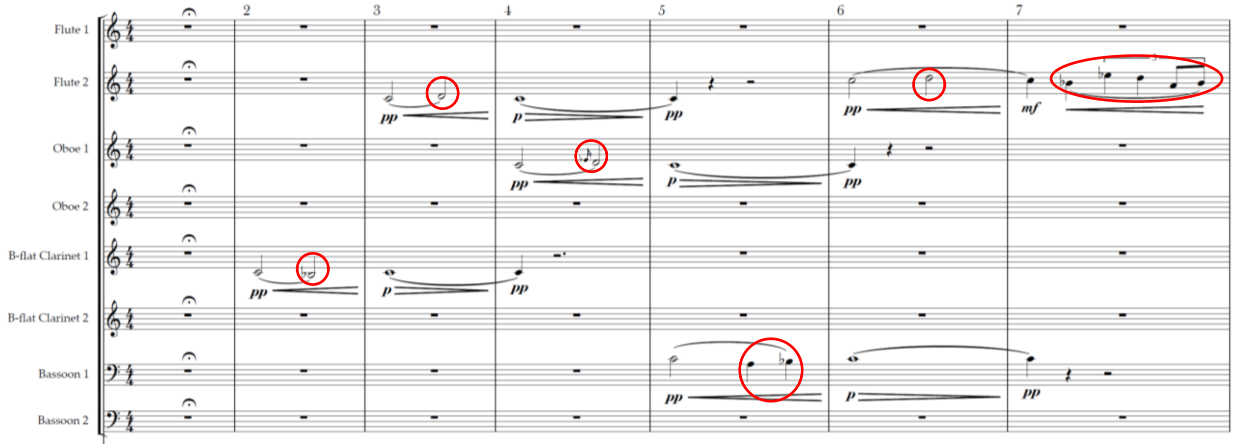
Part IV, unlike all other formal divisions, is built from only a single sonority. This sonority contrasts those heard in part III by containing the highest pitch content in the entire work. The lowest pitch contained in this section is E5 and highest is E7. Part IV is also the shortest section in terms of length. By containing only a single sonority, Part IV also serves to introduce the sonorities and materials presented in Part V.

Part V begins with the arrival of the tenth sonority, in this case a perfect fifth (A5-E5). Unlike all previous sections, each pitch added in the new sonority remains present until the conclusion of the work. Consequently, Part V can also be viewed as a single sonority that simply takes time to build to its entirety. However, as viewed in figure 4, it can also be viewed as consisting of four unique sonorities. These four sonorities are further distinguished by changes in tempo, texture, and instrumentation as they rapidly progress toward the conclusion of the piece.

The work concludes with the closing of the circle of fifths and the realization of the twelfth and final sonority. It is important to note that while these twelve sonorities provide a structural framework from which the entirety of the piece is constructed, they are far from the only pitches heard. Rather, they provide moments of arrival, and they function as harmonic pillars. Other pitches are introduced that have a similar function to those of non-chord tones.

My approach to the melodic and harmonic content is presented within the first measures of the piece. While the string section sustains a single pitch (C4), solo wind instruments undulate above and below middle C by distances of major seconds and minor thirds (or viewed alternatively as a minor second on top of a major second). Figure 6 presents the materials of the woodwinds in the opening measures of the piece. Note that the pitches both above and below middle C being played by the woodwinds are not present in the first sonority of Part I. This is just one of serval approaches used throughout the work to introduce pitches from outside the structural sonorities.

Figure 6: The woodwind material from the opening measures of *Color Circle*, “non-chord” tones marked in red, mm. 1-7 (score notated in C).



Rather than containing any traditional melodies or themes in the classical sense, the upward and downward movement above and below the pitches of each sonority is the primary driving force of melodic content in the entire work. However, it takes on several variations, forms, and mutations as the work progresses. The first approach is shown in figure 6. Each instrument enters on C and moves up or down, either with a minor second followed by a major second or a major second followed by a minor second. The second approach, shown in figure 7, involves approaching a sustained pitch via two shorter notes. These two shorter notes can be either a minor second or major second away in either direction.

This melodic gesture of three notes rising or falling with various intervallic structures is inspired by the opening gestures of Jean Sibelius’ *Symphony No. 2 in D Major, Op. 43*. Sibelius’ entire compositional output helped to inspire *Color Circle*, and using the opening gesture to his second symphony pays homage to his work. Sibelius’ approach to organically unfolding formal structures, notably in his later symphonies and tone poems, is cited as one of the more unique approaches to form in the instrumental music of the early twentieth century (Hepokoski 1993, 84). This approach, sometimes referred to as sonata rotation, has proven influential on *Color Circle* and other recent works in my output.

Figure 7: Sustained pitches approached via two shorter notes in contrary directions, mm. 13-16.

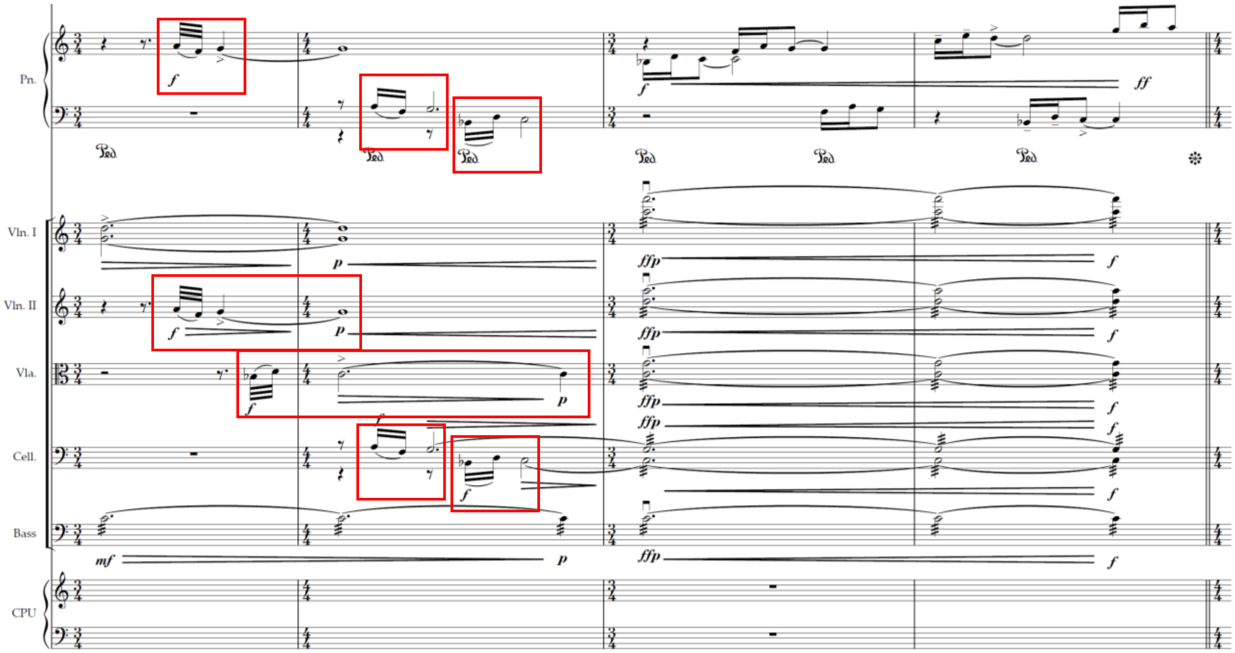


Figure 8 shows the opening to Sibelius' second symphony and the three-note rising gesture in its original presentation. As the symphony progresses, Sibelius develops and mutates this three-note gesture; I take a similar approach in *Color Circle*. In addition, by inverting this gesture and by creating a contour that moves both upward and downward, the shape of the pitch content in *Color Circle* begins to resemble sinusoidal, or wake-like motion.

As *Color Circle* progresses, this three-note motive begins to more closely resemble that of Sibelius' by adopting a similar rhythmic contour, yet it retains its downward motion (an approach Sibelius does not use in his second symphony) to continue spinning out the wave-like gesture. Figure 9 shows the evolution of this motive and how it appears near the end of Part I.

Figure 8: The opening gesture of Sibelius' *Symphony No. 2 in D Major, Op. 43*, mm. 1-6.

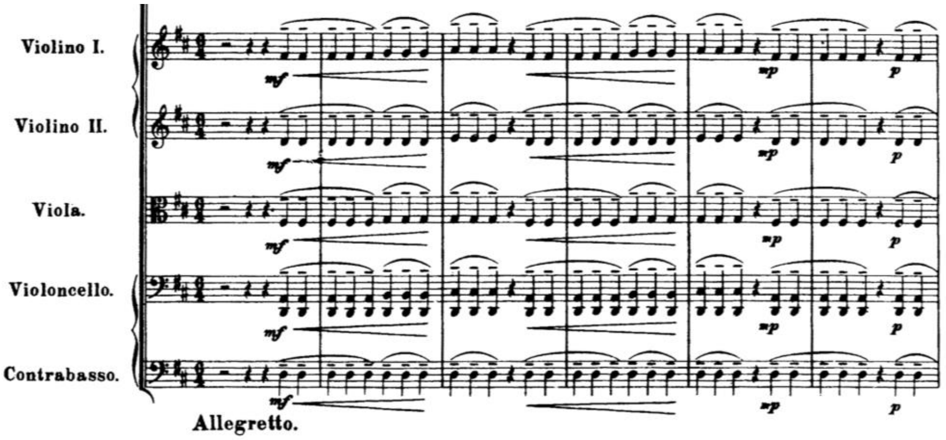
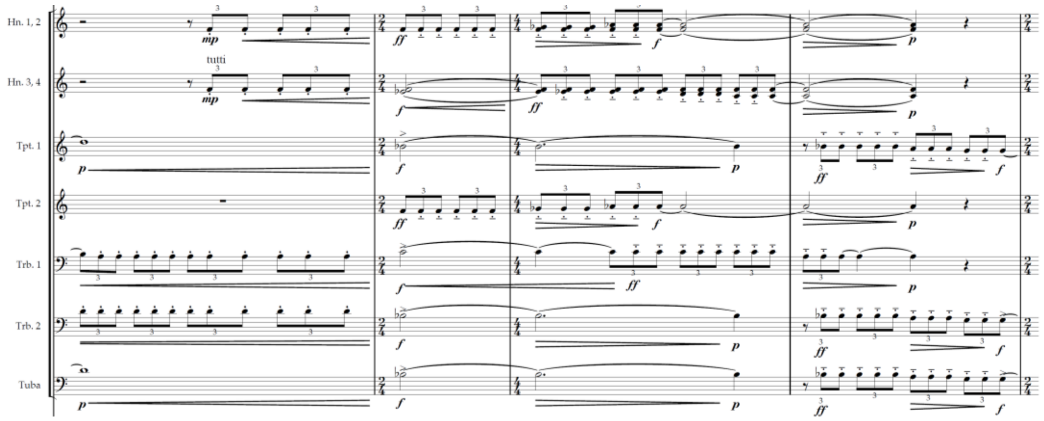
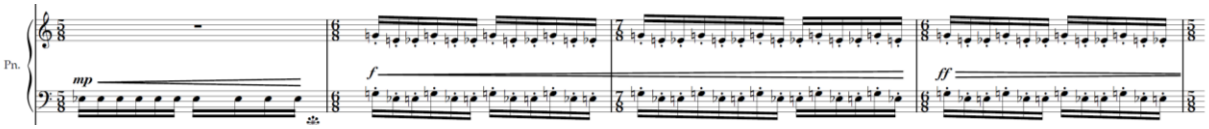

Violino I.
Violino II.
Viola.
Violoncello.
Contrabasso.
Allegretto.

Figure 9: Rising three-note motive in the brass choir, mm. 33-36.


Hn. 1, 2
Hn. 3, 4
Tpt. 1
Tpt. 2
Trb. 1
Trb. 2
Tuba
tutti

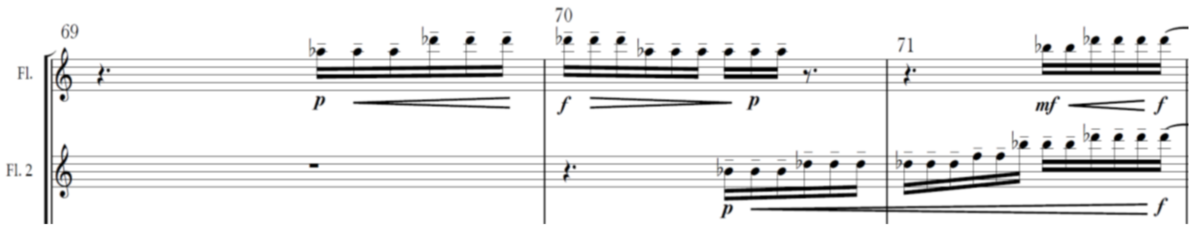
In Part II, the rising three-note motive evolves further. In figure 10, an excerpt taken from the piano part is shown to demonstrate the new presentation of this motive. The motive now presents the pitches entirely in descending order and with the inclusion of a major third. This outward expansion of a greater interval from the central pitch (in this case Eb) is analogous to the underlying sinusoidal waveform increasing in amplitude.

Figure 10: Variation of three-note motive in Part II, mm 53-56.



This mutation continues further in Part II of the work. Figure 11 is an excerpt taken from the two flutes as they present upward and downward motion with a significantly expanded range and intervallic content. Once again, this proves analogous to the increasing amplitude of a wave-like structure, yet by this point in the piece the shape of the pitch structures more closely resembles that of a square or rectangle given the repetition of a single note before progressing upward or downward. This is the first of several transformations to the underlying shape of the wake-like structures. It is also worth noting that this is a direct realization of the concept of a circle as a musical form. The movement away from sinusoidal waves and towards more complex wave shapes, in this case square or rectangle waves (later sawtooth waves and pulse waves), is yet another variation on both the rising three-note motive and the concept of circles guiding compositional choices in *Color Circle.* In fact, the realization of pitch structures as square waves is a means of distorting sinusoidal motion, so in one respect these portions of the piece move beyond the idea of a circle and are influenced by the concept of harmonic distortion.

Figure 11: Two flutes playing an expanded version of the wave-like motive, mm. 69-72.

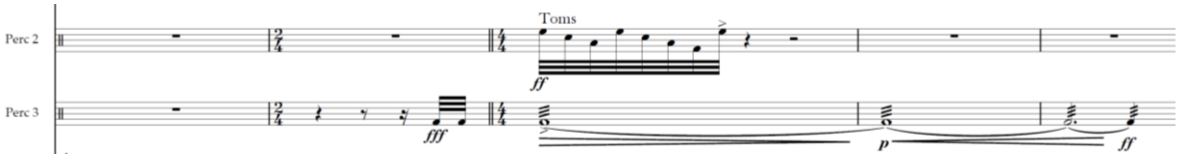


Part III of the work is the only section that does not overtly derive pitch, harmonic, or melodic material from the shape of a wave-like structure. Rather, the accompanying electronic sounds are the primary supplier of wave-like or circular structures. The accompanying electronic drone, which begins in measure 79, provides the lowest pitches of sonority 7 (see figure 5). Given the relatively clear pitch material provided by this drone, as well as the structural importance of these two pitches with regards to the circle of fifths, it is traditionally notated in the score. This drone, created by *Mai Tai* (one of the internal synthesizers of PreSonus's StudioOne software), uses multiple low-frequency oscillators (LFOs) to control both the cutoff frequency of a filter and the amplitude level of a noise generator. These two LFOs move at different rates and remain out of phase with each other. In addition, their frequency modulates via a pulse wave with a stochastic frequency, thus creating the least stable wave-like structure from the entire work to accompany the most dissonant passage of the piece.

Measure 88 begins a brief interruption of Part III that recalls the three-note motive as it was presented in Part I, though it is now presented polyphonically in the upper strings. However, this interruption still adheres to the pitch framework, and it introduces the pitches of sonority 8, now with octave doublings.

Despite adopting a more ephemeral quality, Part III still presents several important gestures that adhere to this wave-like structure, this time in the percussion family. Both toms and temple blocks are used to present short phrases that resemble the shape of sawtooth waves, by moving downward and then rapidly back upward. Figure 12 shows one such instance from measure 94 in the toms.

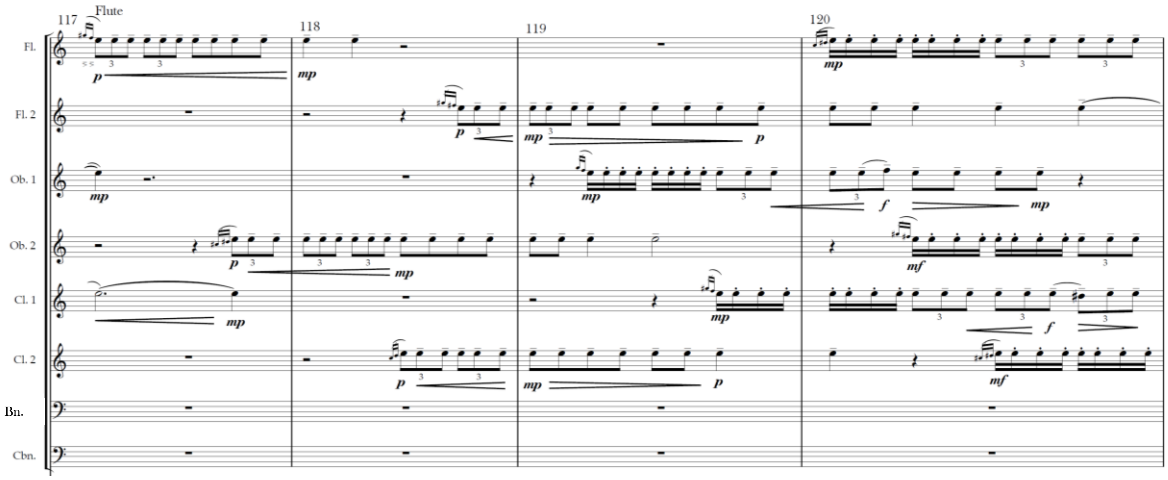
Figure 12: Percussion writing from Part III, mm. 92-97.



Part IV functionally serves as a palette cleanser to prepare the lister for the conclusion in Part V, as well as to provide a moment of respite from the low, loud, dissonant, and distorted material from Part III. The highest register of the piece is employed during this passage, and it is presented via the piccolo. Beginning in measure 103, the piccolo, doubled with crotales, provides two upward renditions of the three-note motive, the first of which reaches upward by a minor third, and the second that achieves its goal of a major third. As with Part III, the material generated by the computer is clearly notated with traditional notation to indicate the pitches of the drone.

Part IV concludes with a cascading array of entrances in the woodwind family, each rearticulating a single pitch (E5). This passage also recalls the presentation of the three-note motive seen in the beginning of the work in which two shorter notes (in this case grace notes) precede the rearticulated pitch. Figure 13 illustrates this treatment of the motive. Take note of the continually shifting approach to the rearticulated E5 by the two short grace notes and how they vary from two major seconds, two minor seconds, and a combination of each, as well as how they approach the rearticulated pitch from both above and below.

Figure 13: Mm. 117-120.



Part V presents the conclusion of the work, and it does so with continued repetition and overlap of the rising three-note motive. Much like Part I, which slowly introduces pitches to build to the complete sonority, Part V adopts a similar technique. The approach to the final sonority of the piece begins in measure 140. The computer-generated sounds once again provide important pitch materials and are consequently notated with traditional pitches.

It is worth noting that, while harmony has been discussed with regards to the underlying sonorities that help provide structure to the work, no formal discussion has been given to individual moments or chords. This is because any harmonies that result from the horizontal motion of individual voices are purely incidental. The pitches outside the twelve structural harmonies can be viewed as non-chord tones, so a reductive harmonic analysis of this work could be accomplished by simply labeling these twelve chords (see figure 2). However, my compositional approach yielded far more material at a level further below the surface, and this approach was heavily influenced by certain techniques used by Ligeti.

Ligeti’s sound-mass compositions including *Lux Aeterna* (1966) and *Lontano* (1967), and also his more mechanically driven work *Continuum* (1968), all proved influential. This is not to say, however, that any individual technique from his pieces (such as his use of micropolyphony or microcannon) is emulated directly in *Color Circle*. Rather, I attempted to capture certain broad characteristics of his works. For example, *Continuum* is composed of several overlaid passages and contains pitches that repeat in a mechanical fashion while gradually introducing new pitch content (Clendinning 1993, 195). *Continuum*, *Lontano*, and *Atmospheres* all rely on the use of range or pitch-space as a primary means of dividing formal sections (Clendinning 1993, 205).

The chosen sonorities, as well as the intervals that are present both above and below the pitches from within, create a more broadly defined soundworld within each section. However, consonance and dissonance are still strictly controlled by choosing which intervals are present within any individual sonority. The intervals that are formed by the addition of any non-chord tones from outside the structural sonorities are also strictly controlled to ensure cohesiveness and relative consonance versus dissonance.

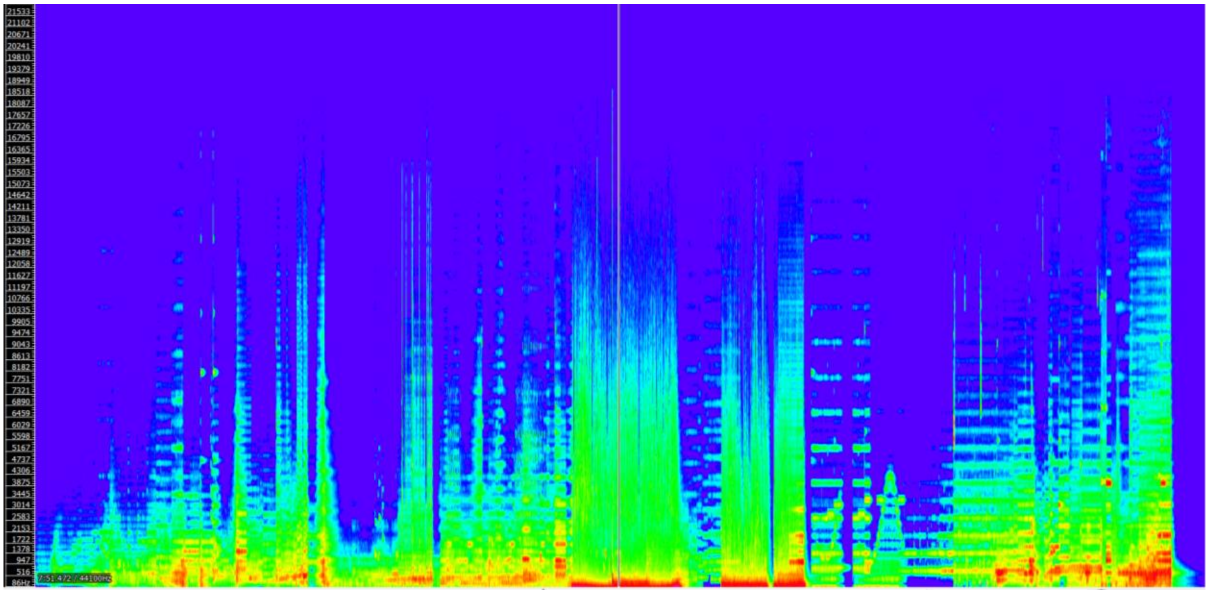
For example, Part I of the work is intended to be a passage of relative consonance compared to the dissonance of Part III. The initial sonority of Part I contains only the interval classes of a unison, a minor third, a major third, and a perfect fourth. This particular grouping of interval classes is rather consonant, and any additional pitches added above or below the notes of the structural sonority are separated by major seconds or minor thirds. By comparison, the interval classes present in sonority 7—the first sonority of Part III—are a minor second, a minor third, a major third, and a tritone. In addition, the pitches added above or below the notes used to create this structural sonority are separated by intervals of minor seconds and tritones.

In a fashion similar to progressing through various sonorities that help to distinguish the formal structure of the work, instrumentation choices also help to delineate the structure of the piece and are sometimes necessary to help realize particular pitch choices based on range. For example, Part III of the work relies on some of the lowest pitches of the orchestra and requires the contrabassoon to articulate its lowest register. Part IV requires the use of crotales and the piccolo in their upper registers to properly realize the sonority. This approach helps to yield an organic and meaningful approach to instrumentation choices, and also ensures a wide, contrasting range of colors within individual instruments and from the orchestra as a cohesive unit.

Part I loosely recalls the instrumentation choices of my previous orchestra work, *Color Variations*, in that the first instrument family to enter are the strings, followed closely by the woodwind choir, and finally the brass choir. The percussion family remains present throughout all of Part I, as does the computer-generated material. Future sections more rapidly and intuitively mix and combine instrumental colors from various instrument groupings and families, and no system beyond that which is required to help realize the structural sonorities and the fully-chromatic circle of fifths is implemented.

Lastly, the use of register has been alluded to thus far, but a more detailed examination of how *Color Circle* moves across the frequency space is warranted. Figure 14 shows a spectrogram of *Color Circle* that helps to more clearly reveal the frequency trajectory of the work.

