Simulacra

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Abstract

This dissertation introduces a theoretical background and an analysis of my composition *Simulacra* for five cellos, electronics and video. This research addresses the following question: what is an authentic form of music with which audiences engage in concerts in the post-pandemic age? I hypothesize that the plethora of telematic concerts in the field of contemporary music during the pandemic time has changed what is authentic for the modern audiences from the substantiation of the recorded performances to a blend of the real and so-called virtual existence in a live space. To this end, I propose the perception of the blurred boundary between the real and simulated performance as an authentic new approach to the content of concerts. The use of performers' absence emerged as a key strategy to engender the perception of the blurred boundary. The thesis introduces compositional approaches and how these approaches were applied to form the composition. The conclusion introduces two useful recommendations and proposes the concept of mixed reality composition to highlight the blurred boundary between real and simulated performance even more substantially.

Abrégé

Cette thèse présente un contexte théorique et une analyse de ma composition Simulacra pour cinq violoncelles, électronique et vidéo. Cette pièce aborde la question suivante : Au sein des concerts à l'ère post-pandémique, qu'est-ce qu'une forme de musique authentique avec laquelle le public s'engage? J'émets l'hypothèse que la pléthore de concerts télématiques dans le domaine de la musique contemporaine au cours de la période pandémique a changé ce qui est authentique pour les publics modernes, passant de la justification des performances enregistrées à un mélange d'existence réelle et virtuelle dans un espace en direct. À cette fin, je propose la perception de la frontière floue entre la performance réelle et simulée comme un nouveau contenu authentique des concerts. L'utilisation de l'absence des interprètes est apparue comme une stratégie clé pour engendrer la perception de cette frontière floue. La thèse présente des approches compositionnelles et comment j'ai appliqué ces approches pour construire la composition. La conclusion introduit deux recommandations utiles et propose le concept de composition en réalité mixte pour mettre en évidence de manière encore plus substantielle la frontière floue entre performance réelle et simulée.

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List of Acronyms

CIRMMT	The Centre for Interdisciplinary Research in Music Media and Technology.
GUI	Graphical User Interface.
IRCAM	Institute for Research and Coordination in Acoustics/Music.
ZKM	Center for Art and Media Karlsruhe.

Chapter 1

Introduction

Simulacra is a music composition written for five cellos, electronics and video with a duration of 33 minutes. This piece is a reflection of my intent, as a composer, to address the following question: How can music bring people from different backgrounds together after the pandemic? This question invokes the social significance of the live concert: providing a shared musical experience to all audience members. The pandemic privatized our listening experiences: telematic concerts under quarantine isolate us from the social space. To reunite us after the pandemic, we need to create a new concert tradition that addresses the following question: What is it that attracts the audiences to live concerts in the post-pandemic age?

1.1 A role of music in the post-pandemic age

Before the COVID-19 pandemic, Philip Auslander asserted that live concerts in the field of pop music have changed from an occasion where the audience verifies performers' actual musicianship to that where the spectators experience fictional performances—performances that have never existed in reality, but were created with the extensive use of edited, synthesized tracks (e.g., lip-synced performances).[1] His assertion suggests that the content with which many new audience types engage in live concerts has changed from actual to fictional performances.

I hypothesize that the pandemic has brought this historical transformation of audience engagement in pop music concerts into the field of contemporary music performance. Telematic concerts have broadcast prerecorded and edited performances over the internet, thereby normalizing the non-live performances in the field of contemporary music (e.g., performances at the Berlin Philharmonic Digital Concert Hall). With this historical transition of liveness to non-live and potentially fictional performances—digitally edited and corrected performances appearing in what seems to be broadcast as prerecorded live performances—in mind, this thesis proposes the question: how can one reimagine the presentation format and contents of contemporary music compositions for a generation who has become accustomed to telematic concerts?

1. Philip Auslander, *Liveness: Performance in a Mediatized Culture* (London, England: Routledge, 2008).

1.2 A brief summary of my approach

To address this question, the composition *Simulacra* was created for five cellos, electronics and video. This piece was conceived in such a way that actual and fictional performances are interwoven using media that project unreal—prerecorded and/or manipulated—performances such as multichannel loudspeakers and video projection. This media led me to develop a compositional approach centred on the functional use of absence in compositional practice. In this dissertation, I will explain (1)how the intertwining relationship between live and recorded concerts shaped the fundamental concept of *Simulacra* and (2)how the concept led me to the compositional approach and the piece's components.

1.3 A brief overview of the dissertation

To this end, this dissertation is divided into eight chapters. The first chapter explains the background of the piece. This includes Jean Baudrillard's notion of simulation, the concept of simulacrum, how the nature of live concerts has changed in relation to the recording technology, and how the concept of simulacrum drew my attention to the concept of absence. The second to the seventh chapters comprise an analysis of my piece. The analysis focuses on the piece's time structure and materials such as melodic motives, playing techniques and series in the instrumental part, recorded and synthesized sound sources in electronics

and recorded and generative graphics in the video part. The eighth chapter encompasses a discussion on the successes and failures in the piece and practical recommendations for implementing the concept of simulacra together with the final conclusion. The appendix includes the score.

Chapter 2

Background

This chapter presents the background of my composition *Simulacra*. I will first point out the gradual disappearance of the performers' bodily presence from the concert space that has occurred in reaction to the gradual encroachment of recording technologies to the concert spaces, and will second introduce preceding approaches to express performers' absence in Western music history such as the hidden orchestra pit at the *Bayreuth Festspielhaus* conceived by Wagner and the offstage performances in Mahler's symphonies.

2.1 Concepts

What is 'live' concert today? Studies[1][2] reveal that the concept of 'live' came into being in contrast to 'recorded'. Before the advent of recording technologies, there was even no

1. Mark Katz, *Capturing Sound* (London, England: University of California Press, 2010).
2. Auslander, *Liveness: Performance in a Mediatized Culture*.

necessity to use the word 'live' to describe live concerts because all concerts were live events. The emergence of recording technologies made it possible to reproduce live concerts: live concerts started to become source events that can be recorded, replicated and replayed after the event. Thus, live concerts were originals, while recorded concerts were copies. This binary distinction between live and recorded concerts has become increasingly ambiguous in parallel with the gradual encroachment of reproduction technologies such as recorded backing tracks into live spaces. A number of reviews about modern concerts point out that live concerts in the field of popular music have become simulations, Jean Baudrillard's concept discussed in his essay *Simulacra and Simulations*,[3] where he explores the concept that simulation stands for a real-world condition filled up with representations that have no referents in the real world, but reproduce their mimicries over and over, similar to a computer script replicating itself in the digital world. To observe the transition of the live concert from originals to simulations, we need to look at how reproduction technologies have influenced the concept of live concerts over recent history.

2.1.1 Historical overview of recording technologies

In 1877, Thomas Edison invented the Phonograph, a device that inscribes the vibration of air pressure into a disc called a record. The phonograph ushered in an unprecedented possibility for music: reproducibility[4] of sounds. This feature enabled one to save and replay

3. Jean Baudrillard, *Simulacra and Simulation* (Ann Arbor, MI, USA: University of Michigan Press, 1994).

4. The phonograph brought several other possibilities such as tangibility and portability of sounds. See chapter 1 in Katz, *Capturing Sound* for more details.

a music performance. The live music performance was the first that comes into being in the world, while the recorded performance was the second that appears after the live music performance took place. At this point, the distinction between live and recorded was clear: live is the original while recorded is a reproduction.

The subsequent invention of the magnetic tape brought forth a unique and powerful possibility: editability. This enabled audio engineers or musicians to record multiple takes and splice them into a single final version. This feature has heightened perfectionism in musical renditions in performance practice. Interestingly, musicians started to take advantage of editability to create not only the perfect version of their interpretations but also to create a performance that transcends the performer's own imagination. Glenn Gould put this "transcendental" practice to work in his production process. For example, at the end of the recording session of *The Well-Tempered Clavier, Book I, BWV 846-869 (1722)*, he was able to get two satisfactory takes of the fugue A minor, No. 20. However, only weeks later, Gould realized that each take sounded monotonous. Therefore, he edited these two takes into a single track by alternating between one take and the other. Gould explains that "[b]y taking advantage of the post-taping afterthought, however, one can very often transcend the limitation that performance imposes upon the imagination".[5] The idea to combine the takes did not originate with from Gould; rather it emanated from the interactions between the editability of recording technologies and Gould's handcraft. The

5. Glenn Gould, "The Prospects of Recording," in *The Glenn Gould Reader*, ed. Tim Page (New York, NY: Vintage Books, 1990), p.339.

role of the recording technology became not only to reproduce a performance but to construct an interpretation whose original form never actually existed in what was heretofore understood as a musical performance.

The construction of music with the extensive use of recording technology has subsequently become a common practice in the field of classical music recording, but is used extensively in the creation and recording of popular music. Paul Théberge points out that multitrack recording technology used by popular music makers gradually changed the role of recording from the documentation of a studio performance to the creation of an illusory performance.[6] Following the introduction of several 'unnatural' studio recording techniques such as recording in an acoustically dry studio with close microphones and artificial reverberations, the overdubbing technique eventually transformed the role of recording from documenting a group performance to 'simulating' a group performance. The overdubbing technique enabled the music producers to record separate takes performed by several performers at different times and locations, assembling them into a single track which sounds as if those performers had played together as an ensemble in real-time.

2.1.2 Live concerts as simulations

Just as recorded performances became simulations of illusory performances because of editing, recording technologies have also encroached into the live performance space.

6. Paul Théberge, "The 'Sound' of Music: Technological Rationalization and the Production of Popular Music," *New Frontiers* 8 (Summer 1989): p.100-104.

Prerecorded backing tracks, digital samplers, drum machines and digital audio workstations are prominently featured in live concerts, changing the trait of live concerts from, as Théberge discusses, the production of an original event to the reproduction of recorded performances,[7] and finally, as Auslander points out, "[l]ive concerts would become what recordings had always been: *simulations*—recreations of performances that never took place, representations without referents in the real".[8]

An example case is the Milli Vanilli scandal in 1990. A duo, Milli Vanilli, achieved the international success that brought them a Grammy Award for Best New Artist on 21 February 1990. However, their Grammy Award was revoked as it became known that the final mix of "Girl You Know It's True" had been performed by studio musicians. An important point is that Milli Vanilli had never sung even in their studio recording sessions. Their concerts were recreations of performances that never took place: simulations.

2.1.3 Live performers as simulacra

If live concerts can sometimes be simulations, following this, live performers in these performative situations at the concerts can be understood as *simulacra*—a term intensively used by the French philosopher Jean Baudrillard. He defines a simulacrum as "the generation by models of a real without origin or reality".[9] This concept was conceived to

7. Paul Théberge, *Any Sound You Can Imagine : Making Music/Consuming Technology* (Hanover, NH: Wesleyan University Press, 1997), p.231.
8. Auslander, *Liveness: Performance in a Mediatized Culture*, p.98.
9. Baudrillard, *Simulacra and Simulation*, p.1.

explain representations that have "no relation to any reality whatsoever".[10] Baudrillard denotes Disneyland as a model constructed by simulacra as the gadgets such as the Pirates, the Frontier and the Future World have no referents in the real world, historically speaking. These are "a play of illusions and phantasms", never material images that represent actual objects or phenomena.

I would argue that those live performers in the simulation concerts play the role of simulacra, similar to those in Disneyland. Steve Wurzler presents Whitney Houston's performance of The Star Spangled Banner at the 1991 Super Bowl at the Tampa Stadium as an example of "recording conceived as the dismantling of any sense of an original event and the creation instead of a copy for which no original exists."[11] In this event, her singing was drowned out by playback of her prerecorded performance since her microphone was turned off. It was a producer's decision to use the prerecorded performance in favour of excluding noise factors such as the crowd and jets flying overhead at the venue, even though the recorded take was far from the realistic rendering of what it actually would have been. In such instances, live performers are not the sound sources that imbue their own musicality into recorded tracks, but rather, pantomimers who simulate the prerecorded performance which is unrealistically polished. The artificially constructed "performers" in the recording function as models from which their live versions are derived. This perfectly

10. Baudrillard, *Simulacra and Simulation*, p.4.

11. Steve Wurtzler, ""She Sang Live, But The Microphone Was Turned Off:" The Live, the recorded and the Subject of Representation.," in *Sound theory/sound practice*, ed. Rick Altman (New York, NY: Routledge, 1992), p.93.

matches Baudrillard's definition of simulacrum. For this reason, live performers in this context may be conceived of as simulacra.

2.1.4 Disappearance of performers

What is disappearing in parallel to the gradual encroachment of reproduction technologies into popular music concerts is not only performers' musicianship, but also their bodily presence. In the case of the Milli Vanilli scandal and Whitney Houston's performance, the performers' musicianship was entirely concealed by the prerecorded performances. Although these performances provoked certain indignations by the adult audiences, the young audience has shown a gradual allowance for the removal of musicianship from the concerts since the 90s. The technologies mentioned earlier such as prerecorded backing tracks, digital samplers, drum machines and digital audio workstations have become a common practice in live music performance, taking over the position of the leading actors/actresses in live concerts from real performers. This trend culminates with the emergence of Vocaloid concerts. A *vocaloid* is a virtual singer projected as a hologram on stage. Their voices are synthesized by the Yamaha Vocaloid software synthesizers. Producers can input musical notes and lyrics into its interface that will be performed vocally by a virtual singer.

What is particular in the Vocaloid concerts is the total disappearance of the performer's body. Instead of a real performer, there is only an avatar on stage, turning a concert from a

place that demonstrates the performer's skills to that in which a preprogrammed sequence of data is executed. As a performer's role has become to simulate virtually constructed performances, the positions previously taken up by human performers have been replaced with Vocaloid avatars.[12] Those Vocaloid avatars are pure immaterial images that have never existed in the physical world, thereby implying the gradual disappearance of the human body from concerts.

To this end, I consider the blurred boundary between performers' absence and their presence as an essential condition that engenders the current sense of what can be called an authentic live concert. Since this approach delineates a contrast to traditional contemporary music performances which rely on the presence of performers, the following sections introduce a few example approaches that support the expression of absence in Western classical music history.

2.2 Expressions of absence in music history

2.2.1 Offstage performances

Before the advent of recording technology, most instrumental music was premised upon the presence of human performers on stage, as in chamber and orchestral works. In contrast,

12. Avatars are representations whose shape and behaviours simulate real human beings. For example, in role-playing games, an avatar typically plays the role of the protagonist that represents the operator. In science fiction movies such as *Avatar*(2009), avatars are sometimes drawn as fictional characters that have their own personalities and are autonomous from any sense of operators.

the absence of a performer has mostly played a supporting role. An example is the *Bayreuth Festspielhaus* opened by Richard Wagner in Germany in 1876. This opera house has a unique characteristic to avoid visual interference with the singers' performances, that is, to hide the orchestra pit under the stage. Although the primary aim of this approach was to make the audience concentrate on the drama onstage, it is important to point out that the invisible orchestra performance makes the location of the sound source unidentifiable which may link to the impression of an illusory performance.

Gustave Mahler also wrote offstage instrumental parts in several of his symphonies. For example, in the 1st movement of his first symphony from mm.22-26, two offstage trumpets perform a fanfare-like phrase with an indication, "*In sehr weiter Entfernung aufgestellt*" (placed at a very far distance). The primary purpose of the offstage performance seems to express the distant location of the sound sources with the acoustic instruments by making the instrumental sounds quieter and darker than the onstage performance. However, it is remarkable that Mahler's example also made the orchestra players invisible from the audience.

2.2.2 Acousmatic music

With the development of acousmatic music, composers placed the performer's absence as a central strategy with the aim of dissociating sounds in field recordings from their everyday context, thus drawing a clear contrast to instrumental music. The term acousmatic originates

from the Greek word, akousmatikoi, and is referred to as "a noise that is heard without the causes from which it comes being seen".[13] This music genre envisions what is called reduced listening, which means an experience of listening to the intrinsic features of a sound without associating it with the context in which the sound was generated. Since sound is usually an acoustic reaction to contact between two or more objects, human beings have developed their capacity to perceive the sound in association with a certain movement of objects or behaviour of human beings. For example, in a percussion performance in which a player produces a sound of a bongo, the sound was understood as a result of a performer's gesture beating the bongo's membrane with his/her hand. The beating gesture was envisaged in listeners' minds even if they do not see it. Acousmatic music aims to create the opposite effect, namely, dissociating the performer's gesture from the sound. This genre of music, therefore, highlights a binary opposition between the performer's presence in instrumental music and the performer's absence in acousmatic music.

2.2.3 Gestural surrogacy

Denis Smalley's concept of gestural surrogacy[14] fills the gap between these two extremes, identifying a continuum between the action-sound link and the dissociation of that link. According to Smalley, listeners become able to decode the performer's actions from

13. Pierre Schaeffer, *Treatise on Musical Objects: An Essay across Disciplines* (University of California Press, 2017), p.64, ISBN: 9780520967465, https://doi.org/doi:10.1525/9780520967465.

14. Denis Smalley, "Spectromorphology: explaining sound-shapes," *Organised Sound* 2, no. 2 (1997): 107–126, https://doi.org/10.1017/S1355771897009059.

resultant sounds through years of audiovisual experiences, since one becomes able to imagine the performer's gestures when listening to a recording of instrumental music. In listening to acousmatic music, this ability enables one to identify the remoteness between the causal gesture and a resultant sound. Smalley outlines four types of surrogacy within music: first-order surrogacy, second-order surrogacy, third-order surrogacy and remote surrogacy. In first-order surrogacy, listeners clearly apprehend the source of a non-musical (i.e. not associated with a musical instrument) sound. Second-order surrogacy refers to the sounds whose causal gesture can be imagined in association with instrumental performances as in, for example, a synthesized violin sound. Third-order surrogacy is a specific sound quality in which the listeners cannot clearly identify but somewhat infer the source material and the causal performing gesture of a perceived sound. Remote surrogacy is a sound quality that has the least association with the source material and causal gesture of a performer. With these four types, gestural surrogacy enables us to comprehensively delineate a continuum between two opposite types of performances: the one with the performer's presence and one with the performer's absence.

2.2.4 Mixed Music

John Croft points out that mixed music, which combines live performance with electroacoustic sounds, can be interpreted as a genre unfolding "between the attempt to reassert the importance of bodily presence and performance, and the purgation of that

presence in favour of disembodied sound production".[15] On the one hand, reassertion of the importance of bodily presence may be seen, for example, in performances with Digital Musical Instruments, which tend to show a clear causal chain between the performer's physical actions and an electronic sound. On the other hand, embodied and disembodied sound sources are used as structural narrative poles in such pieces as *Dialogue de l'ombre double* for a clarinet and electronics (P. Boulez, 1985) and *Vox humana?* for a solo loudspeaker, women's voices and orchestra (M. Kagel, 1979). In *Dialogue de l'ombre double*, prerecorded sound files play an oppositional role to the sound produced by a physical performer present in a concert hall. In *Vox humana?*, a singer performs into a microphone offstage to project her voice to a loudspeaker on a stage. This setting represents "a technically mediated, disembodied voice, emphasizing the *absence* of a human being behind the voice".[16]

2.3 Summary

In this chapter, I pointed out that (1)reproduction technologies such as phonographs, magnetic tapes and digital audio workstations have transformed the attribute of live concerts from showcasing the actual musicianship of real performers to presenting fictional performances—performances that never existed in reality, but were created with the

15. John Croft, "Theses on liveness," *Organised Sound* 12, no. 1 (2007): 59–66, https://doi.org/10.1017/S1355771807001604.

16. Björn Heile, *The Music of Mauricio Kagel* (London, England & New York, NY: Routledge, 1996), p.127.

extensive use of edited, tape-spliced, synthesized and computer-generated tracks as in lip-synced performances; (2)the fictional performances caused the gradual disappearance of the performer's bodily presence; (3)Western music has historically been engaged with some approaches to express the concept of absence as in Wagner's hidden orchestra pit at the *Bayreuth Festspielhaus* and Mahler's offstage performances in his symphonies; and (4)mixed music composition can be interpreted as the attempt to use presence and absence of the performers' corporeality as narrative poles between which a composition can unfold. This expressive potential of mixed music can be used to delineate the blurred boundary between the presence and absence of the performers, which is a central strategy of my composition.

Chapter 3

Overview

This chapter presents an overview of the compositional approaches and goes in-depth for each section. The compositional approaches are conceived to address the following two challenges: (1)how to reflect the concept of simulacra in every component of the piece; and (2)how to blur the boundary between the presence and absence of the performers. The first challenge is tackled in theatrical, musical and theoretical ways. An example theatrical way is to use multiple visible 'copies' of a single main cellist. An example musical way is to use synthesized cello sounds. The theoretical ways are, for example, to use a characteristic scale and an iterated series which are both artificially invented. These approaches are implemented particularly in section I, II and IV. The second challenge is addressed by creating a gradual transition between a state where the action-sound coupling is clearly perceived and another contrasting state where that link is ambiguous and/or destroyed. An

essential approach is to derive musical, visual and theatrical components along three continua: visible/invisible, audible/inaudible and active/inactive continuum. This approach is used extensively in section III. Through these approaches, the piece aims to blur the boundary between the presence and absence of the performers which is a key to expressing the concept of simulacra.

3.1 Compositional approach

Simulacra was composed for five cellists, electronics and video. The five cellists are classified into a single solo cellist and four accompanying cellists. *Simulacra* aims to draw the audience's attention to the transition from authenticity to ambiguity of the performer's presence on stage. This aim presents the piece's unfolding from a clear coupling of the performers' actions and their resulting sounds to a state in which this causal relationship is broken, and then back again. In my piece, absence plays as substantial a role as presence. The absence of the performer creates a vestige that the computer-generated audiovisual elements replace with simulacra of the performer. Table 3.1 exemplifies the approaches to representing the original, copy and simulacrum of the cellist.

	Original	Copy	Simulacrum
Visual	Physical body	Projected body	Computer graphics
Audio	Acoustic sounds	Prerecorded sounds	Synthesized sounds

Table 3.1: Examples of the approaches to representing the original, copy and simulacrum

This ambiguity suggests three essential compositional parameters for the piece: visibility, audibility and activeness. These parameters exist along the continua of visible/invisible, audible/inaudible and active/inactive, respectively. The visible/invisible continuum is a theatrical parameter which determines whether the performer is visually present or absent. The audible/inaudible continuum is a sonic parameter, which has sound on one pole and silence on the other. The active/inactive continuum comprises an intermodal parameter which explores causal relationships between the performer's playing gesture and the resulting sound. This parameter enabled me to create perceived links between gesture and resulting sound in which the causal relationship varies. On the one hand, there is a clearly perceivable causal link between a gesture and the resulting sound. On the other hand, with various techniques, I attempted to blur or even destroy the perception of a causal link.

The piece reflects the concept of simulacra in theatrical, musical and theoretical ways. Theatrical simulacra are achieved by the use of multiple visible 'copies' of a single main cellist. The copies are other performers whose identity is unidentifiable, as they wear a mask, eventually leaving the stage to perform in a virtual world created in the video projection. Although the cellists move between on- and offstage, their basic spatial configuration is linear on stage (Figure 3.1).

The musical simulacra are expressed by the use of synthesized cello sounds that are achieved through a sampling synthesis. As described later in this thesis, sampling synthesis generates sound materials that are artificially made up. The repetitive use of the sound

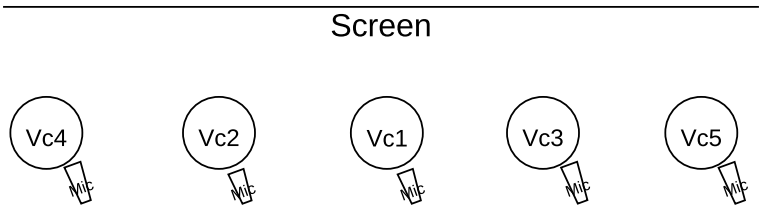


Figure 3.1: Spatial configuration on stage

materials represents the 'copies' of the nonexistent original.

Theoretical simulacra are related to the organization of pitch materials and are achieved by the use of the characteristic scale and the iterated series. The characteristic scale was created by permutations of a pitch interval set that is artificially made up rather than abstracted from existing music (as in pentatonic scales in traditional folk music). The iterated series was created through the repetition of a series that is also artificially invented rather than extracted from existing music. Importantly, both approaches 'replicate' their artificial archetypes, thereby expressing copies of nonexistent originals.

Technologically, the incongruence of the coupling is achieved in part through the use of electronic sound and video projection. The electronic part constitutes amplification and prerecorded sound files which are designed to simulate congruent action-sound couplings, slight decouplings, and total disintegration of couplings. The video projection takes similar approaches, such as a projection of a prerecorded video stream ranging from showing the physical performer synchronized with the real performer on stage, to a situation in which synchrony with the real performer is slightly off, and finally to the playback of video files

that show the virtual figures of performers animated as computer graphics.

3.2 Form

An overview of the theatrical, musical and visual elements of each section is given below(figure 3.2). More detailed discussions of the processes used occur in later chapters.

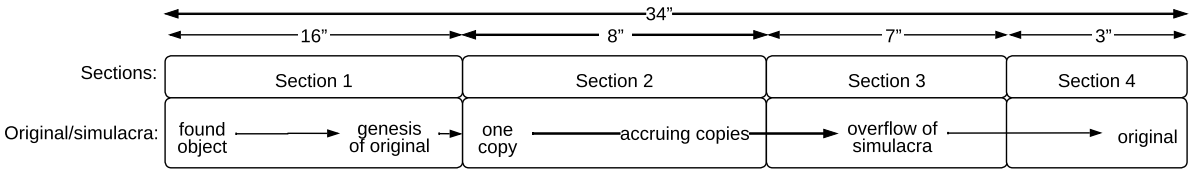


Figure 3.2: Formal structure of *Simulacra*

3.2.1 Section I

The first section (duration of approximately 16 minutes) is from the beginning of the piece to the rehearsal mark M. Conceptually, this section aims to draw a process from first-order surrogacy to second-order surrogacy. In other words, this section shows a process through which a found object gradually becomes a culturally agreed-upon construct of what the authentic cello is. Semantically, this authentic cello symbolizes the genesis of the original that will eventually develop into copies without the original (i.e., simulacra).

Theatrically, the process is portrayed through the gradual establishment of the performance setup. At the start, in order to treat the instrument as a found object, the

cello is laid down on stage, and the performer approaches the instrument. Throughout the section, the performer behaves as if exploring every part of the body of the cello by, for example, gliding a finger (e.g., mm.10), tapping fingertips on the surface of the cello's body (e.g., mm.26) and swinging the bow up and down in the air (mm.50 and 51). The performer explores several ways to hold the instrument. The performer stands up holding the instrument (mm.82), then sits down holding the cello in a guitar position (mm.89), and finally, holds it in the normal playing position (mm.107-109). In these ways, the authentic character of the cello is gradually discovered.

Musically, the process from a found object to the authentic cello is illustrated by the gradual process of tuning the strings. The extreme scordatura at the beginning of the piece (F2, D3, G1, A0 flat from I to IV strings; see figure 4.2) is thought of as a way to objectify the instrument, while the normal tuning is considered as a symbol of a culturally agreed-upon construct of what the authentic cello is. The cello is tuned gradually from the scordatura to the normal pitches throughout the first section. As the strings are finally tuned to their standard pitches in mm.138, pitched materials become more prominent toward the end of the section, where previously inharmonic sound objects were more prominent. The section ends with a repetition of broken chords with open strings (mm.149) which symbolize the completion of the process to the ordinary tuning, followed by a transition to the next section from mm.150 to 153.

The visual projection consists of video recordings of a real cello and computer-generated

graphics. In the case of the video recordings, extremely magnified parts of the body of a cello are thought of as a symbol of the cello as a found object, while showing the whole figure of the cello symbolizes a culturally agreed-upon concept of what the authentic cello is. The extreme magnification makes the object almost unidentifiable, particularly at the very beginning of the section. As the section proceeds, the camera gradually zooms out with the aim of enabling the audience to identify what the magnified images actually are. In the scenes where computer graphics synthesize the image of the cello, I used an interpolation algorithm in such a way that the randomly-fragmentized parts of a computer model of a cello are gradually transformed into a complete figure of a cello.

These theatrical, musical and visual approaches aim at engendering an impression that found objects are gradually assembled into an authentic cello. In this way, I aimed to articulate that what we think of as an authentic cello is a fluid concept that can change over history according to the perception of human beings. In this piece, this fluidity of authenticity is a symptom of its further transition from the authentic to a simulacrum.

3.2.2 Section II

The second section (approximately 8 minutes) is from rehearsal mark M to W and comprises the gradual accrual of the 'copies'.

Theatrically, the copies are represented by four recorded cello parts. The first of the four recorded cello parts appears in mm.166. This added part gradually differentiates its rhythm

and pitch from the main acoustic cello part (e.g., from mm.175 to 185). Other recorded cello parts start to appear one by one from mm.199 as the rhythmic differentiation becomes more extreme.

The music develops in such a way that the pitch space gradually enlarges from D and then converges to high A. Inside this pitch range, repetitions of the pitch D gradually diverge into ascending lines on a chromatic scale from mm.197 and then shift to more steep ascending lines from mm.230 on the scales which I created. Finally, the ascending lines gradually converge on a unison A in mm.243.

Visually, this section starts with the appearance of the performer's first 'human copy,' that is the arrival on the video projection of the first of the accompanying cellists. As the section proceeds, more copies appear on the screen. These copies start to behave differently from their original with the aim of giving the audience an impression that the copied cellists gradually gain their identities. With these approaches, I aimed at expressing a gradual increase of copies of the main cellist.

3.2.3 Section III

The third section (approximately 7 minutes) is from rehearsal mark W to UU and fully uses the aforementioned three compositional parameters (i.e, visibility, audibility and activeness).

Theatrically, the visible/invisible continuum is implemented in such a way that the real performers go back and forth between on- and offstage. The section ends as the real

performers gradually recede backstage while the copies populate the performance space. The copies are recordings and videos. As a result, the copies lose their referent, and thus the physical performers are theatrically replaced by simulacra.

Musically, the section focuses on the audible/inaudible continuum and the active/inactive continuum. The first half of the section focuses on the active/inactive continuum. This continuum is implemented as a transition in the action-sound coupling from a coherent state to an ambiguous state. From rehearsal mark W until QQ, the action-sound coupling is in a coherent state: the performers' behaviour directly causes the cello sounds. From the rehearsal mark QQ to TT, the audibility parameter also starts to influence this action-sound coupling because the coupling is broken as the performers mime as if playing musical phrases, creating a state where the sound is inaudible while the action is active. From the rehearsal mark QQ until UU, the electronic part overlaps numerous synthesized cello sounds over the acoustic and recorded cello parts, thereby creating a situation in which the synthesized cello sounds do not play the role of exact copies of the real cello parts any longer. Rather, the synthesized cello sounds represent simulacra because there is no referential causal playing gesture on stage nor in the projection. The action-sound coupling is totally broken from rehearsal mark TT until UU as the real cellists disappear from the stage while the synthesized cello parts continue to sound. This scene creates an unusual state on stage where the sound is audible while the performer is invisible and inactive.

The video projection focuses on the visible/invisible continuum in order to support the

theatrical quality of the recorded cello parts. The video screen shows the performers' prerecorded video footage while the recorded cello parts are being played. This approach creates an illusion that the recorded cello parts also go back and forth between on and offstage just like the real performers do. In this way, the recorded cello parts become metaphorically visible or invisible alternately. These recorded cello parts remain "visible" at the end of the section with the aim of giving the impression that the physical performers are replaced by simulacra.

In this section, the theatrical, musical and visual elements express the process through which the physical performers are gradually replaced by a plethora of simulacra.

3.2.4 Section IV

The fourth section (3 min approx.) lasts from the rehearsal mark UU to the end of the piece. Conceptually, this section aims to question whether the performers' physical presence is the authentic object in concerts that are designed as simulations.

Theatrically, this question is reflected by revealing the body-identity congruence—a situation where performers' intentions are clearly reflected in their bodily gestures—in contrast to the previous sections where this congruence was blurred. The main approach to this revealment is the removal of the cellists' masks.

Musically, the question of authenticity is reflected in the removal of any simulated cello parts. There are neither recorded nor synthesized cello parts any longer.

The visual projection shows a 3D model of a flower dissolving into particles. This symbolizes the gradual disappearance of the simulated model.

Through these theatrical, musical and visual approaches, the section delineates the gradual disappearance of the technological simulations, thereby articulating that the performers' presence is the authentic object.

3.3 Summary

This chapter introduced an overview of the compositional approaches that achieve the two interrelated objectives: (1)expressing the fluidity between the authentic cello and its simulacra; and (2)blurring the boundary between the presence and the absence of the performer. For the first objective, various approaches were used as in the gradual establishment of the performance setup, the use of the four recorded cello parts and the revealment of the body-identity congruence for theatrics, tuning the strings, gradual divergence of the pitch space, the removal of any simulated cello parts for music, and the gradual zoom out of the cello's figure, the computer-generated image of cello, the dissolution of a computer-generated flower for video projection. The second objective delivered three continua which are audible/inaudible, visible/invisible and active/inactive continuum. These three continua enable the piece to create various scenes in which the performer's actions and their resulting sounds are coupled or broken. An example state is the decoupling of the action and sound—the performers' body is visible and their

performing action is active while their sound is inaudible. Through these approaches, the piece aims to question whether the performers' physical presence is a guarantor of the audience's authentic experience in concerts in which technologies overshadow the actual musicianship of the performers.

Chapter 4

Instrumental part

This chapter introduces the melodic motives used in every section in the instrumental part and discusses (1) how these motives are transformed using the techniques of tuning, pitch differentiation, scale, series, chord progression and rhythm; and (2)how these transformation techniques support representing the concept of simulacra.

4.1 Melodic motives

The piece is divided into four sections, each of which consists of different motivic materials.

4.1.1 Section I (mm.1-153)

The first section consists of two motives: (A)sustained inharmonic timbre using extended techniques (mm.10) and (B)a short attack (mm.18). These motives recur with varied settings

such as changing the playing techniques and transforming to a repetitive figure. Motive A appears for the first time in mm.10 with the playing technique of gliding a finger on the surface of the cello. Motive B appears in mm.18 by tapping the surface of the cello with fingertips.

Motive A transforms to (A'), an accelerating rhythm, by gradually subdividing the sustained noise by emphasizing every onset(e.g., from mm.35 to 41), and (A"), clacking noise with a tuning action (e.g., mm.42).

Motive B transforms to (B'), decaying noise, by blowing (e.g., mm.32), (B"), undetermined pitched attacks, by plucking the strings with the fingertips (e.g., mm.43), and (B"'), a short noise, by swinging the bow or colliding it with some substances such as the performer's arm.

4.1.2 Section II (mm.153-247)

The second section consists only of one motive: repeated notes (e.g., mm.153). This repetitive motive gradually transforms via continuous ascending or descending lines (e.g., from mm.172 to 174) into scales (e.g., from mm.202 to 206).

4.1.3 Section III (mm.247-394)

The third section is thematic. The theme illustrated in figure 4.1 consists of three motives: (1)an ascending/descending line (mm.253), (2)a sustained line (from mm.254 to 267), and

(3)natural harmonics (mm.267). The initial ascending line is often replaced with a descending line. The sustained line contains rapid fluctuations around a central pitch. The last natural harmonics are normally replaced with either an ascending or descending line.

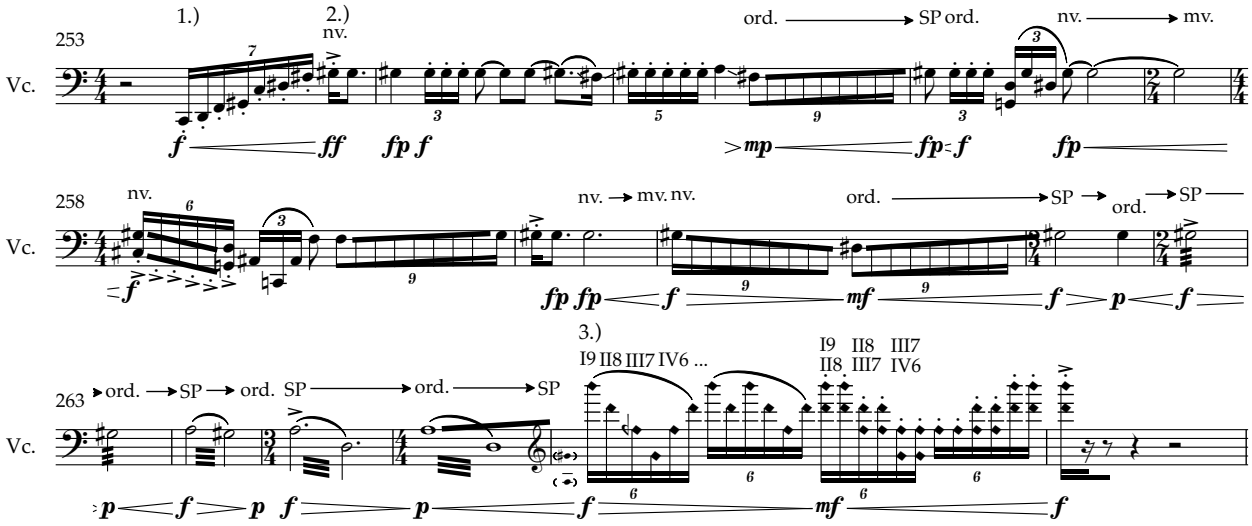


Figure 4.1: The theme in section III

4.1.4 Section IV (mm.394-415)

The fourth section does not contain any instrumental musical materials since there are only electronic sounds and theatrics.

4.2 Tuning

The first section contains a process through which an extreme scordatura is gradually tuned to become the standard cello tuning. The initial state of the tuning is F, D, G, and A flat

from string I to IV as illustrated in the figure 4.2. These are, with the exception of string II, one octave lower than the tuning of the scordatura used in *Pression* (H.Lachenmann, 1970) in which the strings I to IV are tuned to F, D flat, G and A flat, respectively. I used this scordatura in order to express my respect for Lachenmann's attempt to deconstruct the culturally agreed-upon concept of what the authentic cello is. String II maintains the standard tuning to give enough tension to hold the soundpost in place inside the cello's body.

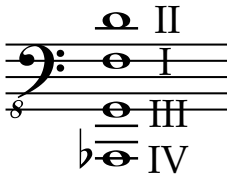


Figure 4.2: Scordatura for cello 1 at the beginning of *Simulacra*

The strings are tuned up gradually from the initial state to the standard tuning in order from the string IV, III then I. As illustrated in the figure 4.3, the strings are generally tuned up by increasingly smaller intervals as the music proceeds. In the case of string I, the pitch interval from one tuning to other shifts from a major 3rd in mm.42, a minor 3rd in mm.68 and 69, a diminished 4th in mm.76 and 77, an augmented 2nd in mm.84 and a minor 2nd from mm.92 to 94. String III is tuned up a major 3rd from mm.123 to 124, a minor 3rd from 124 to 125, a minor 3rd from 125 to 126, then a major 2nd from 126 to 127. String I is tuned up an augmented 4th from mm.132 to 133, a perfect 4th from mm.133 to 134, a minor 3rd from mm.134 to 135, then a major 2nd from mm.135 to 136 where the original tuning is complete.

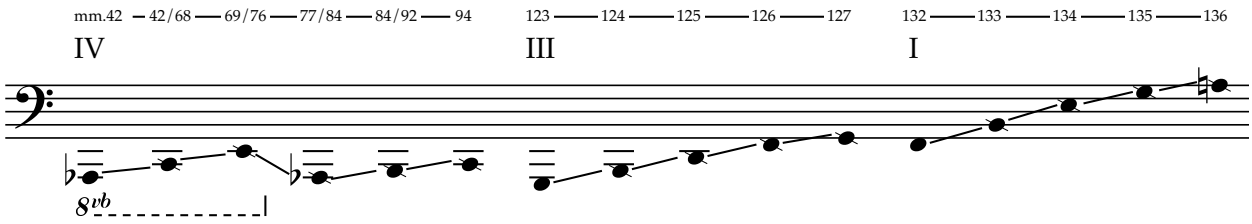


Figure 4.3: Tuning process in section I. The backslashed notes indicate approximate pitches.

The completion of the tuning process symbolizes the construction of the 'authentic' cello. There is no further process to tune up the strings in the following sections. This is because the focus of the piece shifts from the authenticity of the instrument to the authenticity of the performers which is articulated by the ambiguity of the performer's presence.

4.3 Pitch differentiation

The second section is characterized by a gradual differentiation of pitches between the cello 1 part and the recorded cello parts. This process is intended to represent a gradual appearance of copies of the original represented by the cello 1 part. The music unfolds between two extremes: a unison state and a canonic state. The unison state represents that the cello 1 part and the other cello parts are identical, thereby playing the role of perfect "copies." The canonic state represents that the cello 1 part and the other parts play slightly different roles, thereby sewing the seeds for them to grow into simulacra that have a separate identity from the original.

An example of a gradual pitch differentiation is from mm.153 until 221. The pitch difference between cello 1 part and recorded cello 2 part starts from unison in mm.166 and then, as the pitch in the recorded cello 2 part moves down to C sharp from mm.172 to 174 (see the figure 4.4), the pitch difference expands from unison to a minor 2nd. Similar downward movement occurs from mm.182 to 184 where the D in the recorded cello 2 part moves down to C, resulting in a major 2nd of pitch difference against D in the cello 1 part. From mm.187 to 196, the cello 1 part and other recorded cello parts start to play upward glissandi and then a chromatic scale canonically.

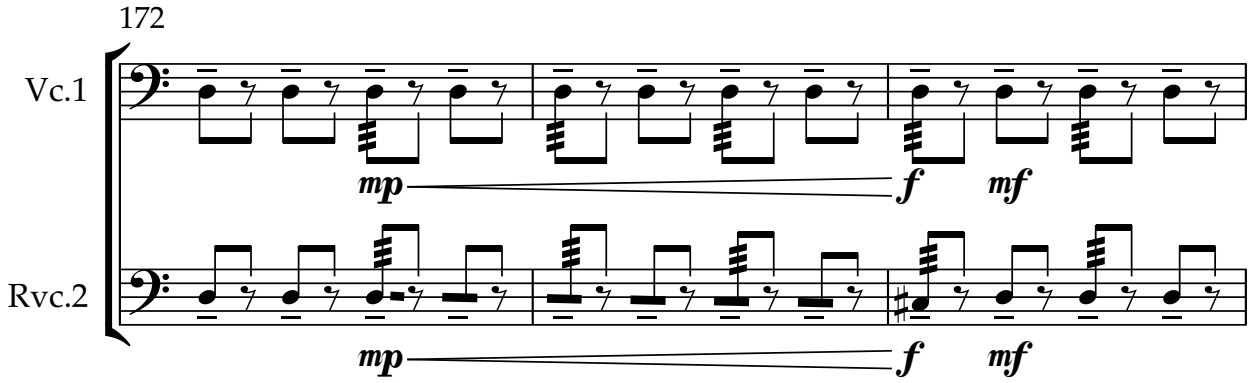


Figure 4.4: Gradual pitch differentiation from D to C sharp in the recorded cello 2 part creates a minor 2nd against the cello 1 part.

Through this gradual pitch differentiation, the second section musically illustrates a process in which the original gradually gives birth to its alter egos, and then these grow into simulacra.

4.4 Scale

The second section introduces a chromatic scale and a characteristic scale. The chromatic scale appears in the recorded cello 2 part in mm.197 as a figure transformed from glissandi in the preceding measures, and then is gradually extended. The characteristic scale is introduced in the recorded cello 5 part on the 4th beat in mm.228. This scale is a permutation of specific pitch intervals as shown in figure 4.5.

Various transpositions are used in section II and III. Figure 4.6 exemplifies two transpositions of the characteristic scale that are used in the piece along with various other transpositions. Transposition 1 is created by transposing the original of the characteristic scale (4.5) a major 7th higher. Transposition 2 is a result of transposing the original of the characteristic scale a major 2nd higher.

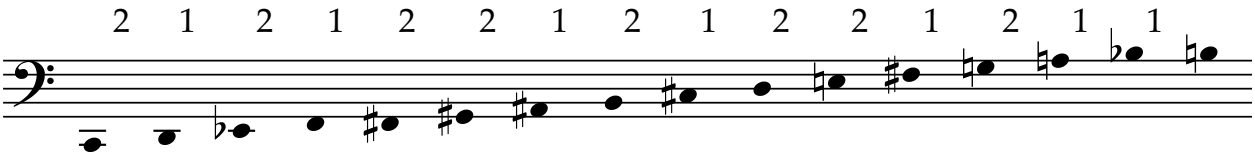


Figure 4.5: A characteristic scale is formed by permutations of the pitch interval set above. The numbers above the staff indicate pitch intervals.

Figure 4.7 shows mm.230 which exemplifies the use of the two transpositions introduced in the figure 4.6. Transposition 1 appears on the fourth beat in the recorded cello 2 part. Transposition 2 is observed in the ascending phrases in the recorded cello 3, 4 and 5 parts.

Conceptually, the scale represents simulacra. The scale was created by permutations of

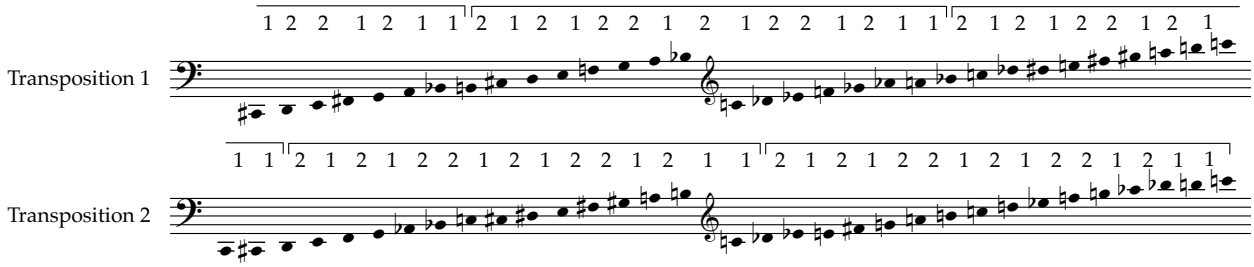


Figure 4.6: Two example transpositions of the characteristic scale formed by permutations of the pitch interval set illustrated in figure 4.5

the specific pitch interval set that is artificially made up rather than preexisted in the traditional culture as in pentatonic scales. Thus, the scale stands for the copies of the original that has no referent in the real world. Furthermore, the repetitive use of various transpositions of the scale that contains permutations of the artificially made-up pitch interval set represents infinite replications of the non-referential original, expressing the overflow of simulacra.

4.5 Series

In the third section, a twelve-tone series, G sharp-G-D sharp-D-E-F-B-A sharp-C sharp-C-F sharp-A (figure 4.8), is used to as the basis for transpositions of the theme mentioned in 4.1.

This series recurs three times. The first time from mm.254 to 309, the second time from mm.309 to 324, and the third time from mm.325 to 355. The fourth recurrence starts in mm.353 before the third recurrence ends in mm.355, therefore breaking off from the twelve-tone technique, starting in mm.355. Figure 4.9 shows the overview of how the series is

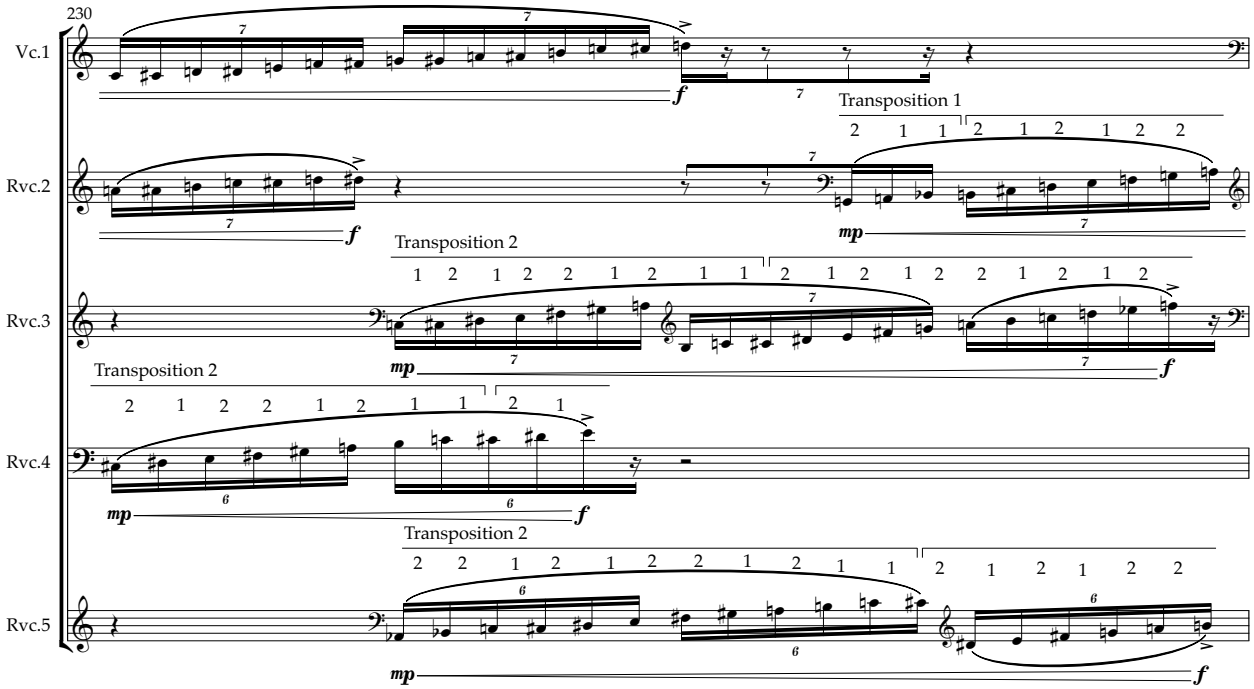


Figure 4.7: The two transpositions of the characteristic scale in use in mm.230.

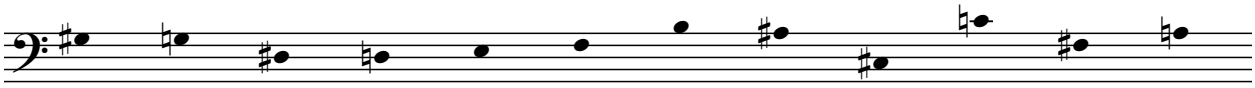


Figure 4.8: A twelve-tone series, G sharp-G-D sharp-D-E-F-B-A sharp-C sharp-C-F sharp-A, is used to transpose the theme mentioned in figure 4.1

iterated from mm.254 to 355.

Figure 4.10 gives an example of a segment of the series, E-F-B-A sharp-C sharp-C, in use from mm.295 to 299.

Conceptually, the iterations of the series are regarded as copies of the archetype series. Since this archetype series is a result of abstract manipulations of pitch intervals that have no referent in the real world (unlike, for example, a melody from folk music), these copies

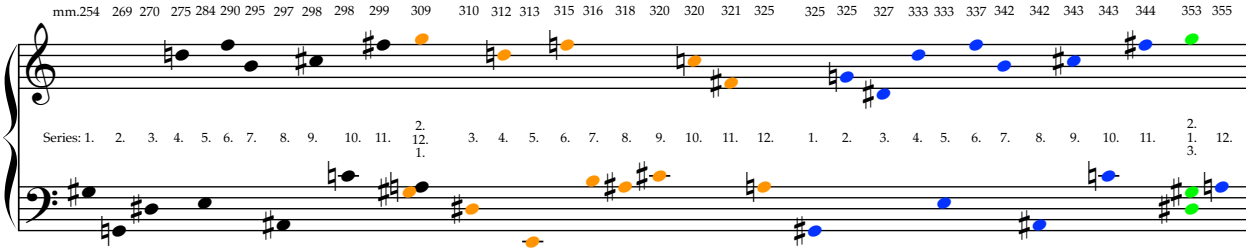


Figure 4.9: A series was iterated four times to determine transpositions of the theme. However, the fourth iteration operates incompletely. In the figure, the first, second, third and fourth iterations are coloured black, orange, blue and green, respectively.

musically represent the overflow of simulacra.

4.6 Chord progression

The end of the third section focuses on horizontal, rather than vertical, pitch structures (i.e. chords rather than melodies). A large chord in mm.358 proceeds in quasi-parallel motion to the end of the section in mm.389 as illustrated in the figure 4.11. This chord was formed as a result of the preceding serial manipulations: the theme was transposed in the order of the aforementioned series in every recurrence, and the transposed themes were overlaid and stratified. As a result, these superimposed themes formed the large chord.

Figure 4.12 depicts an example of the chord in use in mm.358 and 359. The notes with red noteheads represent chord tones while those with black noteheads are non-chord tones that elaborate the musical texture.

Conceptually, the chord progression symbolizes a real-world environment that is filled

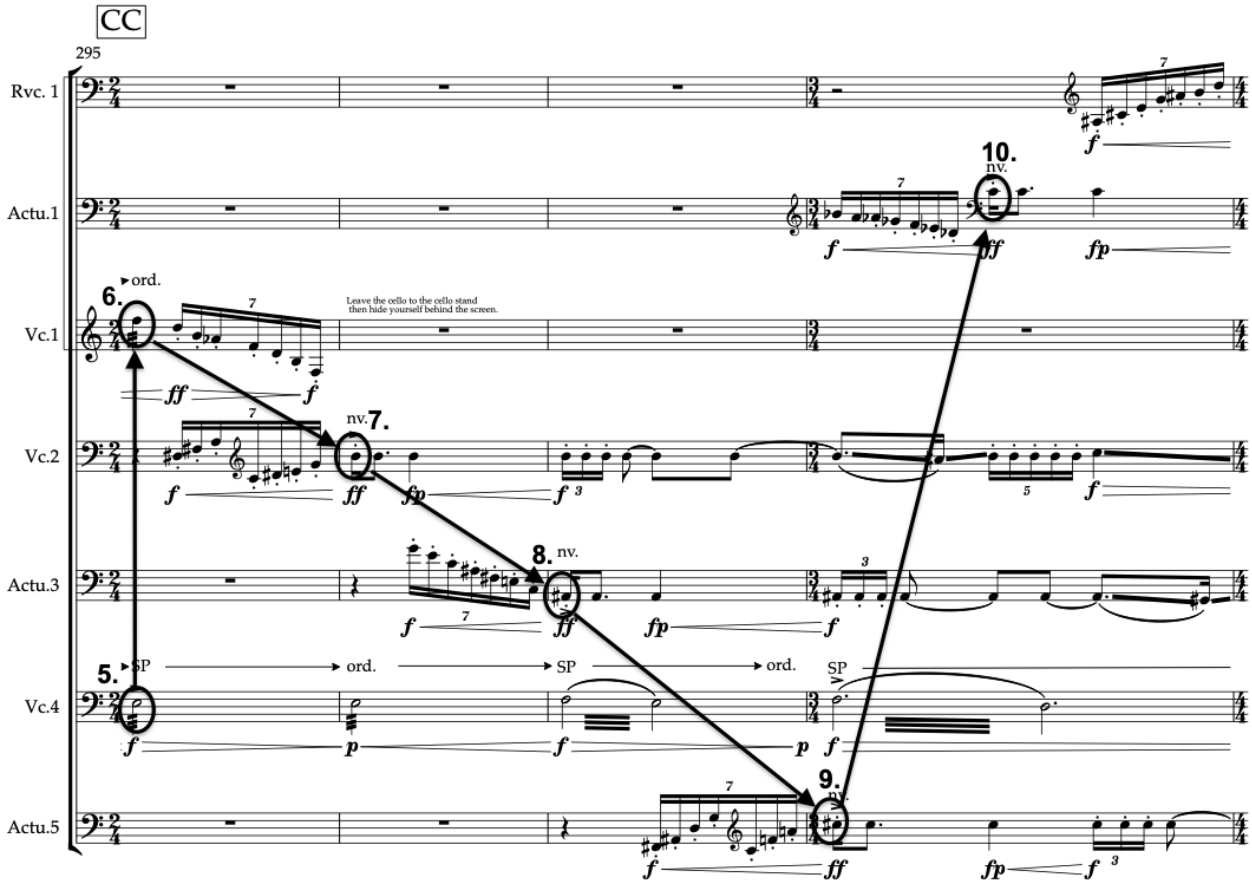


Figure 4.10: An example of the twelve-tone series in use. E-F-B-A sharp-C sharp-C, which are from the 5th to the 10th notes in the series, are seen in the figure.

up with simulacra, similar to what the iterations of the series represent. The large chord was formed as a result of the superimposition of the various transitions of the theme that was made up by the artificial manipulation of the series. Since this series was not extracted from existing musical materials but invented according to the composer's imagination, every chord can be interpreted as a repetition of copies without an original.

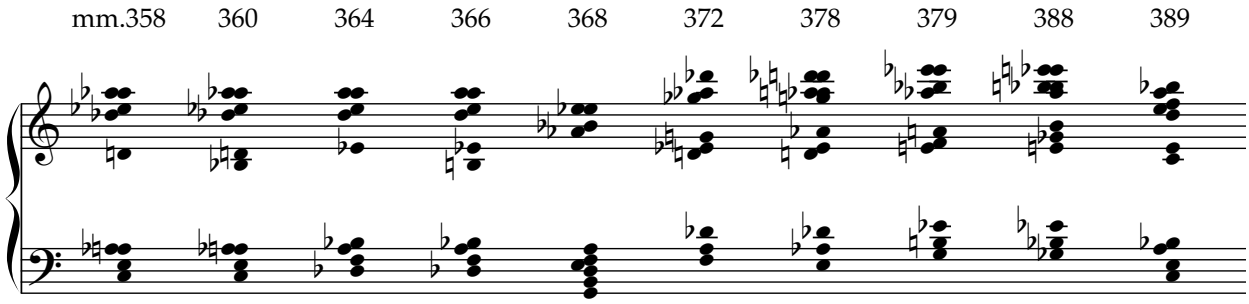


Figure 4.11: The chord progression from mm.358 to 392

4.7 Rhythm

In section I, rhythmic materials are determined based on the regularity/irregularity continuum. Regularity is a state where notes are consecutively juxtaposed over time with a metric pattern. Irregularity is a state where the length of time between notes is proportionally complex, and so, listeners may not perceive the sounds as metrical. Irregularity relates to the concept of the cello as a found object, while regularity relates to the concept of the authentic cello.

Structurally, Section I shows a gradual transition from a rhythmically irregular state to a regular state. During the first half of the section, the length of and the time interval between sounds changes often, thereby making it difficult to perceive metric regularity. From rehearsal mark L, the succession of 64th notes engenders the perception of metric regularity in the music.