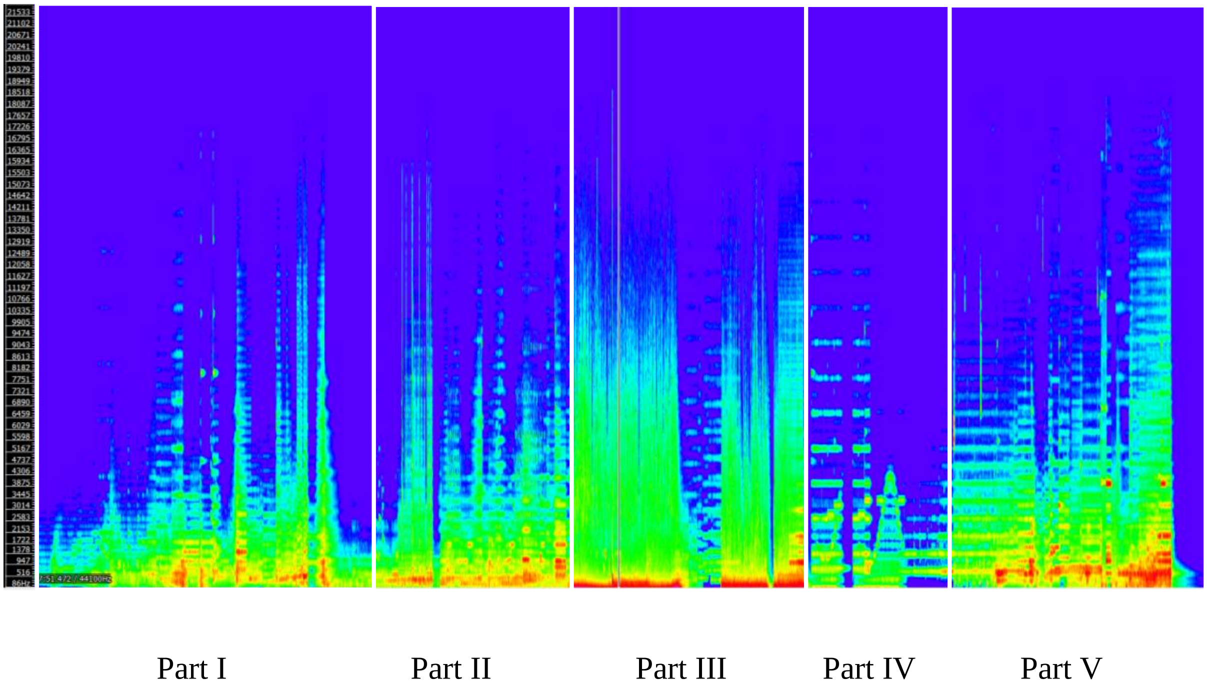
Figure 14: Frequency spectrogram of *Color Circle*; x-axis represents time, y-axis represents frequency, color represents intensity of frequency.



When viewed as a spectrogram, peaks and valleys and the plateaus and heights of the frequency trajectory become even more clear than when viewing the circle of fifths and the structural sonorities built above it. For example, just before the dividing line in the middle of figure 14, a massive increase of energy in the low frequency range can be viewed. In the score this is the arrival of Part III. In this particular spectrogram, the closer the color moves towards red on the spectrum, the more energy is present at that frequency. While the sounds supplied by the computer provide a broad range of frequencies, this section of the piece clearly emphasizes the low register in terms of instrumentation and total energy. The final section of the piece and the clear addition of higher partials is also viewable in the final fourth of this diagram, and it also becomes clear that the final moment of the piece contains the broadest and most powerful presence of sound across the entirety of the frequency space.

This diagram also allows one to view the proportionality of the piece as a whole. Figure 15 shows the spectrogram of *Color Circle* with the formal sections of the piece overlaid. When viewed this way, the importance of frequency space as a means of helping to delineate form becomes apparent.

Figure 15: Spectrogram of *Color Circle* with formal divisions overlaid.



Chapter 4: The Role of the Computer

The computer-generated component presents a wide variety of sonic material throughout *Color Circle*. Nearly all sounds from the computer find their source from samples of orchestral instruments. High-quality orchestral sound libraries, developed by Native Instruments, were used to create short samples of each of the twelve sonorities. These short samples were created with the instruments featured in each formal section, and consequently they share a very similar spectral quality to the actual orchestral sections that they accompany. To create longer durations as well as contrast, these samples were time-stretched and sometimes pitch-shifted upward or downward to increase the depth of the frequency content.

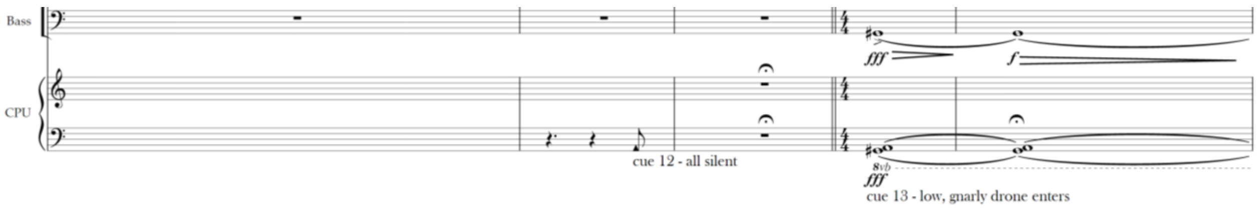
In keeping with the concept of waves, these time-stretched samples are modified with a tremolo effect to modulate their amplitude with a wave-like structure. In addition to their amplitude being modulated at any given moment via the tremolo effect, the overall amplitude of the completed soundfiles also slowly increases and decreases in amplitude over time so as to fade in and out with the orchestra.

This approach to sample manipulation creates slowly evolving textures that accompany and enhance the orchestral material, particularly in Parts I and II of the piece. The qualities of all these sounds lend themselves to be asynchronously aligned with the orchestra; this is an important characteristic of *Color Circle*: the piece does not require a strict synchronization between the live orchestra and the computer-generated sounds. This is achieved in two ways. First, most sounds generated by the computer are lengthy, textural sounds masses that are intended to simply exist with and enhance the live sound of the orchestra. Second, these sounds do not adhere to a strict format of fixed media such as a record, a tape, a compact disc, or playback of a single file type such as an mp3, WAV, or AIFF. Rather, they are divided into short segments that are triggered by a performer. Hence, the computer is treated as a performance instrument like any other from the orchestra, and it is given a staff in the score (designated CPU) and a dedicated part for the performer. The pitches and other material provided by the computer are presented on a grand staff. This allows the necessary space to notate the broad frequency content provided by the electronically generated sounds.

By notating the computer part as traditionally as possible, the difficulties of rehearsing and performing the piece should be limited. The CPU part contains cue numbers that progress chronologically as the piece moves forward. In many cases, traditional pitches are provided to show the content of the computer part, particularly when the pitches are of harmonic or structural significance. To assist with notating non-pitched sounds or gestures that are not faithfully captured by standard notation, text is provided along with each cue number, as well as non-traditional noteheads. In a few instances, graphic notation is used to help demonstrate the growth of a particular gesture or the sustained quality of a particular sound.

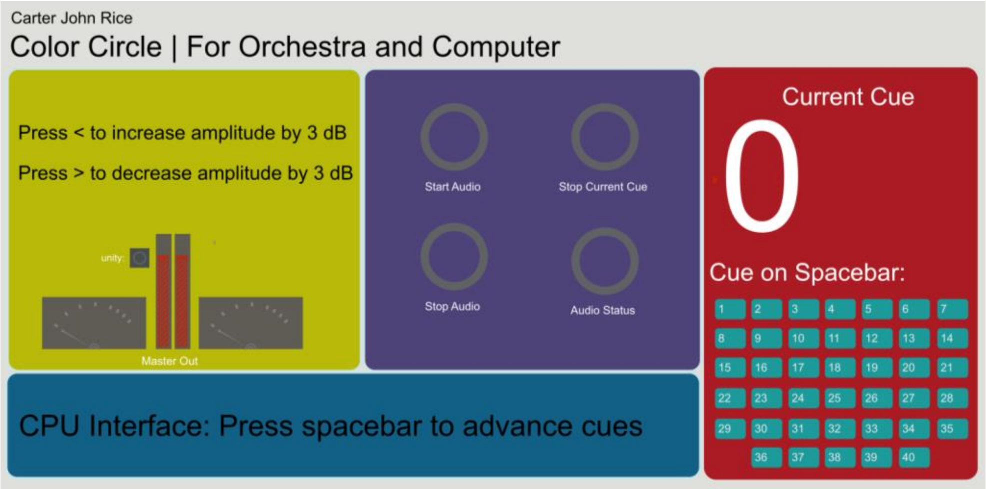
Figure 16 provides an example of the CPU part that includes text, a cue number, and traditionally notated pitches; this helps demonstrate the timing and quality of the gesture coming from the CPU.

Figure 16: Excerpt taken from the CPU notation of *Color Circle*.



The CPU is controlled via a stand-alone application built in Cycling 74’s Max 7. The CPU performer is given a musical part with detailed instructions on how to access, open, manipulate, and control this application. A very similar set of instructions is provided in the opening pages of the score to assist the conductor. The verbiage of these instructions is made intentionally simple under the assumption that the conductor and the CPU performer will have little or no technical knowledge. However, in order to facilitate a proper performance, at least one additional sound engineer will be required to assist with the setup of speakers, a mixer, and to balance levels from the front-of-house position. Figure 17 shows the application built for the performance of *Color Circle*. The performer is given the option of advancing from one cue to the next by simply pressing the spacebar key (as would be done in performance), but he or she is also given the option of beginning at any cue in the piece on the next depression of the spacebar key. This facilitates a smooth rehearsal process. The CPU performer also has the option of raising and lowering the amplitude of the sound output (controlled via the “<” and “>” keys to resemble crescendos and decrescendos) to allow the conductor some degree of expressive control over the balance between the orchestra and the electronic sounds. Finally, the CPU performer may stop any audio that is sounding in the event of stopping and starting during a rehearsal. All of these steps were taken to create as dynamic of an experience as possible when rehearsing and performing *Color Circle*.

Figure 17: The graphical user interface of the stand-alone application for *Color Circle*.



Carter John Rice

Color Circle | For Orchestra and Computer

Press < to increase amplitude by 3 dB

Press > to decrease amplitude by 3 dB

CPU Interface: Press spacebar to advance cues

unity
Master Out
Start Audio
Stop Current Cue
Stop Audio
Audio Status
Current Cue
0
Cue on Spacebar:
1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31 32 33 34 35
36 37 38 39 40

Chapter 5: Conclusion

Color Circle is my third work for orchestra and my first work that combines an electronic component with an ensemble of this size. The process has been a challenging one but also a revealing one. I first came up with the ideas that inspired this piece well over a year ago, and consequently I had a great length of time to ruminate on them. The piece adopted a “top down” approach in that the fully chromatic circle of fifths and the sonorities built from it were the very first ideas I penned on paper. As a result, the piece went through multiple drafts, each adding more and more material to each of the twelves sonorities. The first draft was nothing but twelve chords strung together by a harmonic framework. The next draft expanded each chord into varying subsets and included instrumentation choices. This process continued until the final version was completed.

The process of integrating soundfiles with an ensemble on the scale of an orchestra is challenging and intimidating. A great deal of my time was spent analyzing the spectral content of orchestral samples and creating sounds that could reinforce the natural timbres of an orchestra, or in certain cases work against the orchestra. My hope is that the completed result is both organic sounding and technically savvy. I also hope that the electronic portion of the work sparks an interest in those who might otherwise be unfamiliar or uncomfortable with electroacoustic music.

Color Circle is not the longest piece in my output, but it is certainly the most detail oriented. No previous piece of mine was inspired by such a small idea only to grow into something so large and intricate. Consequently, I hope my next major composition can adopt a contrasting approach, one that focuses on smaller moments. I find the result of the methodology of *Color Circle* to be successful, but I recognize that I have always preferred viewing and understanding the "big picture" of my works as well as those of my peers and colleagues. Perhaps this will be the last work before I see the other side of the coin and focus on building a work out of smaller moments instead of building smaller moments out of a large idea.

Unlike many of my previous works, which drew inspiration from a narrative, a poem, or other extra-musical idea, *Color Circle* is inspired purely by the abstract—by circles and waves and acoustic phenomena. This process was freeing as there was no dramatic narrative or ideal to which the piece had to be held. Rather, I was free to create my own, purely abstract and ethereal narrative that changes from moment to moment and from read-through to read-through.

This piece was written with the intention of being performable by a university orchestra. It contains few virtuosic passages but requires skilled ensembleship. This level of difficulty was constantly on my mind while composing, and certain passages required revision along the way to make certain they did not cross into a professional difficulty level. The piece was also composed with the intent of being satisfying to conduct, giving the conductor many opportunities for expressive interpretation. As is written in the performance notes from the score, the conductor is encouraged to explore tempi and to experiment with pacing so as to interact with the computer-generated sounds in a variety of ways.

This piece is also the most conservative in my recent output in terms of form, rhythm, and harmonic content. This was a deliberate choice in order to make the piece approachable to those who might perform it. My goal was to compose a piece that included an electroacoustic component so as to familiarize and demystify the concept of combining electronic sounds with acoustic ones. If the piece were extremely dissonant, difficult to follow, or overly lengthy, it might turn future listeners away from other pieces in this emerging technical configuration. My friend and colleague John Nichols III recently told me that he has turned down more than one commission from a large ensemble because they refused to entertain the idea of allowing an electroacoustic component. The more that I and my colleagues can do to increase the commonality of works for large ensemble and electronics, the more likely we will see a surge of such works being performed. Perhaps this surge will be one of many steps that composers can take to re-engage the modern orchestra.

Appendix 1: Relevant Compositions

Mason Bates. *Mothership* (2011), orchestra/wind ensemble and electronica.

Steven Bryant. *Ecstatic Waters* (2008), wind ensemble and electronics.

Christopher Biggs. *Object Metamorphosis* (2010), wind ensemble and electronics.

Christopher Biggs. *Object Metamorphosis II* (2011), wind ensemble and electronics.

Unsuk Chin. *Xi* (1998), ensemble and electronics.

Mario Davidovsky. *Synchronisms 1-10* (1962-1992), various solo instrument and fixed media.

Eli Fieldsteel. *Singularity* (2015), wind ensemble and live electronics.

Anders Hillborg. *King Tide* (1999), orchestra.

Gyorgy Ligeti. *Atmospheres* (1961), orchestra.

Györgi Ligeti. *Lux Aeterna* (1966), mixed choir.

Györgi Ligeti. *Lontano* (1967), orchestra.

Györgi Ligeti. *Continuum* (1968), harpsichord.

Michael James Olson. *Arcadia* (2013), amplified mixed quartet and audiovisual fixed media.

Curtis Roads. *Sonal Atoms* (1999), fixed media.

Jean Sibelius. *Symphony No. 2 in D Major, Op. 43*. (1902), orchestra.

Karlheinz Stockhausen. *Kontakte* (1960), piano, percussion, electronic sounds.

Egard Varèse. *Déserts* (1954), mixed ensemble and electronic tape.

Iannis Xenakis. *Metastasis* (1954), orchestra.

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Color Circle

For Orchestra and Computer

Carter John Rice

2017

Color Circle

Instrumentation:

Piccolo (flute 1)
2 Flutes
2 Oboes
2 Clarinets in B-flat
2 Bassoons
Contrabassoon (bassoon 2)
4 Horns in F
2 Trumpets in B-flat
2 Trombones
Tuba
Timpani
3 Percussion
    1. vibraphone (with bow), temple blocks (5)
    2. crotales (with bow), woodblock, xylophone, tam-tam, toms (5)
    3. suspended cymbal, bass drum, triangle

Piano
Computer
Violins I
Violins II
Violas
Cellos
Basses

Technical Notes:

Color Circle makes use of a computer (CPU) and a dedicated performer in order to realize a series of electronically generated sounds that accompany the orchestra. The computer runs a stand-alone application that allows a member of the orchestra to perform with the rest of the ensemble similarly to any other instrument. The CPU performer is given a grand staff in the score and an individually printed part like other performing forces, and this part includes graphic notation, text that explains what may be happening at any given moment, and a series of cue numbers that indicate when to advance the CPU.

The CPU performer simply presses the spacebar key at the cues notated in the score. Each time the performer presses the spacebar, a variety of new sounds may appear and previous ones may fade out. It is highly recommended that the conductor and the CPU performer rehearse together in advance of working with the rest of the ensemble to gain a sense of what sounds will accompany the varying sections of the piece.

The CPU performer is given several options in the stand-alone application to assist with performance and rehearsal. They may stop the audio coming from the computer at any moment if the conductor chooses to stop, they may also select any cue number and upon the next press of the spacebar key the application will begin generating sounds at the chosen cue, and they are able to increase and decrease their amplitude output in order to respond to expressive gestures from the conductor. This allows the conductor to create his or her ideal balance between the orchestra and the electronically generated sounds.

With few exceptions, the conductor need not worry about remaining synchronized with the CPU. Instead, the CPU performer simply follows the pace of the conductor. At a few select moments, as is notated in the score, slightly more precise timing is required.

A dedicated sound engineer is recommended to assist with routing the audio from the CPU to the speakers in the performance space. The audio signal from the CPU is two-channel (stereo) audio. The two speakers should ideally be placed within the ensemble, one on each side of the winds and brass section. It is recommended that the sound engineer provide more precise balance levels between the CPU and the orchestra from the front-of-house position.

Please contact the composer for a copy of the required stand-alone application, and for further technical instructions.

Musical Notes:

Accidentals apply only to the measure in which they appear and are non-transferable over the octave. Both within the score and within individual parts, various courtesy accidentals have been provided to assist with reading.

The score contained within this document is transposed so all instruments are in C.

All tempo markings are intended as suggestions more than rules. The conductor is encouraged to experiment with varying tempi, as well as with adding various accelerando and ritardando at moments they feel may benefit from their presence. Doing so will greatly affect the way in which the orchestra interacts with the sounds of the CPU, and may produce interesting results.

The included score is in C, but instruments which transpose at the octave (piccolo, crotales, string basses) are intended to sound an octave above or below their written line.

Program Notes:

Color Circle is one of several pieces in a recent series, each of which is inspired by the geometry of circles. *Color Circle* draws particular inspiration from the realization of circles as waves, as well as from the harmonic function of the circle of fifths. The entire work is guided by an omni-present yet often obscured circle of fifths that helps to generate harmonic momentum and create contrast. This work was completed in the Spring of 2017 as part of my dissertation work, and it is happily dedicated to the entire music faculty of Ball State University.

Contact:

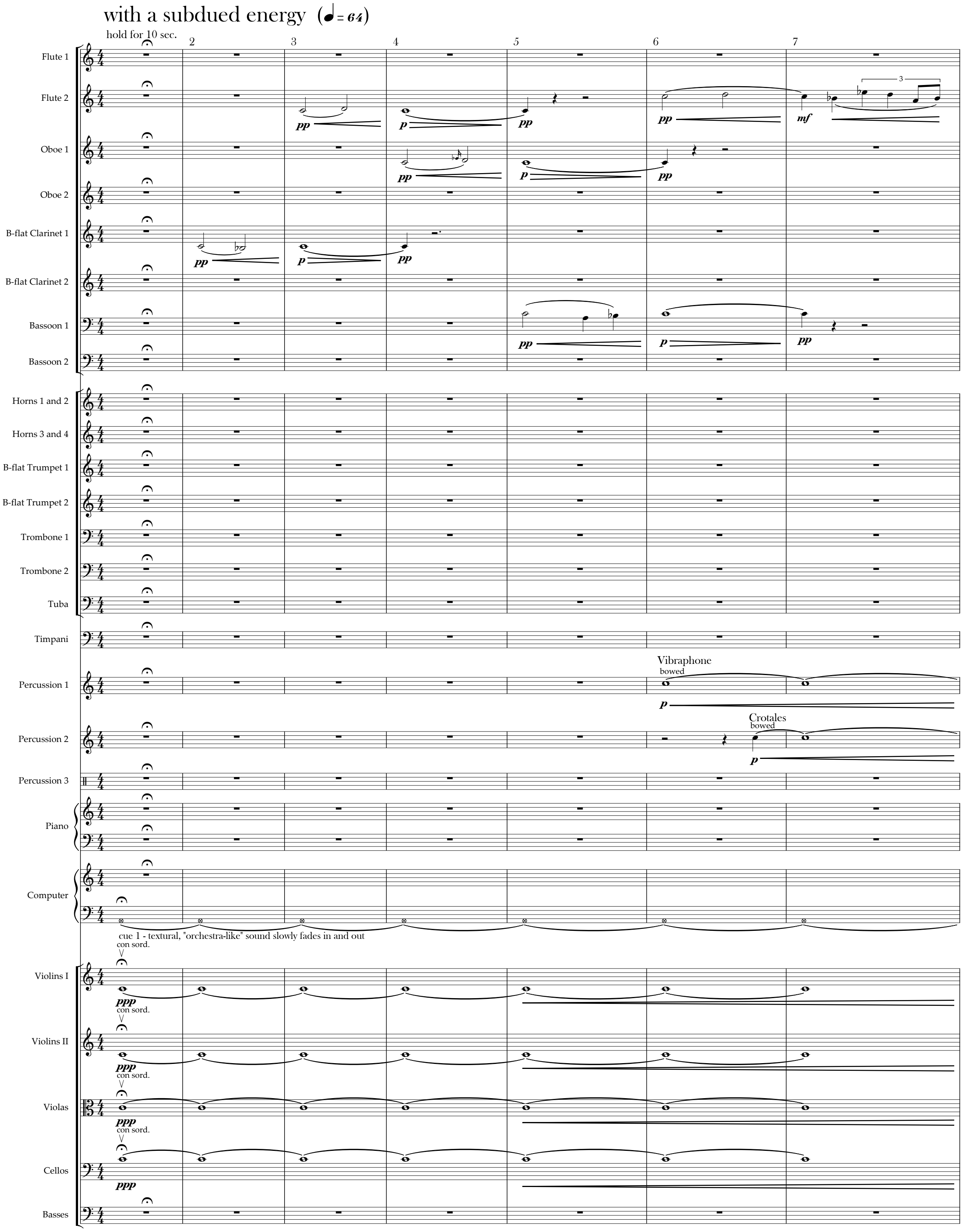
carterricecomposer@gmail.com

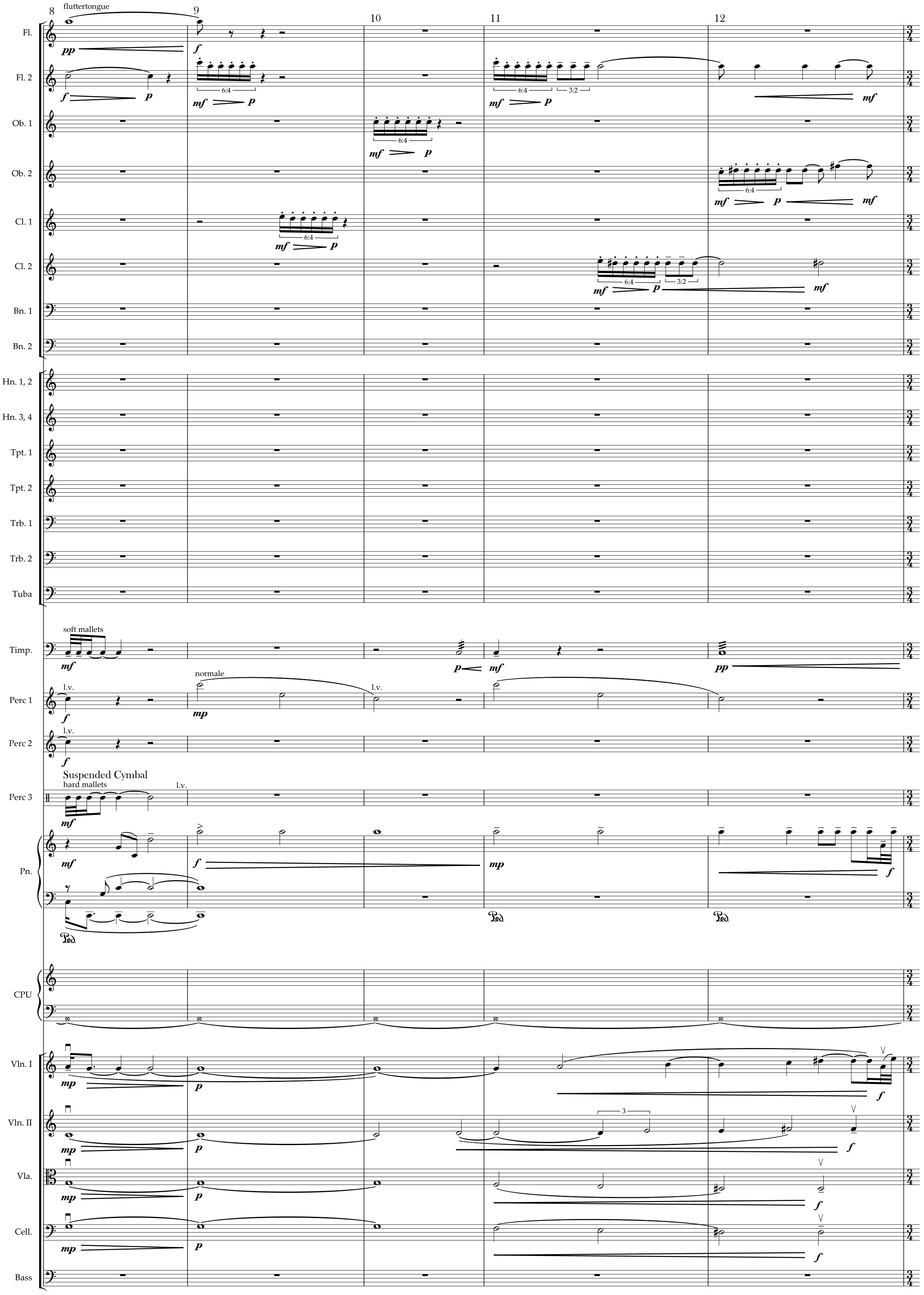
Color Circle

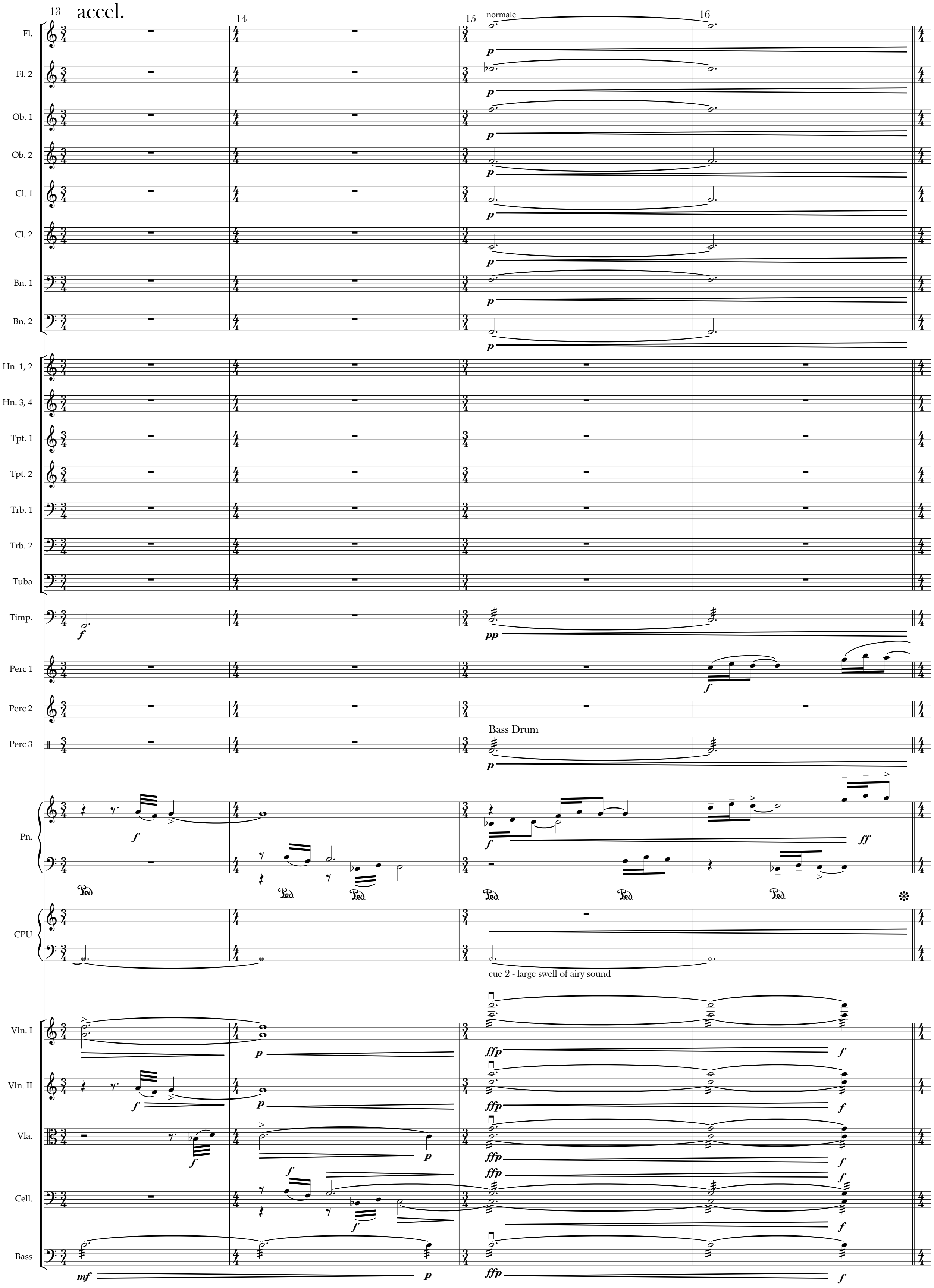
for orchestra and computer

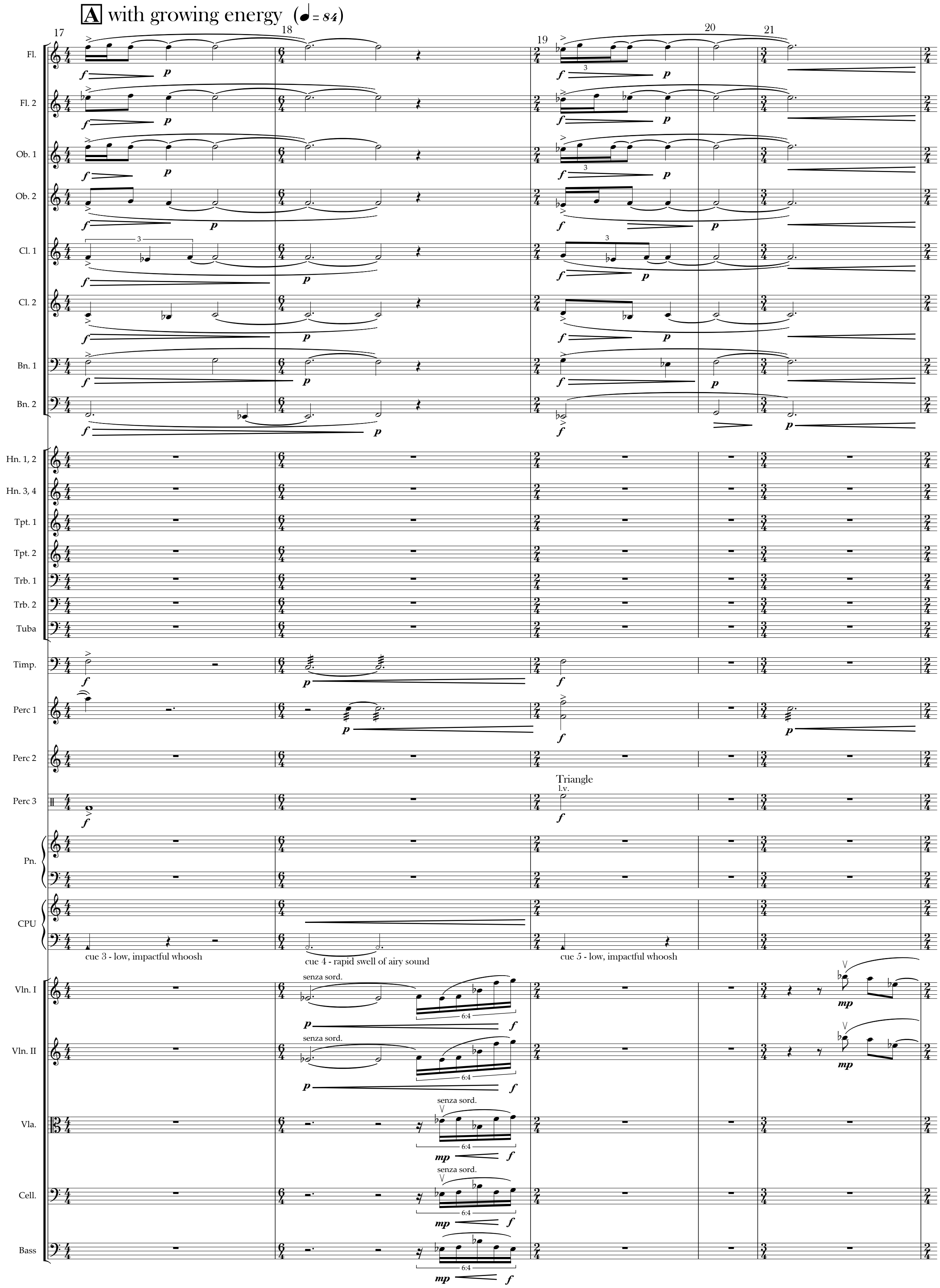
Score in C

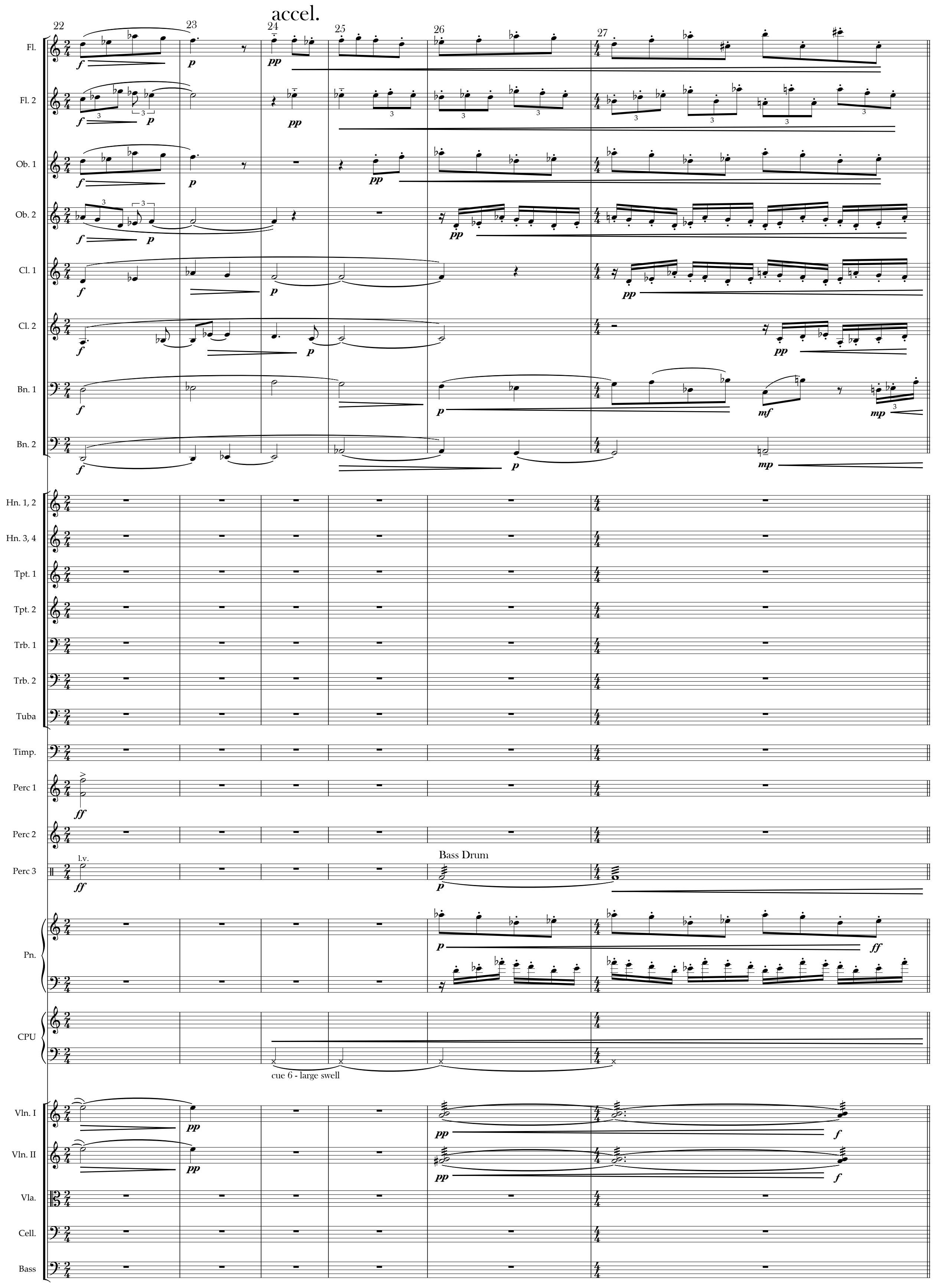
Carter John Rice

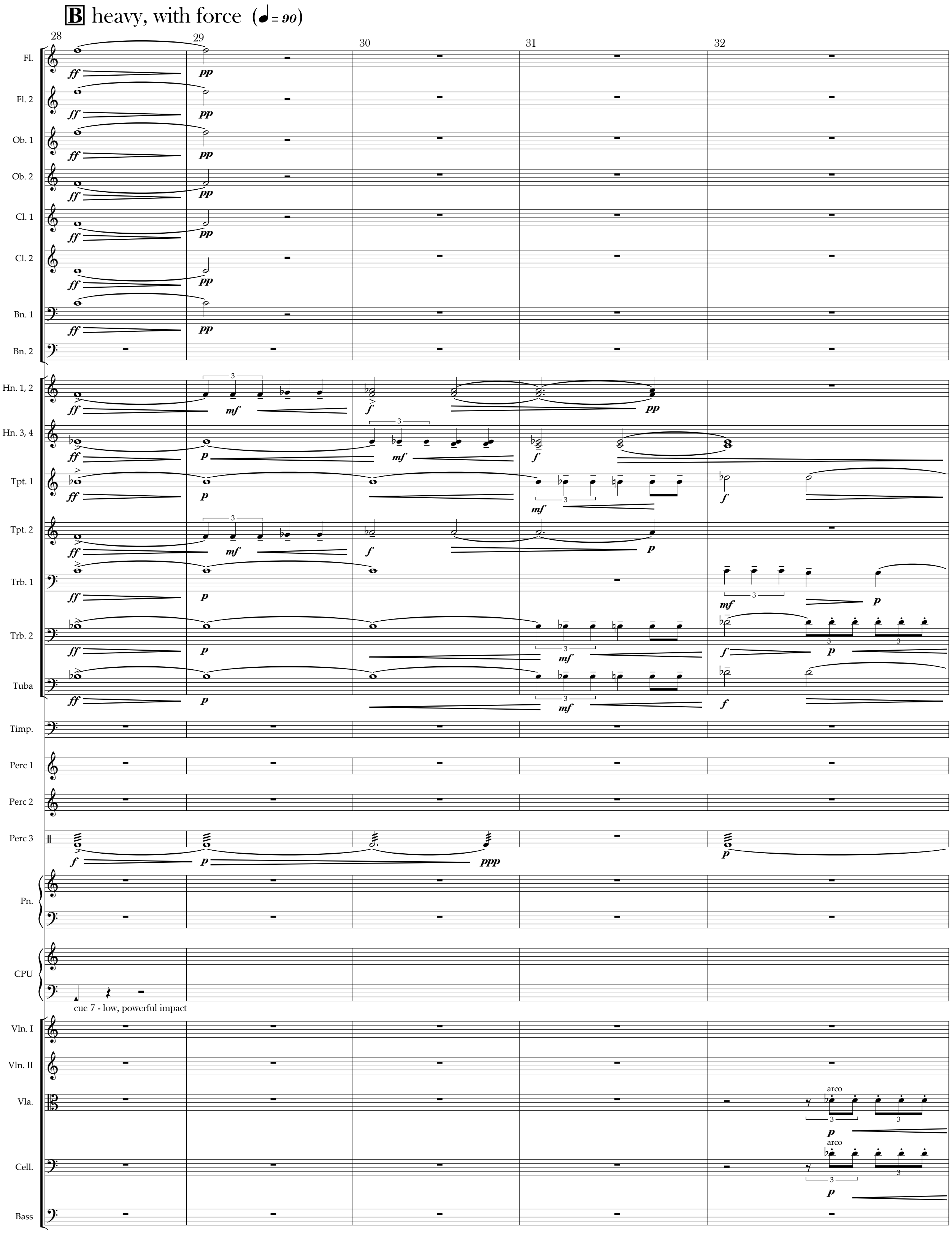

with a subdued energy (♩= 64)
hold for 10 sec.
2
3
4
5
6
7
Flute 1
Flute 2
Oboe 1
Oboe 2
B-flat Clarinet 1
B-flat Clarinet 2
Bassoon 1
Bassoon 2
Horns 1 and 2
Horns 3 and 4
B-flat Trumpet 1
B-flat Trumpet 2
Trombone 1
Trombone 2
Tuba
Timpani
Percussion 1
Percussion 2
Percussion 3
Piano
Computer
Violins I
Violins II
Violas
Cellos
Basses
pp
p
mf
3
Vibraphone
bowed
Crotales
bowed
cue 1 - textural, "orchestra-like" sound slowly fades in and out
con sord.
ppp

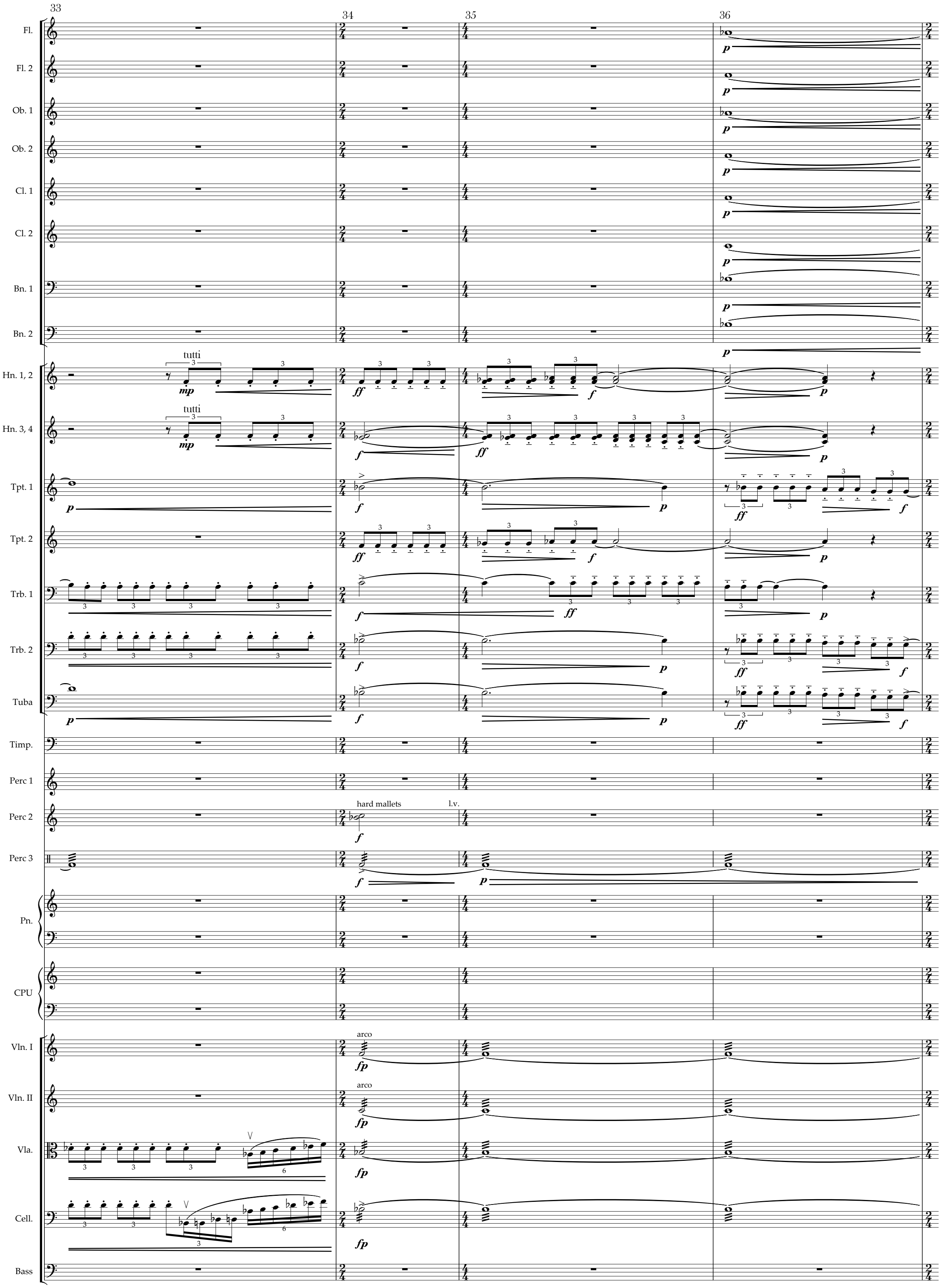

8
fluttertongue
9
10
11
12
Fl.
Fl. 2
Ob. 1
Ob. 2
Cl. 1
Cl. 2
Bn. 1
Bn. 2
Hn. 1, 2
Hn. 3, 4
Tpt. 1
Tpt. 2
Trb. 1
Trb. 2
Tuba
Timp.
Perc 1
Perc 2
Perc 3
Pn.
CPU
Vln. I
Vln. II
Vla.
Cell.
Bass
soft mallets
normale
l.v.
Suspended Cymbal
hard mallets
6:4
3:2
3
pp
f
mf
p
mp
Ped.

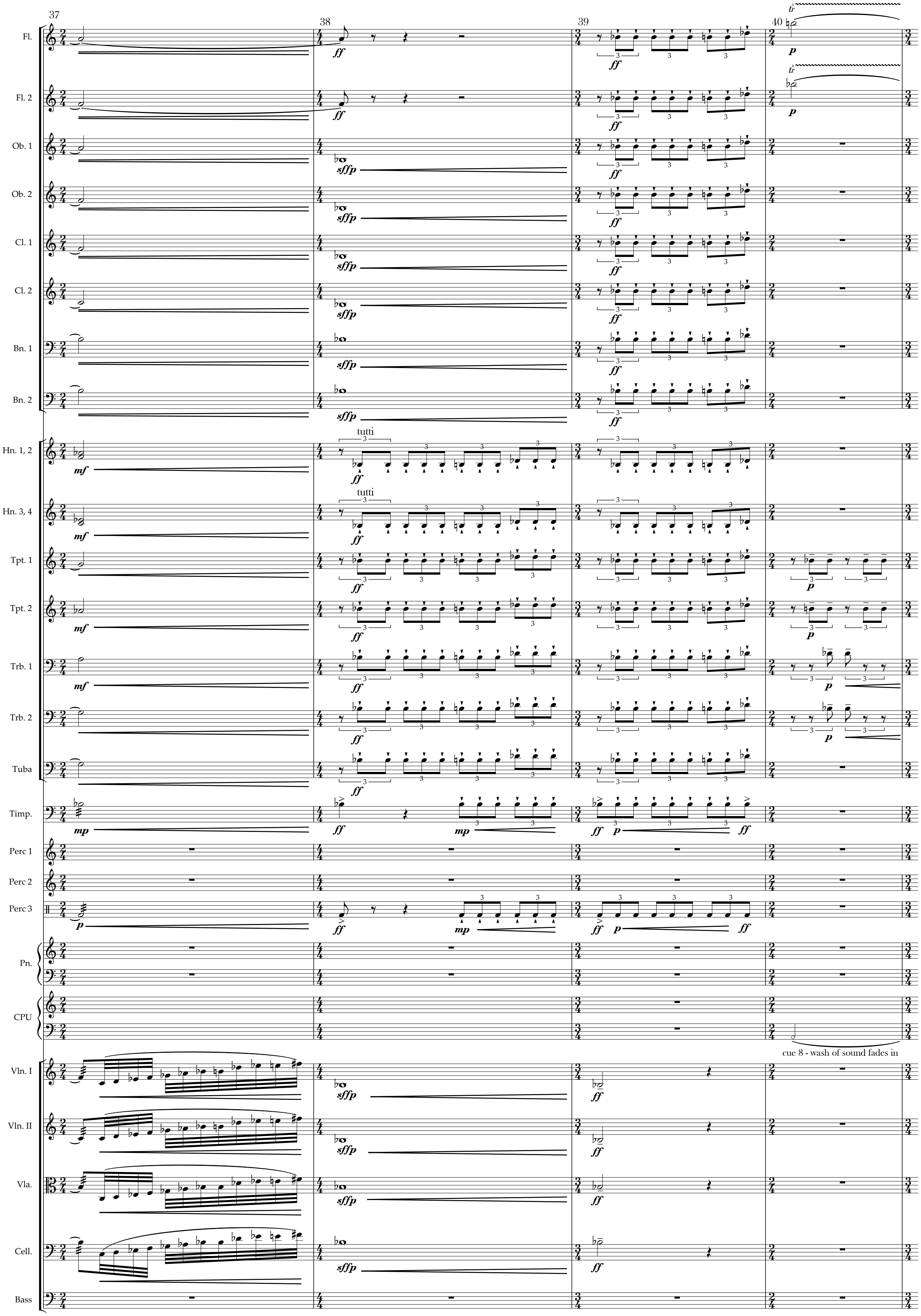

13
accel.
14
15
16
normale
Fl.
Fl. 2
Ob. 1
Ob. 2
Cl. 1
Cl. 2
Bn. 1
Bn. 2
Hn. 1, 2
Hn. 3, 4
Tpt. 1
Tpt. 2
Trb. 1
Trb. 2
Tuba
Timp.
Perc 1
Perc 2
Perc 3
Bass Drum
Pn.
CPU
cue 2 - large swell of airy sound
Vln. I
Vln. II
Vla.
Cell.
Bass
p
pp
f
ff
ffp
mf