In section II, rhythms are determined according to the synchrony/asynchrony continuum. Synchrony is a state where different cello parts play the same rhythmic material in time,

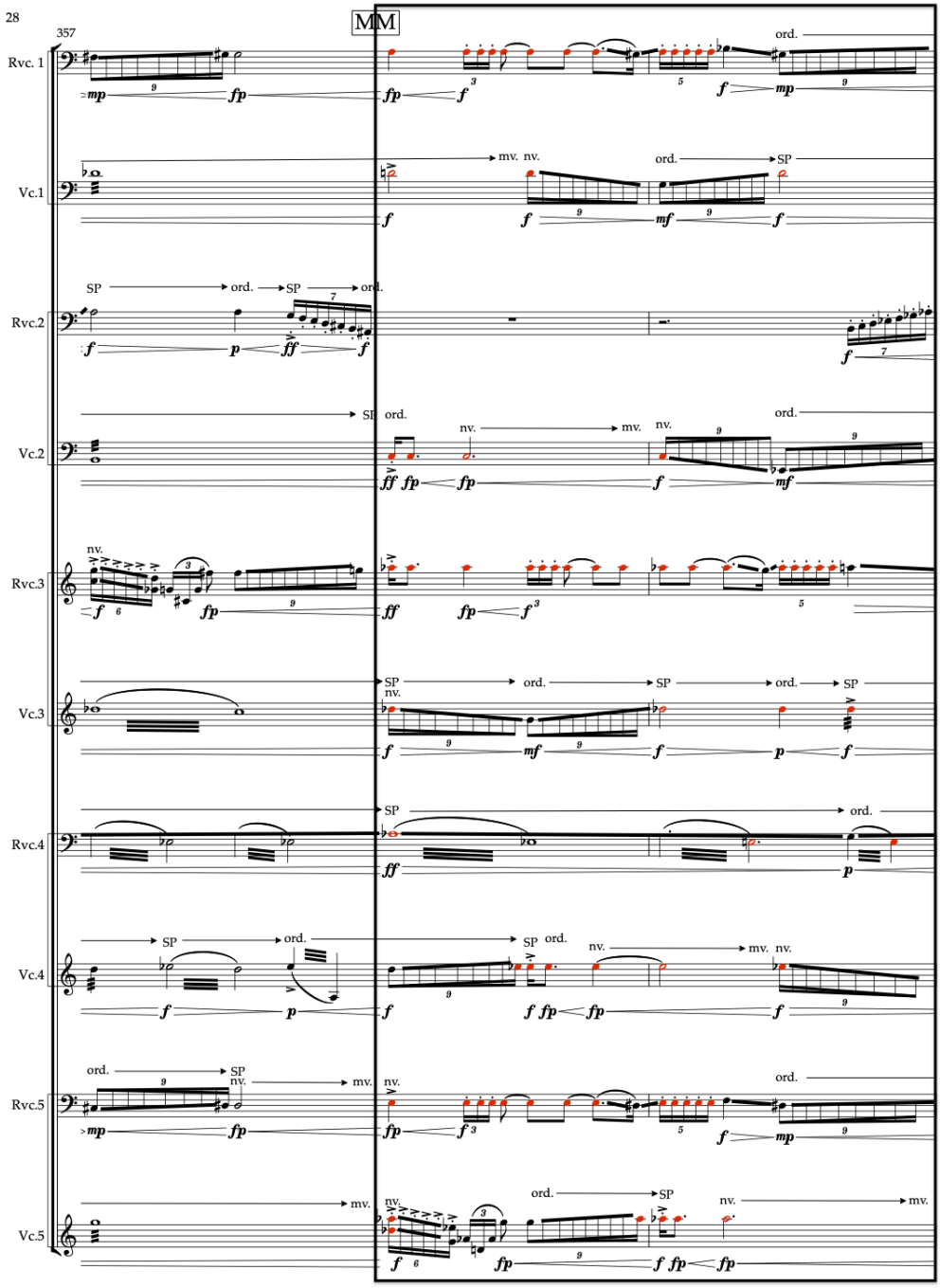


Figure 4.12: An example of the chord in use in mm.358 and 359. Notes with red noteheads represent chord tones.

while asynchrony is a state where different cello parts play similar materials with a different parameter setting. An example of the asynchronous state is mm.176 where two parts play a repetition of D. While the cello 1 part plays an alternation between an eighth note and an eighth rest, the recorded cello 2 part plays an alternation between an eighth note and an eighth rest nested in a nonuplet (Figure 4.13). This nonuplet creates a slight difference in note length between the cello 1 part and the recorded cello 2 part, thereby resulting in an asynchronous state in music.

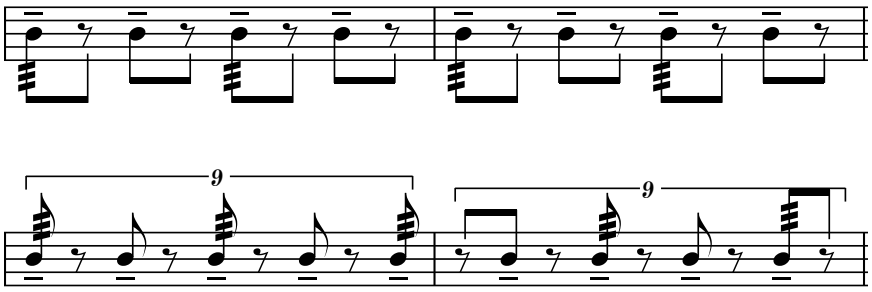


Figure 4.13: Two parts in an asynchronous state in mm.176 and 177

In section III, rhythmic materials are always in a regular and asynchronous state. The theme demonstrates a clear regularity as it contains various motives that are aligned with the beats. This theme is performed in multiple parts in the manner of a hocket so that the parts taken together generate an asynchronous texture. The hocket in this context means that one part plays actively while another part performs inertly. Figure 4.14 shows an example of the hocket relationship between the cello 2 and cello 3. When the cello 2 plays rhythmically articulated motives, cello 3 tends to play a long note, and vice versa.

The rhythmic independence of every part symbolizes that each part plays the role of one simulacrum.

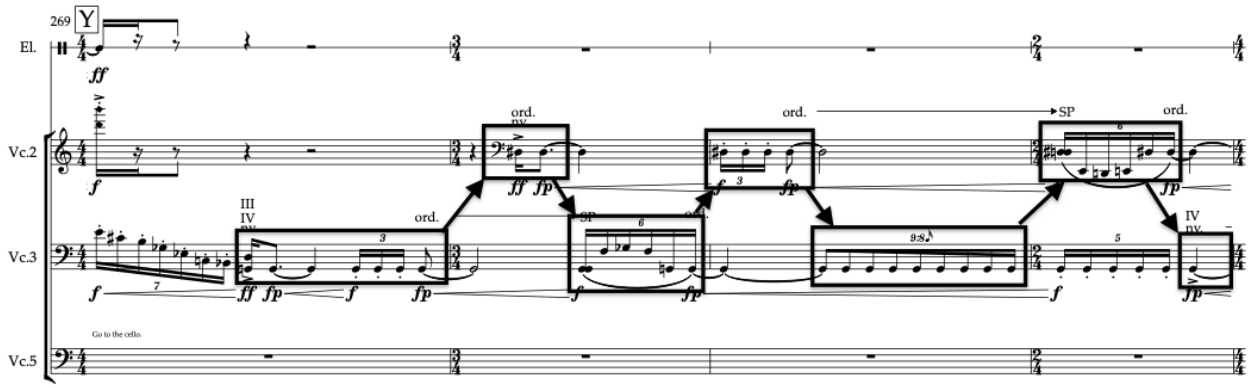


Figure 4.14: Two parts forming a hocket

4.8 Summary

This chapter introduced the melodic motives as the main compositional materials in the instrumental part and how these motives are transformed using such techniques as tuning, pitch differentiation, scale, series, chord progression and rhythm. The transformation techniques support expressing the concept of simulacra in various ways. An example is the gradual tuning process to the standard tuning that symbolizes the construction of the 'authentic' cello. Another example is the repetitive use of the artificially invented scale that represents the repetition of the non-referential original (i.e., simulacrum). Using these transformation techniques, the instrumental part expresses the concept of simulacra.

Chapter 5

Electronics

This chapter introduces the form, materials and spatialization in electronics, and discusses how these materials support expressing the concept of simulacra.

5.1 Form

The electronic part plays an important role in segmenting the composition into four sections since the sections are divided according to the change of the compositional materials in the electronic part. These compositional materials are: natural soundscape, synthesized cello, "mash-up" and recorded cellos. Sections I and IV consist of natural soundscape and synthesized cello. Sections II and III constitute recorded cellos. The mash-up material (described below) is inserted twice as a separator between sections II and III as well as between sections III and IV as illustrated in table 5.1.

	Section I (mm.1-153)	Section II (mm.153-245)	Separator I (mm.245-247)
Compositional materials	Natural soundscape Synthesized cello	Recorded cello	mash-up

	Section III (mm.247-392)	Separator II (mm.392-394)	Section IV (mm.394-415)
Compositional materials	Recorded cello	mash-up	Natural soundspace Synthesized cello

Table 5.1: The distribution of electronic materials in each section

5.2 Materials

In the following sections, I will explain what roles the materials in the electronic part play in the context of the composition, where each material occurs in the piece and how these materials were constructed.

5.2.1 Natural soundscape

Conceptually, the natural soundscape symbolizes a realm outside man-made environments and relates to a concept opposite to that of the authentic cello, namely, a found object.

In the composition, this material frames the piece. The material lasts for the entirety of section I from the beginning until the rehearsal mark M. During section IV, the material proceeds from rehearsal mark TT until the end of the piece.

Practically, this material comprises three types of sounds: overtones, crickets and wind. The overtones sound was created in the following manner: recording a single bell sound,

removing noise, prolonging the sustain of the single bell sound using Digital Signal Processing techniques and transposing the stretched sustain sound to the pitches of the partials over an arbitrarily determined fundamental pitch.

The cricket sound originates from a contemporary butoh [1] project *Femme Insecte* (Ippei Hosaka, 2007), in which I was involved in 2008 and 2009. The sound file was generated by a granular synthesizer importing a recording of cricket sounds as sound material in the Max programming environment at that time. In *Simulacra*, I reused and extended this sound material in order to express a synthetic, and thus nonexistent nature disconnected from the real world.

The wind sound was created by filtering white noise using a bank of bandpass filters. This sound also contributes to creating a nonexistent natural soundscape as the cricket sound does.

During section I, a collision sound and bass attacks synthesized by a granular synthesizer are added in order to dramatize the music. There is no added material to the natural soundscape in section IV.

5.2.2 Synthesized cello

Conceptually, the synthesized cello represents the nonexistent cello because this material was created synthetically by using a sampling technique. Although the sampling synthesizer

1. A form of Japanese contemporary dance theater

uses a real recorded sound as its sound source, what is generated by the synthesizer is a result of computational manipulation of the recorded sound. This manipulation dissociates the real material from its original context, thereby expressing the concept of simulacra.

In the composition, this material is overlaid on the natural soundscape and symbolizes the birth of a copy of the authentic cello from rehearsal mark G until shortly after M.

Musically, this material constitutes a complex of three sustained sounds whose pitches are equal to the pitches of three of the open strings in the standard tuning of the cello: G, A and D.

5.2.3 Mash-up

Conceptually, the "Mash-up" material stands for accrual of copies. Mash-up is a genre of music first made popular in the late 1990s that features to combine short fragments of multiple recordings into one track. Similar to the sampler synthesizer, this technique also dissociates the recorded materials from the context where the recording took place, as the recorded materials are extremely fragmented to the point that their sound source becomes unidentifiable. In my piece, those decontextualized sound sources are repeated multiple times, making the original indiscernible among the plethora of its copies.

In my piece, this material is introduced twice. The first time occurs at rehearsal mark V. The mash-up material gradually recedes shortly after rehearsal mark X. The second occurence starts quietly at rehearsal mark QQ and gets louder toward SS. This time, the

material disappears gradually from TT to VV. Structurally, this material functions to create a segment between section II and III and between section III and IV.

Practically, this material consists of multiple recorded materials. Different materials were used each time. For the first occurence, I used recordings of all my previous works. For the second occurence, I used sound materials recorded originally for other compositional material in the piece, the recorded cellos mentioned before. Both times, the recordings were chopped and scattered into small fragments, and then recombined to create iterations of the sound disassociated from their original sources.

5.2.4 Recorded cello

Conceptually, the recorded cello material symbolizes a state that sways between copies that have original referents and copies that have no referents.

In this piece, the recorded cello material was used during section II and III. Practically, this sound material plays recorded cello 1-5 parts and actuator 1-5 parts (see section 7.3.2 for more information about actuators) notated on the score. The recorded cello parts are used in section II and III, and the actuator parts are introduced in section III as table 5.2 shows.

To create the recorded cello material, the recorded cello parts and the actuator parts were composed, scored, then, recorded. The compositional techniques introduced in Chapter 4 in this thesis were used to compose the recorded cello 1-5 parts and the actuator 1-5 parts. For

	Section I (mm.1-153)	Section II (mm.153-247)	Section III (mm.247-394)	Section IV (mm.394-415)
Recorded cellos	No	Yes	Yes	No
Actuators	No	No	Yes	No

Table 5.2: The alignment of the recorded cello parts and actuator parts in the piece

example, figure 4.4 shows a gradual pitch differentiation between the cello 1 part and the recorded cello 2 part in section II. While the cello 1 part maintains D, the recorded cello part plays a descending glissando from D to C sharp. For more detailed explanations, see section 4.3. Another example is figure 4.7 which illustrates the use of the characteristic scale in the recorded cello 2-5 parts in section II. See figure 4.5 for more details of the characteristic scale. In section III, series and chord progression were used to compose the recorded cello parts and the actuator parts. For more details regarding the use of the series and the chord progression, see section 4.5 and section 4.6, respectively. Sibelius notation software was used to score the composed parts. After the recording was done, noise reduction was applied to the recorded tracks.

At the end of section III, this material is overlapped with the mash-up material as if the recorded material developed into the mash-up material. This development represents the gradual transition of the copies with referents into copies without referents because the mash-up material is decontextualized as much as the original sound source is indiscernible.

5.3 Spatialization

Spatialization plays an important role to express the absence of the performers because of its capability to weaken the link between the performers' actions and the resulting sounds. Spatialization relocates the acoustic sound from the body of the instrument to the position of the loudspeakers that may be located far away from the instrument. In this scenario, listeners may listen to the sound without seeing the sounding body. Using this characteristic of relocation, I aimed to not only relocate but even dissociate the sounding actions with the resulting sounds within the action-sound link. This dissociation creates the situation in which, from the listeners' perspective, performed sounds come from a position where the player is not present. Thus, spatialization simulates the absence of the performers in a concert space.

Spatialization takes place over a 24-channel surround loudspeaker array. This setup consists of three layers of horizontal loudspeaker arrays installed at different height levels (figure 5.1) surrounding the audience. This loudspeakers array enables me to move the position of every sound both horizontally and vertically.

Each compositional material mentioned in 5.2 is spatialized differently. Natural soundscape and mash-up were spatialized in such a way that the position of every sound moves rapidly in a randomly determined direction. In the case of synthesized cello, the sound position moves from the center of the stage to the top of the 3D surround environment while the music proceeds from mm.142 to 146. Recorded cello material was

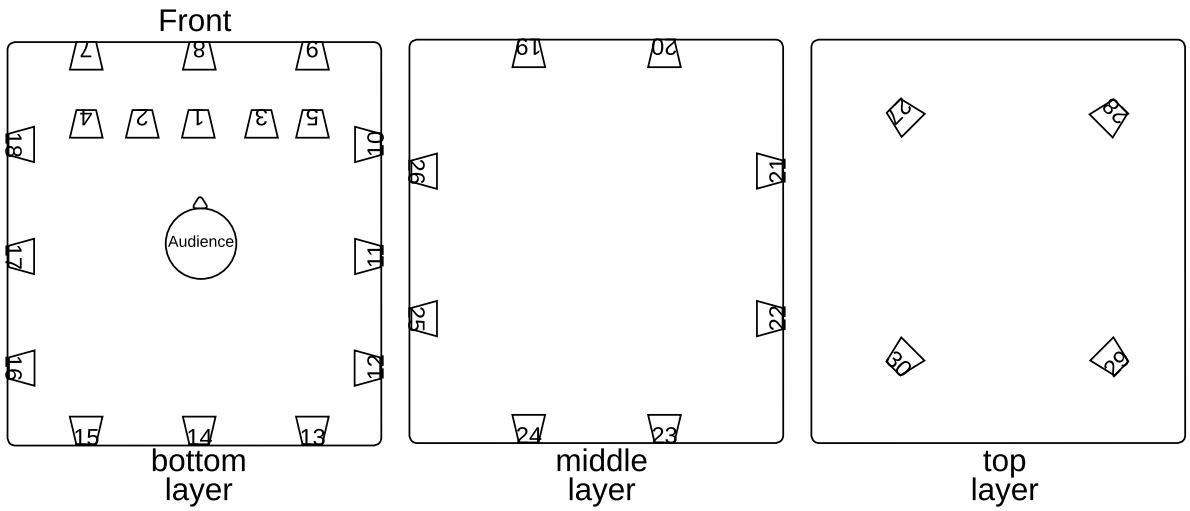


Figure 5.1: Speaker positions. Speaker numbering identified by the Max patch. For more details of the Max programming environment, see 7.2.1.

spatialized differently depending on the sections. During section II, all the constituent recorded cello parts were located at the front center. During section III, I located the constituent recorded cello parts in the following positions; recorded cello I part = rear center, recorded cello II part = rear left, recorded cello III part = rear right, recorded cello IV part = middle left, recorded cello V part = middle right. Note that the positions of the recorded cello parts are not aligned with the screen. This decision was made strategically to dissociate the link between the performing actions that the audience sees and the resultant sounds that the audience hears.[2]

2. See 7.4 for synchronization between the performers, electronics and video

5.4 Summary

In this chapter, I introduced the form, materials and spatialization in electronics, and discussed how these materials support expressing the concept of simulacra. Extreme decontextualization through sampling techniques appeared to be an effective approach to blurring the boundary between the authentic object and the nonexistent copies as in the synthesized cello and mash-up materials. Through these techniques, the electronics support engendering the impression of the simulacra in sound.

Chapter 6

Video

This chapter presents the form and materials used in the video part of the piece and discusses how each material support expressing the concept of simulacra.

6.1 Form

The video content of *Simulacra* is projected onto a screen behind the performers during the concert so it is visible to all of the audience members. The video part also contributes to articulating the boundaries between sections, as what the video projection shows is different in each section. In section I, the video shows a mixture of recorded material and computer graphics. The recording shows the body of a real cello while the computer graphics displays 3D models of the bodies of cellos. In section II and section III, the video shows only recorded cellists that symbolize copies of the real cellists on stage. By "copying" the real cellists in

this way, I aim to express the appearance and then accrual of the original cellists. Section IV shows a 3D model of a flower that eventually dissolves into particles. This dissolution of the 3D model symbolizes the section's focus on the disappearance of any simulation technologies. There are no longer cellos projected onto the screen.

6.2 Materials

Visual materials were created using two different methods: recording and computer graphics. While the recording method generated the material showing the cellos alone and the cellos with the cellists, computer graphics generated materials showing 3D models of a cello, a cello with a cellist and a virtual terrain.

Conceptually, both methods, recording and computer graphics, aim to express the fluidity of reality on the continuum between a real and simulated world. While the recording method was used to stand for both the real and simulated world, the computer graphics were utilized purely to represent a simulated world that is different from the real world.

In the following sections, I will explain what roles the materials in the video part play in the context of the piece, when each material is introduced in the piece and how these materials were created.

6.2.1 Recorded cello's body

Conceptually, the recorded cello's body represents a gradual transition of the concept of the cello from a found object to an authentic cello. To express this in the composition, the video shows this material in such a way that the whole figure of the cello's body gradually becomes discernible throughout section I. Section I starts from an extreme magnification of the cello's body, and the camera gradually zooms out as the piece proceeds. In this way, the focus of the video changes from parts of the cello to the whole figure of the cello. This was a strategy to engender the illusion that the cello is gradually being constructed. This material is introduced during section I.

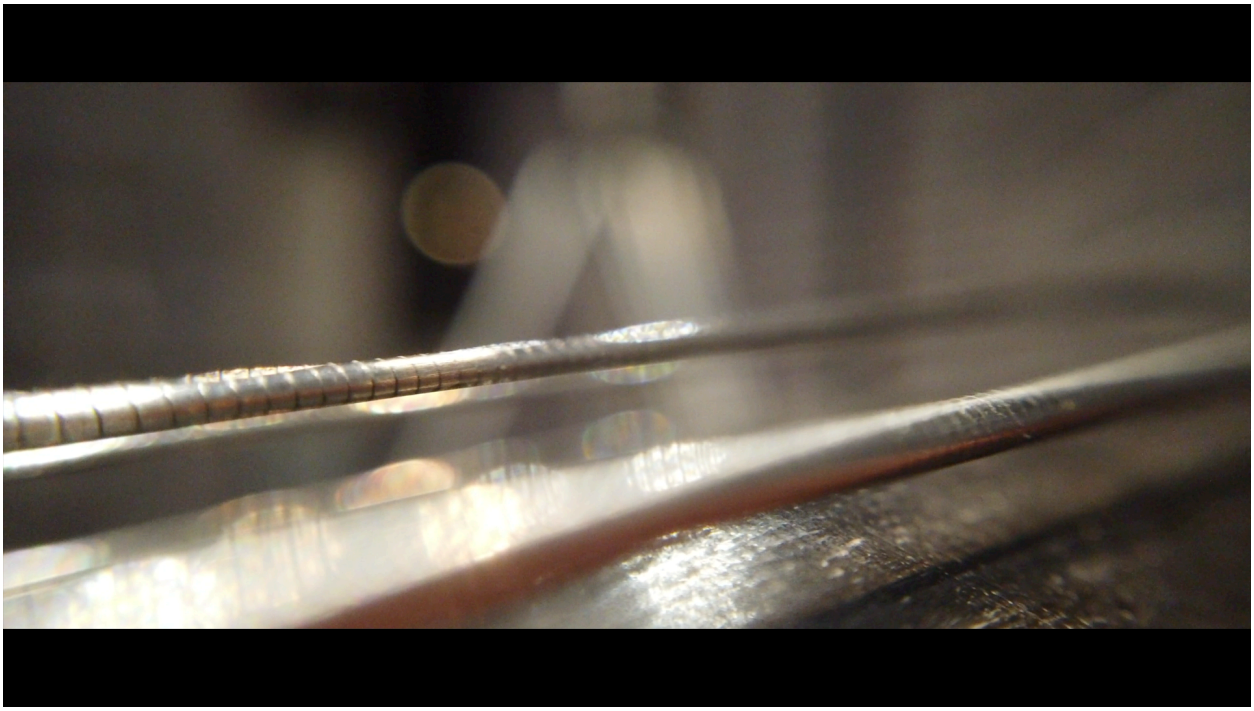


Figure 6.1: Recorded cello's body

Practically, This magnified footage was created using a video camera with a macro lens. The macro lens makes it possible to focus on the object even if the distance between the camera and the object is extremely small. This enabled me to capture an extremely magnified figure of the body of the cello as I was able to place the camera extremely close to the cello.

6.2.2 3D models of a cello

A number of 3D models of a cello were used in order to express the unreal cellos whose association with the real cellos on stage is ambiguous. This material was inserted from time to time during section I.

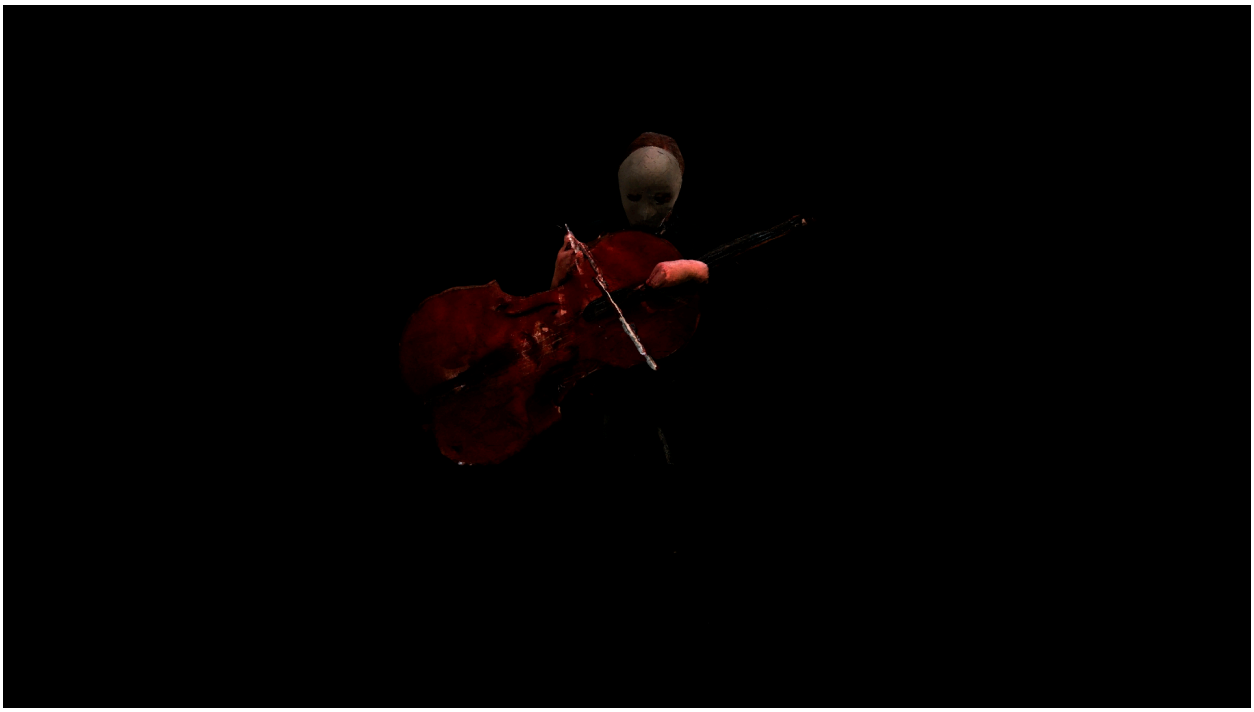


Figure 6.2: A 3D model of a cello with performer

Practically, I use two types of 3D models. One type is computer-generated models. These models are created by online creators and shared on the Sketchfab web platform[1] where users can share, sell and purchase their own 3D models. I downloaded the two cello models both named "Cello"[2] to use in this piece. The first model was downloaded as a .obj file format, and the second model was downloaded as a .glTF file format, both of which consist of the models' geometry data. After downloading, these models were imported into the Max environment using a Jitter functionality in order to render in a virtual 3D space and project to the screen.

Another type of 3D model used was created by volumetric capture technology. Volumetric capture technology is a technique to capture a 3D space including objects, humans and their movements. This technology creates a 3D model using a large set of data captured at multiple depths by optical cameras in space, suited to express copies of the real objects in a virtual 3D space. I was able to access equipment for volumetric capture through an artist-in-residence at the Centre for Art and Media Karlsruhe (ZKM), Germany. In collaboration with their volumetric capture creative team and a cellist, I created various 3D models of a cello as well as the cellist playing the cello. Once the 3D models were created, I exported the models in the .obj file format. Then, these .obj files were imported into the Max environment using Jitter so that I was able to render the models in a virtual 3D space.

1. "Sketchfab," Sketchfab, Inc., accessed April 9, 2023, https://sketchfab.com/.
2. "Cello" by slidon is licensed under Creative Commons Attribution. "Cello" by Vaclav Marena is licensed under Creative Commons Attribution-NonCommercial.

6.2.3 A 3D model of a terrain

Conceptually, A 3D terrain was created to give the audience the impression of a location different from the real world. To achieve it, the terrain was not scanned from the real world but algorithmically generated on a computer. Thus, the terrain is a pure simulation resulting from the computational manipulation of a set of data generated inside the computer. The 3D terrain was shown at the end of section I. Figure 6.4 shows the Max patch that generates the 3D terrain.

Figure 6.3: A 3D model of terrain behind a 3D model of a cello and cellist

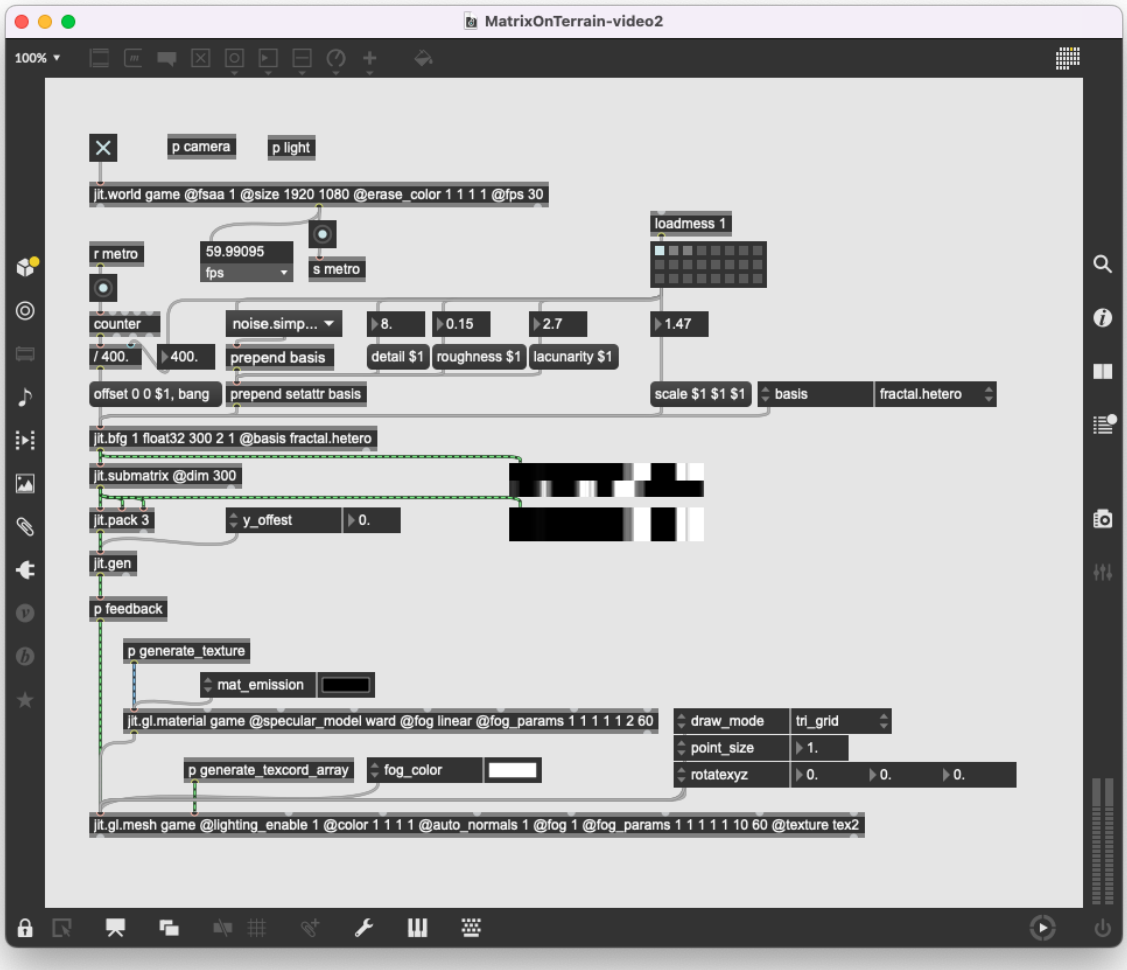


Figure 6.4: The Max patch that generates the 3D terrain

6.2.4 Recorded cellists

Conceptually, the video recorded cellists were intended to highlight the blurred boundary between real and simulated performances. To support this idea, video recordings of cellists are sometimes treated as copies of the real cellists but sometimes treated as simulacra who

do not have referential cellists in the real world. In practice, the copies of the real cellists were expressed by the perfect synchronicity of body movements between the real cellists and recorded cellists while the simulacra cellists are expressed by the asynchrony between them. Throughout section II, the state of synchronicity gradually changes from perfect synchrony to complete asynchrony, expressing a gradual process that traverses from the birth of an alter ego to an entity independent from the original referential cellists. In section III, these independent entities accumulate up to five entities to express the overflow of simulacra. The recorded cellists appear in the video part during section II and III.

Figure 6.5: Recorded cellists

6.2.5 A 3D model of a flower

Conceptually, a 3D model of a flower was used to symbolize a simulated world that is nonexistent in the real world. In the piece, the model is dissolved into particles, thereby expressing the fragility of the simulated existence of objects and avatars. The dissolving 3D model of the flower appears in section IV.

The model I used for this flower is named "Red Rose"[3] and it was also downloaded from the Sketchfab website.[4] To achieve the effect of dissolving, I decoded the geometry data of the 3D model into mesh data, then transitioned the position of its vertices using Jitter. This approach enabled me to create a scene where the 3D model of the flower is gradually deconstructed into small particles.

6.3 Summary

In this chapter, I introduced the form, materials and methods to construct these materials in the video part. The materials are a recorded cello's body, 3D models of a cello, a 3D model of terrain, recorded cellists and a 3D model of a flower and were created using Jitter functionalities in the Max programming environment.

3. "Red rose" by Lassi Kaukonen is licensed under Creative Commons Attribution.
4. "Sketchfab."

Figure 6.6: A 3D model of a flower

Chapter 7

Performance system

This chapter introduces the system for the electronic and video part that consists of three elements: input devices, a computer and output devices. The input devices represent microphones. The computer plays a role to play back prerecorded sound/video files. The output devices are categorized into two different types of sound emitters: a surround loudspeaker array and actuators attached to the cellos' bodies. In addition, the use of a click track is mentioned as the essential method for synchronization between performers, the audio tracks and the video file.

7.1 Input devices

The six microphones amplify the instrumental sounds. Five microphones focus on the cellos in the sitting position. One microphone is used to capture the sound from the first cello while

it is laid down from the beginning of the piece until the rehearsal mark E. Audio signals from these microphones are sent to a computer via an audio interface.

7.2 Computer

The computer plays back prerecorded sound files in synchronization with the performance by the players. The Max programming environment was used for this purpose.

7.2.1 Max programming environment

Max is a node-based programming environment specialized for real-time audiovisual processing and prerecorded file playback. This environment is well suited for implementing a computer program for performances of the piece.[1] Programs created in Max are called *patches*. A patch allows users to implement custom-designed functionalities. In my case, I implemented a functionality to play back prerecorded sound files and a decoder to spatialize audio signals to the multichannel speaker array. My patch consists of three elements: a graphical user interface (GUI), a data translator and a prerecorded file playback system.

1. https://cycling74.com/products/max

7.2.2 GUI

A GUI (figure 7.1) was implemented to enhance the operability of the patch during the performance and rehearsals.

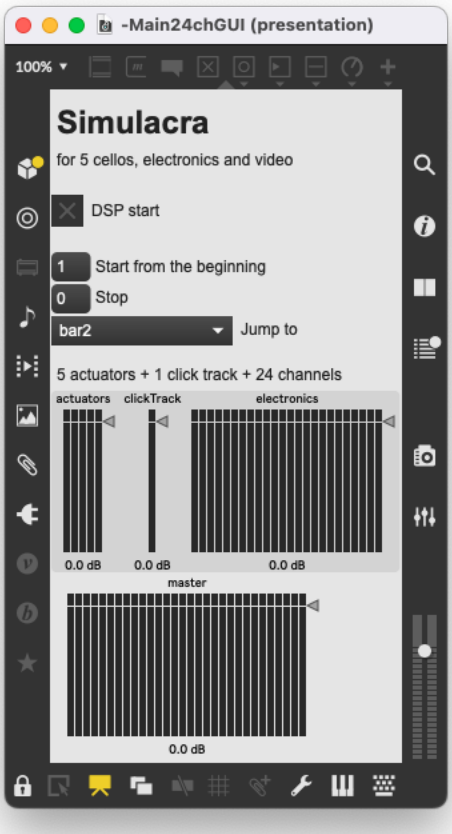


Figure 7.1: The GUI on Max

The GUI provides a number of parameters that allow the operator of the computer to adjust the setting in real time. These parameters are categorized into three functions: DSP switch; Playback system operators; and audio volume faders. The DSP switch allows the

user to turn on and off the Digital Signal Processing (DSP). The playback system interface objects are used to start and stop the prerecorded files. A pull-down menu next to the "jump to" text on the GUI allows the user to instantaneously jump to a specific rehearsal mark. The audio volume faders are for adjusting the audio volume of every sound source. These parameters enable a user to operate the electronics and video even if they are not accustomed to the Max programming environment.

7.2.3 Prerecorded file playback system

A prerecorded file playback system was created in order to play back the prerecorded sound files and video files. The playback system requires the users to install the following two dependencies: the Spat 5 package[2] and the Ambisonics package.[3]

The Spat 5 package is a set of Max external objects distributed by the Institute for Research and Coordination in Acoustics/Music (IRCAM). A Max object called spat5.sfplay~ from the Spat package was used for the playback of sound files. This external object allows playing back a sound file that is larger than 2 GB that were not supported until the most recent version of the Max environment. Additionally, the spat5.sfplay~ provides the users with the functionality to jump to a specified marker point embedded in the imported sound file. This was convenient when I implement the function to jump to a specific rehearsal

2. "SPAT," Institute for Research and Coordination in Acoustics/Music (IRCAM), accessed April 9, 2023, https://forum.ircam.fr/projects/detail/spat/.

3. "Ambisonics Externals for MaxMSP," Institute for Computer Music and Sound Technology (ICST), accessed April 9, 2023, https://ambisonics.ch/page/ambisonics-externals-for-maxmsp.

mark. For these two reasons, I used the spat5.sfplay~ object as the core of the audio file playback system.

The Ambisonics package is a library of Max external objects distributed by the Institute for Computer Music and Sound Technology (ICST). An mc.ambidecode~ from the Ambisonics package object was used to decode a prerecorded file for the electronics from the 7th-order ambiX format to the standard audio signals in real time. This method enables me to decode the electronics to various speaker configurations in addition to the 24-channel surround loudspeaker array explained in 5.3.

7.2.4 Data translator

Data translators are intermediate programs that transfer commands from the GUI to the prerecorded file playback system. The information from the GUI is not always readable by the object that executes certain functionalities in the program. The controllers translate the information from the GUI to messages that the objects can interpret. The data translators thus play a role to mediate between the GUI and the object executing the desired commands.

7.3 Output devices

The output devices are classified into two different types of sound emitters: a surround loudspeaker array and actuators attached to the cellos' bodies.

7.3.1 Surround loudspeaker array

A 24-channel surround loudspeaker array is required to render the electronic part. A large number of loudspeakers such as this array enables me to render the movement of sounds both horizontally and vertically at high resolution in space. Refer to section 5.3 for further discussion.

7.3.2 Actuators

Actuators were used to enable the body of the cello to resonate without the aid of the performer. An actuator is a round shaped device that converts a source of energy such as an electronic signal to vibrations that may be audible to the listeners. For the performance of *Simulacra*, an actuator was attached to the body of each cello in order to have the cello resonated by the actuators for which the audio signal was streamed from the computer. In this way, the bodies of the cellos function in a similar way to the driver of a loudspeaker.

Conceptually, the actuators enable a generation of sounds without performing actions by performers. Thus, it is a suitable method for expressing the absence of the performer. The actuators play the sounds from material that was prerecorded before the performance. This approach creates a situation where the source of the sounds emitted by the actuators is not visible to the audience as there is no performing action required. Therefore, this approach contributes to destroying the causal link between performing actions and performed sounds, which is a key strategy to express the absence of the performer.

7.4 Synchronization

A click track was used for synchronization between performers, the audio tracks and the video file. The click track facilitates communications between performers and between performers and electronics. Since the performers are aligned linearly, they were not able to maintain eye contact for sending visual cues to each other. This is a problem in section III where all the performers play together as an ensemble. Communication between performers and electronics was another problem that needed to be solved. The electronic and video parts comprise a playback of sound and video files that are not capable of adjusting their tempo to the malleable tempo of human performers. Thus, rather than trying to make the playback speed of the prerecorded files malleable, I decided to have the performers synchronize with the electronic and video part with the click track.

The click track consists of a ticking sound on every beat and my voice uttering the rehearsal marks. These two pieces of information enable the performers to orient themselves in the piece. My voice uttering the rehearsal marks is useful particularly if the performers were to get lost during a performance. By hearing every rehearsal mark, they are able to get back to synchronizing with other performers, the audio and video files.

7.4.1 The role of the operator

The parameters on the GUI mentioned in 7.2.2 allow the operator to start the piece not only from the beginning but also from every rehearsal mark. It is particularly important to be able

to jump to specific rehearsal marks instantaneously to pursue rehearsals smoothly without making the performers wait for the computer operator. To achieve a smooth rehearsal, a "jump to" function was implemented. This function allows starting the audio and video parts from a specified rehearsal mark so that, during the rehearsals, we were able to practice specific sections efficiently.

7.5 Summary

In this chapter, I introduced the design of the performance system for the electronic and video part. The system consists of three elements: input devices, a computer and output devices. The input devices represent microphones. The computer plays a role to play back prerecorded sound/video files. The output devices are categorized into two different types of sound emitters: a surround loudspeaker array and actuators attached to the cellos' bodies.

The fact that the cellists are aligned linearly on stage imposed an extra challenge to have the performance synchronized by the cellists: the cellists are unable to send visual cues to each other. This problem was solved by using a click track. Additionally, the click track contributed to synchronization not only between performers but between all performing agents as in performers, the audio tracks and the video file.

Chapter 8

Conclusion

My piece aims to express the concept of simulacra by showing a blurred boundary between real and simulated worlds. The physical performers represent the real world while the electronics and video projection symbolize the simulated one. To generate the simulated world, the idea of the metaphorical absence of the performers with the audiovisual projection was explored extensively.

One remaining question would be the effectiveness of the approaches used. First, to create a situation where the performers' physical bodies are hidden from the audience while the audiovisual contents are projected, I requested the musicians to move between on and off stage. This was somewhat problematic because the musicians needed to let the end pin of the cello in and out every time they go back and forth between on and off stage. This process requires an extended amount of time that prevents the swift movement of the performers.

To avoid this problem, I would now recommend that creators turn spotlights on and off to hide the instrumentalists rather than requesting them to move. This alternative approach would solve the problem of requiring an extended amount of time to hide the musicians.

Second, to express the transition from a found object to an authentic cello in section I, I requested the 1st cellist to tune the strings up during performance. This caused a practical issue in achieving the ordinary tuning of the cello within an amount of time given by the fixed prerecorded tracks and a click track. Although I dealt with this issue by putting one minute of rest during which the cellist must precisely fine-tune the strings right before the rehearsal mark K in section I, it was not certain whether the performer would be able to finish the process of fine-tuning within this amount of time since the tuning process is never straightforward. If one string is tuned up, other strings may potentially lose their tension in reaction. For this reason, in the future I would recommend that composers write the piece in such a way that the sections following the tuning-up process may be played by arbitrarily detuned strings, or simply avoid this technique.

In future work, I envision continuing to apply the concept of mixed reality performance to my composition. Mixed reality performances are "hybrid forms that combine the real and virtual in multiple ways"[1] and, in the context of my piece, juxtapose and/or superimpose the physical performers and computer-generated imagery on stage, thereby illuminating the ambiguity of the borderline between real and simulated performances. Although mixed

1. Benford Steve and Giannachi Gabriella, *Performing Mixed Reality* (Cambridge, MA & London, England: MIT Press, 2011), p.4.

reality performance has been used for works in the field of multimedia performing arts such as *Can you Hear Me Now?* by the Blast Theory artist collective[2] and *Silicium 01* by C.E.Carlsen,[3] its expressive potential has been relatively unexplored in the realm of contemporary music composition. I would like to cultivate this underdeveloped territory by incorporating mixed reality techniques in my future compositions.

The Simulacra project was initiated as a reflection of my sense that performers' body presence might be disappearing from the stage as live concerts have become simulations—recreations of recorded performances that never took place in reality. This thought led me to the piece *Simulacra*, that proposes the blurred boundary between the real and simulated performance as an alternative authenticity of the modern concert. To articulate the blurred boundary, I took the strategy of engendering performers' absence during the performance. This strategy suggested me practical approaches such as the use of audiovisual projection without performers' physical bodies and dissociation of the causal link between performing actions and performed sounds. Those approaches required technical challenges such as the use of extreme scordatura, a 24-channel loudspeaker array, actuators, visual projection, computer graphics and the integration of all those elements into a unified form of multimedia performance. It is my hope that these challenges successfully engendered the absence of the performers on stage to highlight the blurred boundary between the real and simulated performance. My goal is for this piece to draw the audience's attention to the question of

2. Steve and Gabriella, *Performing Mixed Reality*, p.27-34.
3. Carl Emil Carlsen, "Carl Emil Carlsen," accessed April 9, 2023, https://cec.dk/works/silicium-01/.

what is it that engenders the sense of authenticity in live concerts in the post-pandemic age.

Bibliography

"Ambisonics Externals for MaxMSP." Institute for Computer Music and Sound Technology (ICST). Accessed April 9, 2023. https://ambisonics.ch/page/ambisonics-externals-for-maxmsp.

Auslander, Philip. *Liveness: Performance in a Mediatized Culture*. London, England: Routledge, 2008.

Baudrillard, Jean. *Simulacra and Simulation*. Ann Arbor, MI, USA: University of Michigan Press, 1994.

Carlsen, Carl Emil. "Carl Emil Carlsen." Accessed April 9, 2023. https://cec.dk/works/silicium-01/.

Croft, John. "Theses on liveness." *Organised Sound* 12, no. 1 (2007): 59–66. https://doi.org/10.1017/S1355771807001604.

Gould, Glenn. "The Prospects of Recording." In *The Glenn Gould Reader*, edited by Tim Page, 331–357. New York, NY: Vintage Books, 1990.

Heile, Björn. *The Music of Mauricio Kagel*. London, England & New York, NY: Routledge, 1996.

Katz, Mark. *Capturing Sound*. London, England: University of California Press, 2010.

Schaeffer, Pierre. *Treatise on Musical Objects: An Essay across Disciplines*. University of California Press, 2017. ISBN: 9780520967465. https://doi.org/doi:10.1525/9780520967465.

"Sketchfab." Sketchfab, Inc. Accessed April 9, 2023. https://sketchfab.com/.

Smalley, Denis. "Spectromorphology: explaining sound-shapes." *Organised Sound* 2, no. 2 (1997): 107–126. https://doi.org/10.1017/S1355771897009059.

"SPAT." Institute for Research and Coordination in Acoustics/Music (IRCAM). Accessed April 9, 2023. https://forum.ircam.fr/projects/detail/spat/.

Steve, Benford, and Giannachi Gabriella. *Performing Mixed Reality*. Cambridge, MA & London, England: MIT Press, 2011.

Théberge, Paul. *Any Sound You Can Imagine : Making Music/Consuming Technology*. Hanover, NH: Wesleyan University Press, 1997.

———. "The 'Sound' of Music: Technological Rationalization and the Production of Popular Music." *New Frontiers* 8 (Summer 1989): 99–111.

Wurtzler, Steve. ""She Sang Live, But The Microphone Was Turned Off:" The Live, the recorded and the Subject of Representation." In *Sound theory/sound practice*, edited by Rick Altman, 87–103. New York, NY: Routledge, 1992.

Appendix A

Score

Simulacra

for 5 cellos, electronics and video

Takuto Fukuda

Acknowledgement

I am grateful to the following five cellists, Audréanne Filion, Viviane Gosselin, Juliette Leclerc, Amelia Smerz and Crystal Kim for the world premiere of the piece; and the cellist, Esther Saladin for the European premiere. Finally, I would like to thank the ZKM production support team members, Boris Neubert, Bernd Lintermann, Götz Dipper, Dominik Kautz and all other staff members for their generous commitment to creating the composition.

Program note

Simulacra was composed for five cellos, electronics and video in 2021 and 2022. The piece describes the blurred boundaries between a real and a virtual performance in the context of audiovisual performance and raises the socio-cultural question: What is it that creates the feeling of an "authentic" concert experience in the age of simulation? Today's pop music concerts focus on simulating the mediated image of the singers rather than conveying their musicianship. This calls into question the role of the performers–is their presence an embodiment of the performers' intention or an incarnation of a simulation? Through the superimposition of and the interplay between the physically existent performing body and the volumetrically generated audiovisual projections, this piece aims to highlight the augmentation of gesture-sound coupling in performing actions as a new authenticity in concert performance today.

Paper size

The score is laid out for the US letter size paper (216*279mm).

Instrumentation

- 5 cellos
- 1 computer (Cycling'74 Max installed)

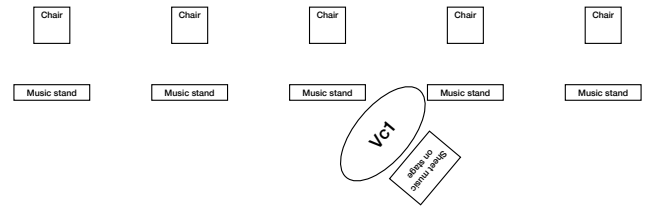
General information about the sore

Tablature, transposed score and score in C are used as written in the score and parts.

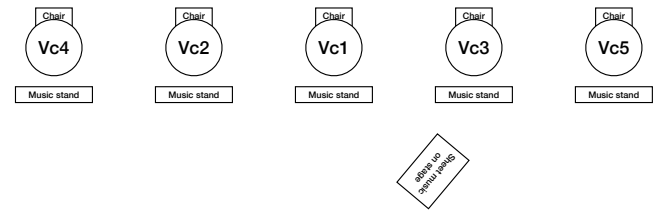
Positions on stage

As noted in the score and parts, the cellists move between on- and offstage during a performance. In addition, the position of the 1st cello changes from Position 1 to 2. In Position 1, a chair and a music stand are placed at the center of the stage, and a cello is laid down on the right from the music stands from the audience's perspective. Position 2 is the normal positioning where the cellist sits down on the chair placed in the middle of the stage.

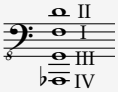
Position 1



Position 2



Notation note

Symbols	Explanations
Accidentals	Accidentals are applied until the end of the bar.
	Scordatura stands for a turning that is unconventional to the normal tuning. At the beginning of this piece, the 1st, 3rd and 4th strings of the 1st cello are detuned as shows on the left.
	The symbol of a cello is used to specify a point of contacts between the cello and the playing body such as a finger, finger tip and bow.
x	The x notehead represents a tap with a finger tip.
	Blow to the F-hole
	Inhale
	Approximate pitch
	Hit the surface of the body of the cello
	Swing the bow down or up to produce wind noise
n.v	Non-vibrato
m.v	Molto vibrato

Technical rider

General information about electronics

The electronic parts are prerecorded. No real-time signal processing involved. Amplification required.

Technical requirements

Required equipment

- 1 computer
- 1 hemispheric loudspeaker dome (speaker number variable up to 64ch)
- 6 condenser microphones
- 5 earbuds
- 5 wireless transmitters
- 5 music stands
- 1 mixing console
- 1 audio interface (e.g., RME Madiface)
- 1 MIDI fader

Required software

- 1 audio interface driver
- 1 Cycling'74 Max software version 8 or above
  - Dependencies
    - IRCAM Spat 5 package (download from https://forum.ircam.fr/projects/detail/spat/)
    - ICST Ambisonics 3 package (install through the Max package manager)
- 1 set of Max patches
  To obtain the set, please contact the composer from the following email addresses;
  takujin3@yahoo.co.jp or fukudentakujin@hotmail.com

Microphone setup

6 microphones are used for amplification. 5 microphones out of the 6 condenser microphones should be set to focus on the area among the tailpiece, F-hole and the right edge of every cello. Capture a clearly manifested level of sound such as the sounds played by ordinario, col legno batutto and hitting the body of the cellos.

The remaining 1 microphone should be placed in the vicinity of the cello while the cello is laid down at Position 1. This microphone should be set to focus on the area among the tailpiece, F-hole and either edge of the body of the cello, and should be placed not too far, but not too close to the cello in order, on the one hand, to give the cellist enough space to approach to the cello's surface and strings with his/her arm and hands, and, on the other hand, to avoid feedback between the microphone and the loudspeakers. Try to find a microphone position that can compromise the dilemma.

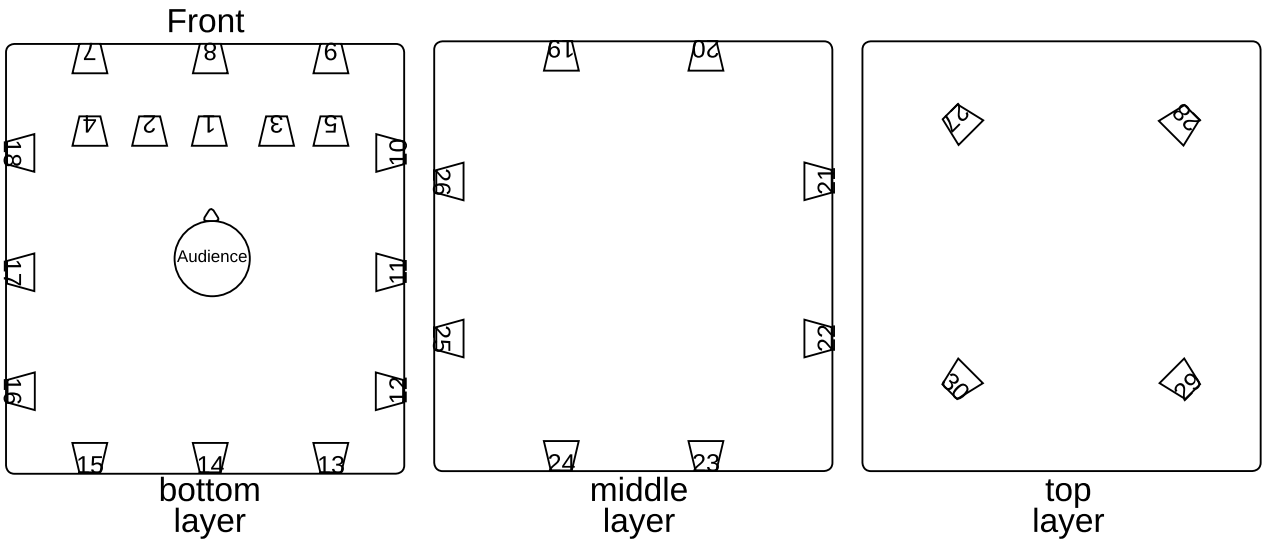
Microphone placements

Input device	Placement
Microphone 1	Placed focusing on the cello 1 in the Position 1

Input device	Placement
Microphone 2	Placed focusing on the cello 1 in the Position 2
Microphone 3	Placed focusing on the cello 2
Microphone 4	Placed focusing on the cello 3
Microphone 5	Placed focusing on the cello 4
Microphone 6	Placed focusing on the cello 5

Actuators and loudspeakers placements

The number in the trapezoids represents the output channel from the Max patch. The 1st to 5th trapezoids stand for actuators. Other trapezoids represent loudspeakers.



Input signal paths

Input device	Output device	Panning
Microphone 1	Front stereo speakers	Front centre
Microphone 2	Front stereo speakers	Front centre
Microphone 3	Front stereo speakers	Between the front centre and front left
Microphone 4	Front stereo speakers	Between the front centre and front right
Microphone 5	Front stereo speakers	Most left
Microphone 6	Front stereo speakers	Most right

Output signal paths from the Max patch

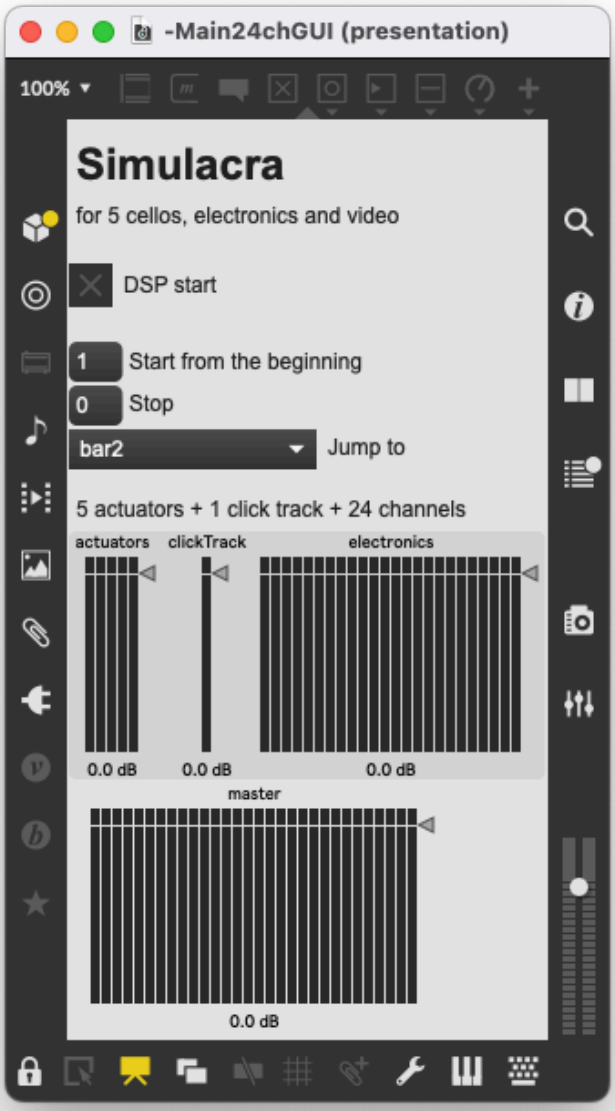
Output channel	
1	Actuator 1
2	Actuator 2
3	Actuator 3
4	Actuator 4
5	Actuator 5
6	Ear buds 1, 2, 3, 4, 5

Output channel	Type	Speaker index	X	Y	Z
7	xyz	1	-0.375	0.5	0
8	xyz	2	0	0.5	0
9	xyz	3	0.375	0.5	0
10	xyz	4	0.5	0.375	0
11	xyz	5	0.5	0	0
12	xyz	6	0.5	-0.375	0
13	xyz	7	0.375	-0.5	0
14	xyz	8	0	-0.5	0
15	xyz	9	-0.375	-0.5	0
16	xyz	10	-0.5	0.375	0
17	xyz	11	-0.5	0	0
18	xyz	12	-0.5	0.375	0
19	xyz	13	-0.25	0.5	0.25
20	xyz	14	0.25	0.5	0.25
21	xyz	15	0.5	0.25	0.25
22	xyz	16	0.5	-0.25	0.25
23	xyz	17	0.25	-0.5	0.25
24	xyz	18	-0.25	-0.5	0.25
25	xyz	19	-0.5	0.25	0.25

Output channel	Type	Speaker index	X	Y	Z
26	xyz	20	-0.5	0.25	0.25
27	xyz	21	-0.25	0.35	0.5
28	xyz	22	0.25	0.35	0.5
29	xyz	23	0.25	0.35	0.5
30	xyz	24	-0.25	-0.35	0.5

Setup of Max patches

1. Open ~/Simulacra/Max/Simulacra4Performance/-Simulacra.maxpat
2. A Max patch named -Main24chGUI and an Audio status window will open
3. Look at the Audio status window to choose your;
    1. audio driver;
    2. input device;
    3. output devise.
4. Look at the -Main24chGUI
    1. Turn the "DSP start" on
    2. Set the "master" volume
    3. You are ready to perform
5. Press "1" to start the piece from the beginning



Tips

When you want to jump to a specific practice number during a rehearsal, click the menu box next to "Jump to", then choose the practice number you want to jump to. Be aware that the sound file will start immediately after choosing the practice number.