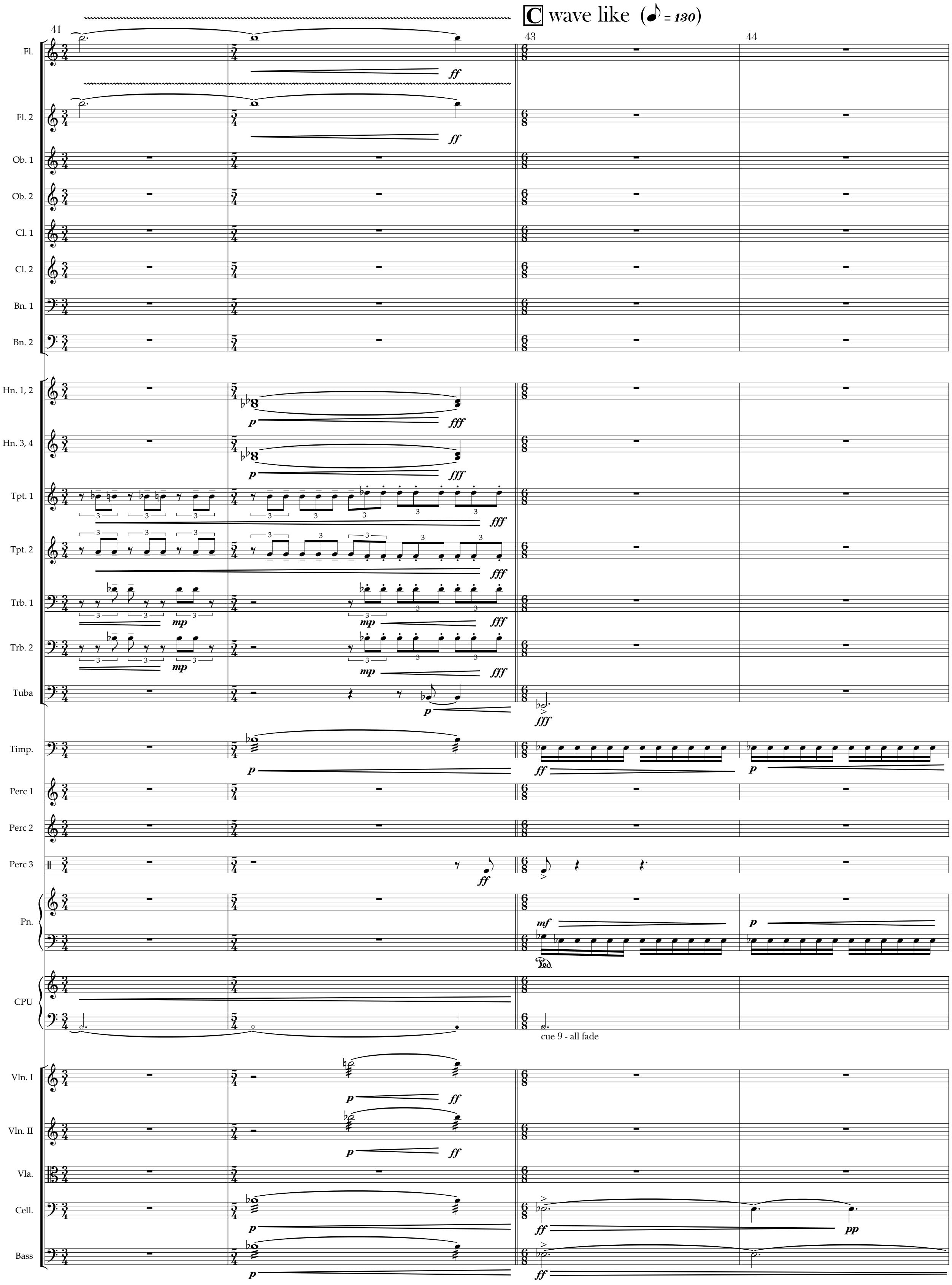

A with growing energy (♩= 84)
17
18
19
20
21
Fl.
Fl. 2
Ob. 1
Ob. 2
Cl. 1
Cl. 2
Bn. 1
Bn. 2
Hn. 1, 2
Hn. 3, 4
Tpt. 1
Tpt. 2
Trb. 1
Trb. 2
Tuba
Timp.
Perc 1
Perc 2
Perc 3
Pn.
CPU
Vln. I
Vln. II
Vla.
Cell.
Bass
Triangle
l.v.
cue 3 - low, impactful whoosh
cue 4 - rapid swell of airy sound
cue 5 - low, impactful whoosh
senza sord.
6:4
f
p
mp

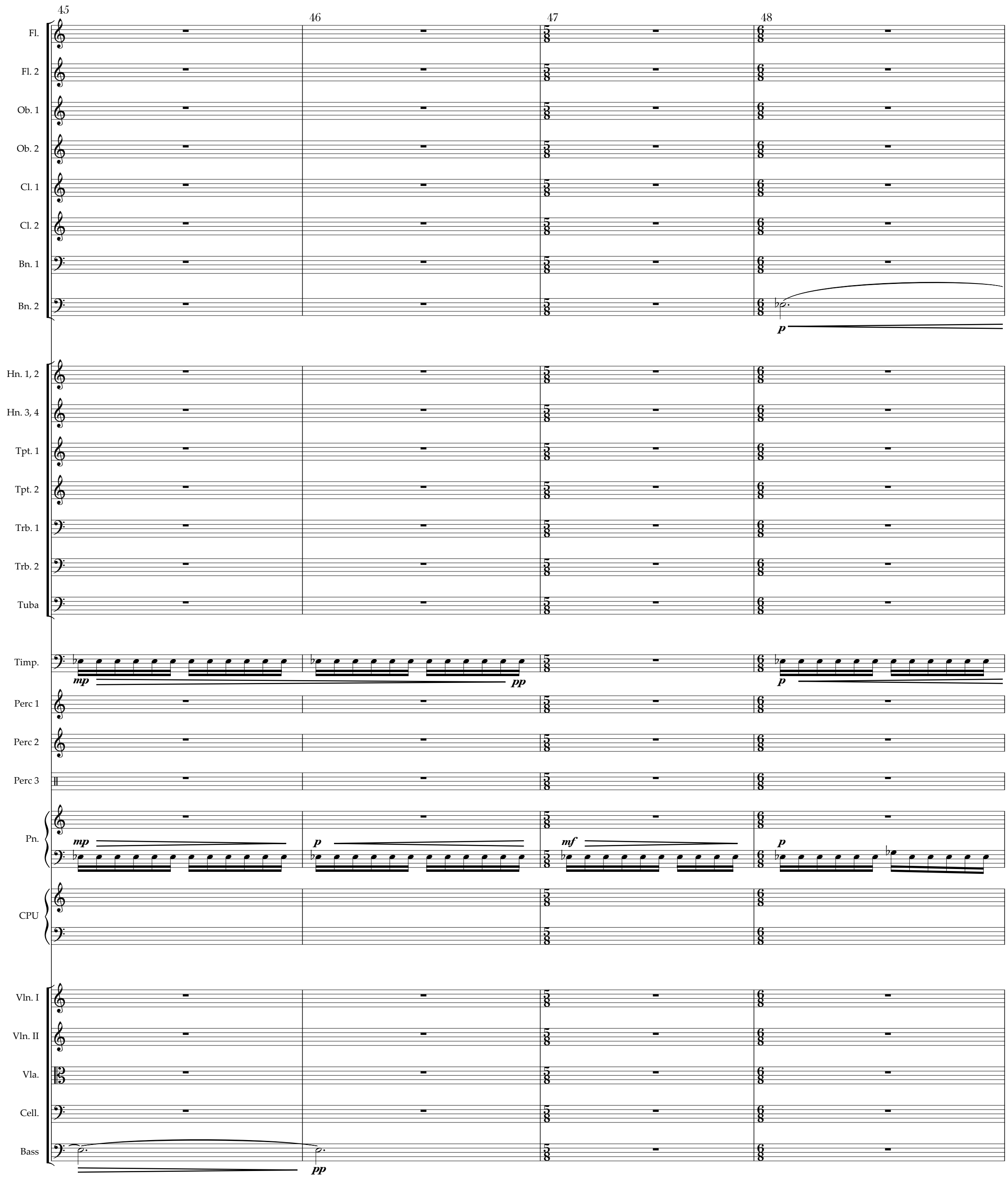

accel.
22
23
24
25
26
27
Fl.
Fl. 2
Ob. 1
Ob. 2
Cl. 1
Cl. 2
Bn. 1
Bn. 2
Hn. 1, 2
Hn. 3, 4
Tpt. 1
Tpt. 2
Trb. 1
Trb. 2
Tuba
Timp.
Perc 1
Perc 2
Perc 3
Pn.
CPU
Vln. I
Vln. II
Vla.
Cell.
Bass
f
p
pp
mf
mp
ff
l.v.
Bass Drum
cue 6 - large swell

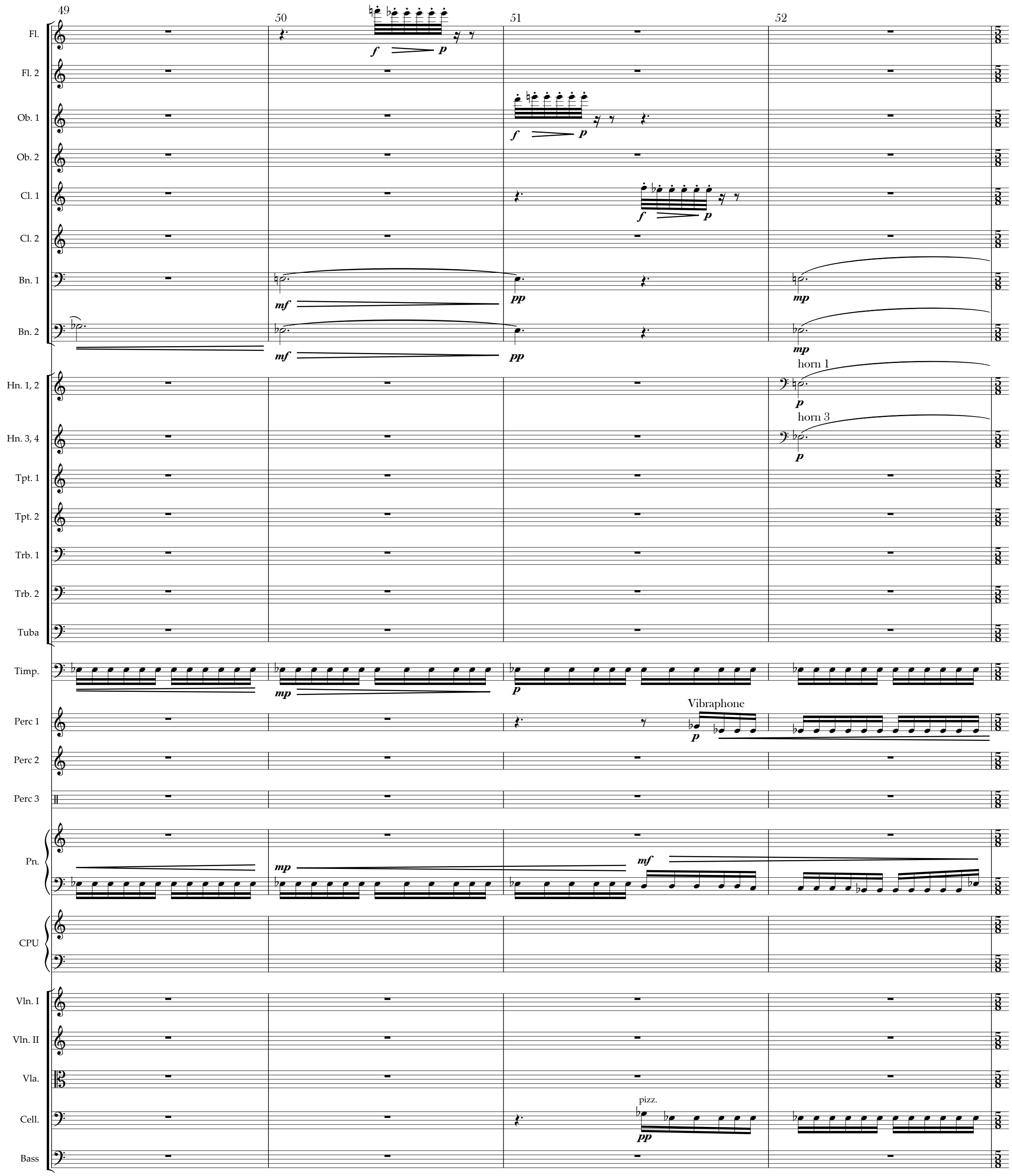

B heavy, with force (♩= 90)
28
29
30
31
32
Fl.
Fl. 2
Ob. 1
Ob. 2
Cl. 1
Cl. 2
Bn. 1
Bn. 2
Hn. 1, 2
Hn. 3, 4
Tpt. 1
Tpt. 2
Trb. 1
Trb. 2
Tuba
Timp.
Perc 1
Perc 2
Perc 3
Pn.
CPU
Vln. I
Vln. II
Vla.
Cell.
Bass
ff
pp
mf
f
p
ppp
cue 7 - low, powerful impact
arco
3

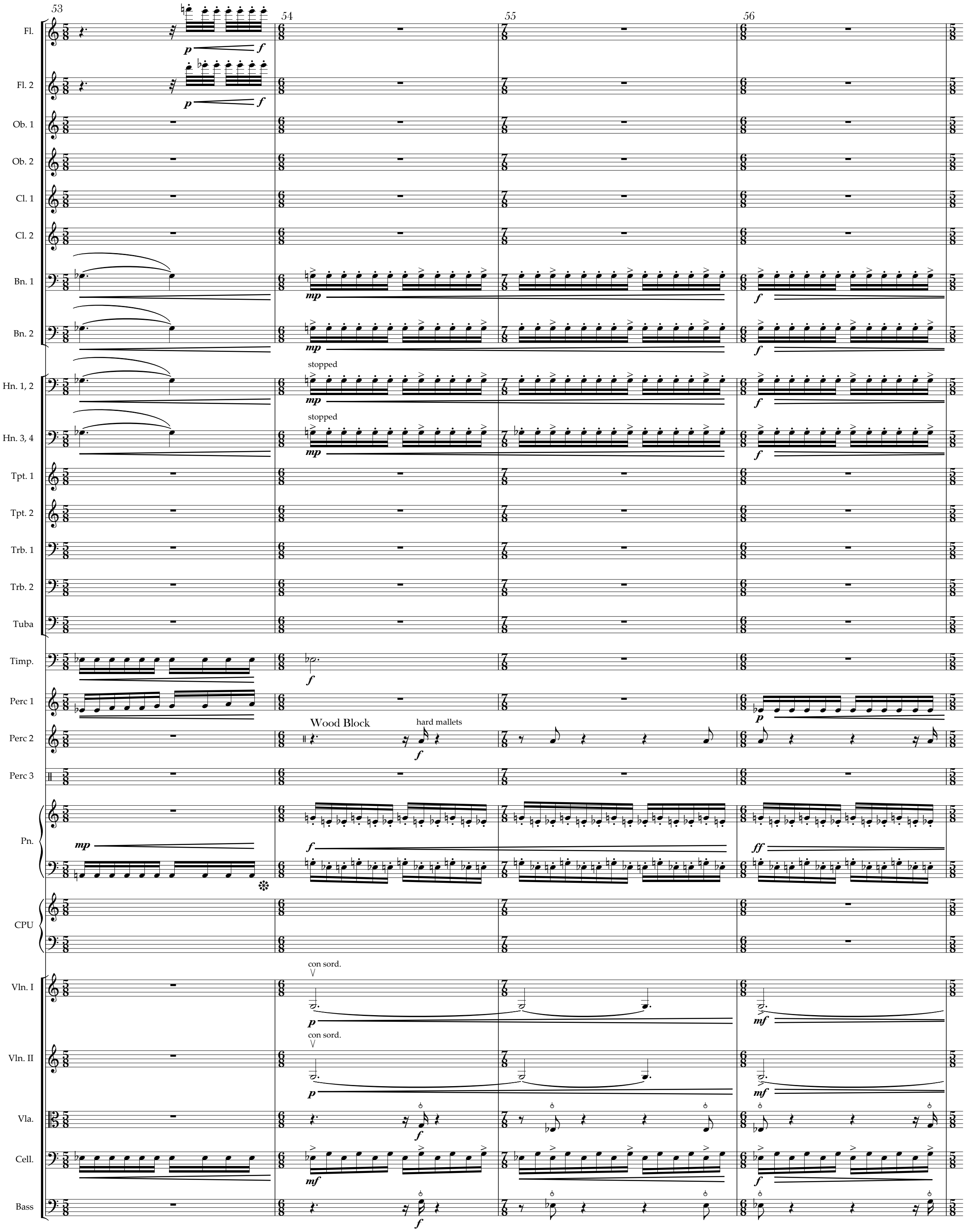

33
34
35
36
Fl.
Fl. 2
Ob. 1
Ob. 2
Cl. 1
Cl. 2
Bn. 1
Bn. 2
Hn. 1, 2
Hn. 3, 4
Tpt. 1
Tpt. 2
Trb. 1
Trb. 2
Tuba
Timp.
Perc 1
Perc 2
Perc 3
Pn.
CPU
Vln. I
Vln. II
Vla.
Cell.
Bass
tutti
tutti
hard mallets
l.v.
arco
arco
p
mp
ff
f
fp

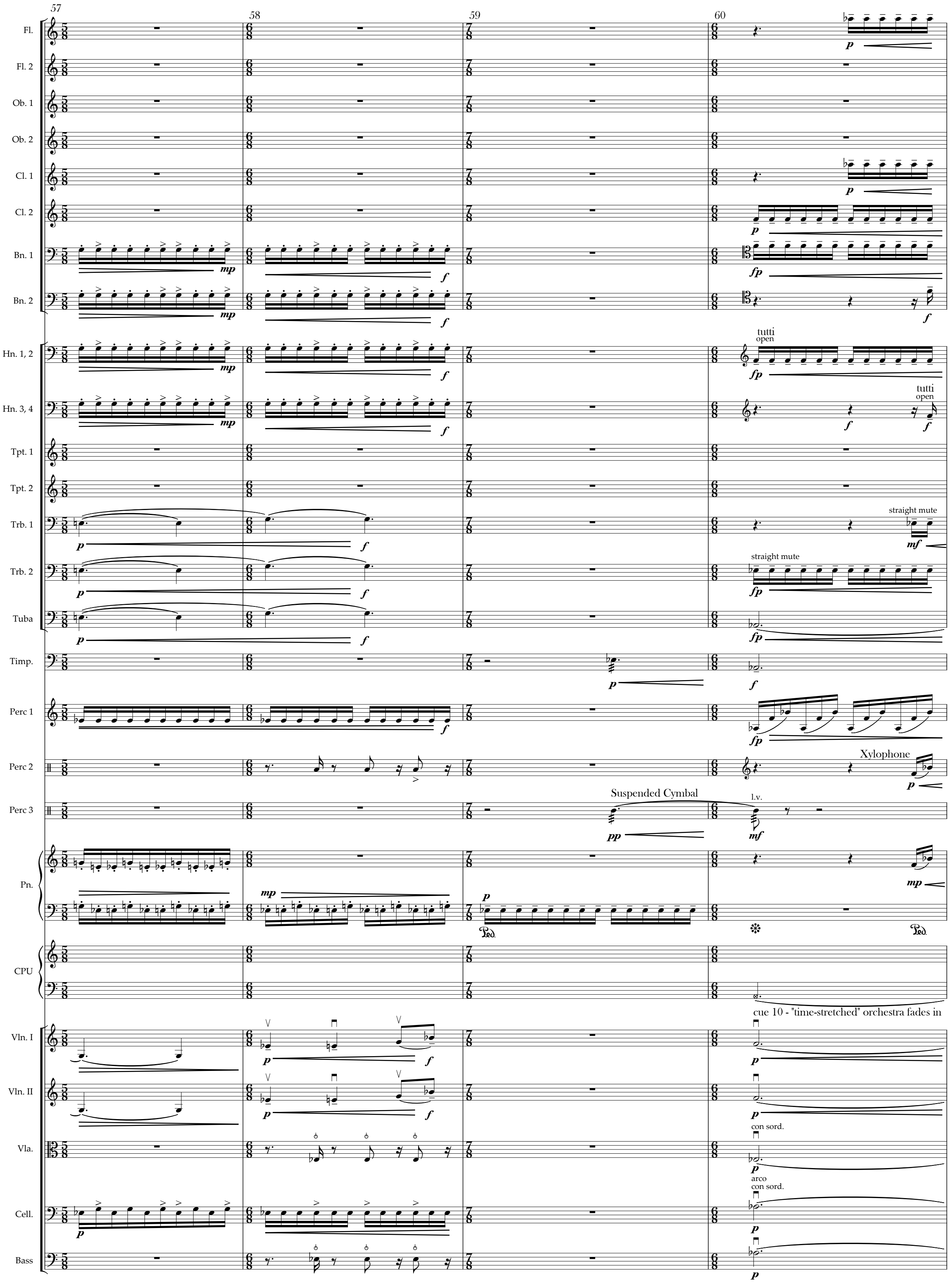

37
38
39
40
Fl.
Fl. 2
Ob. 1
Ob. 2
Cl. 1
Cl. 2
Bn. 1
Bn. 2
Hn. 1, 2
Hn. 3, 4
Tpt. 1
Tpt. 2
Trb. 1
Trb. 2
Tuba
Timp.
Perc 1
Perc 2
Perc 3
Pn.
CPU
Vln. I
Vln. II
Vla.
Cell.
Bass
tutti
tr
ff
sffp
mf
mp
p
cue 8 - wash of sound fades in

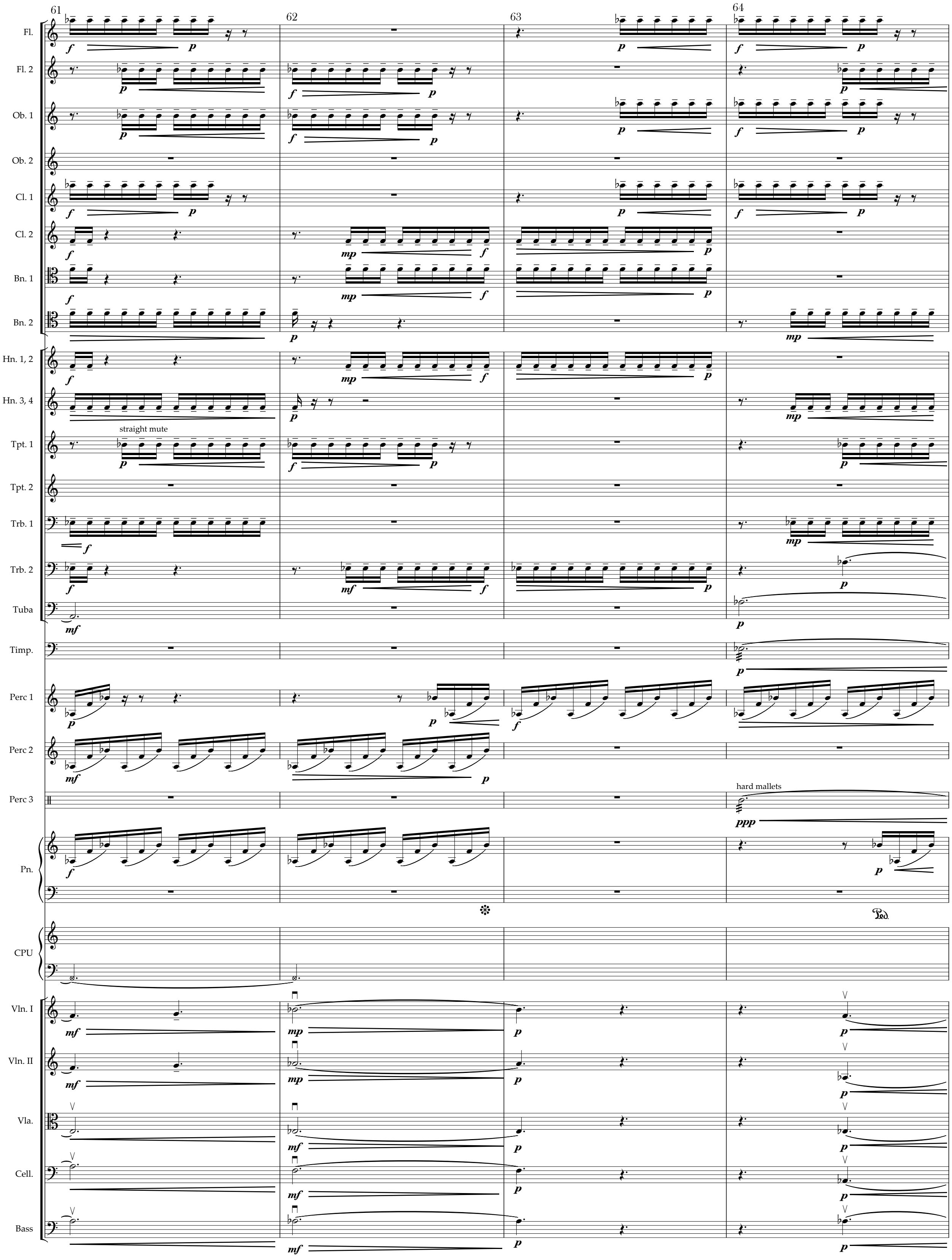

C wave like (♪ = 130)
41
43
44
Fl.
Fl. 2
Ob. 1
Ob. 2
Cl. 1
Cl. 2
Bn. 1
Bn. 2
Hn. 1, 2
Hn. 3, 4
Tpt. 1
Tpt. 2
Trb. 1
Trb. 2
Tuba
Timp.
Perc 1
Perc 2
Perc 3
Pn.
CPU
Vln. I
Vln. II
Vla.
Cell.
Bass
ff
p
fff
mp
mf
pp
cue 9 - all fade