Lighting

Three setups are required as follows;
①: Dark

②: Spotlight on the 1st cello in position I & II

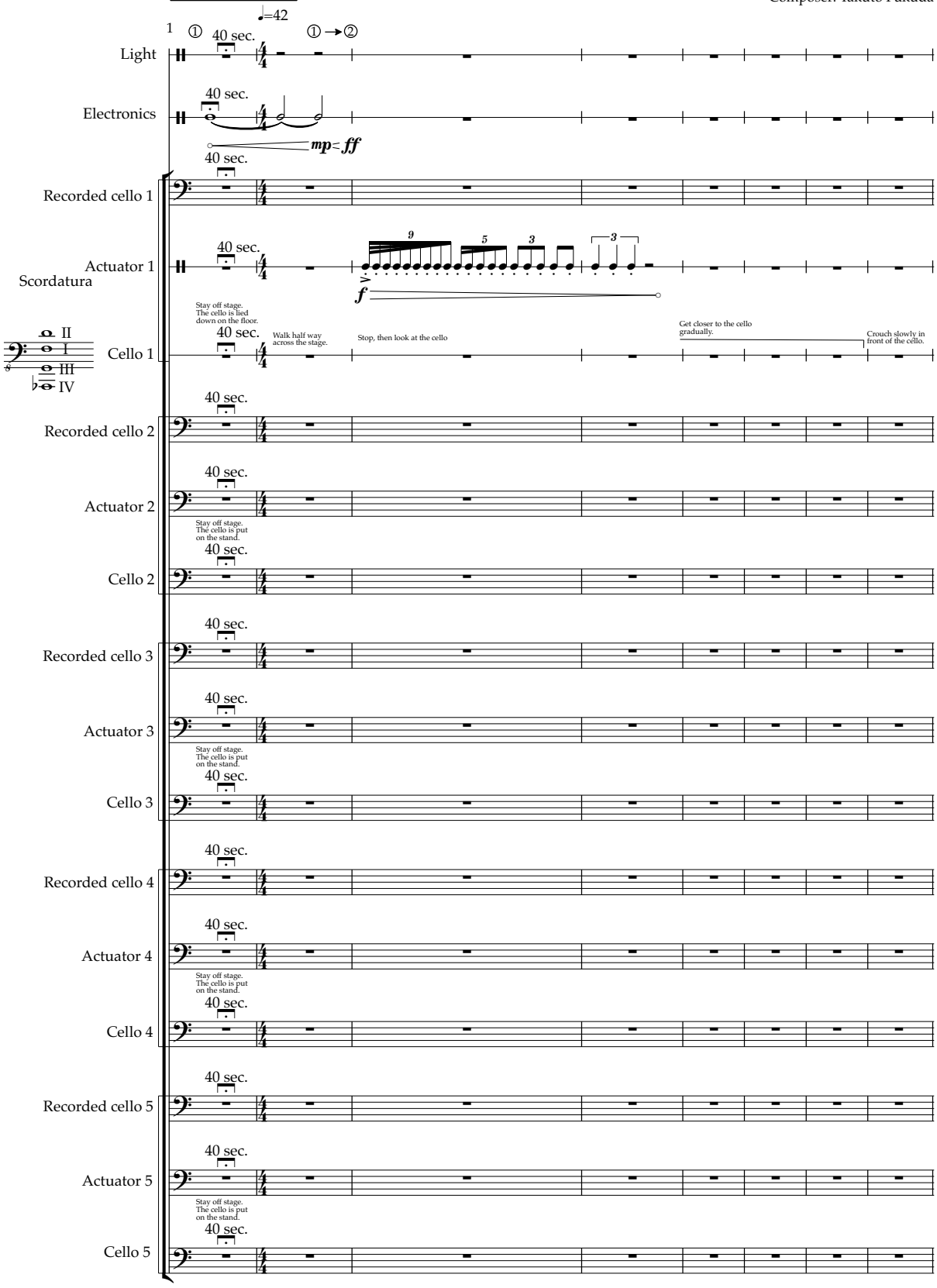
③: Spotlights on all the cellos in position II

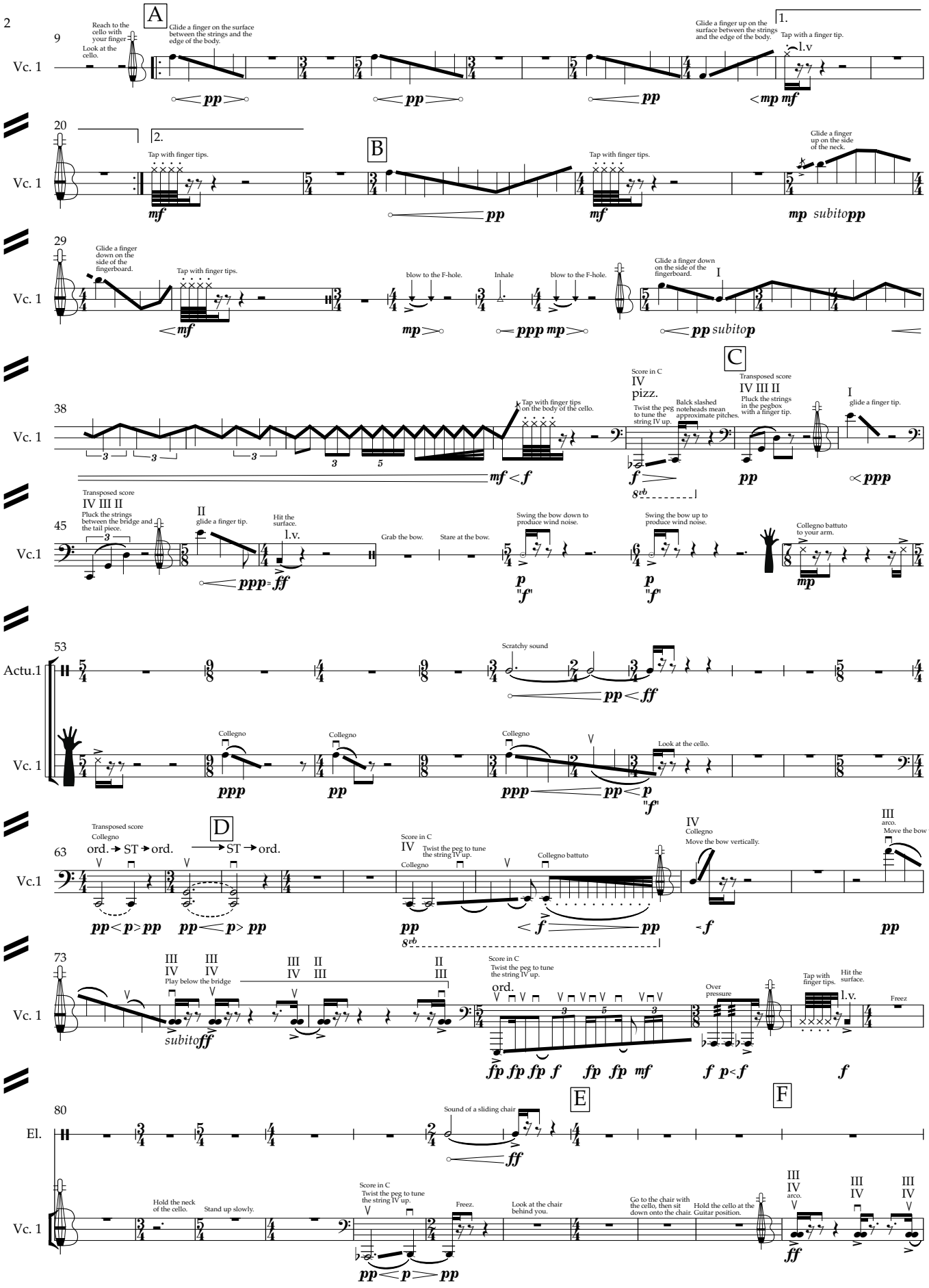
Simulacra

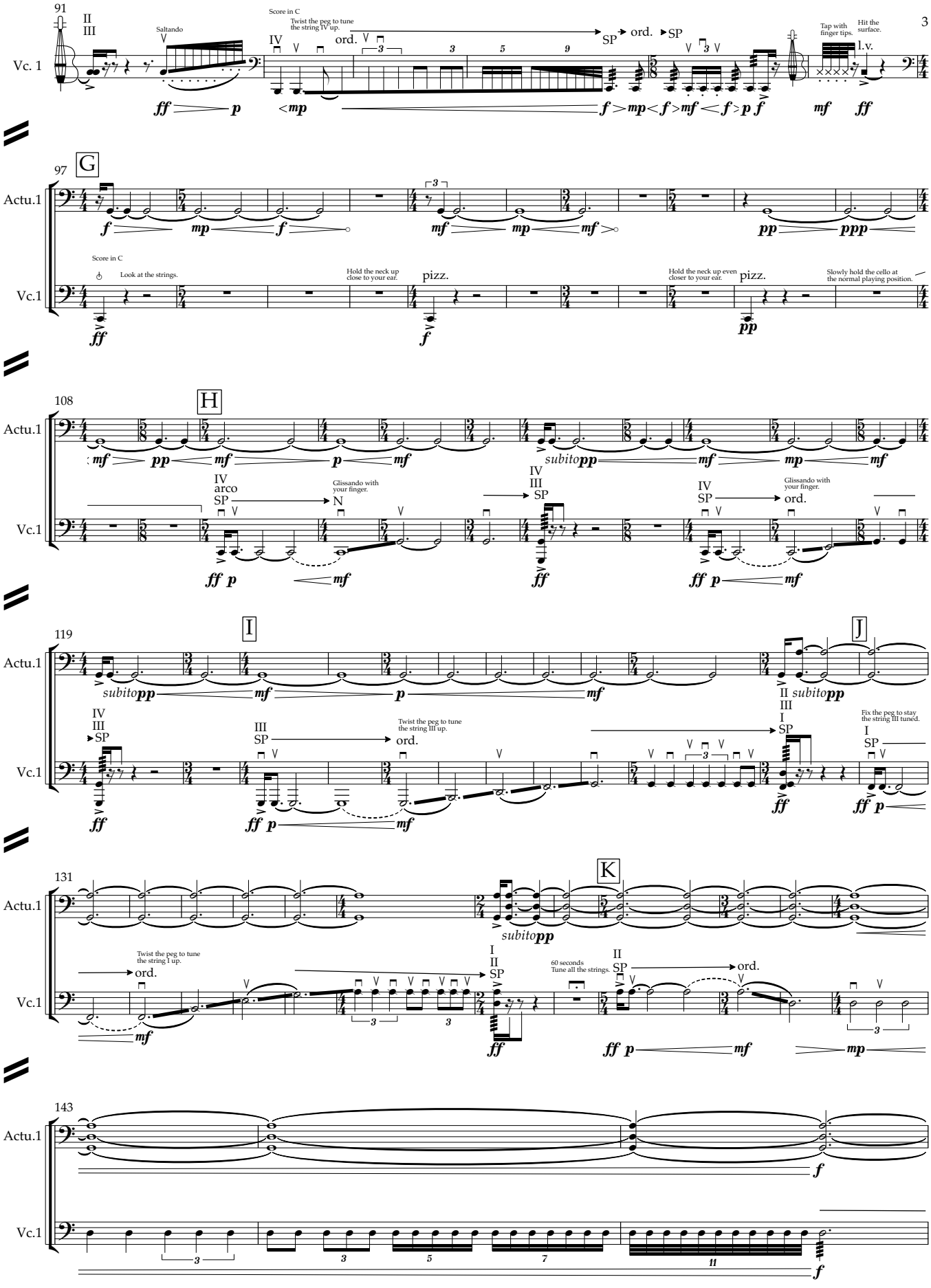
for five cellists and audiovisual electronics

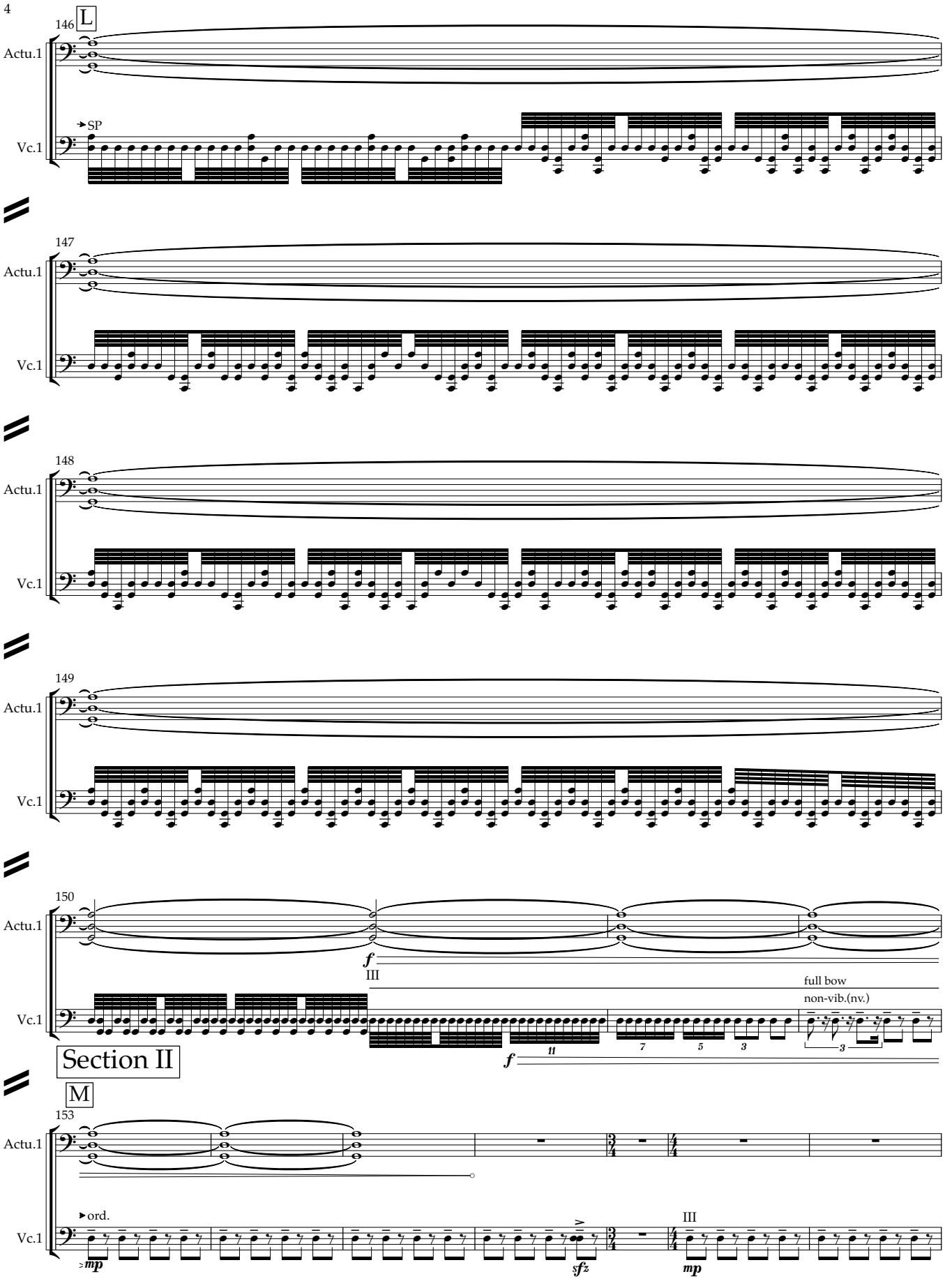
Section I

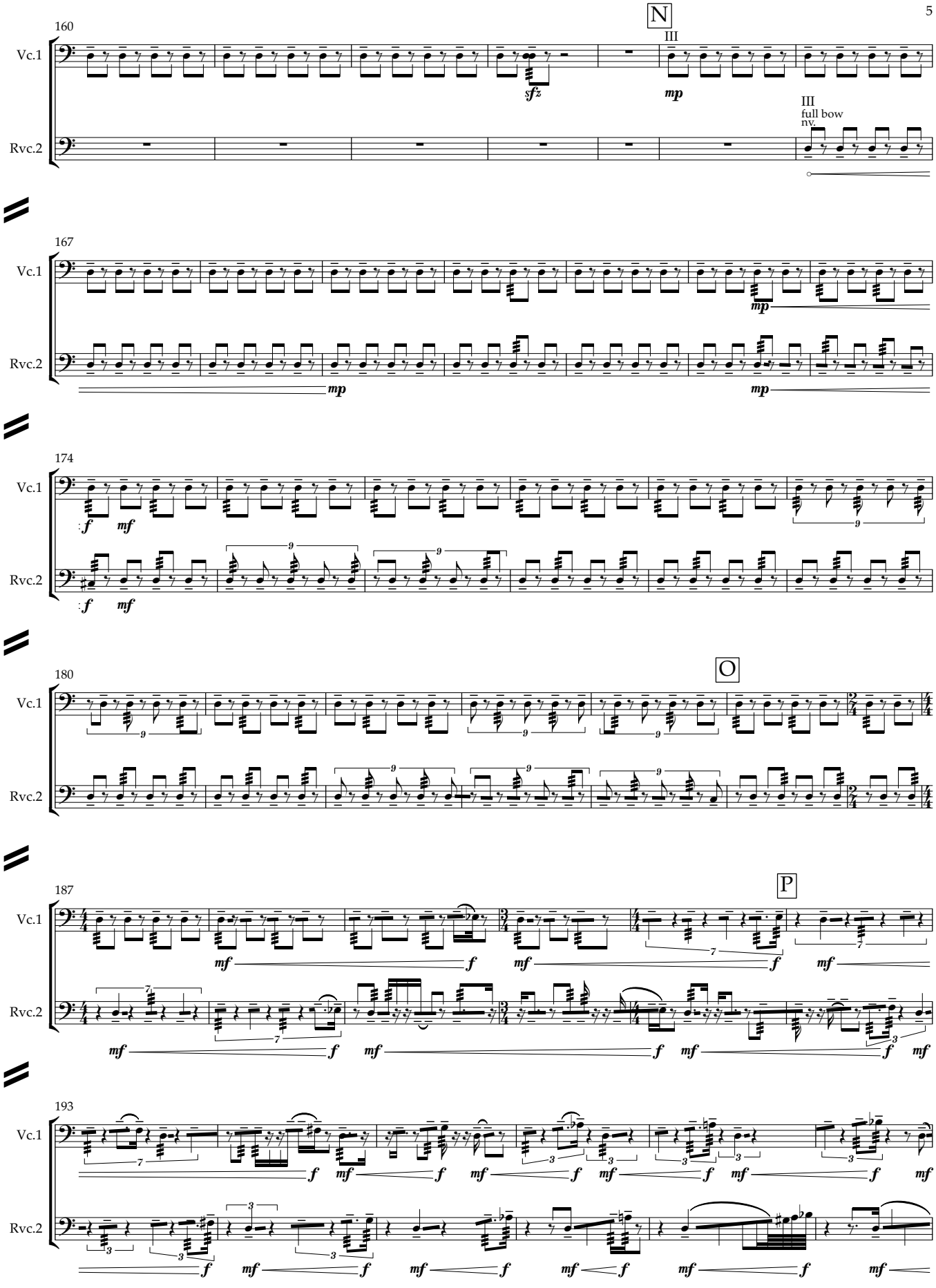
Composer: Takuto Fukuda

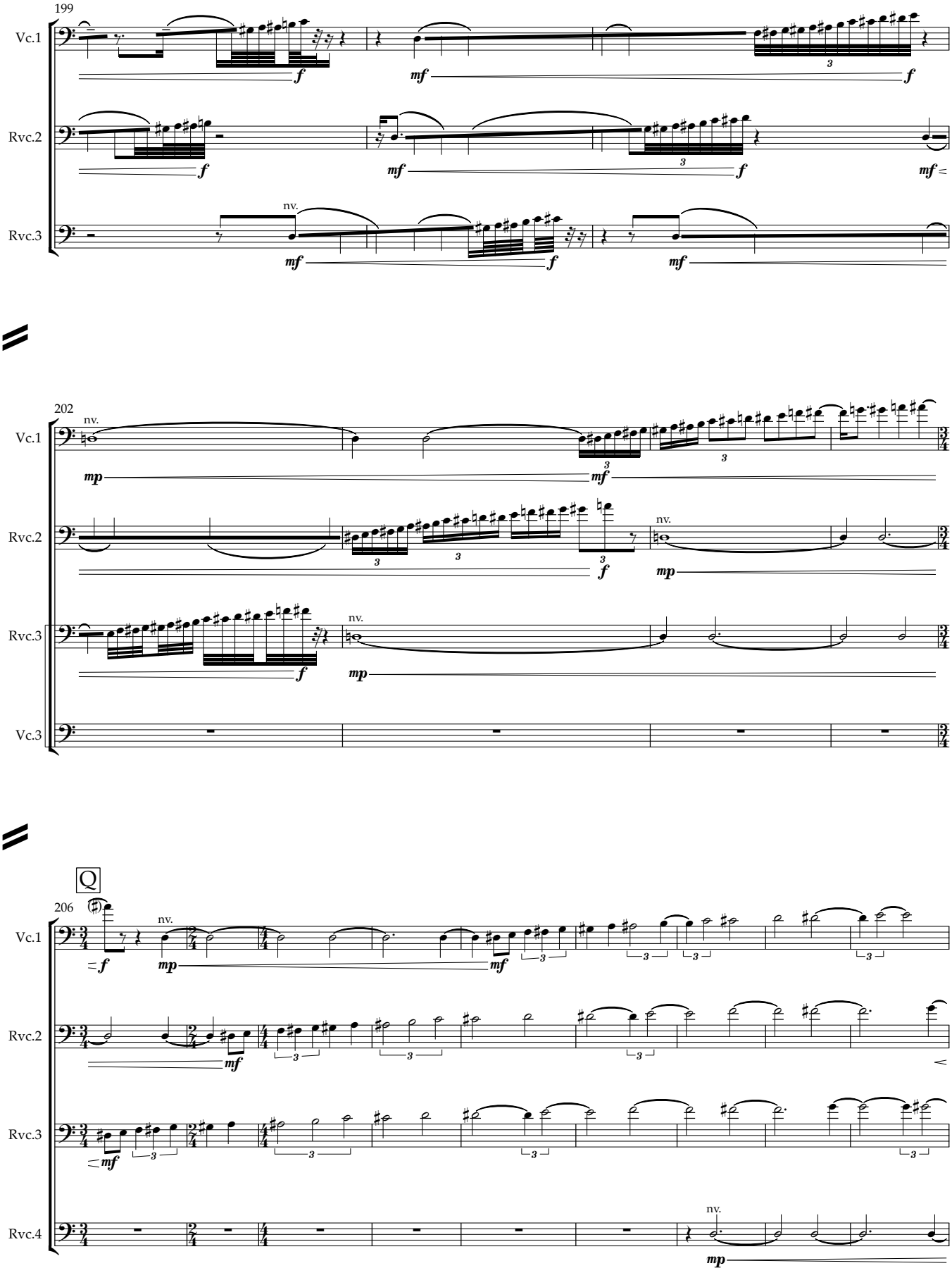


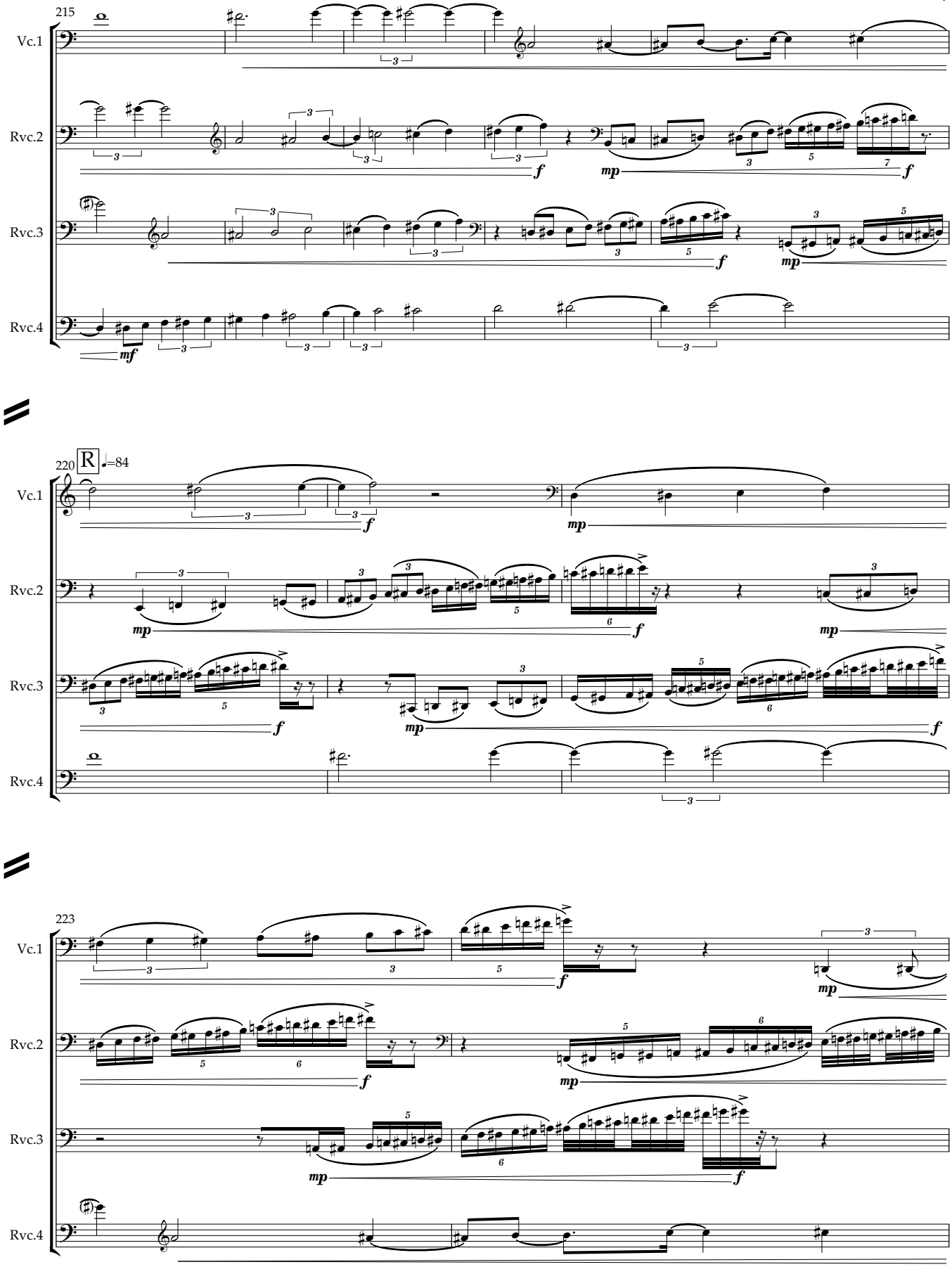

9
Vc. 1
A
Reach to the cello with your finger
Look at the cello.
Glide a finger on the surface between the strings and the edge of the body.
1.
Glide a finger up on the surface between the strings and the edge of the body.
Tap with a finger tip.
l.v
pp
pp
pp
mp mf
20
2.
B
Tap with finger tips.
Tap with finger tips.
Glide a finger up on the side of the neck.
mf
pp
mf
mp subitopp
29
Glide a finger down on the side of the fingerboard.
Tap with finger tips.
blow to the F-hole.
Inhale
blow to the F-hole.
Glide a finger down on the side of the fingerboard.
I
mf
mp
ppp mp
pp subitop
38
C
Score in C
IV
pizz.
Transposed score
IV III II
Tap with finger tips on the body of the cello.
Twist the peg to tune the string IV up.
Balck slashed noteheads mean approximate pitches.
Pluck the strings in the pegbox with a finger tip.
I
glide a finger tip.
mf < f
f
8vb
pp
ppp
45
Transposed score
IV III II
Pluck the strings between the bridge and the tail piece.
II
glide a finger tip.
Hit the surface.
l.v
Grab the bow.
Stare at the bow.
Swing the bow down to produce wind noise.
Swing the bow up to produce wind noise.
Collegno battuto to your arm.
ppp = ff
p
"f"
p
"f"
mp
53
Actu.1
Vc. 1
Scratchy sound
pp < ff
Collegno
Collegno
Collegno
Look at the cello.
ppp
pp
ppp
pp < p
"f"
63
D
Transposed score
Collegno
ord. → ST → ord.
ST → ord.
Score in C
IV
Twist the peg to tune the string IV up.
Collegno
Collegno battuto
IV
Collegno
Move the bow vertically.
III
arco.
Move the bow vertically.
pp < p > pp
pp < p > pp
pp
8vb
< f
pp
-f
pp
73
III IV
III IV
Play below the bridge
III IV
II III
II III
Score in C
Twist the peg to tune the string IV up.
ord.
Over pressure
Tap with finger tips.
Hit the surface.
l.v.
Freez
subitoff
fp fp fp f
fp fp mf
f p < f
f
80
El.
E
Sound of a sliding chair
F
ff
Vc. 1
Hold the neck of the cello.
Stand up slowly.
Score in C
Twist the peg to tune the string IV up.
Freez.
Look at the chair behind you.
Go to the chair with the cello, then sit down onto the chair.
Hold the cello at the Guitar position.
III IV
arco.
III IV
III IV
ff
pp < p > pp


91
Vc. 1
II
III
Saltando
Score in C
Twist the peg to tune the string IV up.
IV
ord.
SP
ord.
SP
Tap with finger tips.
Hit the surface.
l.v.
ff
p
<mp
f
>mp
<f
>mf
<f
>p
f
mf
ff
97
G
Actu.1
Vc.1
Score in C
Look at the strings.
Hold the neck up close to your ear.
pizz.
Hold the neck up even closer to your ear.
pizz.
Slowly hold the cello at the normal playing position.
108
H
Actu.1
Vc.1
IV
arco
SP
Glissando with your finger.
N
IV
III
SP
IV
SP
Glissando with your finger.
ord.
119
I
J
Actu.1
Vc.1
subito pp
II subito pp
IV
III
SP
III
SP
Twist the peg to tune the string III up.
ord.
I
SP
Fix the peg to stay the string III tuned.
131
K
Actu.1
Vc.1
subito pp
Twist the peg to tune the string I up.
ord.
I
II
SP
60 seconds
Tune all the strings.
II
SP
ord.
143
Actu.1
Vc.1


146
L
Actu.1
Vc.1
SP
147
Actu.1
Vc.1
148
Actu.1
Vc.1
149
Actu.1
Vc.1
150
Actu.1
f
III
Vc.1
full bow
non-vib.(nv.)
f
Section II
M
153
Actu.1
ord.
Vc.1
mp
sfz
III
mp


160
N
III
Vc.1
Rvc.2
sfz
mp
III
full bow
nv.
167
mp
174
f
mf
180
O
187
P
193


199
Vc.1
Rvc.2
Rvc.3
202
Vc.3
Rvc.4
Q
206
nv.
mp
mf
f


215
Vc.1
Rvc.2
Rvc.3
Rvc.4
220
R
♩=84
223

S

225

Vc.1

Rvc.2

Rvc.3

Rvc.4

Rvc.5

226

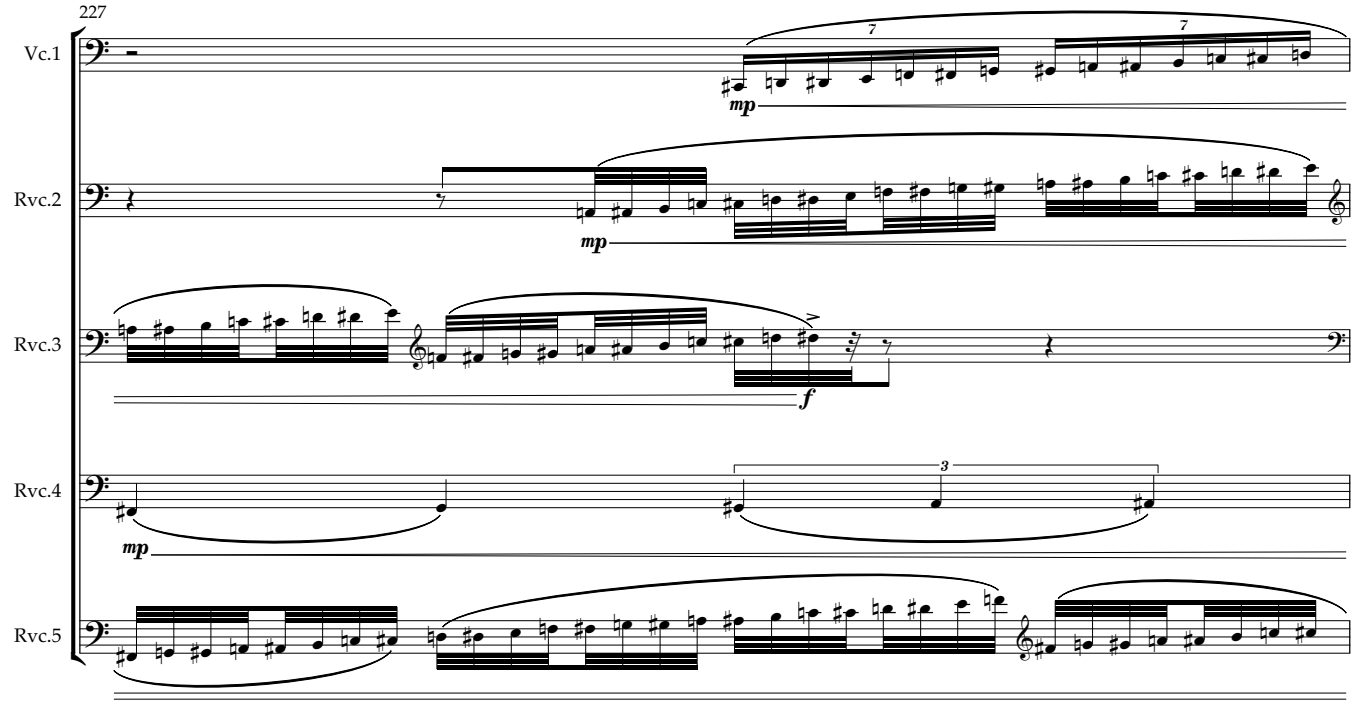
Vc.1

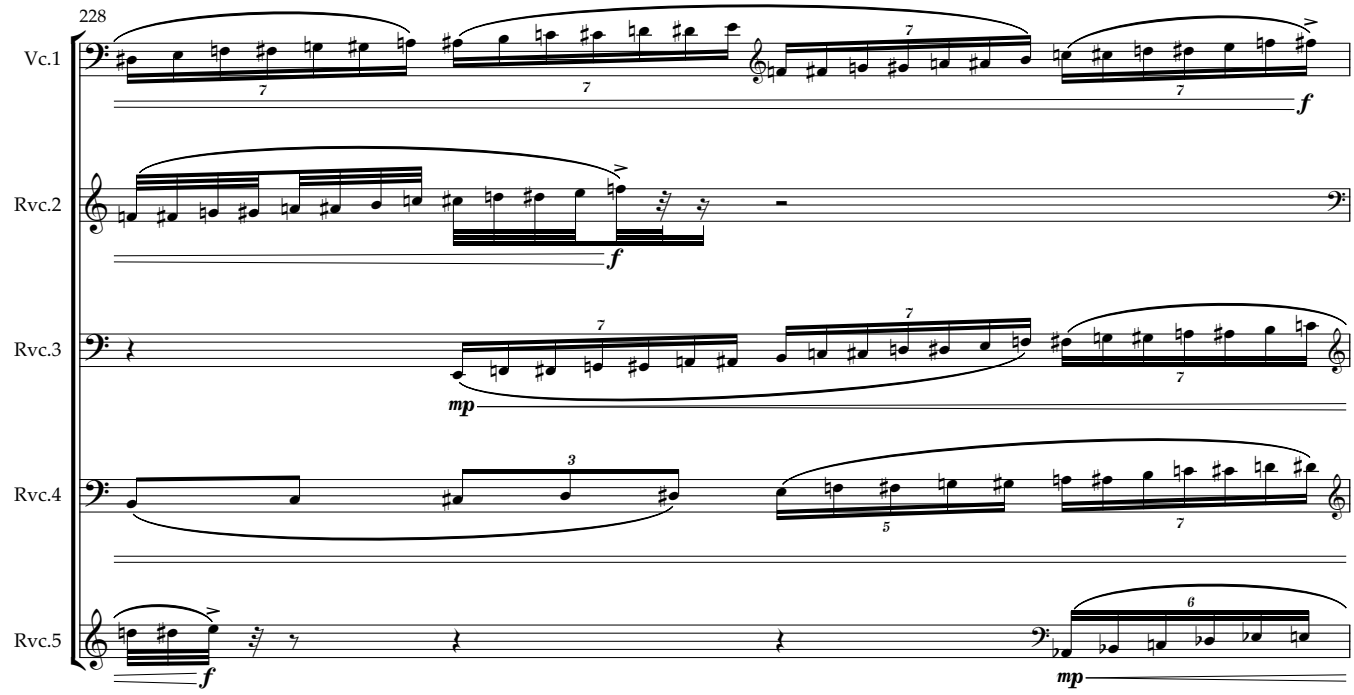
Rvc.2

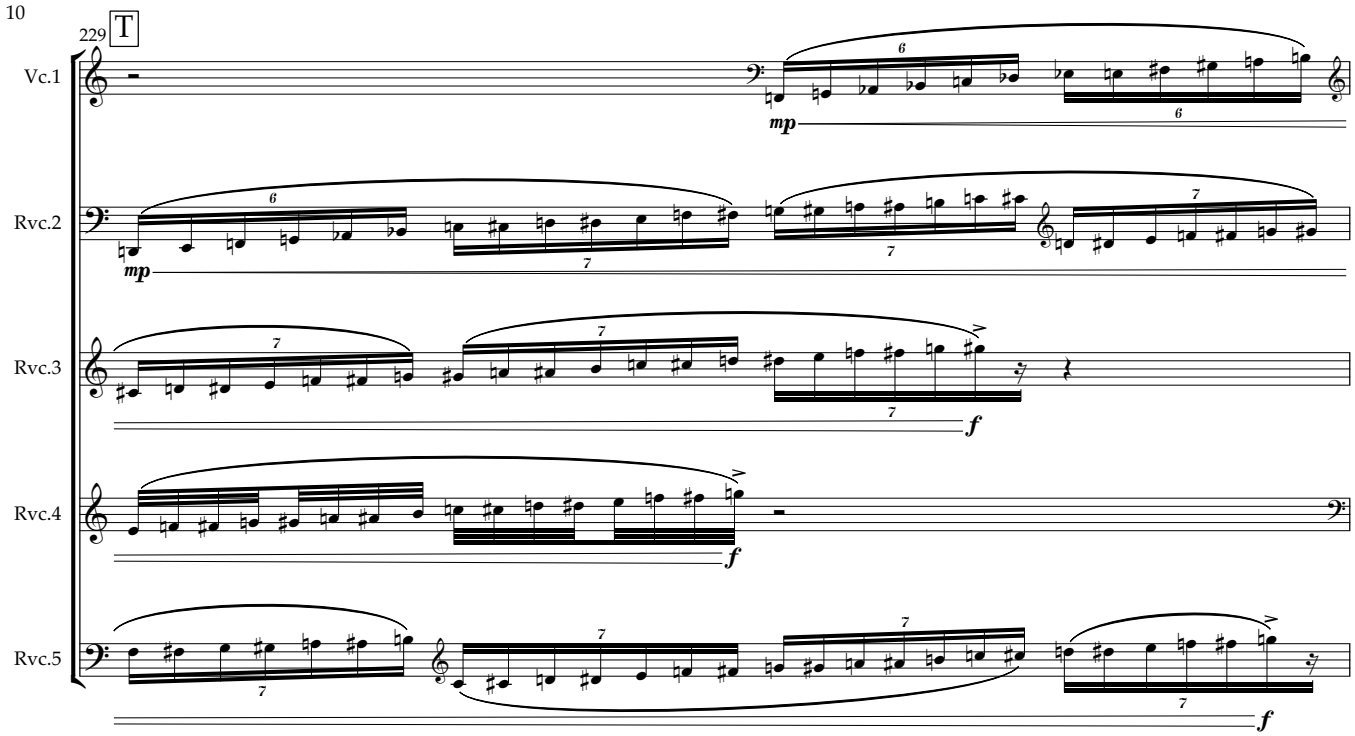
Rvc.3

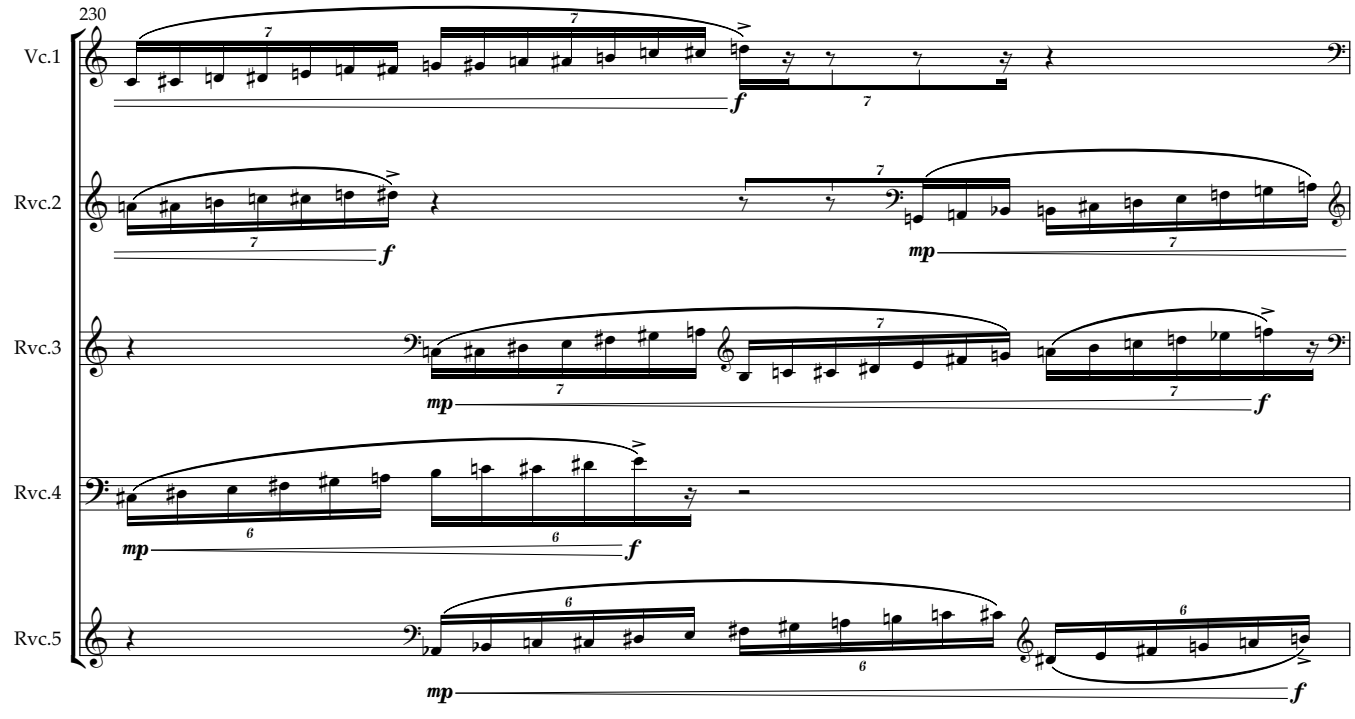
Rvc.4

Rvc.5

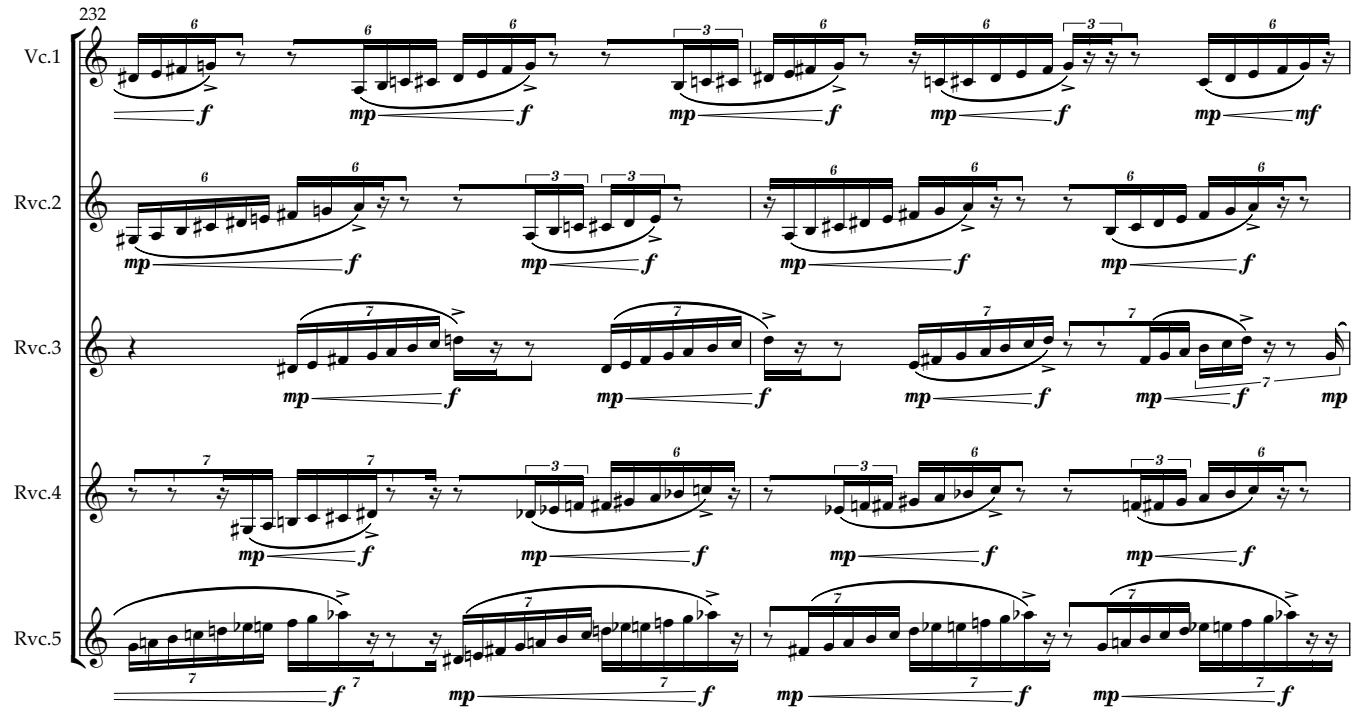

227
Vc.1
Rvc.2
Rvc.3
Rvc.4
Rvc.5
mp
mp
f
mp

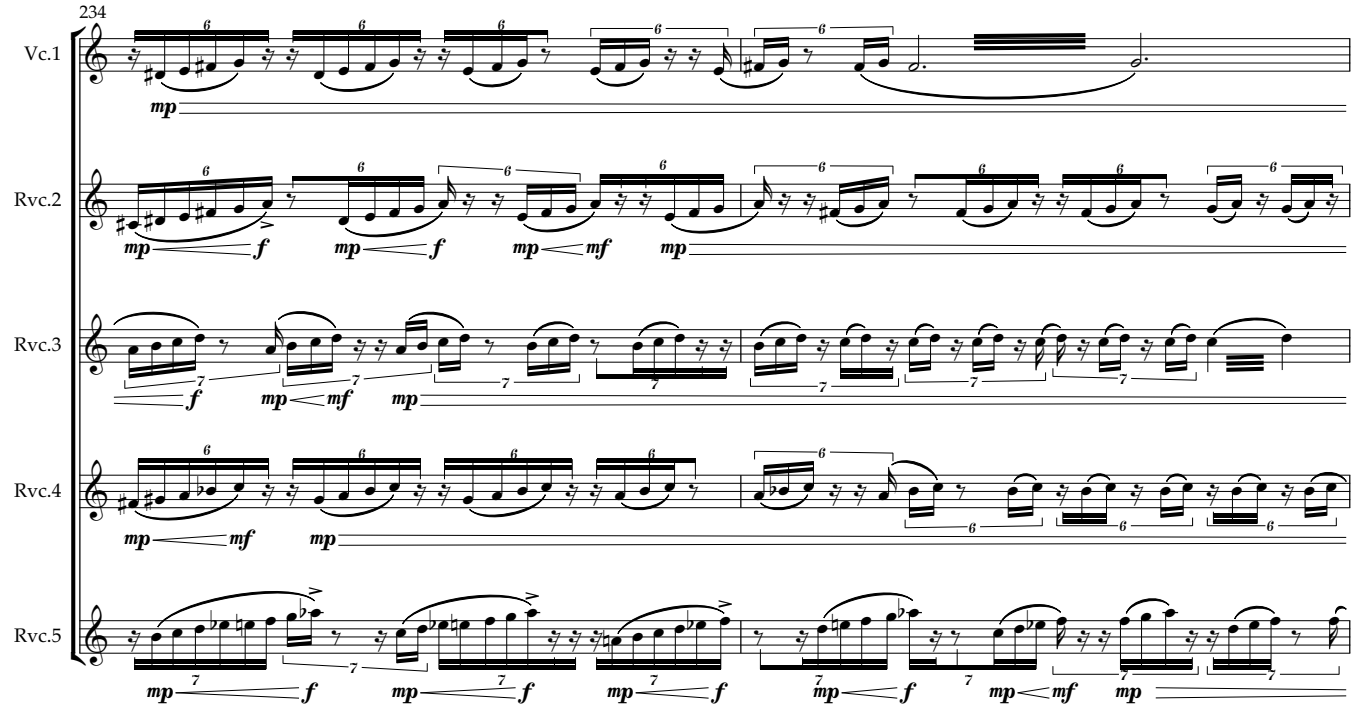

228
Vc.1
Rvc.2
Rvc.3
Rvc.4
Rvc.5
f
f
mp
f
mp

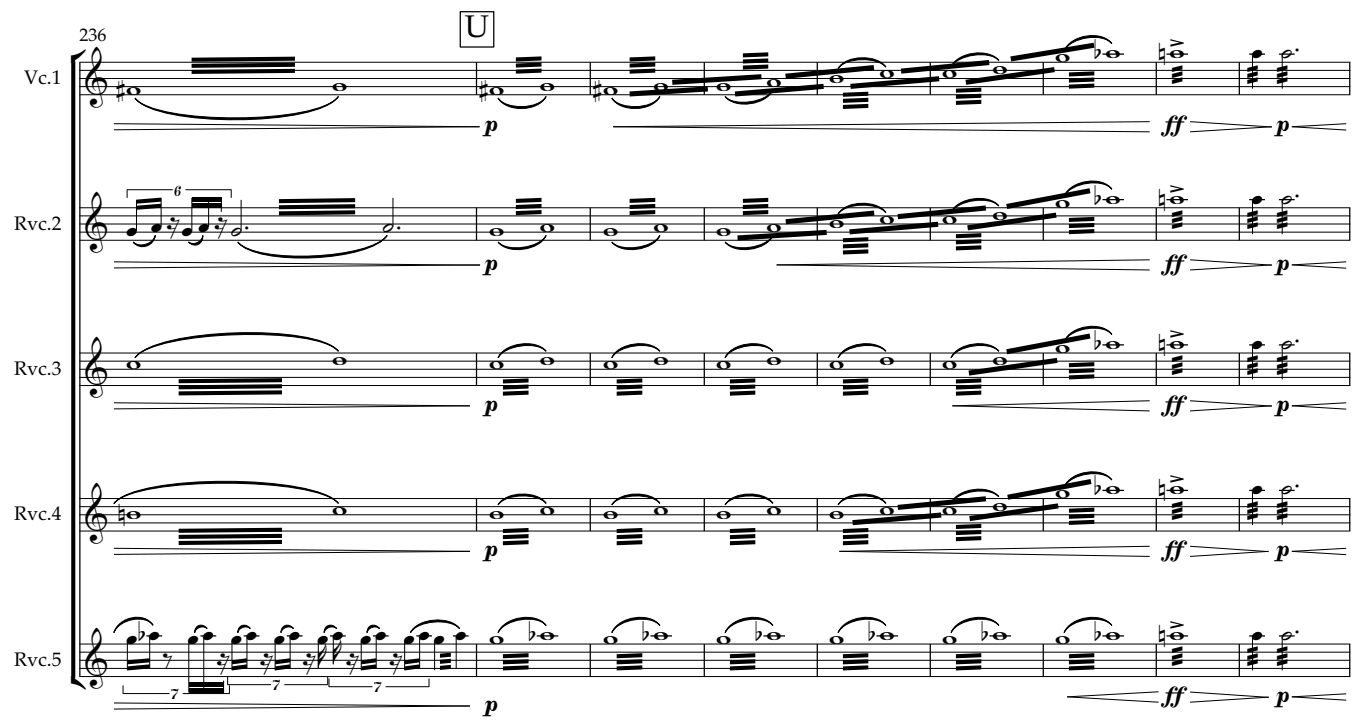

229
T
Vc.1
Rvc.2
Rvc.3
Rvc.4
Rvc.5
mp
f


230
Vc.1
Rvc.2
Rvc.3
Rvc.4
Rvc.5
mp
f


231
Vc.1
Rvc.2
Rvc.3
Rvc.4
Rvc.5


232
Vc.1
Rvc.2
Rvc.3
Rvc.4
Rvc.5


234
Vc.1
Rvc.2
Rvc.3
Rvc.4
Rvc.5


236
U
Vc.1
Rvc.2
Rvc.3
Rvc.4
Rvc.5

Section III

V W X

245

Lt. — 40 sec. — ② → ③

El. — Chaos sound — 40 sec. — *ff* *pp*

Vc.1 — Leave the cello to the cello stand. — 40 sec. — Go behind the screen. — *ff*