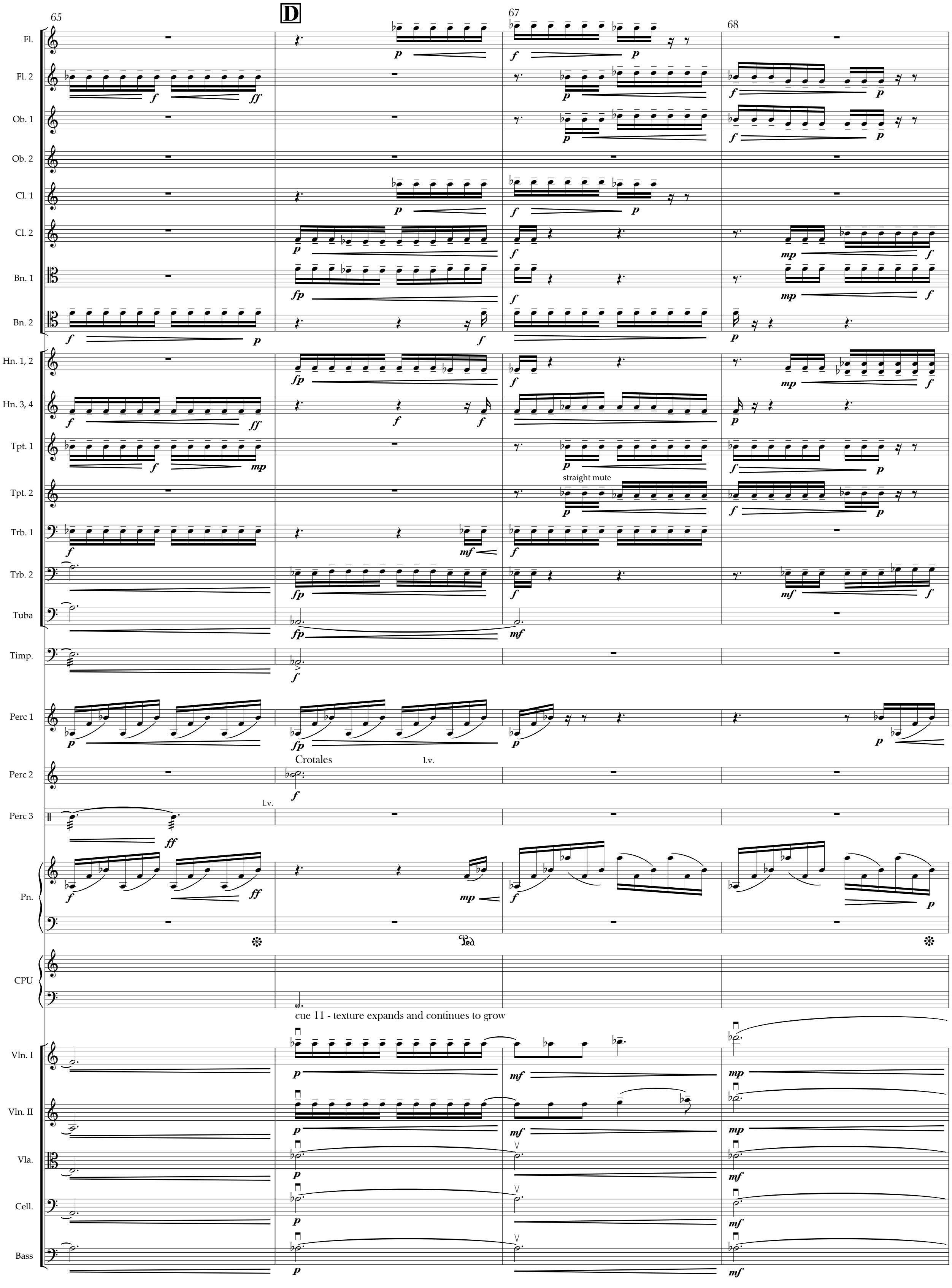

45
46
47
48
Fl.
Fl. 2
Ob. 1
Ob. 2
Cl. 1
Cl. 2
Bn. 1
Bn. 2
p
Hn. 1, 2
Hn. 3, 4
Tpt. 1
Tpt. 2
Trb. 1
Trb. 2
Tuba
Timp.
mp
pp
p
Perc 1
Perc 2
Perc 3
Pn.
mp
p
mf
p
CPU
Vln. I
Vln. II
Vla.
Cell.
Bass
pp

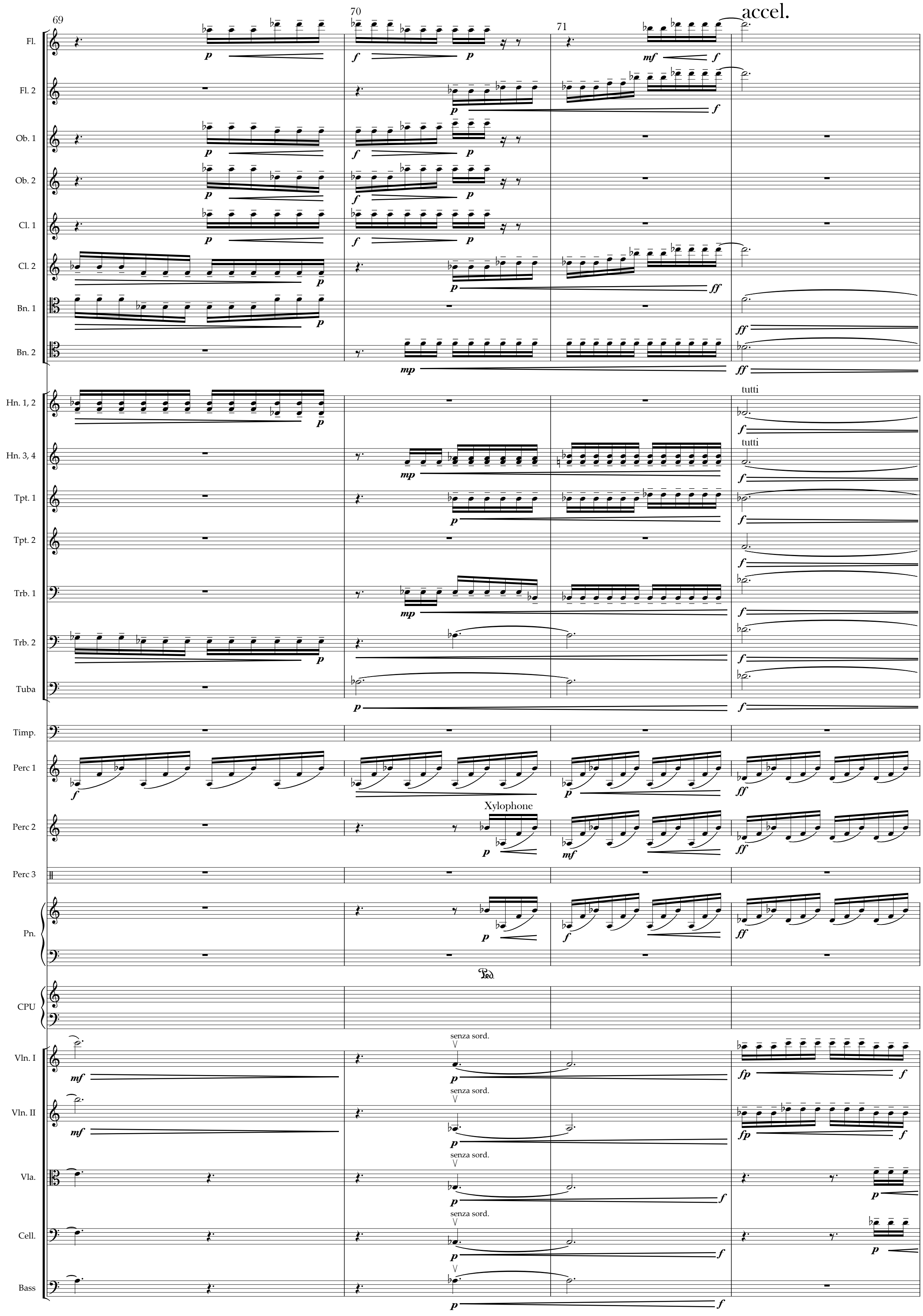

49
50
51
52
Fl.
Fl. 2
Ob. 1
Ob. 2
Cl. 1
Cl. 2
Bn. 1
Bn. 2
Hn. 1, 2
Hn. 3, 4
Tpt. 1
Tpt. 2
Trb. 1
Trb. 2
Tuba
Timp.
Perc 1
Perc 2
Perc 3
Pn.
CPU
Vln. I
Vln. II
Vla.
Cell.
Bass
f
p
mf
pp
mp
horn 1
horn 3
Vibraphone
pizz.
5/8

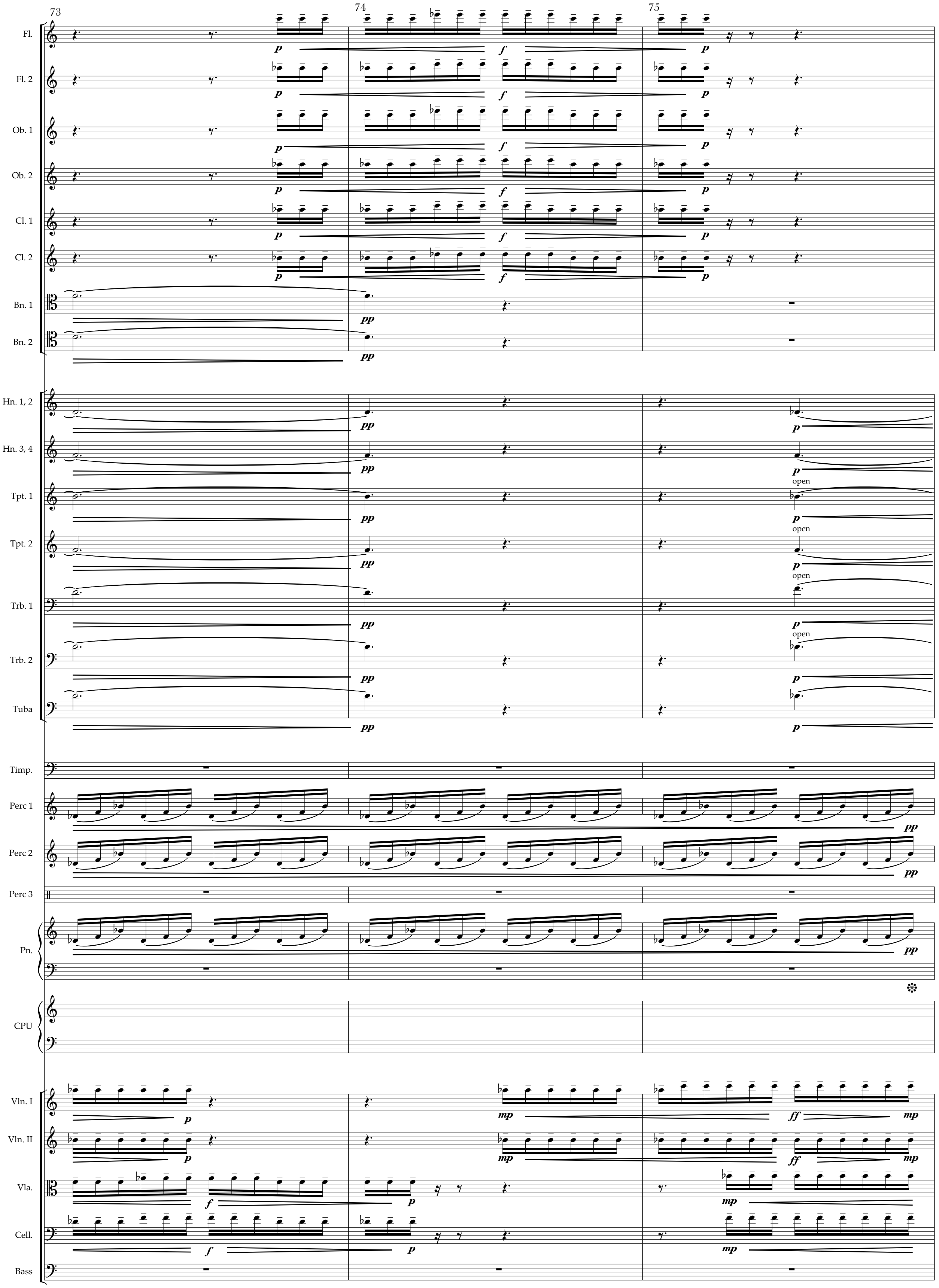

53
54
55
56
Fl.
Fl. 2
Ob. 1
Ob. 2
Cl. 1
Cl. 2
Bn. 1
Bn. 2
Hn. 1, 2
Hn. 3, 4
Tpt. 1
Tpt. 2
Trb. 1
Trb. 2
Tuba
Timp.
Perc 1
Perc 2
Perc 3
Pn.
CPU
Vln. I
Vln. II
Vla.
Cell.
Bass
stopped
stopped
Wood Block
hard mallets
con sord.
con sord.
p
f
mp
mf
ff

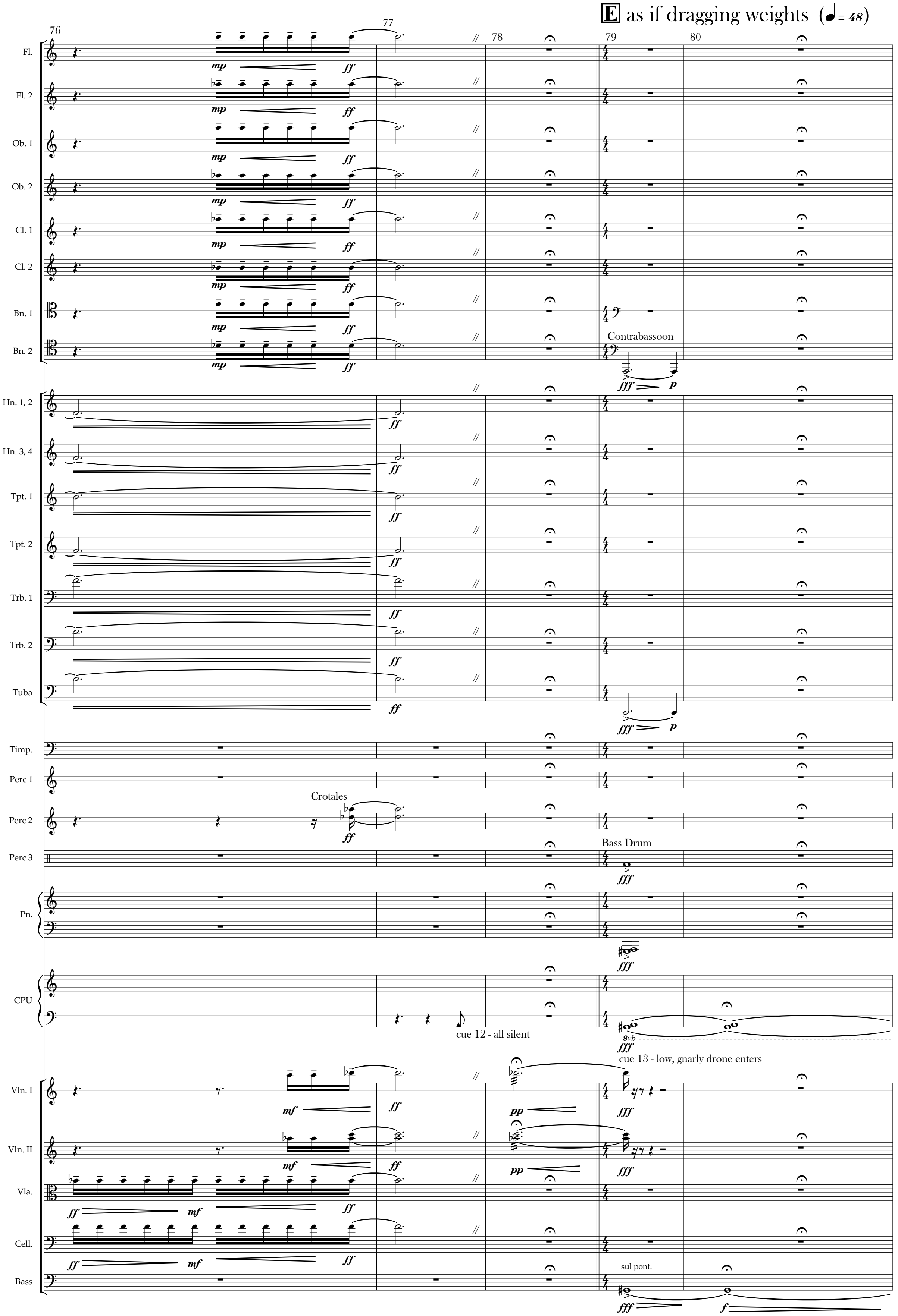

57
58
59
60
Fl.
Fl. 2
Ob. 1
Ob. 2
Cl. 1
Cl. 2
Bn. 1
Bn. 2
Hn. 1, 2
Hn. 3, 4
Tpt. 1
Tpt. 2
Trb. 1
Trb. 2
Tuba
Timp.
Perc 1
Perc 2
Perc 3
Pn.
CPU
Vln. I
Vln. II
Vla.
Cell.
Bass
p
mp
f
fp
mf
pp
tutti
open
straight mute
Xylophone
Suspended Cymbal
l.v.
cue 10 - "time-stretched" orchestra fades in
con sord.
arco
Ped.

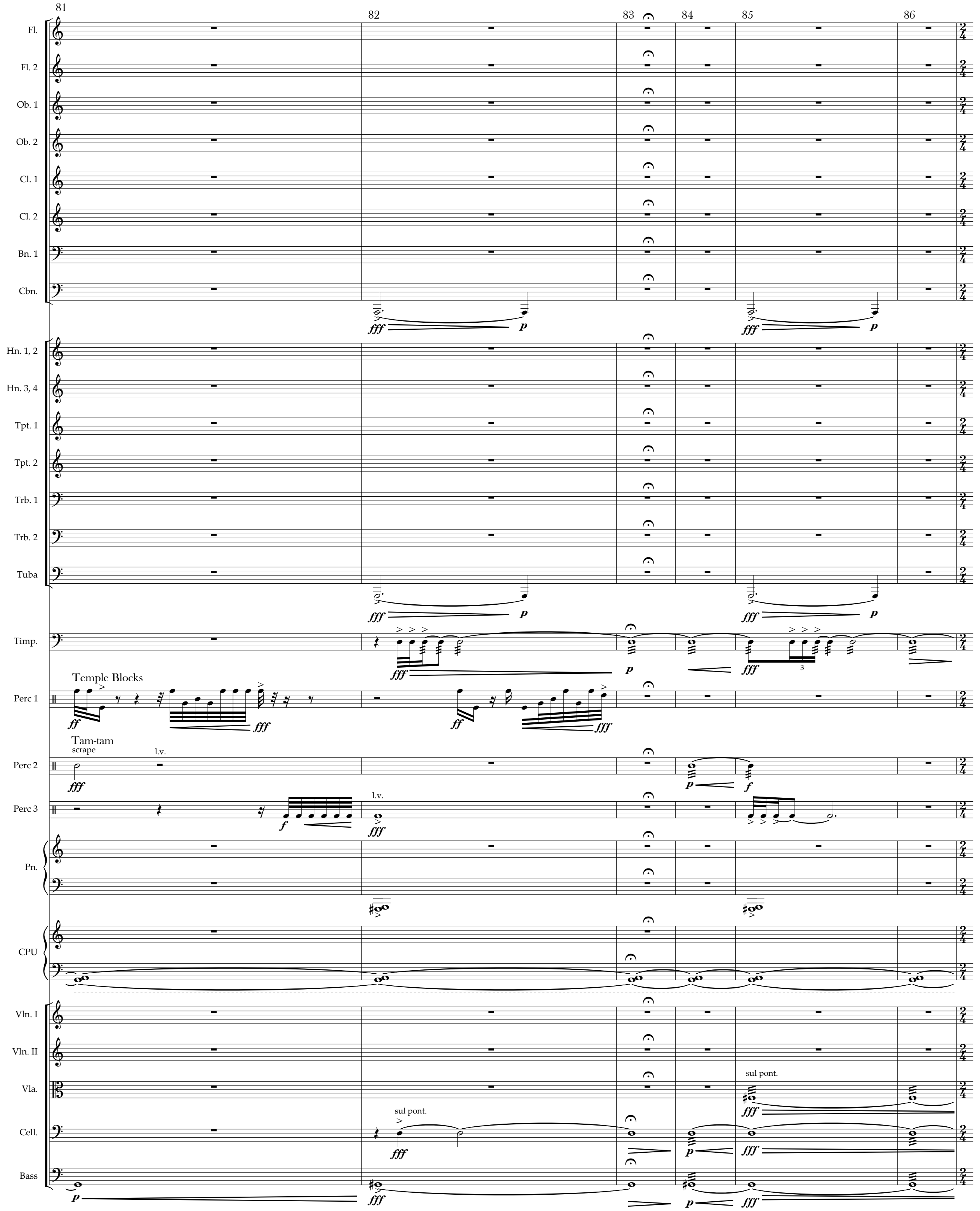

61
62
63
64
Fl.
Fl. 2
Ob. 1
Ob. 2
Cl. 1
Cl. 2
Bn. 1
Bn. 2
Hn. 1, 2
Hn. 3, 4
Tpt. 1
Tpt. 2
Trb. 1
Trb. 2
Tuba
Timp.
Perc 1
Perc 2
Perc 3
Pn.
CPU
Vln. I
Vln. II
Vla.
Cell.
Bass
straight mute
hard mallets
f
p
mp
mf
ppp

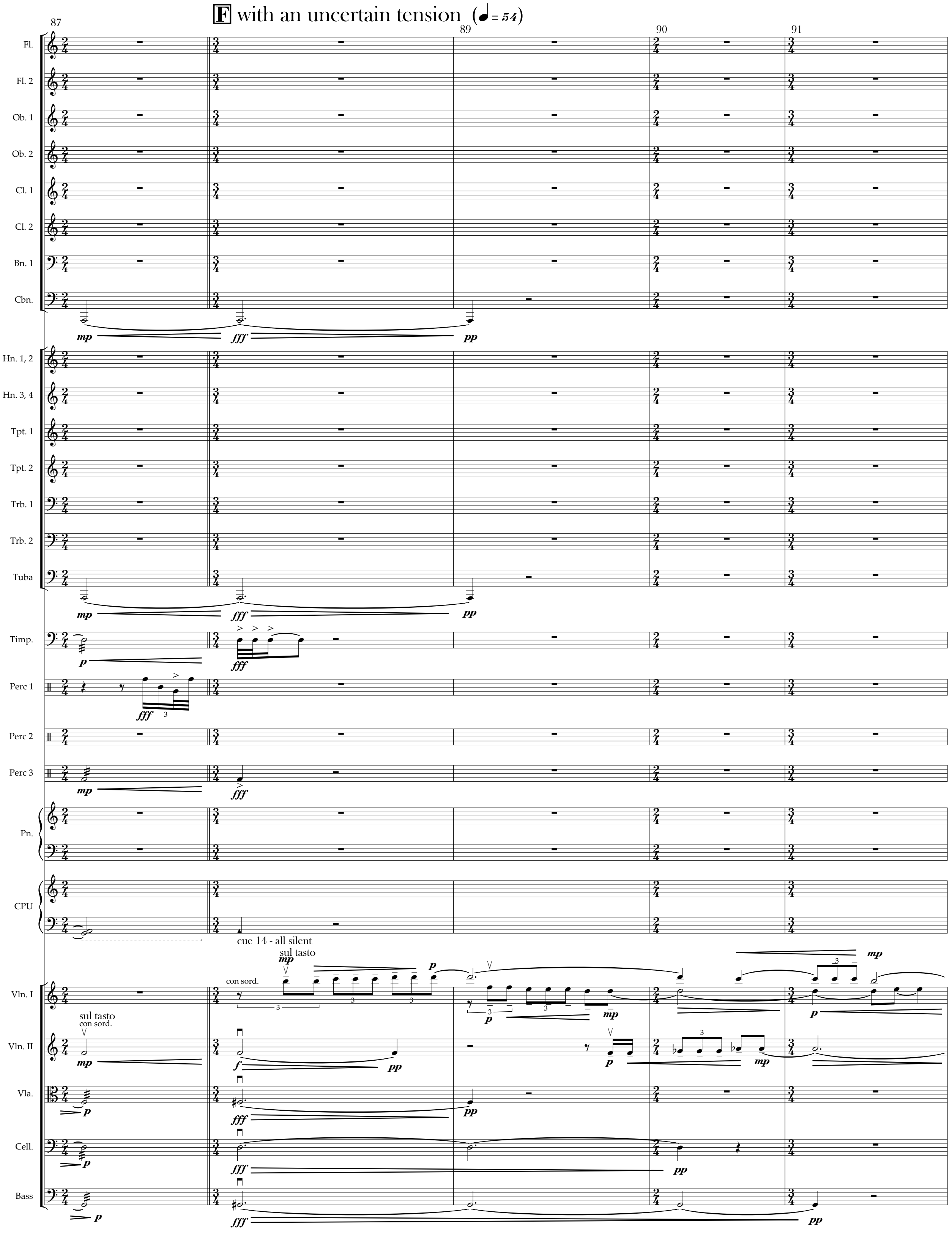

65
D
67
68
Fl.
Fl. 2
Ob. 1
Ob. 2
Cl. 1
Cl. 2
Bn. 1
Bn. 2
Hn. 1, 2
Hn. 3, 4
Tpt. 1
Tpt. 2
straight mute
Trb. 1
Trb. 2
Tuba
Timp.
Perc 1
Perc 2
Crotales
l.v.
Perc 3
l.v.
Pn.
CPU
cue 11 - texture expands and continues to grow
Vln. I
Vln. II
Vla.
Cell.
Bass

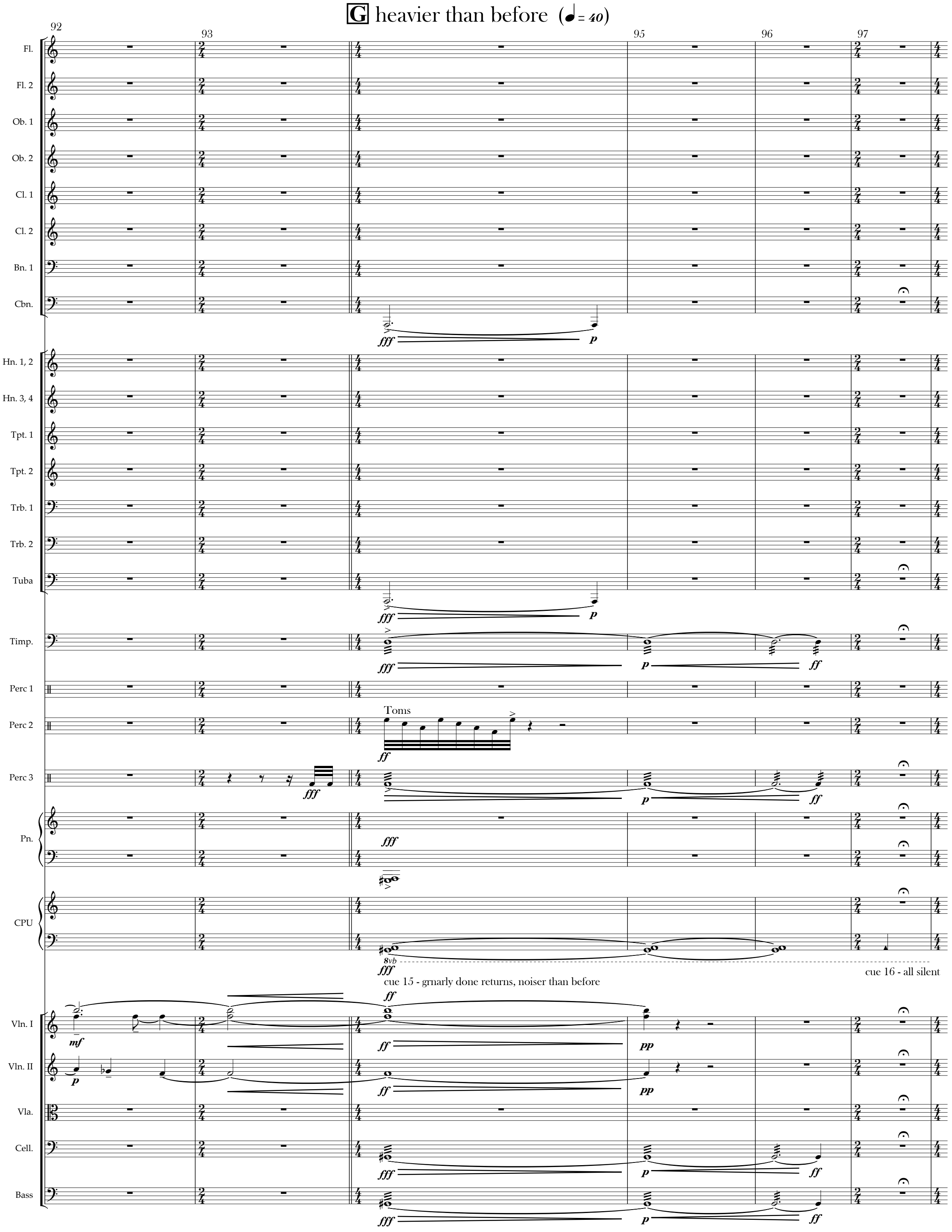

69
70
71
accel.
Fl.
Fl. 2
Ob. 1
Ob. 2
Cl. 1
Cl. 2
Bn. 1
Bn. 2
Hn. 1, 2
Hn. 3, 4
Tpt. 1
Tpt. 2
Trb. 1
Trb. 2
Tuba
Timp.
Perc 1
Perc 2
Perc 3
Pn.
CPU
Vln. I
Vln. II
Vla.
Cell.
Bass
tutti
Xylophone
senza sord.
p
f
mf
mp
ff
fp

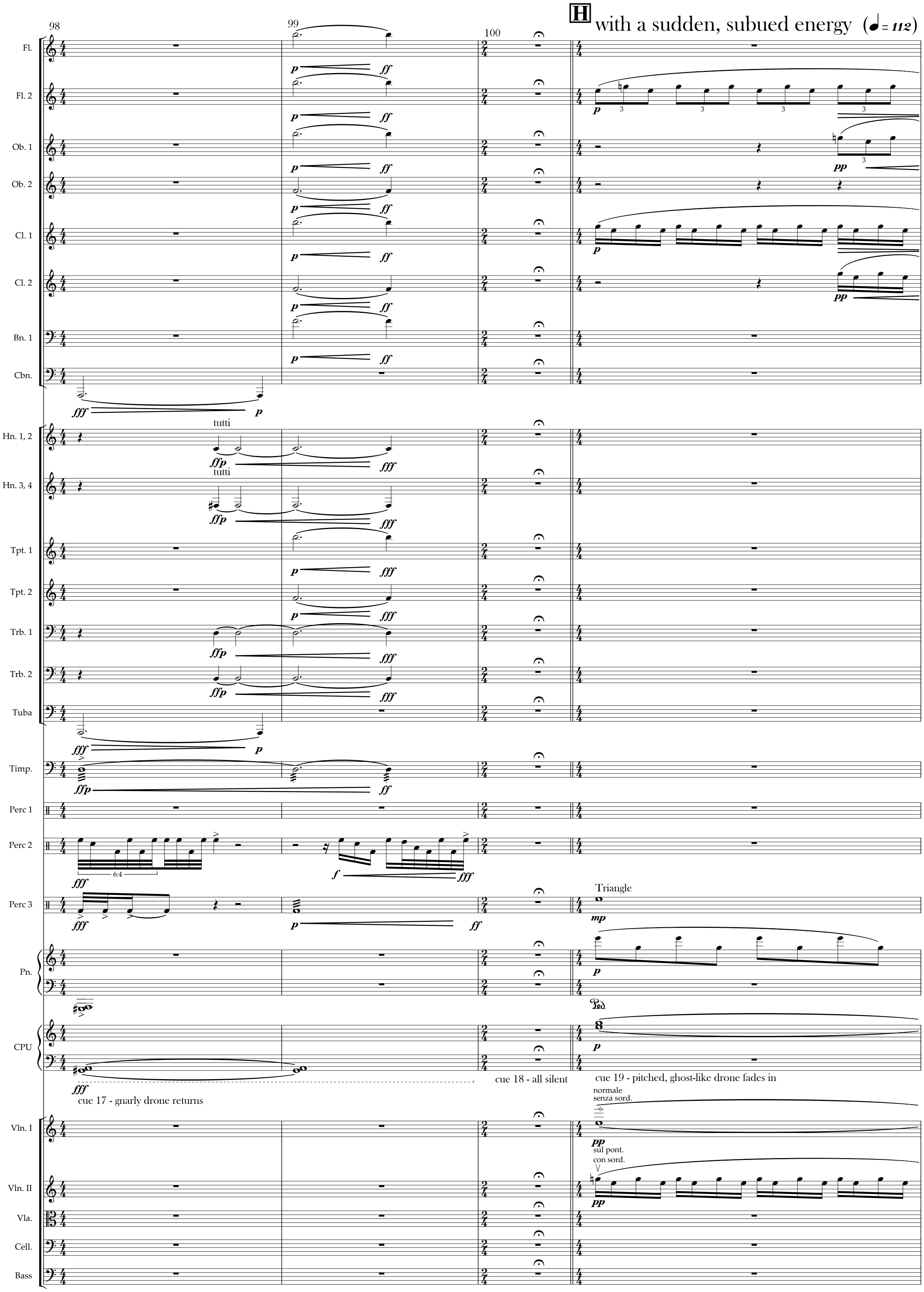

73
74
75
Fl.
Fl. 2
Ob. 1
Ob. 2
Cl. 1
Cl. 2
Bn. 1
Bn. 2
Hn. 1, 2
Hn. 3, 4
Tpt. 1
Tpt. 2
Trb. 1
Trb. 2
Tuba
Timp.
Perc 1
Perc 2
Perc 3
Pn.
CPU
Vln. I
Vln. II
Vla.
Cell.
Bass
p
f
pp
mp
ff
open

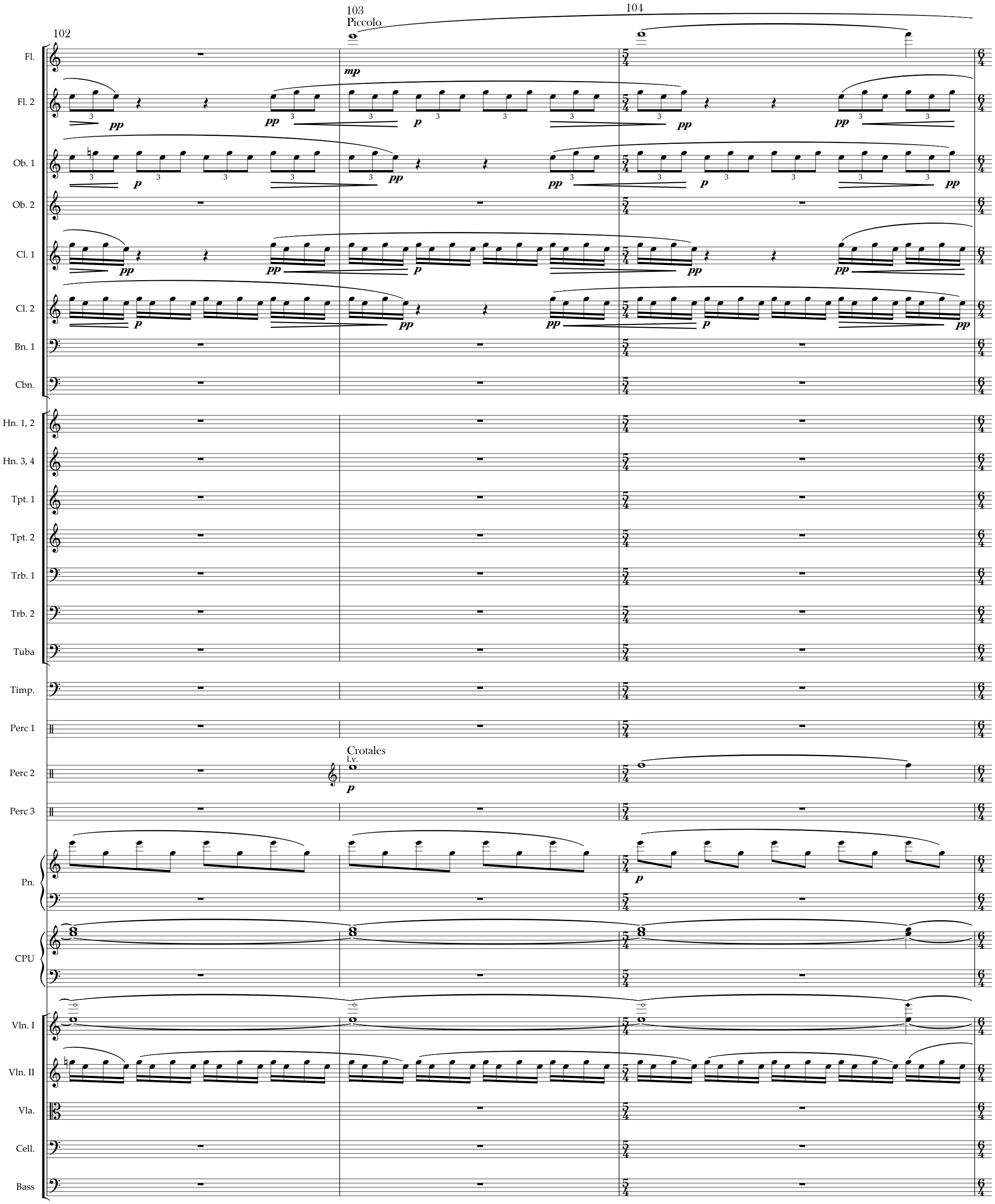

E as if dragging weights (♩= 48)
76
77
78
79
80
Fl.
Fl. 2
Ob. 1
Ob. 2
Cl. 1
Cl. 2
Bn. 1
Bn. 2
Contrabassoon
Hn. 1, 2
Hn. 3, 4
Tpt. 1
Tpt. 2
Trb. 1
Trb. 2
Tuba
Timp.
Perc 1
Perc 2
Crotales
Perc 3
Bass Drum
Pn.
CPU
cue 12 - all silent
8vb
cue 13 - low, guarly drone enters
Vln. I
Vln. II
Vla.
Cell.
Bass
sul pont.
mp
ff
fff
p
mf
pp
f

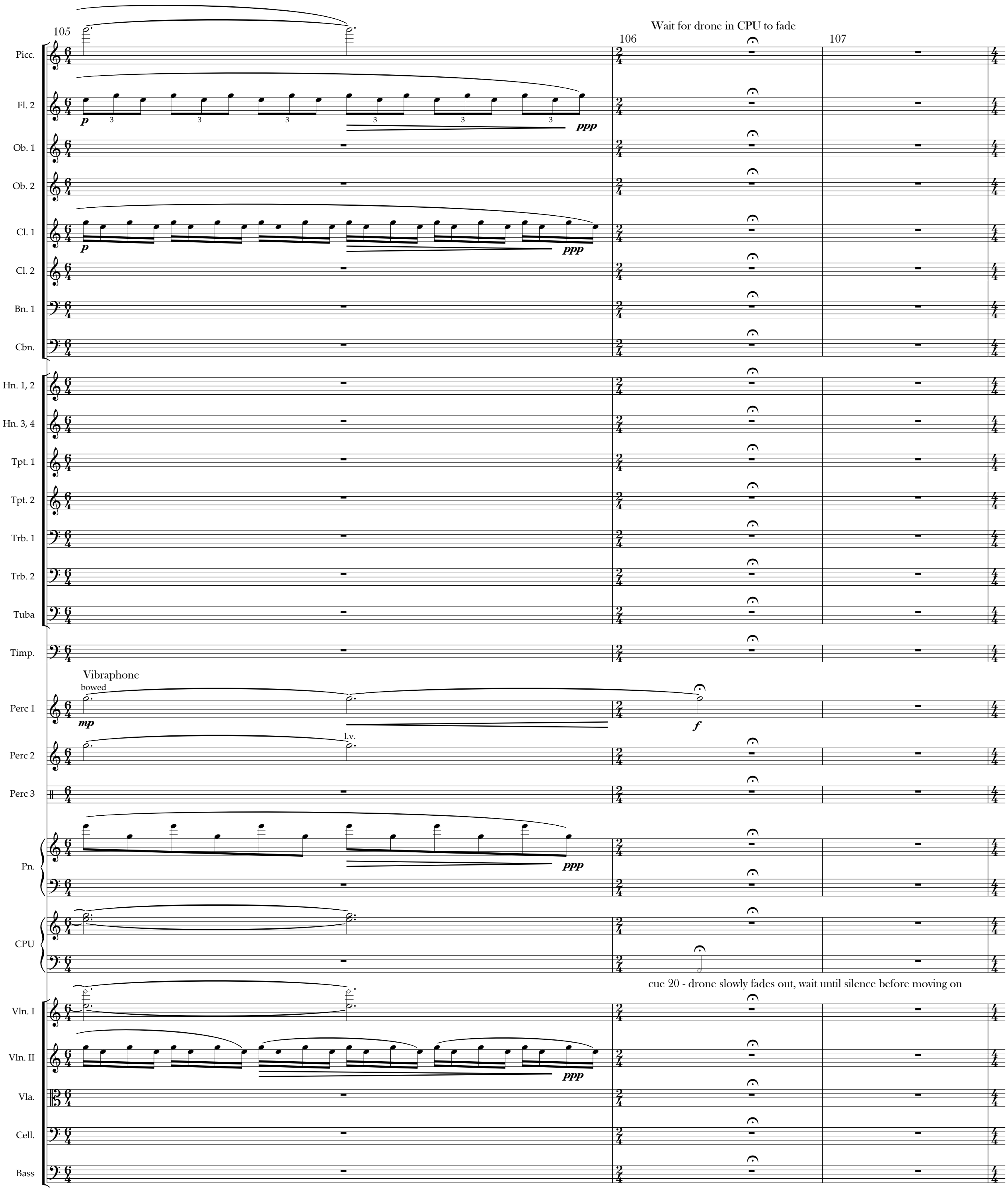

81
82
83
84
85
86
Fl.
Fl. 2
Ob. 1
Ob. 2
Cl. 1
Cl. 2
Bn. 1
Cbn.
Hn. 1, 2
Hn. 3, 4
Tpt. 1
Tpt. 2
Trb. 1
Trb. 2
Tuba
Timp.
Perc 1
Perc 2
Perc 3
Pn.
CPU
Vln. I
Vln. II
Vla.
Cell.
Bass
Temple Blocks
Tam-tam
scrape
l.v.
l.v.
sul pont.
sul pont.
fff
p
ff
f
3

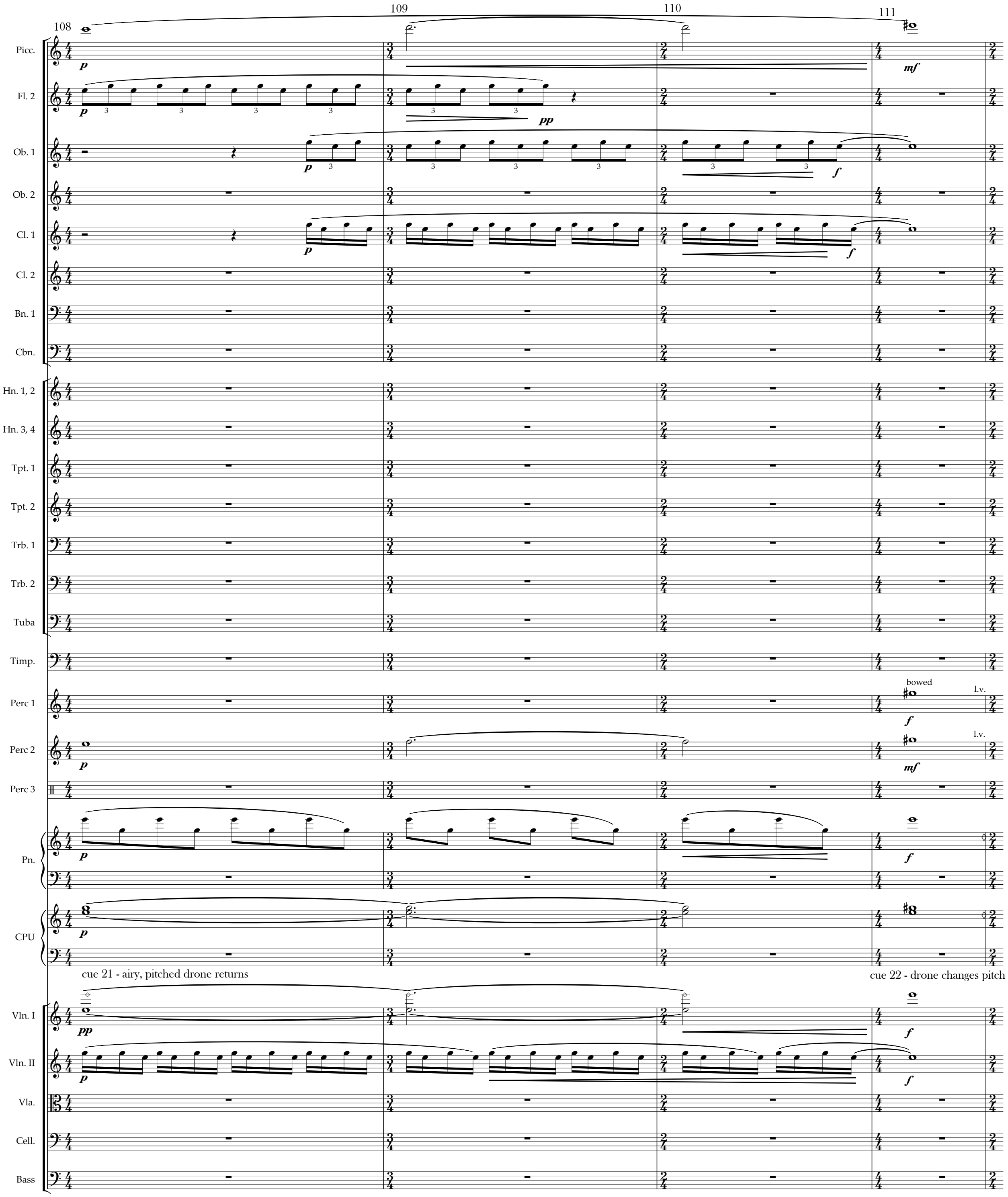

F with an uncertain tension (♩= 54)
87
89
90
91
Fl.
Fl. 2
Ob. 1
Ob. 2
Cl. 1
Cl. 2
Bn. 1
Cbn.
Hn. 1, 2
Hn. 3, 4
Tpt. 1
Tpt. 2
Trb. 1
Trb. 2
Tuba
Timp.
Perc 1
Perc 2
Perc 3
Pn.
CPU
cue 14 - all silent
Vln. I
Vln. II
Vla.
Cell.
Bass
sul tasto
con sord.
mp
mf
p
pp
fff


G heavier than before (♩= 40)
92
93
95
96
97
Fl.
Fl. 2
Ob. 1
Ob. 2
Cl. 1
Cl. 2
Bn. 1
Cbn.
fff
p
Hn. 1, 2
Hn. 3, 4
Tpt. 1
Tpt. 2
Trb. 1
Trb. 2
Tuba
fff
p
Timp.
fff
p
ff
Perc 1
Perc 2
Toms
ff
Perc 3
fff
p
ff
Pn.
fff
CPU
8vb
fff
cue 15 - grnarly done returns, noiser than before
cue 16 - all silent
Vln. I
mf
ff
ff
pp
Vln. II
p
ff
pp
Vla.
Cell.
fff
p
ff
Bass
fff
p
ff

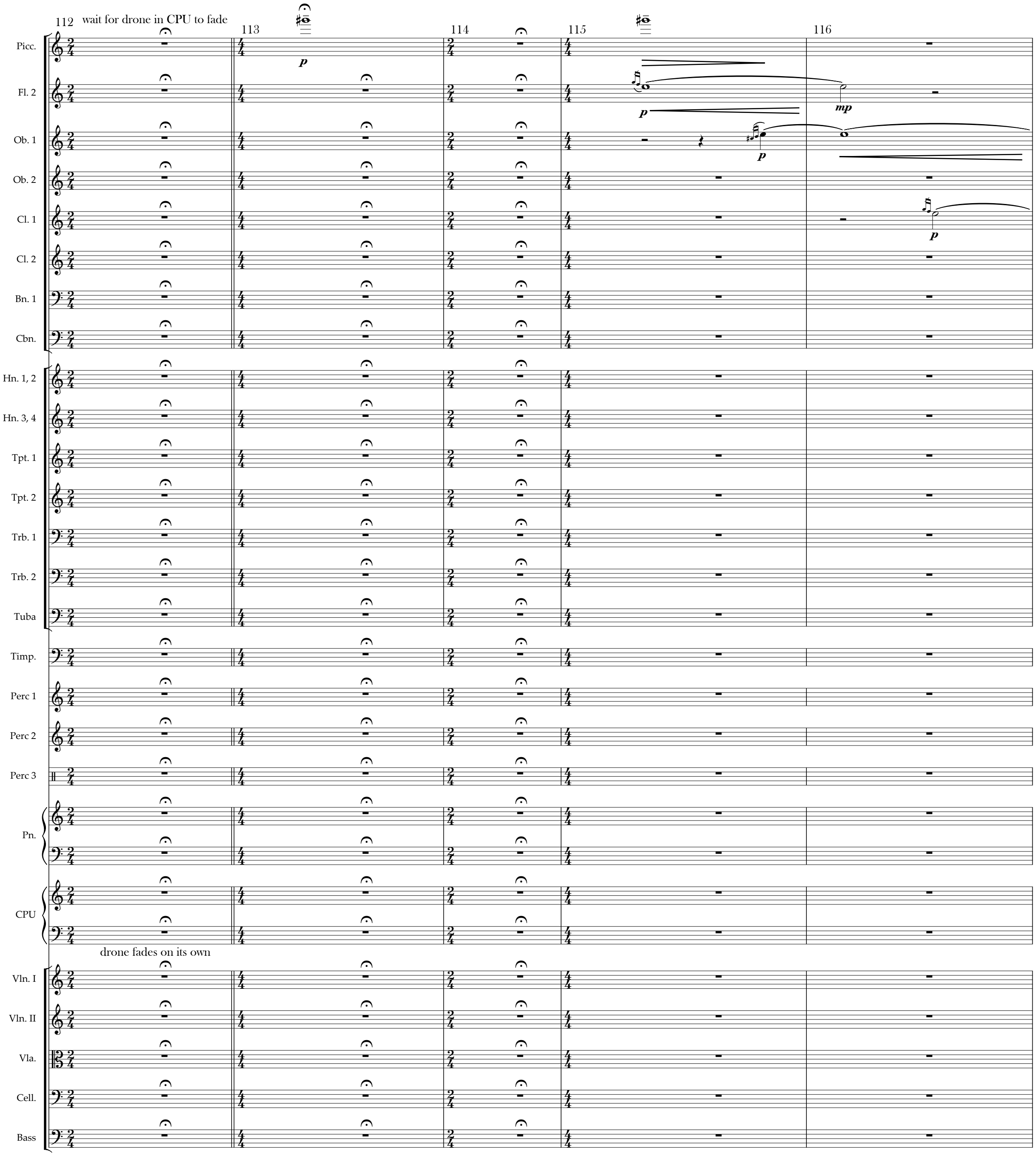

H with a sudden, subued energy (♩= 112)
98
99
100
Fl.
Fl. 2
Ob. 1
Ob. 2
Cl. 1
Cl. 2
Bn. 1
Cbn.
Hn. 1, 2
Hn. 3, 4
Tpt. 1
Tpt. 2
Trb. 1
Trb. 2
Tuba
Timp.
Perc 1
Perc 2
Perc 3
Pn.
CPU
Vln. I
Vln. II
Vla.
Cell.
Bass
tutti
tutti
Triangle
cue 17 - gnarly drone returns
cue 18 - all silent
cue 19 - pitched, ghost-like drone fades in
normale
senza sord.
sul pont.
con sord.
6:4
3
p
pp
ff
fff
ffp
f
mp