Rvc.2 — 40 sec. — *ff*

Vc.2 — 40 sec. — Go to the cello. — nv. — *f* *ff* *fp f*

Rvc.3 — 40 sec. — *ff*

Rvc.4 — 40 sec. — *ff*

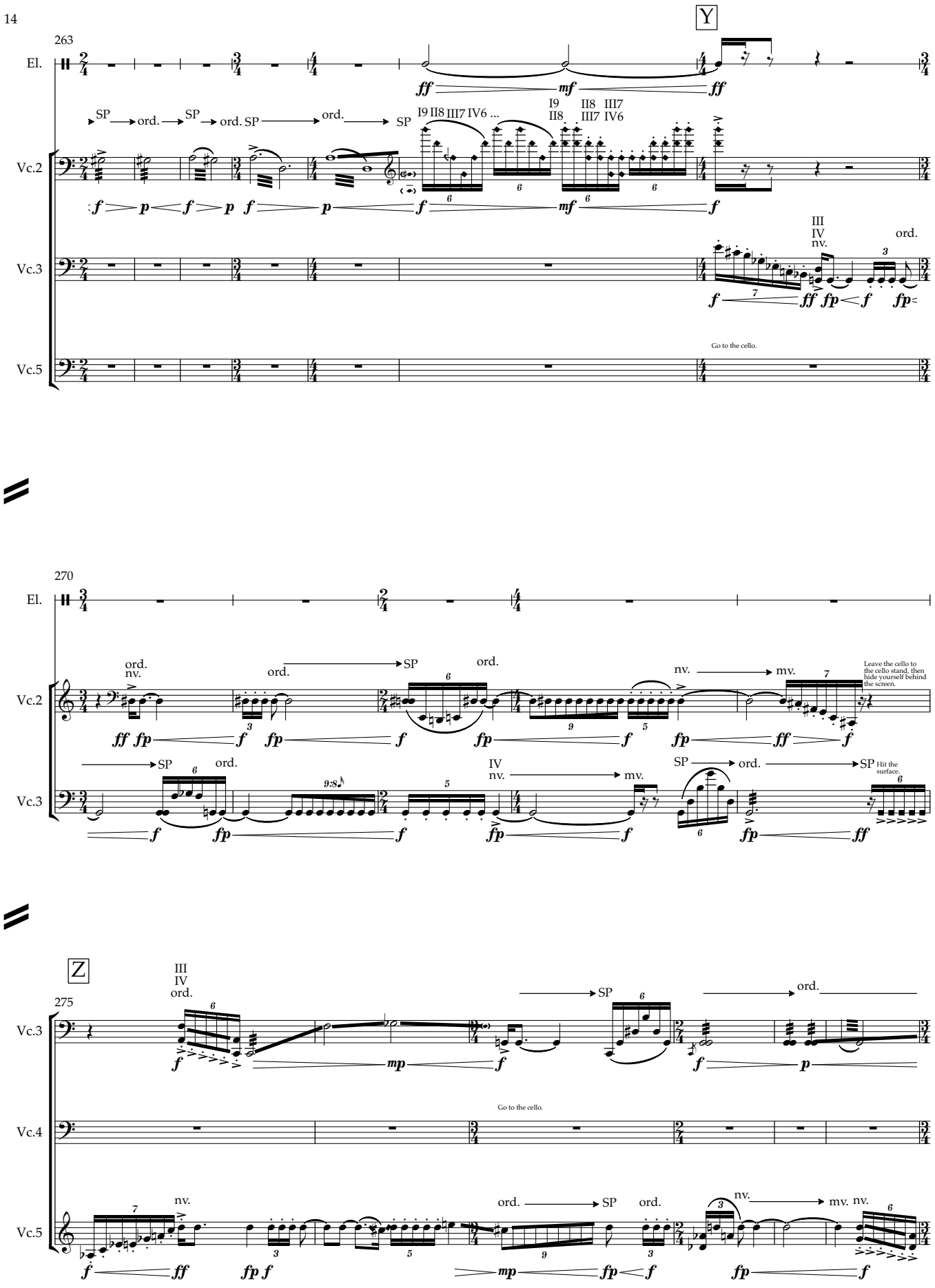
Rvc.5 — 40 sec. — *ff*

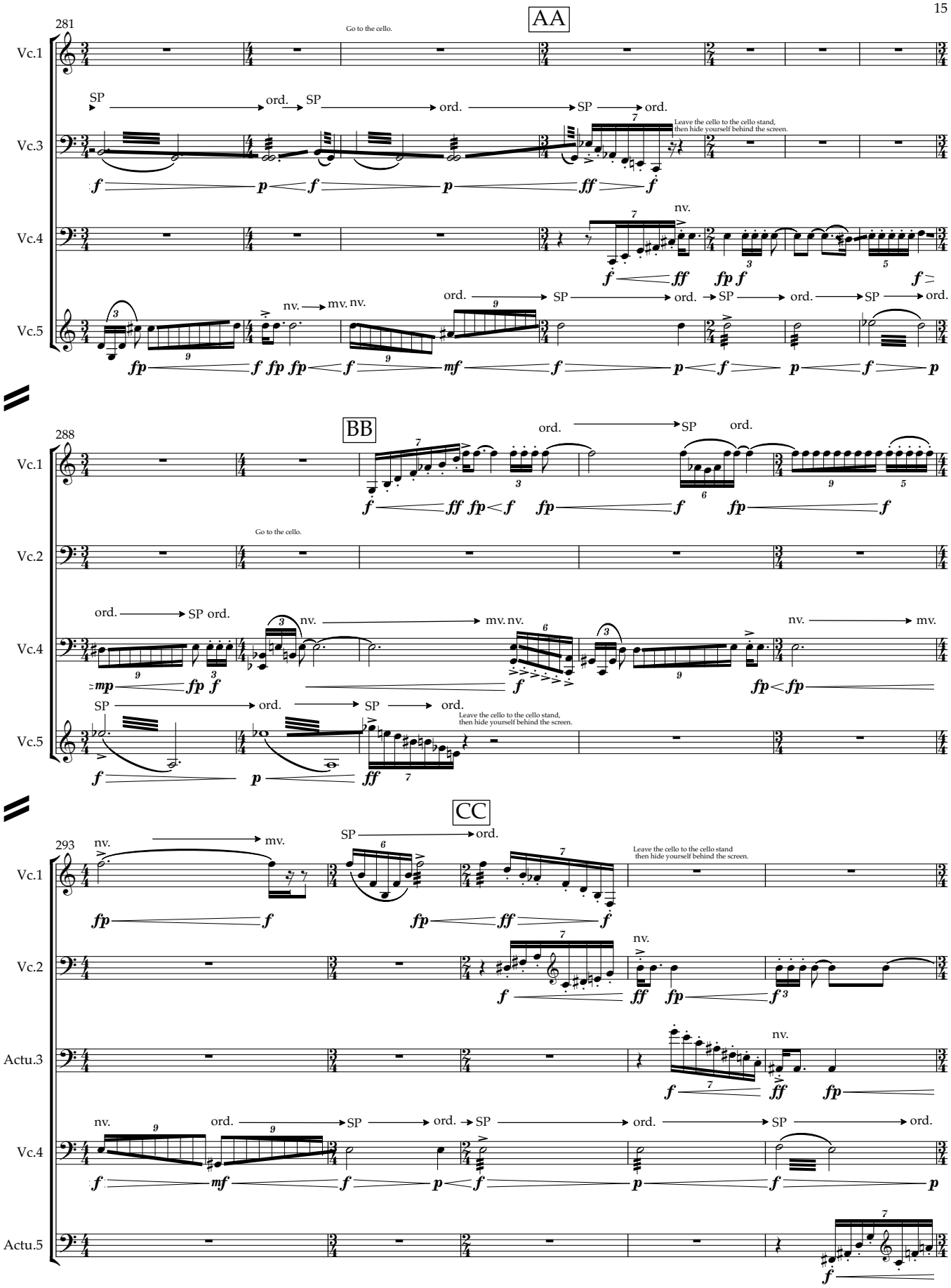
256

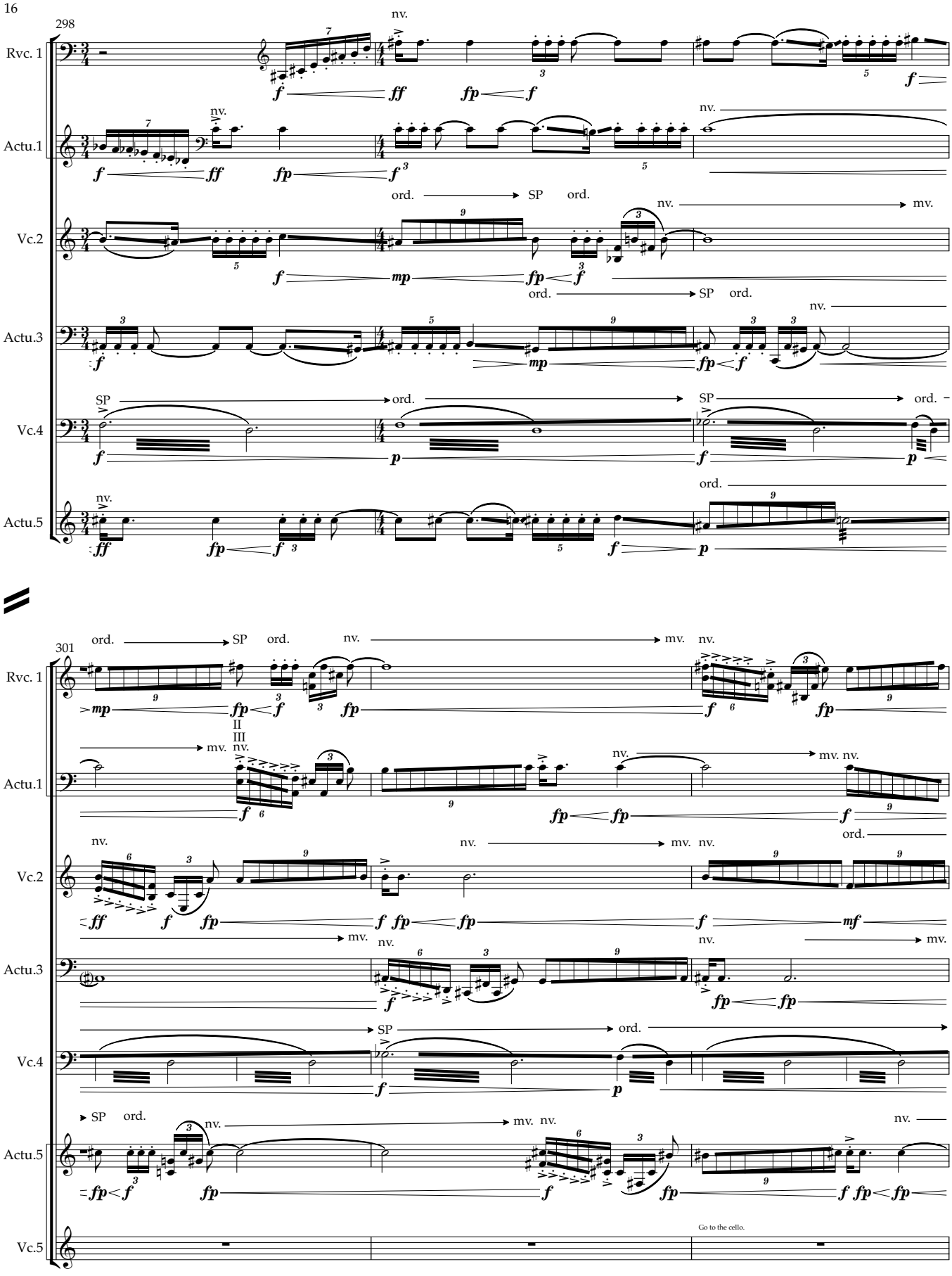
El.

Vc.2 — ord. → SP ord. — nv. → mv. nv. — nv. → mv. nv. — ord. → SP ord. — *mp* *fp f* *fp* *f* *fp fp* *f* *mf* *f* *p*

Vc.3 — Go to the cello.


263
Y
El.
Vc.2
Vc.3
Vc.5
SP
ord.
I9 II8 III7 IV6 ...
III
IV
nv.
Go to the cello.
270
Leave the cello to the cello stand, then hide yourself behind the screen.
Hit the surface.
Z
275
Vc.4


281
AA
Go to the cello.
Vc.1
Vc.3
Vc.4
Vc.5
SP
ord.
Leave the cello to the cello stand, then hide yourself behind the screen.
nv.
mv.
288
BB
Vc.2
293
CC
Actu.3
Actu.5
Leave the cello to the cello stand then hide yourself behind the screen.


298
Rvc. 1
Actu.1
Vc.2
Actu.3
Vc.4
Actu.5
nv.
mv.
ord.
SP
301
Vc.5
Go to the cello.

DD

304

Rvc. 1

nv. → mv. nv. ord. → SP SP → ord.

f fp< fp f mf fp ff f

Actu.1

ord. → SP ord. → SP ord. SP → ord.

mf f p f p fp ff f

Rvc.2

f

Vc.2

SP → ord. SP → ord. SP ord. SP → ord.

Leave the cello to the cello stand, then hide yourself behind the screen.

f p f p f p ff f

Rvc.3

f

Actu.3

nv. ord. → SP ord. SP → ord.

f mf f p ff f

Vc.3

Go to the cello.

Vc.4

SP → ord. SP ord.

Leave the cello to the cello stand, then hide yourself behind the screen.

f p f ff f

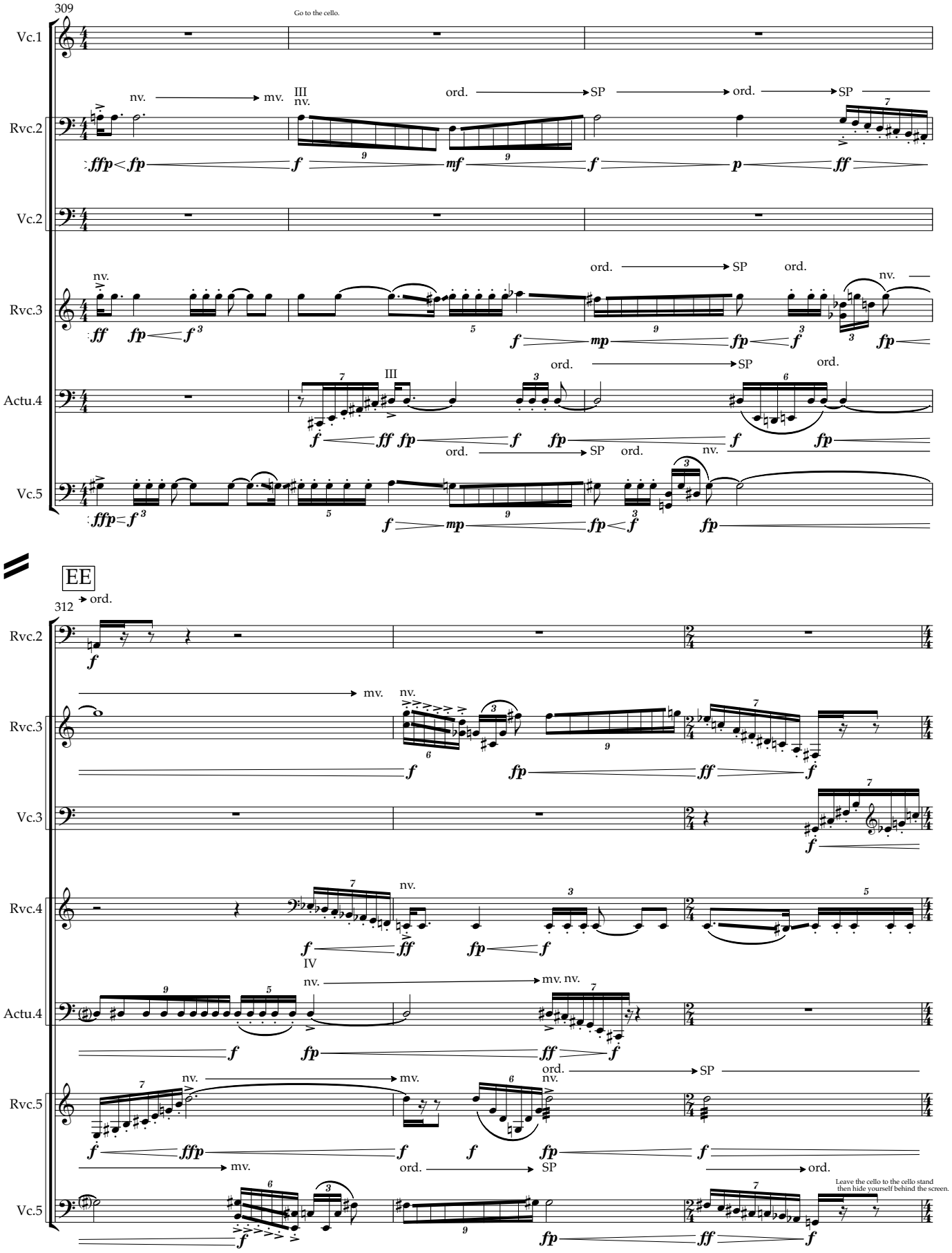
Actu.5

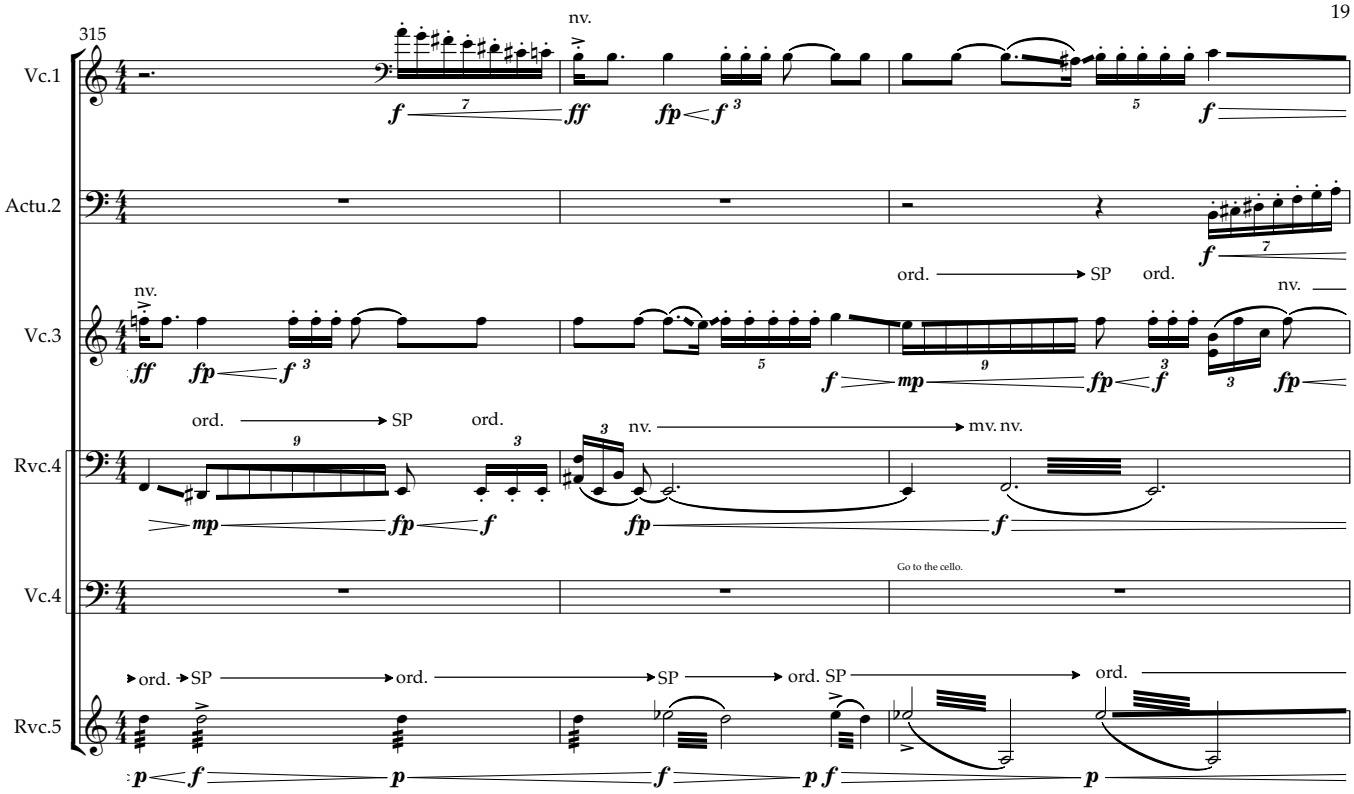
mv. nv. ord. → SP ord. SP → ord. → SP ord.

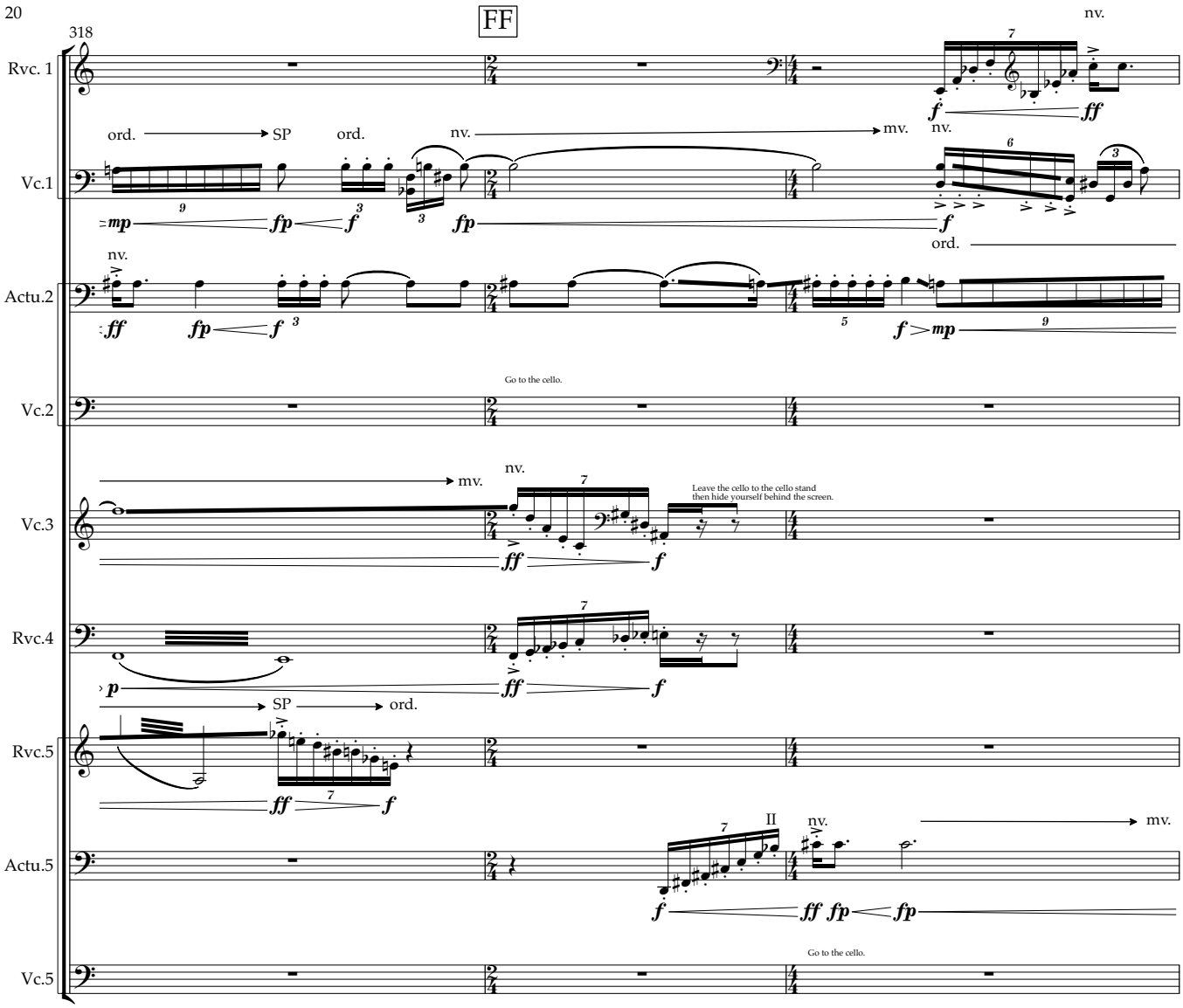
f mf f p< f > p< f > fp< ff f

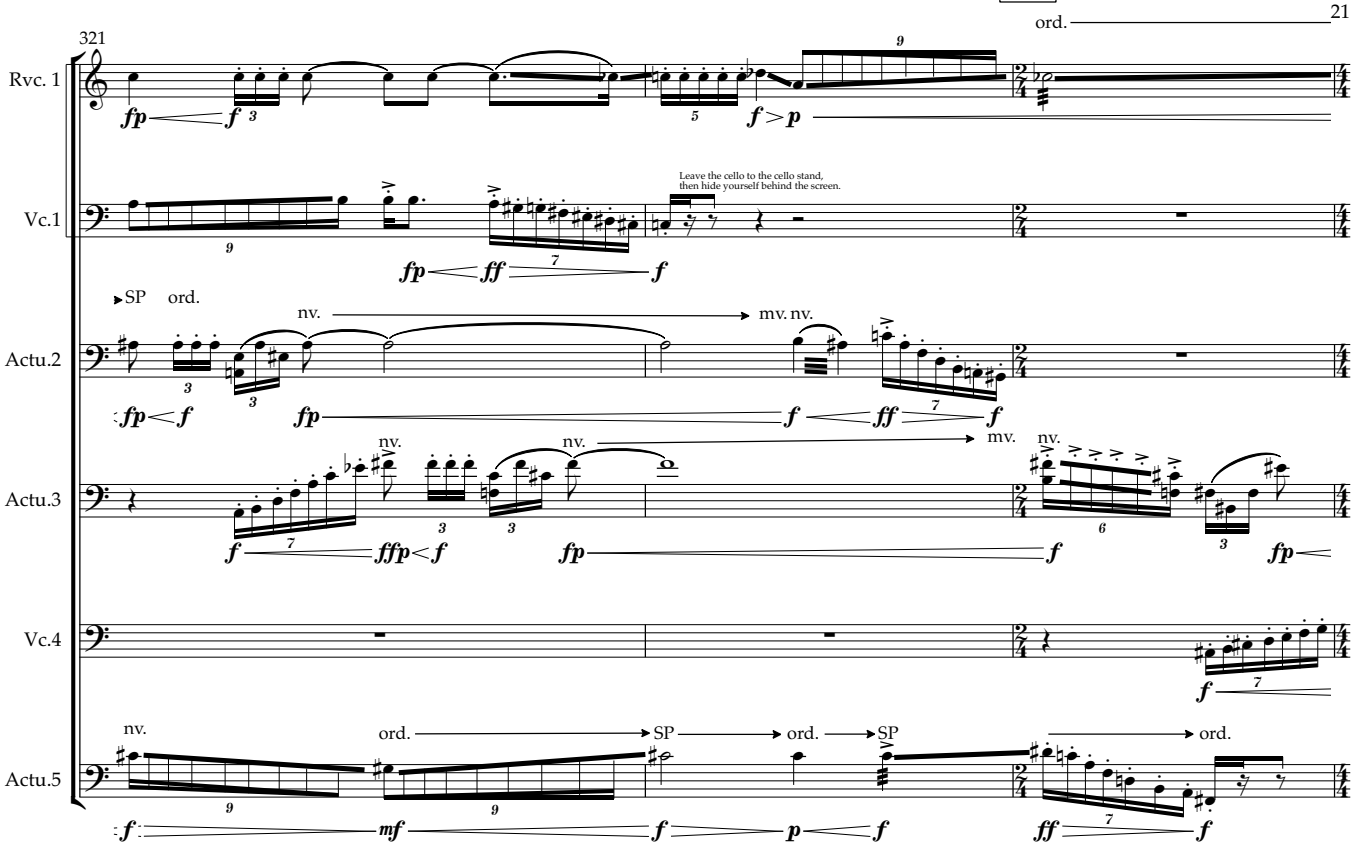
Vc.5

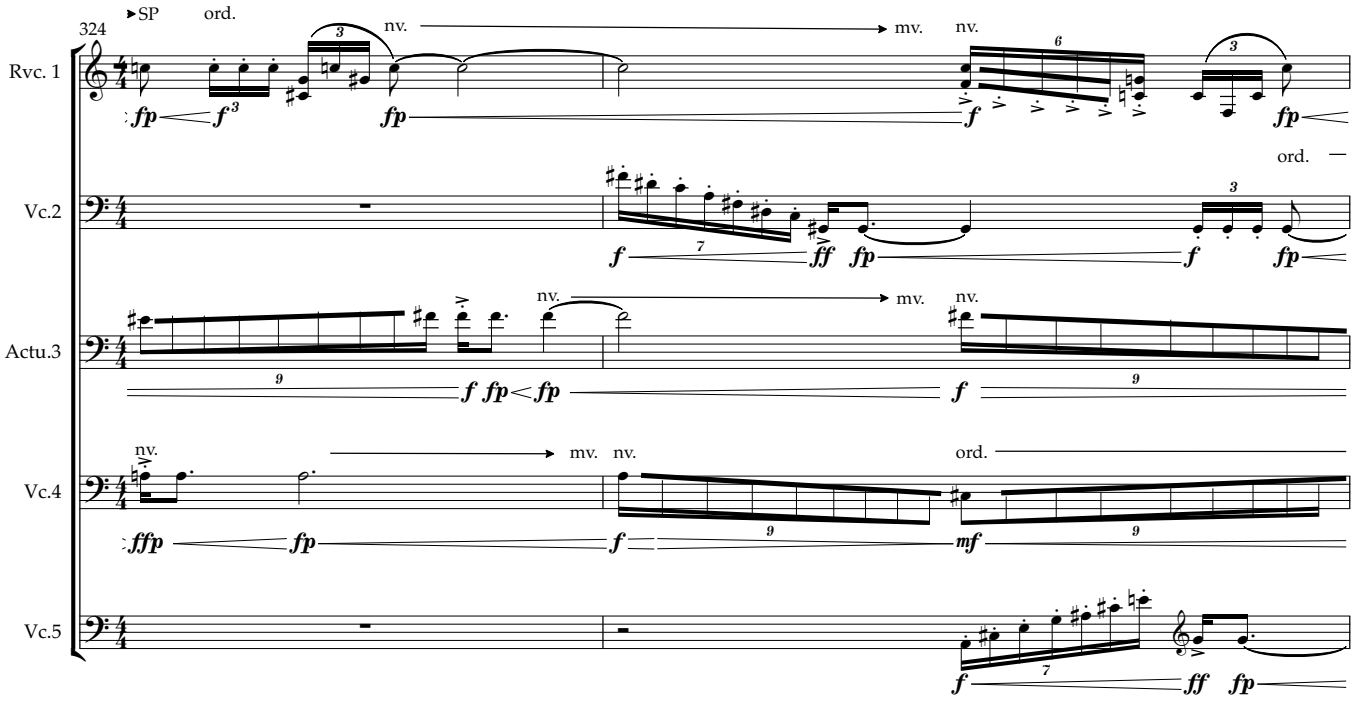
f

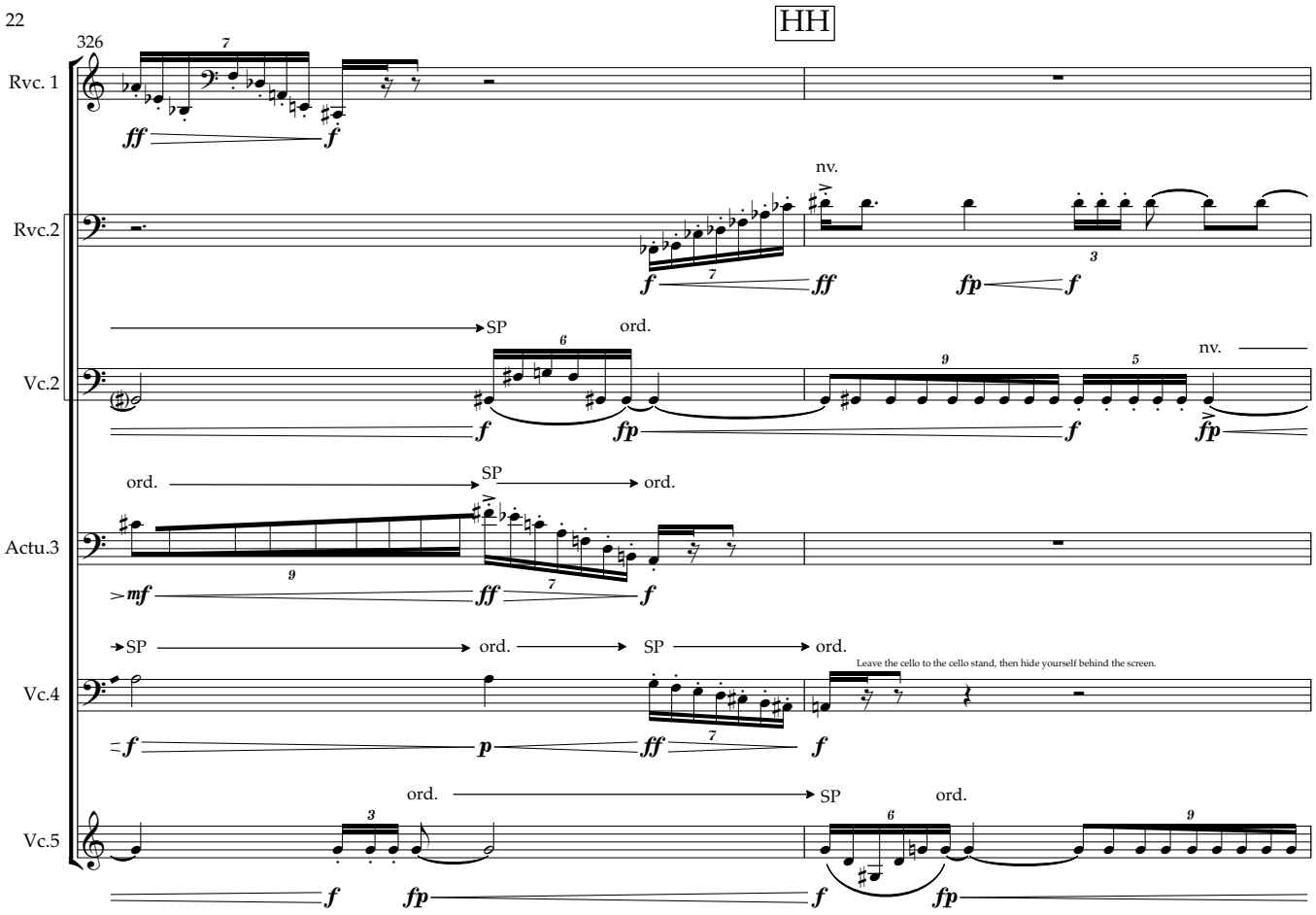

309
Go to the cello.
Vc.1
Rvc.2
Vc.2
Rvc.3
Actu.4
Vc.5
nv.
mv.
III
ord.
SP
EE
312
IV
Leave the cello to the cello stand
then hide yourself behind the screen.