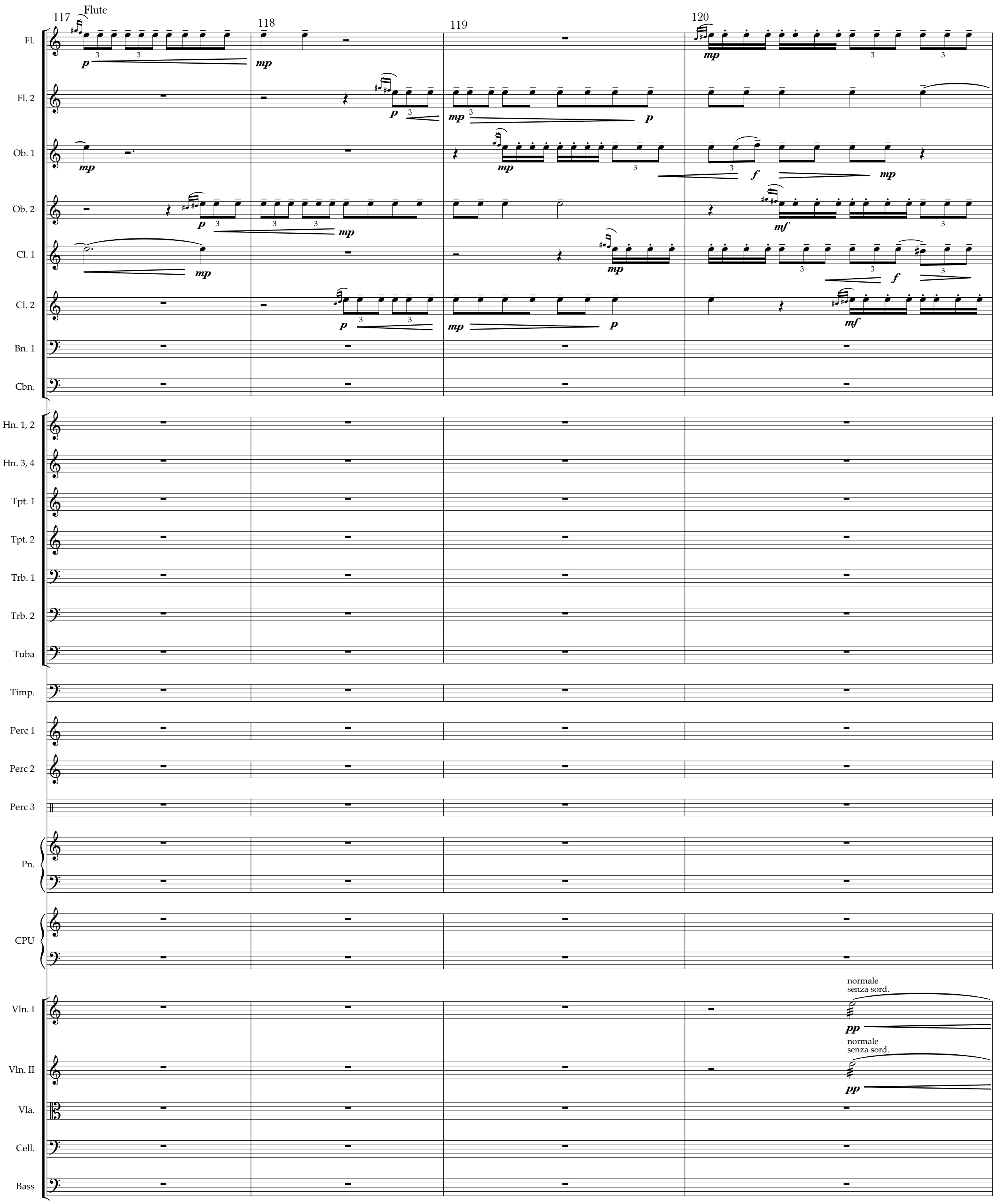

102
103
104
Piccolo
Fl.
Fl. 2
Ob. 1
Ob. 2
Cl. 1
Cl. 2
Bn. 1
Cbn.
Hn. 1, 2
Hn. 3, 4
Tpt. 1
Tpt. 2
Trb. 1
Trb. 2
Tuba
Timp.
Perc 1
Perc 2
Perc 3
Crotales
l.v.
Pn.
CPU
Vln. I
Vln. II
Vla.
Cell.
Bass
mp
pp
p


105
Wait for drone in CPU to fade
106
107
Picc.
Fl. 2
Ob. 1
Ob. 2
Cl. 1
Cl. 2
Bn. 1
Cbn.
Hn. 1, 2
Hn. 3, 4
Tpt. 1
Tpt. 2
Trb. 1
Trb. 2
Tuba
Timp.
Perc 1
Perc 2
Perc 3
Pn.
CPU
Vln. I
Vln. II
Vla.
Cell.
Bass
p
ppp
mp
f
Vibraphone
bowed
l.v.
cue 20 - drone slowly fades out, wait until silence before moving on

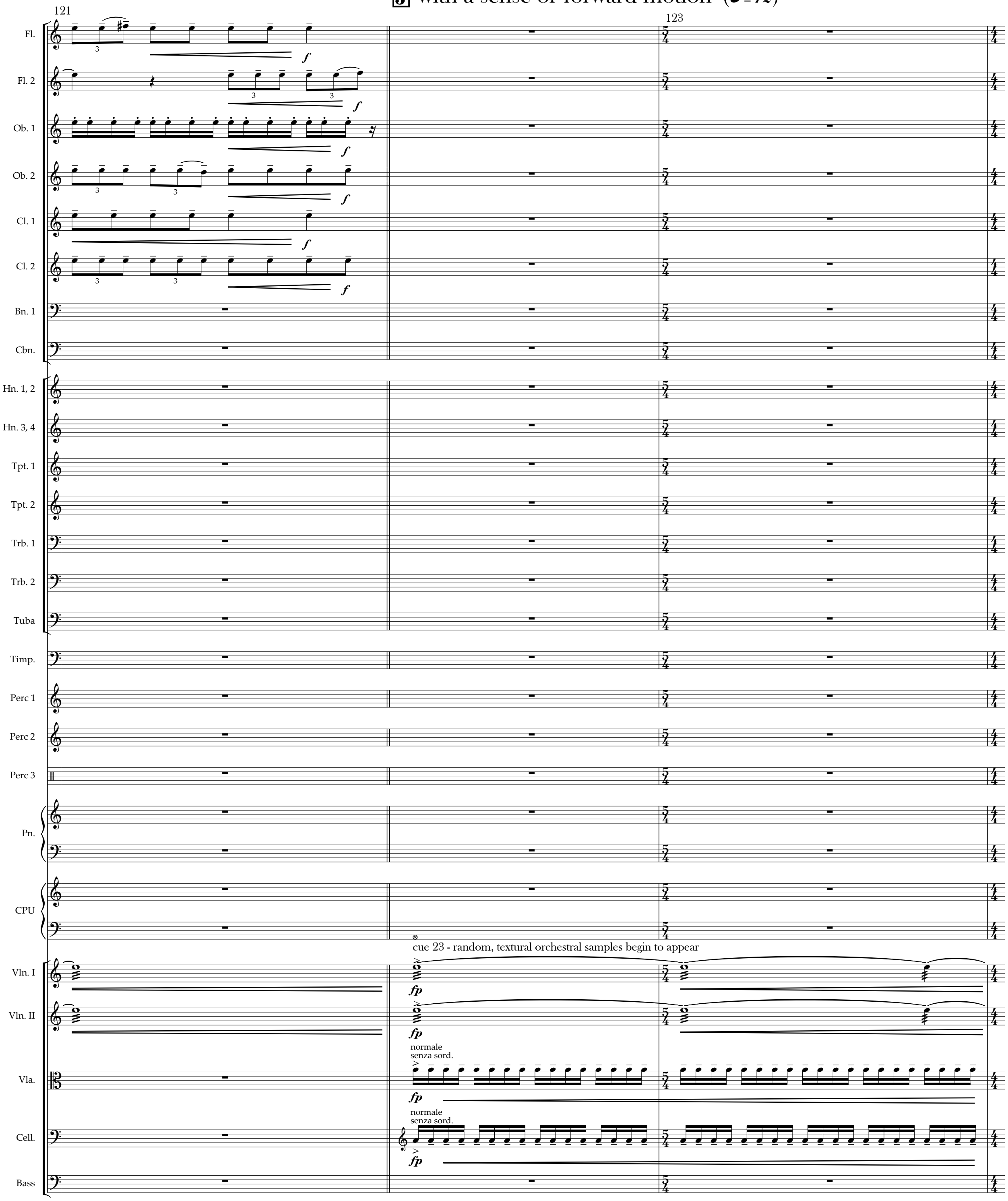

108
109
110
111
Picc.
Fl. 2
Ob. 1
Ob. 2
Cl. 1
Cl. 2
Bn. 1
Cbn.
Hn. 1, 2
Hn. 3, 4
Tpt. 1
Tpt. 2
Trb. 1
Trb. 2
Tuba
Timp.
Perc 1
Perc 2
Perc 3
Pn.
CPU
Vln. I
Vln. II
Vla.
Cell.
Bass
bowed
l.v.
l.v.
cue 21 - airy, pitched drone returns
cue 22 - drone changes pitch
p
mf
pp
f

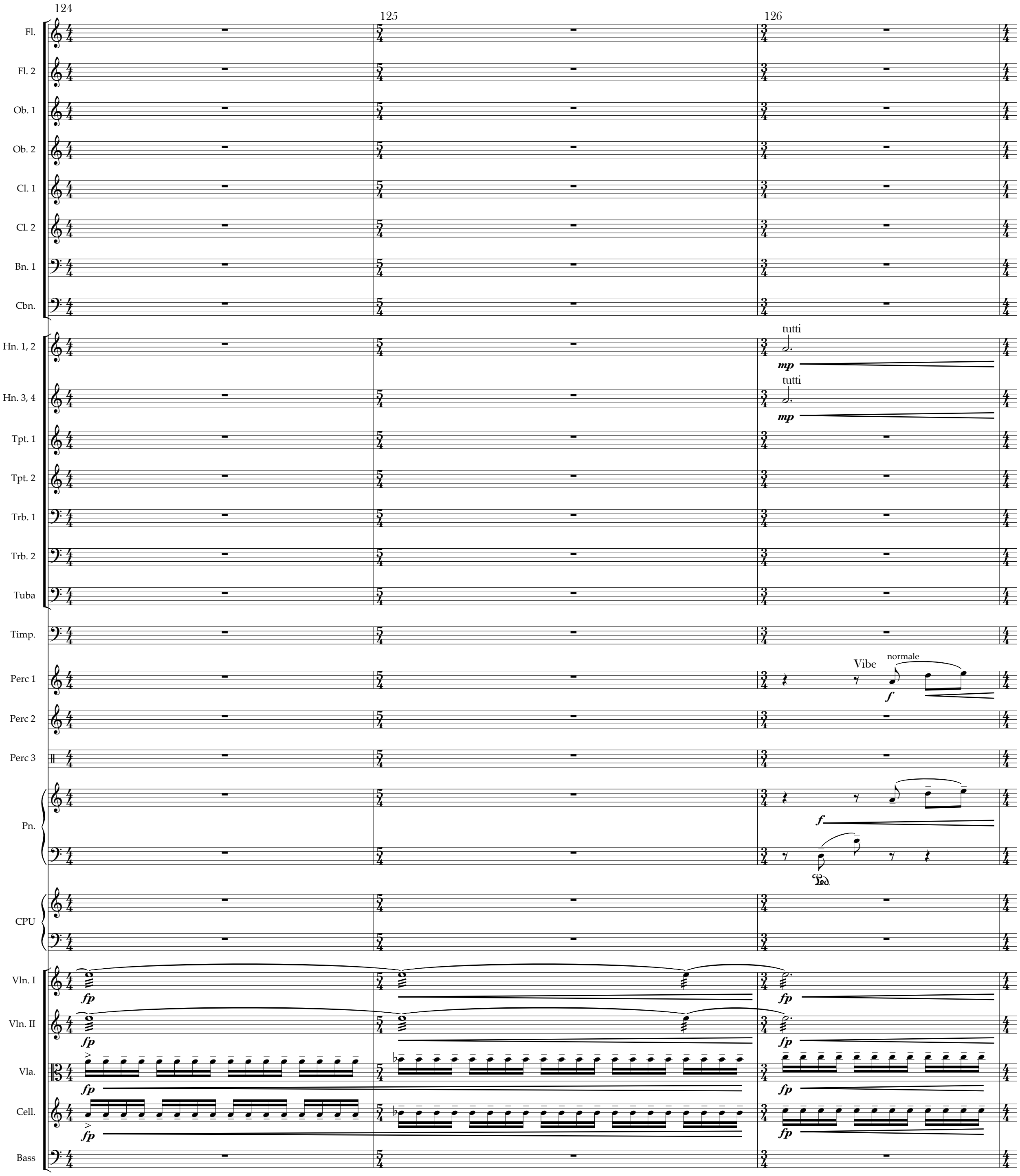
I held back, but with lingering momentum (♩= 76)

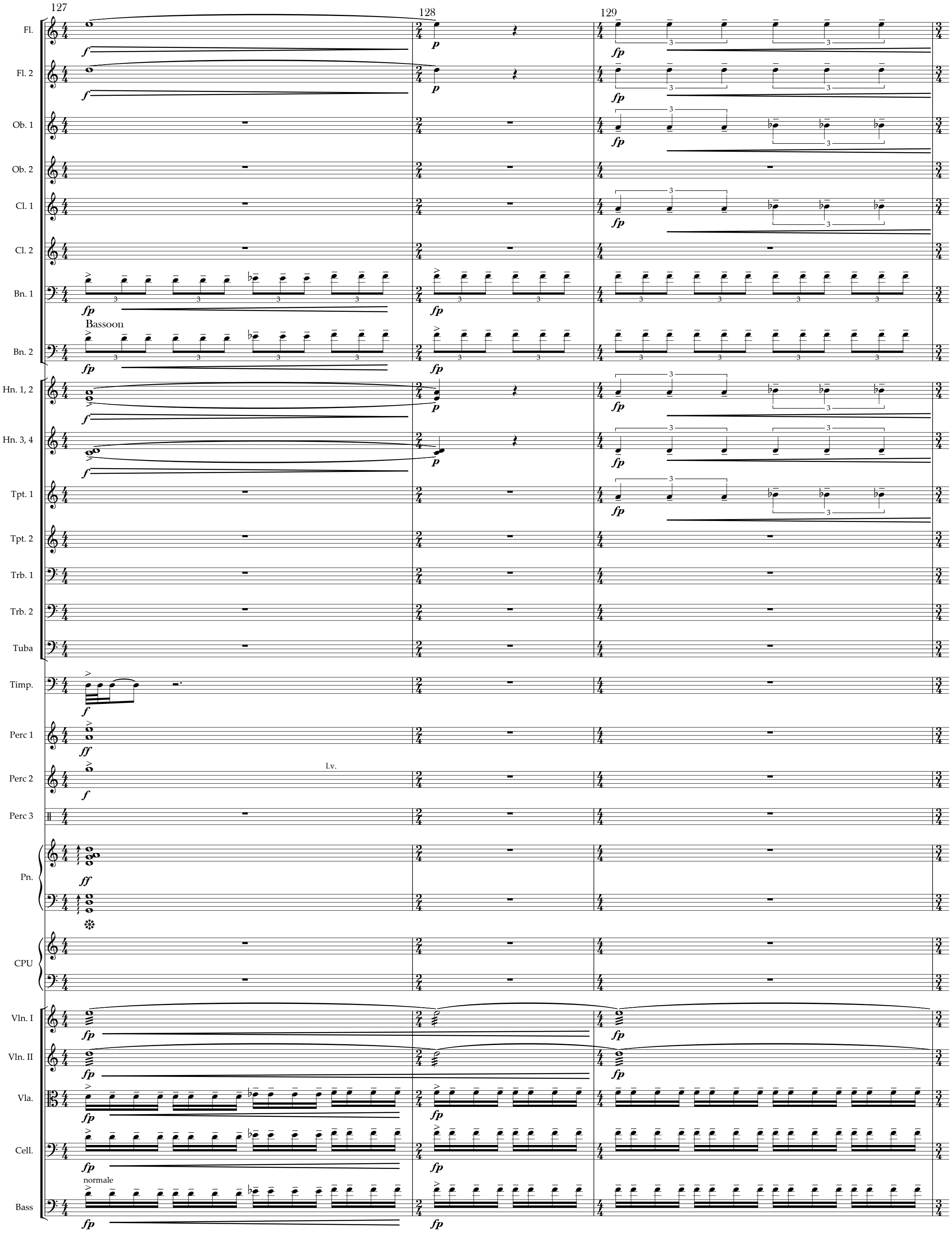

112
wait for drone in CPU to fade
113
114
115
116
Picc.
Fl. 2
Ob. 1
Ob. 2
Cl. 1
Cl. 2
Bn. 1
Cbn.
Hn. 1, 2
Hn. 3, 4
Tpt. 1
Tpt. 2
Trb. 1
Trb. 2
Tuba
Timp.
Perc 1
Perc 2
Perc 3
Pn.
CPU
drone fades on its own
Vln. I
Vln. II
Vla.
Cell.
Bass
p
p
mp
p
p

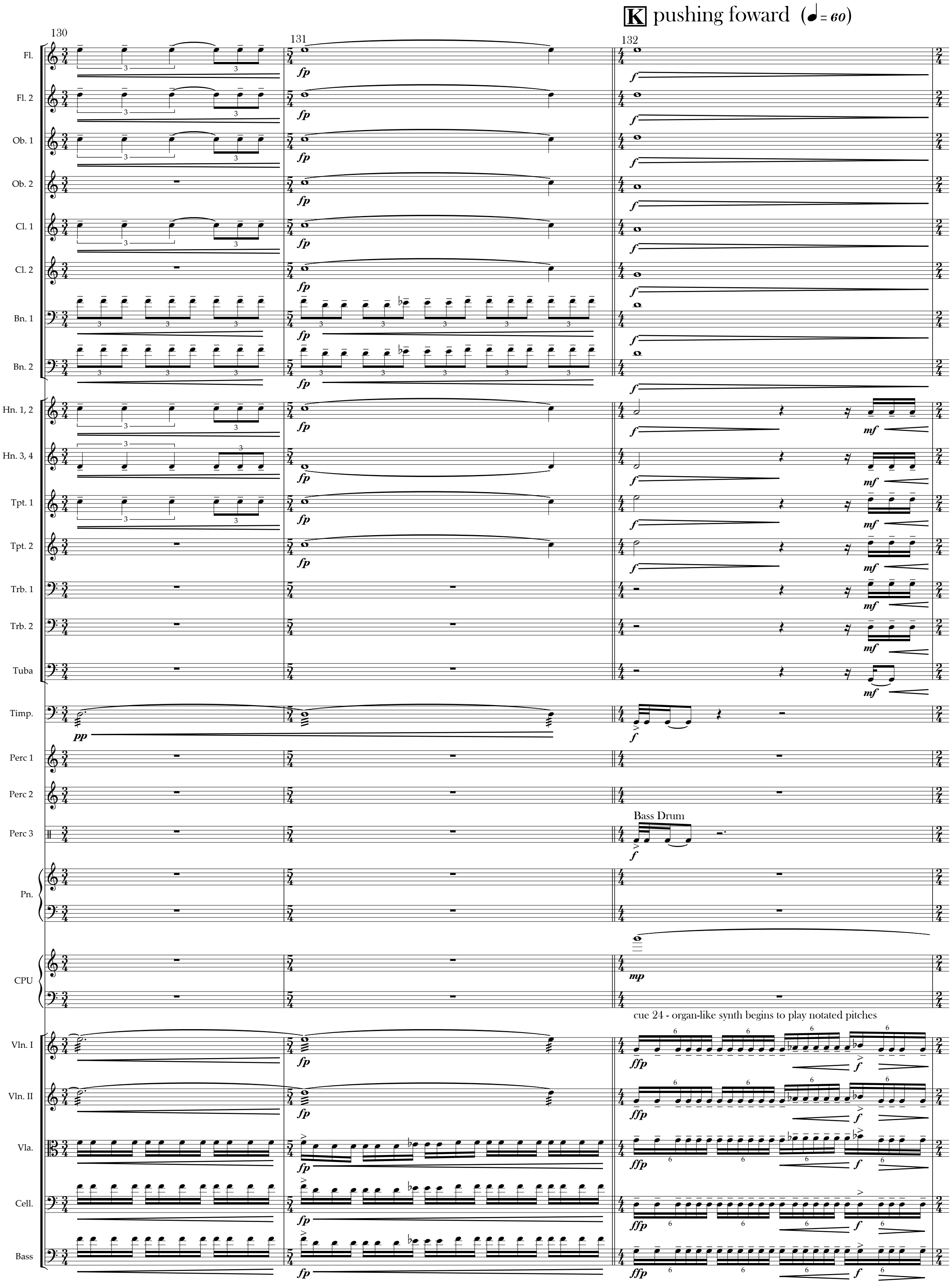

117
Flute
118
119
120
Fl.
Fl. 2
Ob. 1
Ob. 2
Cl. 1
Cl. 2
Bn. 1
Cbn.
Hn. 1, 2
Hn. 3, 4
Tpt. 1
Tpt. 2
Trb. 1
Trb. 2
Tuba
Timp.
Perc 1
Perc 2
Perc 3
Pn.
CPU
Vln. I
Vln. II
Vla.
Cell.
Bass
p
mp
mf
f
pp
normale
senza sord.
3

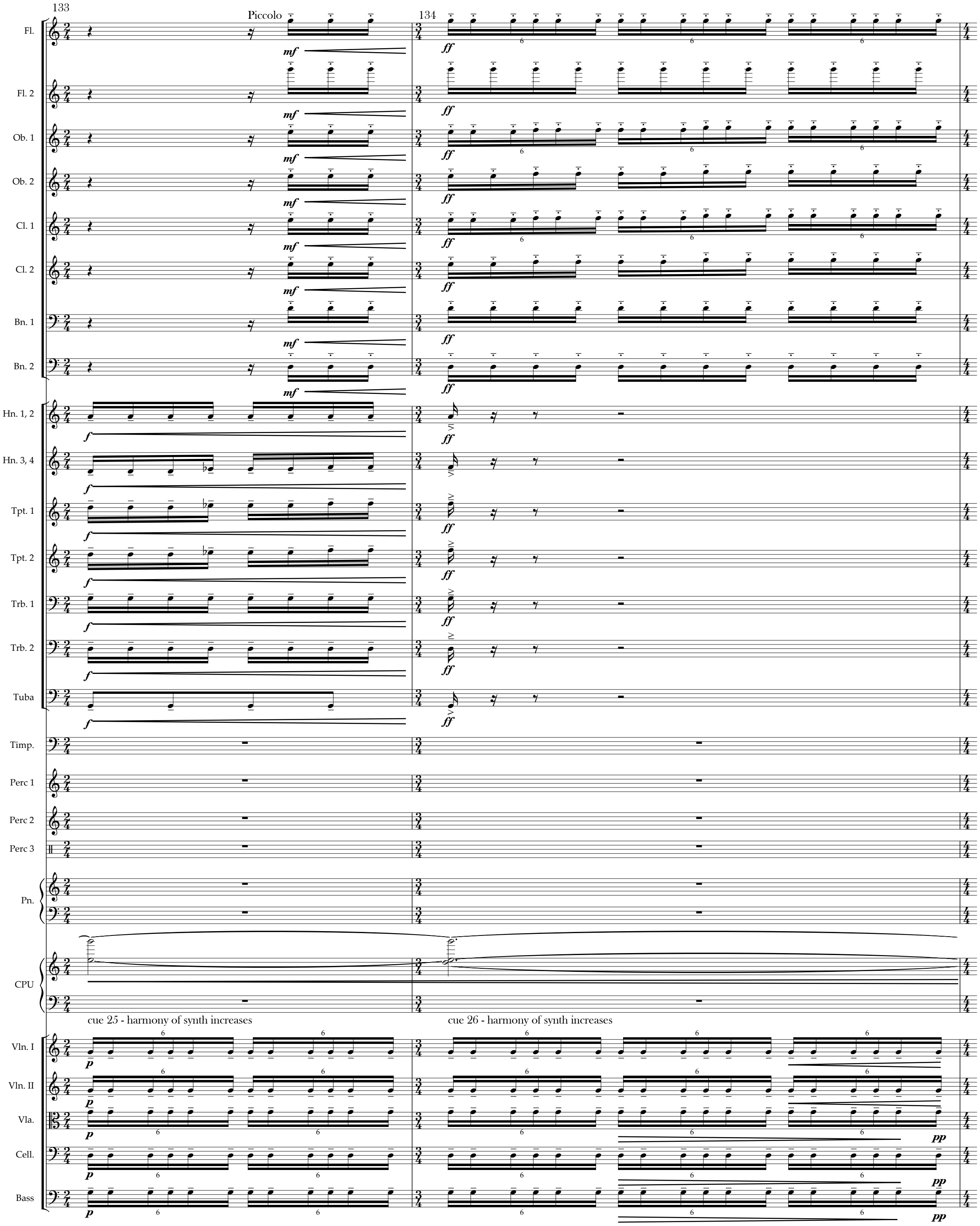
J with a sense or forward motion (♩= 72)

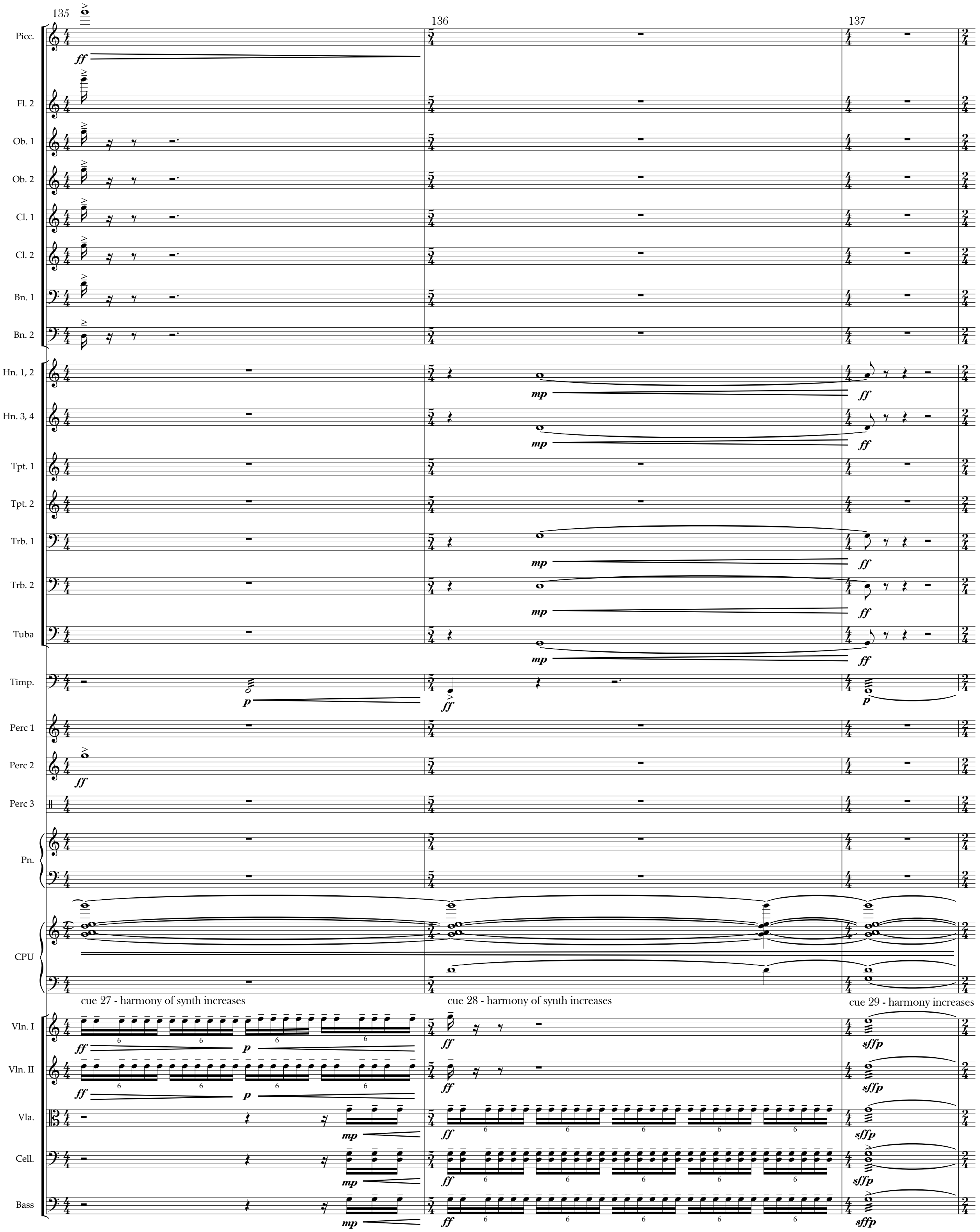

121
123
Fl.
Fl. 2
Ob. 1
Ob. 2
Cl. 1
Cl. 2
Bn. 1
Cbn.
Hn. 1, 2
Hn. 3, 4
Tpt. 1
Tpt. 2
Trb. 1
Trb. 2
Tuba
Timp.
Perc 1
Perc 2
Perc 3
Pn.
CPU
Vln. I
Vln. II
Vla.
Cell.
Bass
f
fp
cue 23 - random, textural orchestral samples begin to appear
normale
senza sord.

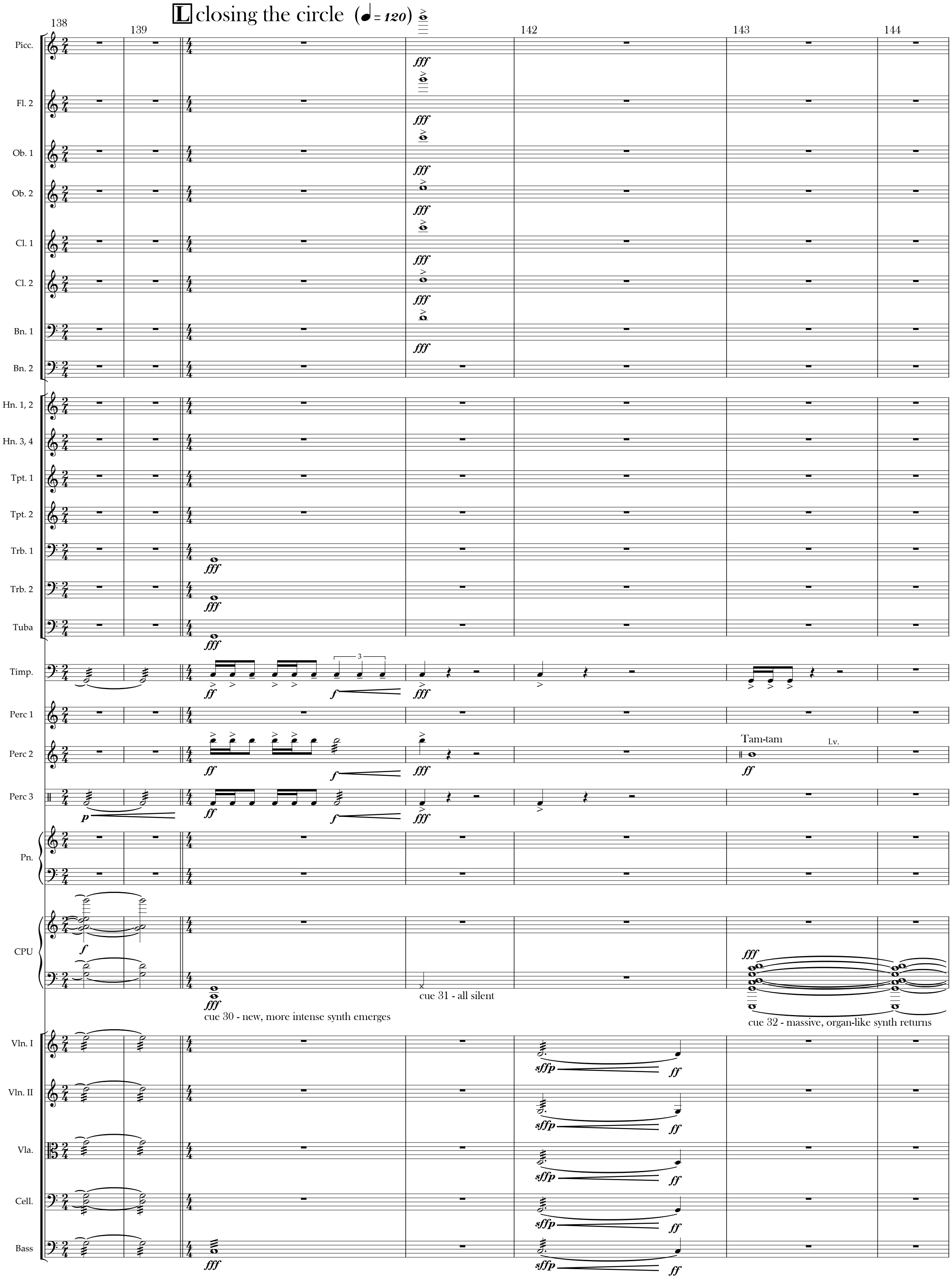

124
125
126
Fl.
Fl. 2
Ob. 1
Ob. 2
Cl. 1
Cl. 2
Bn. 1
Cbn.
Hn. 1, 2
Hn. 3, 4
Tpt. 1
Tpt. 2
Trb. 1
Trb. 2
Tuba
Timp.
Perc 1
Perc 2
Perc 3
Pn.
CPU
Vln. I
Vln. II
Vla.
Cell.
Bass
tutti
mp
tutti
mp
Vibe
normale
f
f
Ped.
fp
fp
fp
fp
fp
fp
fp
fp

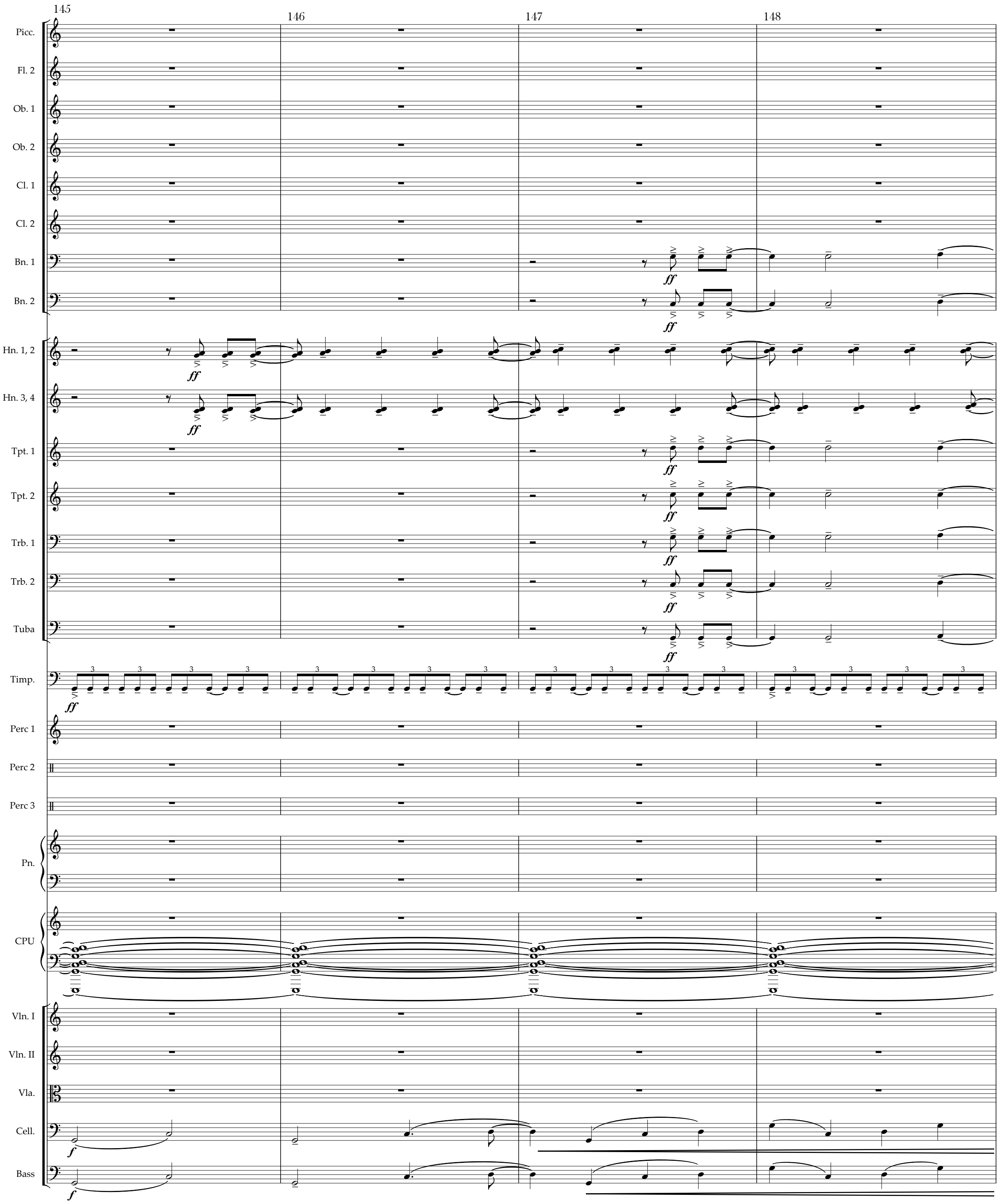

127
128
129
Fl.
Fl. 2
Ob. 1
Ob. 2
Cl. 1
Cl. 2
Bn. 1
Bassoon
Bn. 2
Hn. 1, 2
Hn. 3, 4
Tpt. 1
Tpt. 2
Trb. 1
Trb. 2
Tuba
Timp.
Perc 1
Perc 2
l.v.
Perc 3
Pn.
CPU
Vln. I
Vln. II
Vla.
Cell.
normale
Bass
f
p
fp
ff

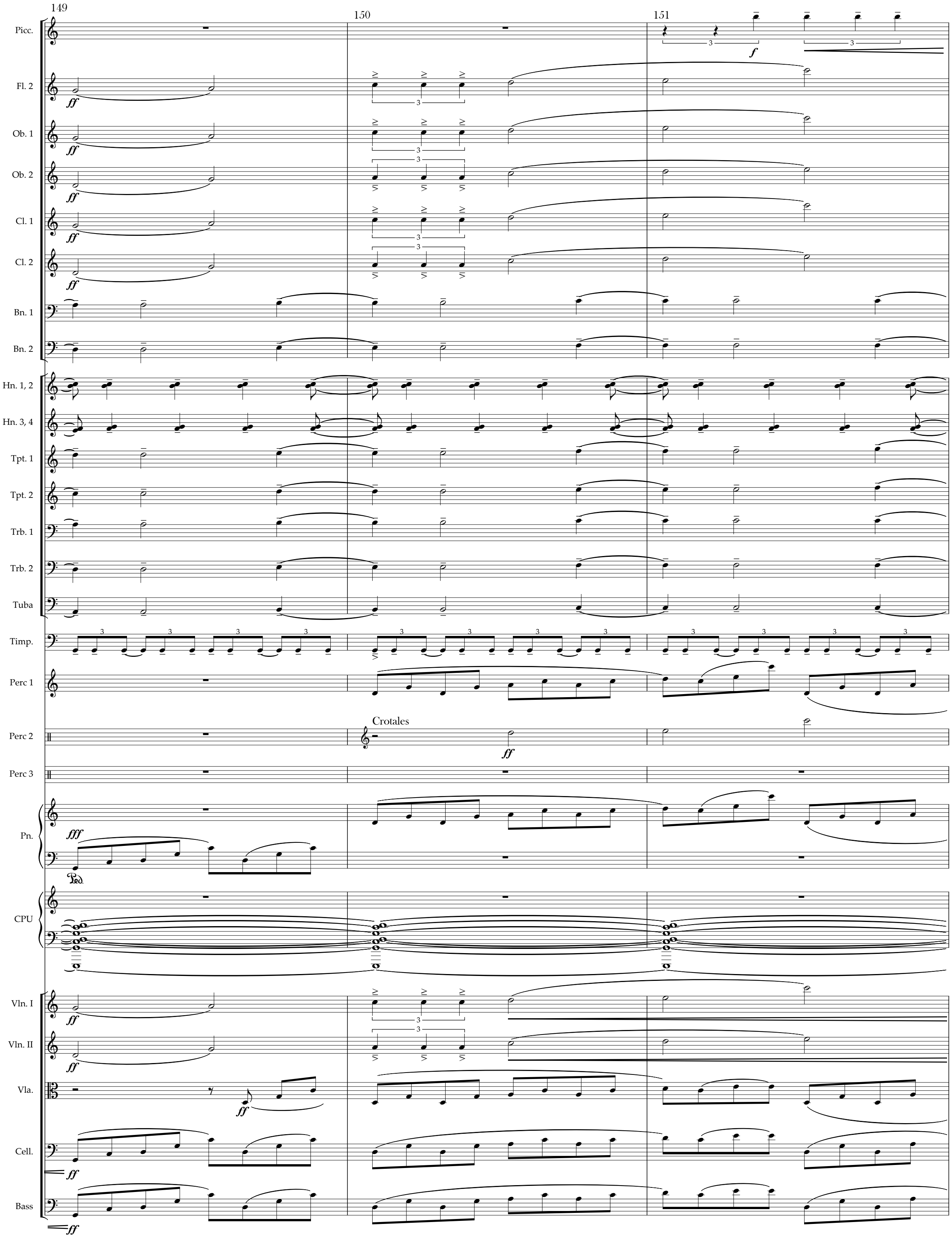

K pushing foward (♩= 60)
130
131
132
Fl.
Fl. 2
Ob. 1
Ob. 2
Cl. 1
Cl. 2
Bn. 1
Bn. 2
Hn. 1, 2
Hn. 3, 4
Tpt. 1
Tpt. 2
Trb. 1
Trb. 2
Tuba
Timp.
Perc 1
Perc 2
Perc 3
Bass Drum
Pn.
CPU
cue 24 - organ-like synth begins to play notated pitches
Vln. I
Vln. II
Vla.
Cell.
Bass
fp
f
mf
pp
mp
ffp

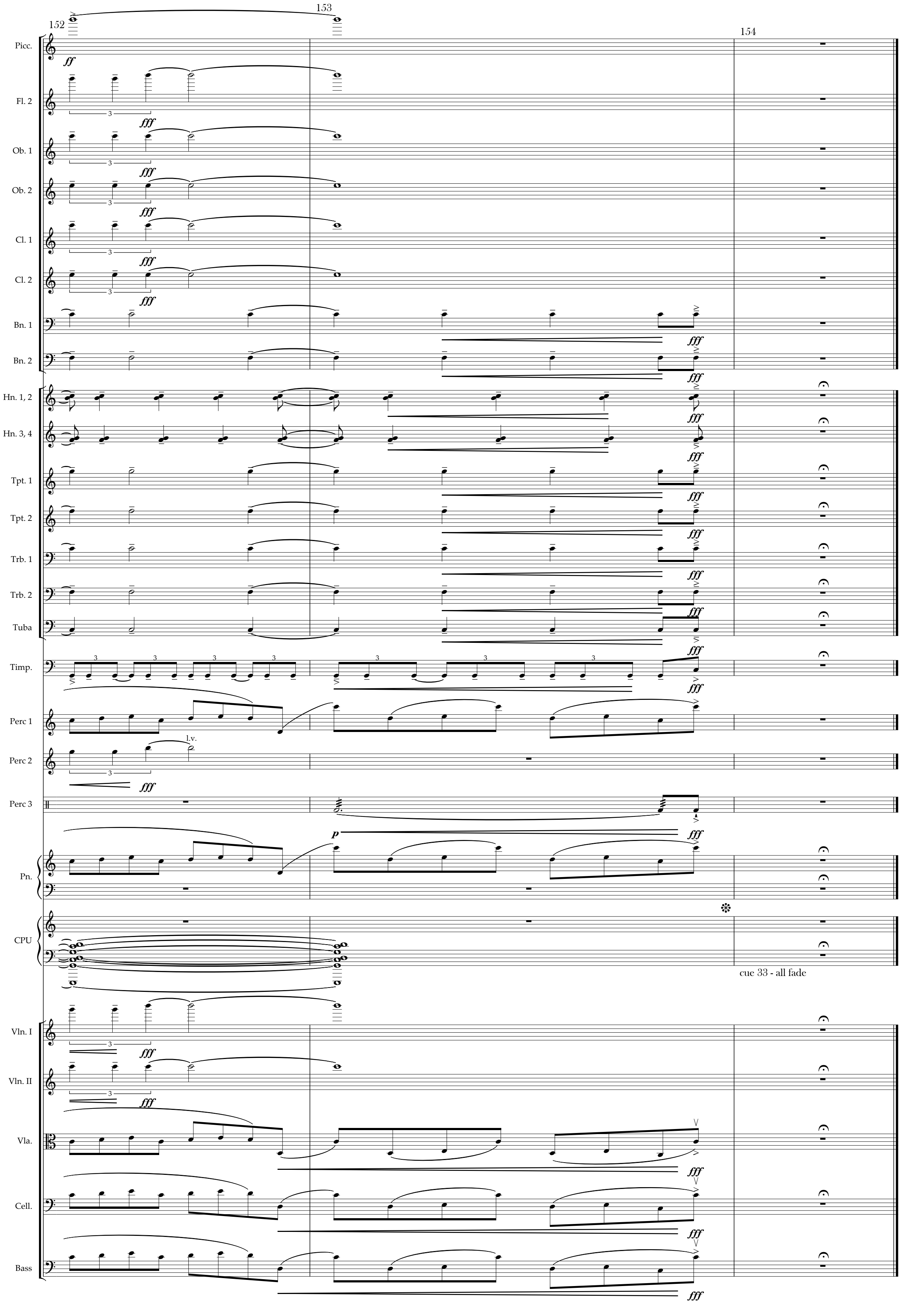

133
Piccolo
134
Fl.
Fl. 2
Ob. 1
Ob. 2
Cl. 1
Cl. 2
Bn. 1
Bn. 2
Hn. 1, 2
Hn. 3, 4
Tpt. 1
Tpt. 2
Trb. 1
Trb. 2
Tuba
Timp.
Perc 1
Perc 2
Perc 3
Pn.
CPU
cue 25 - harmony of synth increases
cue 26 - harmony of synth increases
Vln. I
Vln. II
Vla.
Cell.
Bass
mf
ff
f
p
pp
6


135
136
137
Picc.
Fl. 2
Ob. 1
Ob. 2
Cl. 1
Cl. 2
Bn. 1
Bn. 2
Hn. 1, 2
Hn. 3, 4
Tpt. 1
Tpt. 2
Trb. 1
Trb. 2
Tuba
Timp.
Perc 1
Perc 2
Perc 3
Pn.
CPU
cue 27 - harmony of synth increases
cue 28 - harmony of synth increases
cue 29 - harmony increases
Vln. I
Vln. II
Vla.
Cell.
Bass
ff
mp
p
sffp


L closing the circle (♩= 120)
138
139
142
143
144
Picc.
Fl. 2
Ob. 1
Ob. 2
Cl. 1
Cl. 2
Bn. 1
Bn. 2
Hn. 1, 2
Hn. 3, 4
Tpt. 1
Tpt. 2
Trb. 1
Trb. 2
Tuba
Timp.
Perc 1
Perc 2
Perc 3
Pn.
CPU
Vln. I
Vln. II
Vla.
Cell.
Bass
fff
ff
f
p
sffp
3
Tam-tam
l.v.
cue 30 - new, more intense synth emerges
cue 31 - all silent
cue 32 - massive, organ-like synth returns


145
146
147
148
Picc.
Fl. 2
Ob. 1
Ob. 2
Cl. 1
Cl. 2
Bn. 1
Bn. 2
Hn. 1, 2
Hn. 3, 4
Tpt. 1
Tpt. 2
Trb. 1
Trb. 2
Tuba
Timp.
Perc 1
Perc 2
Perc 3
Pn.
CPU
Vln. I
Vln. II
Vla.
Cell.
Bass
ff
f
3


149
150
151
Picc.
Fl. 2
Ob. 1
Ob. 2
Cl. 1
Cl. 2
Bn. 1
Bn. 2
Hn. 1, 2
Hn. 3, 4
Tpt. 1
Tpt. 2
Trb. 1
Trb. 2
Tuba
Timp.
Perc 1
Perc 2
Perc 3
Pn.
CPU
Vln. I
Vln. II
Vla.
Cell.
Bass
Crotales
ff
fff
f
3


152
153
154
Picc.
Fl. 2
Ob. 1
Ob. 2
Cl. 1
Cl. 2
Bn. 1
Bn. 2
Hn. 1, 2
Hn. 3, 4
Tpt. 1
Tpt. 2
Trb. 1
Trb. 2
Tuba
Timp.
Perc 1
Perc 2
Perc 3
Pn.
CPU
Vln. I
Vln. II
Vla.
Cell.
Bass
ff
fff
p
l.v.
3
cue 33 - all fade