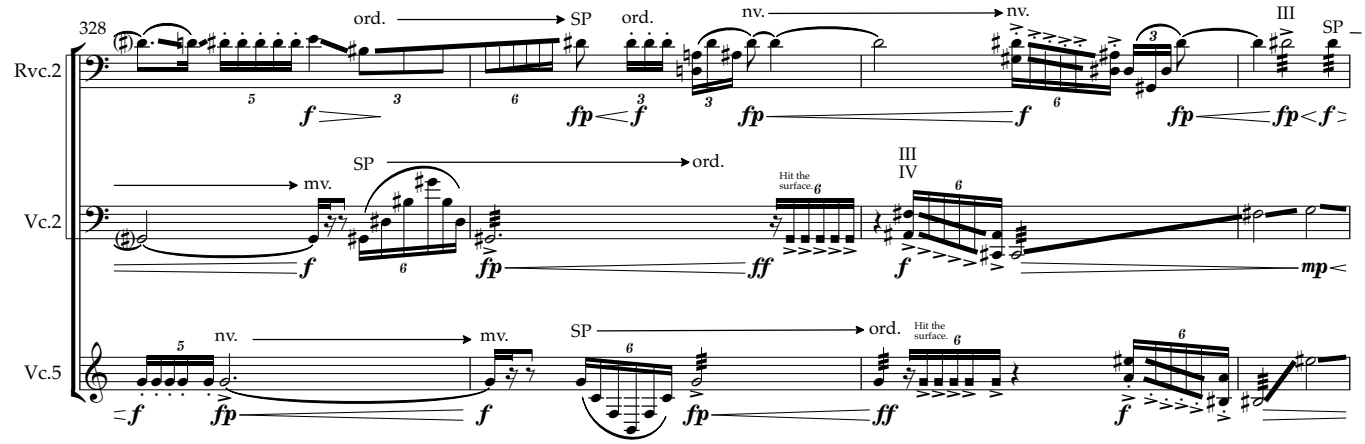

315
Vc.1
Actu.2
Vc.3
Rvc.4
Vc.4
Rvc.5
nv.
ord.
SP
mv. nv.
Go to the cello.

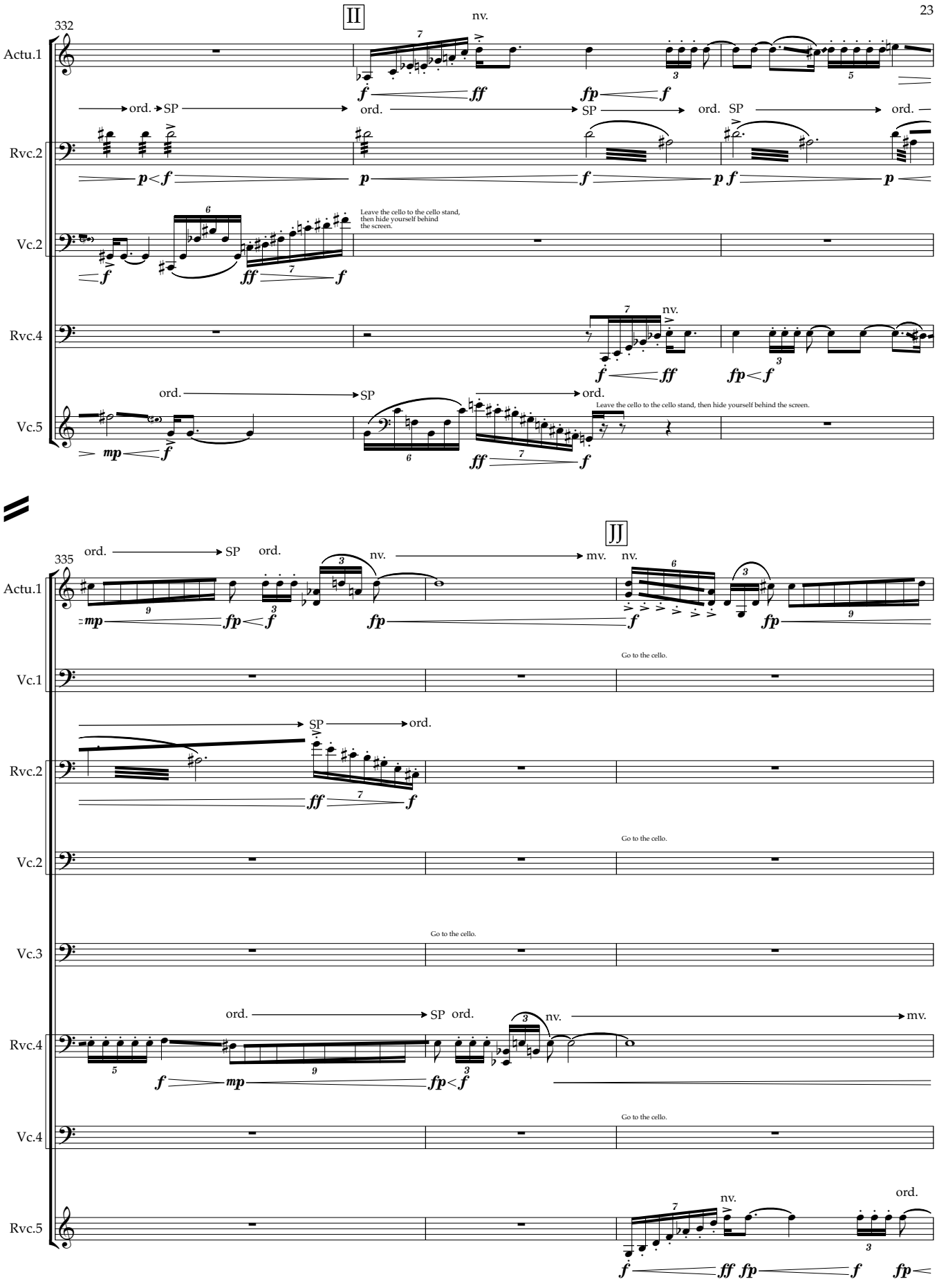

FF
318
Rvc. 1
Vc.1
Actu.2
Vc.2
Vc.3
Rvc.4
Rvc.5
Actu.5
Vc.5
nv.
mv.
ord.
SP
Go to the cello.
Leave the cello to the cello stand
then hide yourself behind the screen.
II

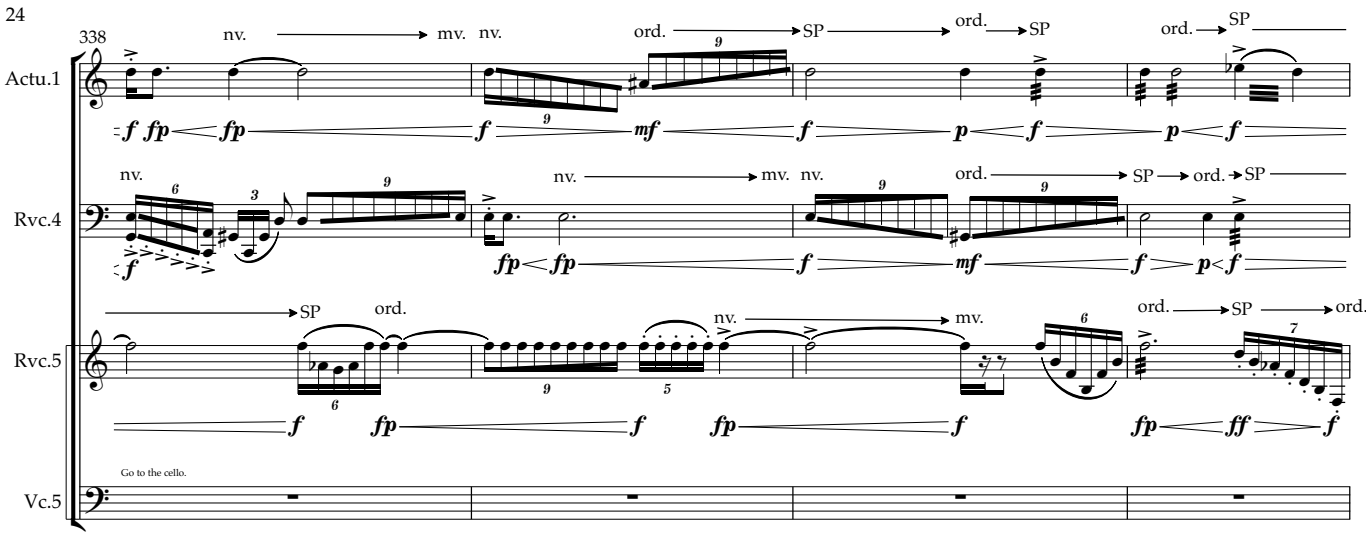

321
Rvc. 1
Vc.1
Actu.2
Actu.3
Vc.4
Actu.5
ord.
Leave the cello to the cello stand, then hide yourself behind the screen.
SP
nv.
mv.
fp
ff
f
ffp
mf
p

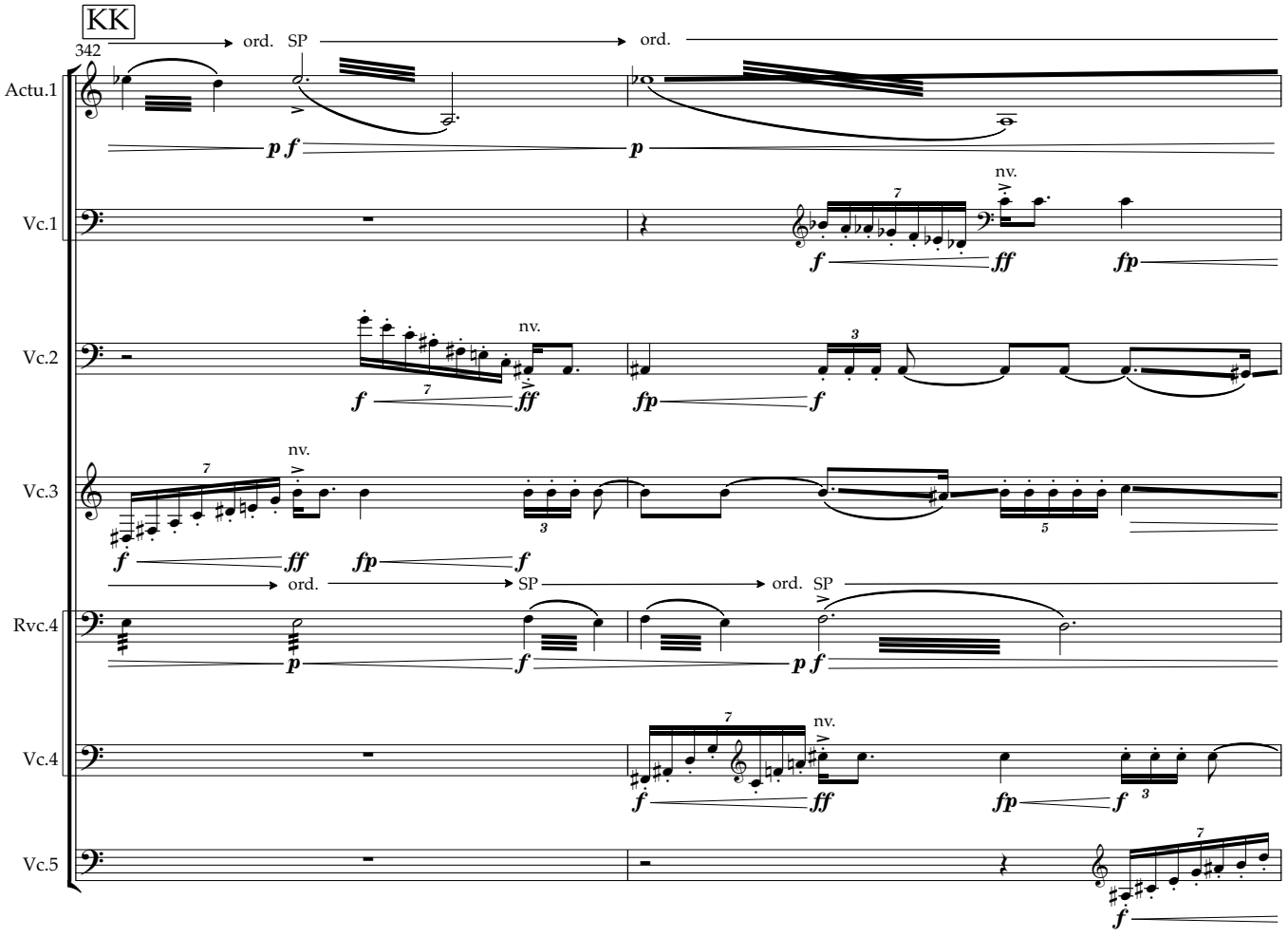

324
Rvc. 1
Vc.2
Actu.3
Vc.4
Vc.5
SP
ord.
nv.
mv.
fp
ff
f
ffp
mf

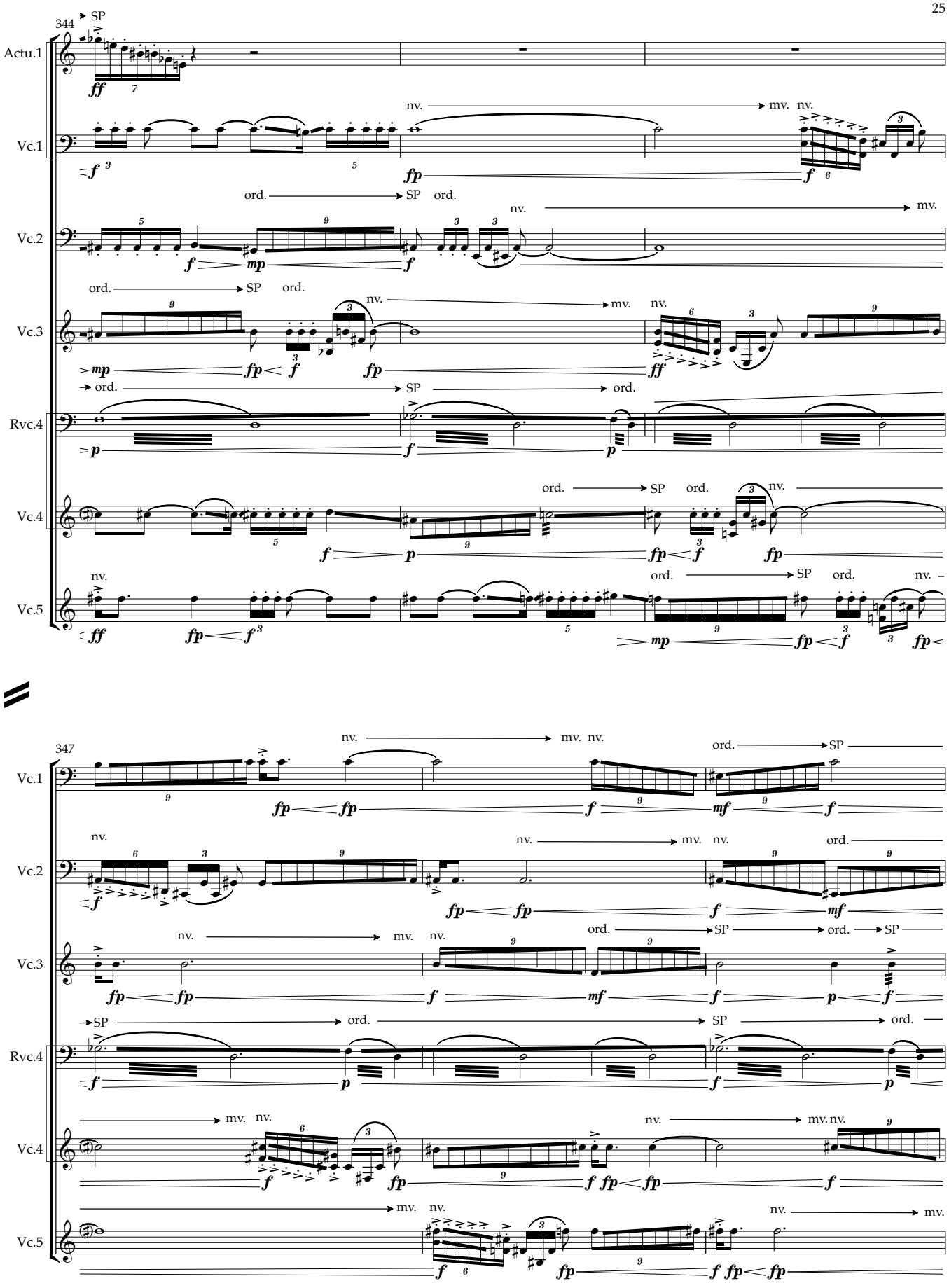

HH
326
Rvc. 1
Rvc.2
Vc.2
Actu.3
Vc.4
Vc.5
nv.
SP
ord.
Leave the cello to the cello stand, then hide yourself behind the screen.


328
Rvc.2
Vc.2
Vc.5
ord.
SP
nv.
III
IV
mv.
Hit the surface.

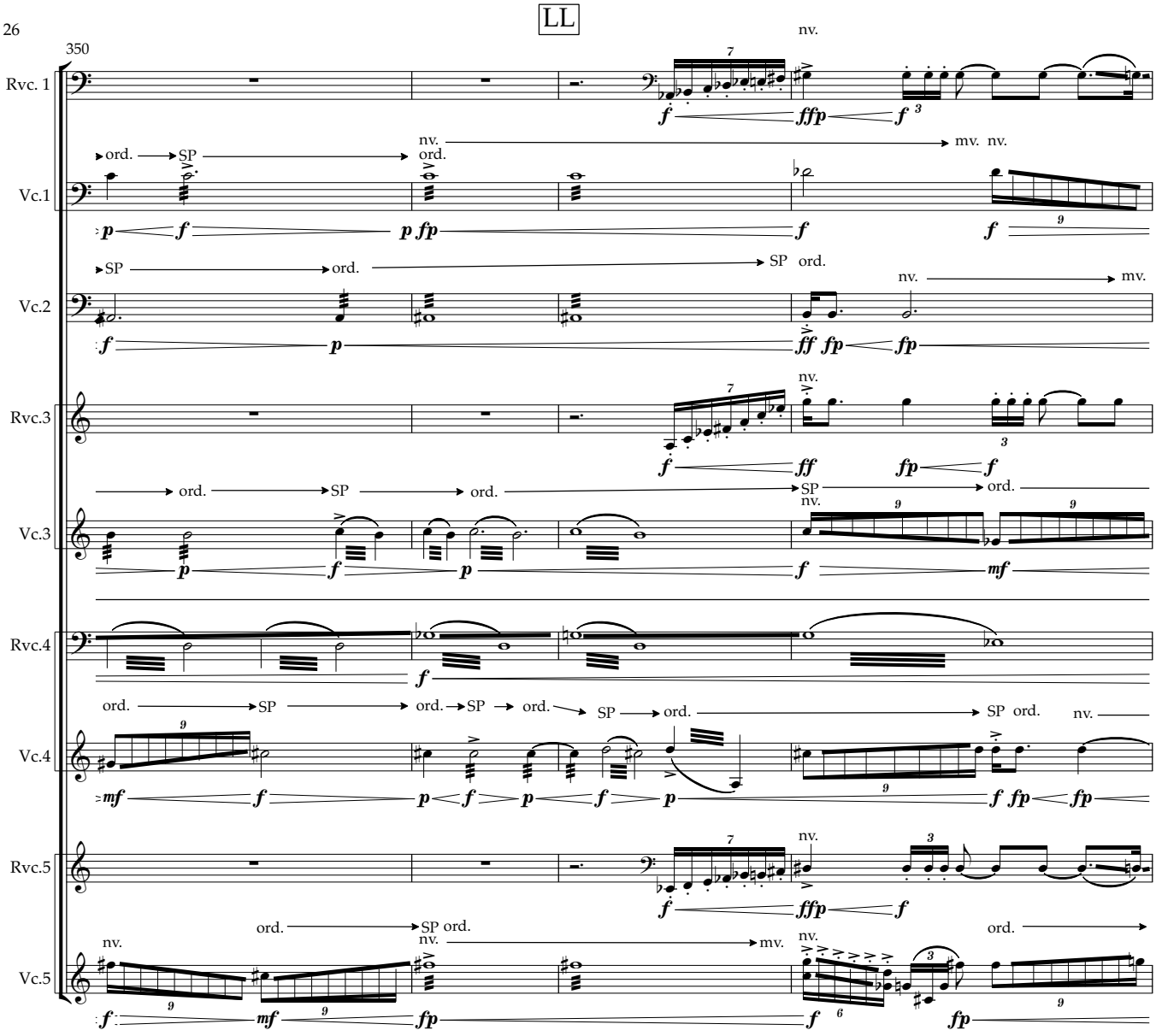

332
II
nv.
Actu.1
ord.
SP
Rvc.2
Vc.2
Leave the cello to the cello stand, then hide yourself behind the screen.
Rvc.4
Vc.5
Leave the cello to the cello stand, then hide yourself behind the screen.
335
JJ
mv.
Vc.1
Go to the cello.
Vc.3
Vc.4
Rvc.5

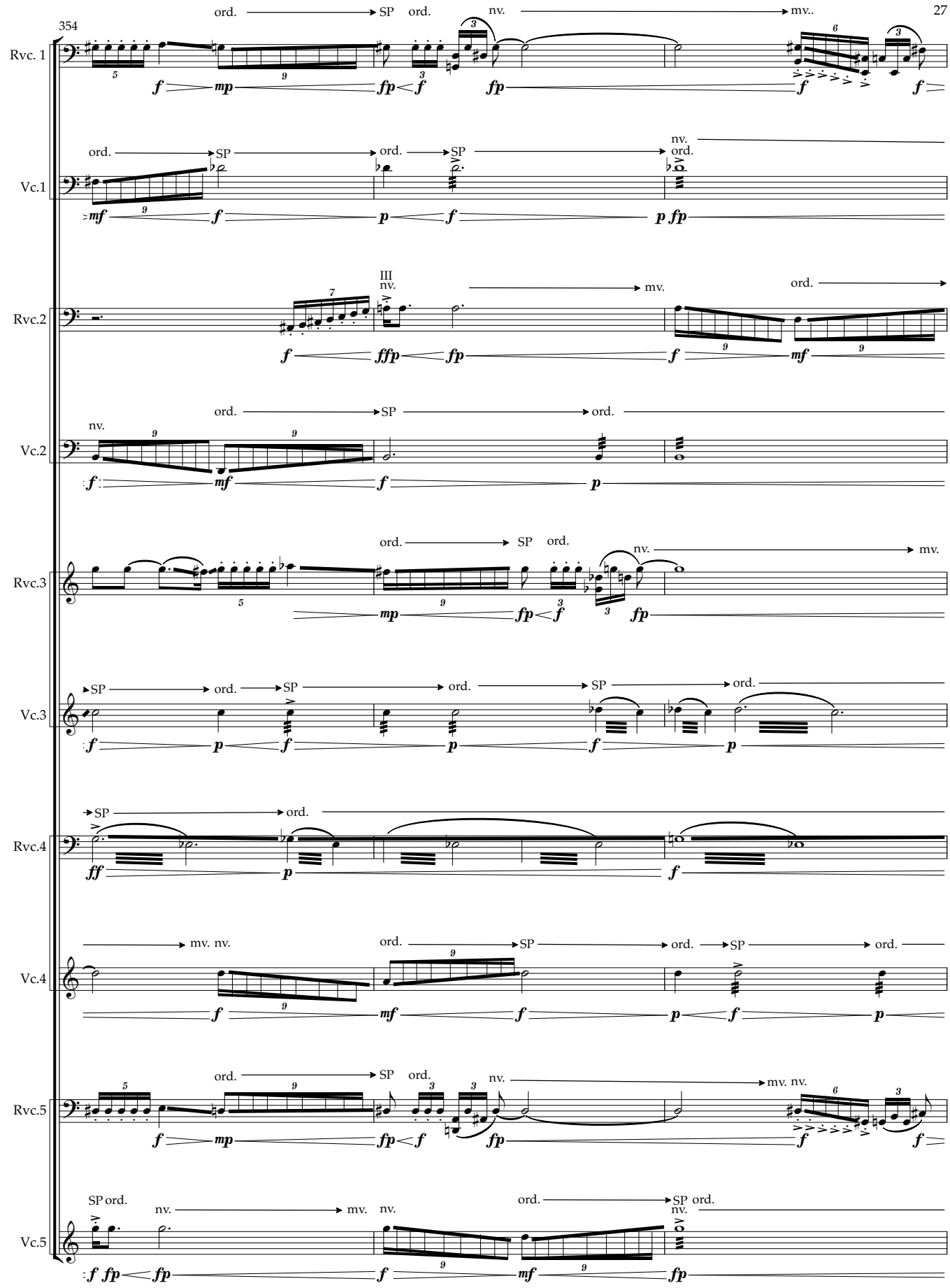

338
Actu.1
Rvc.4
Rvc.5
Vc.5
nv.
mv.
ord.
SP
Go to the cello.

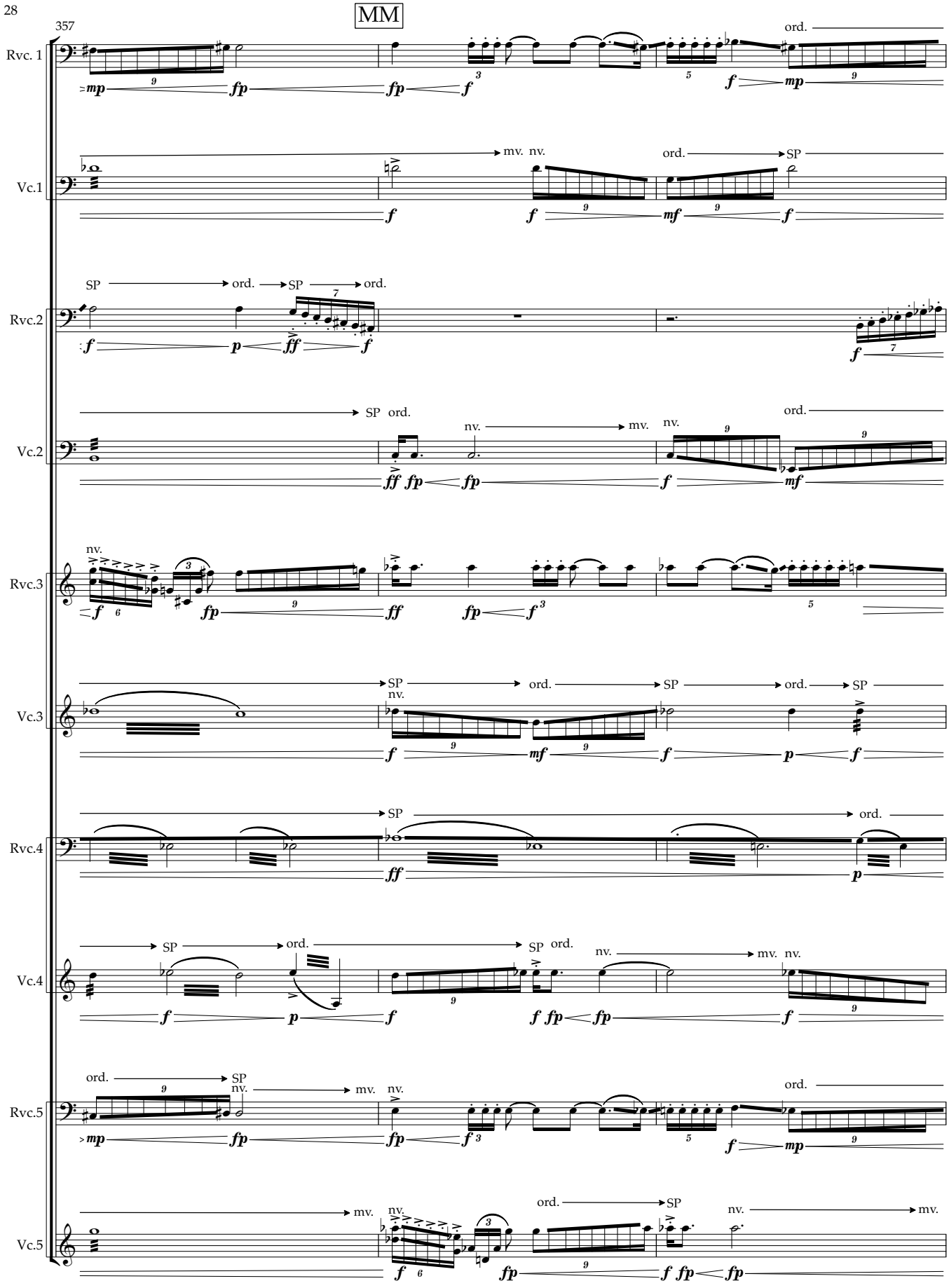

KK
342
Actu.1
Vc.1
Vc.2
Vc.3
Rvc.4
Vc.4
Vc.5
ord.
SP
nv.

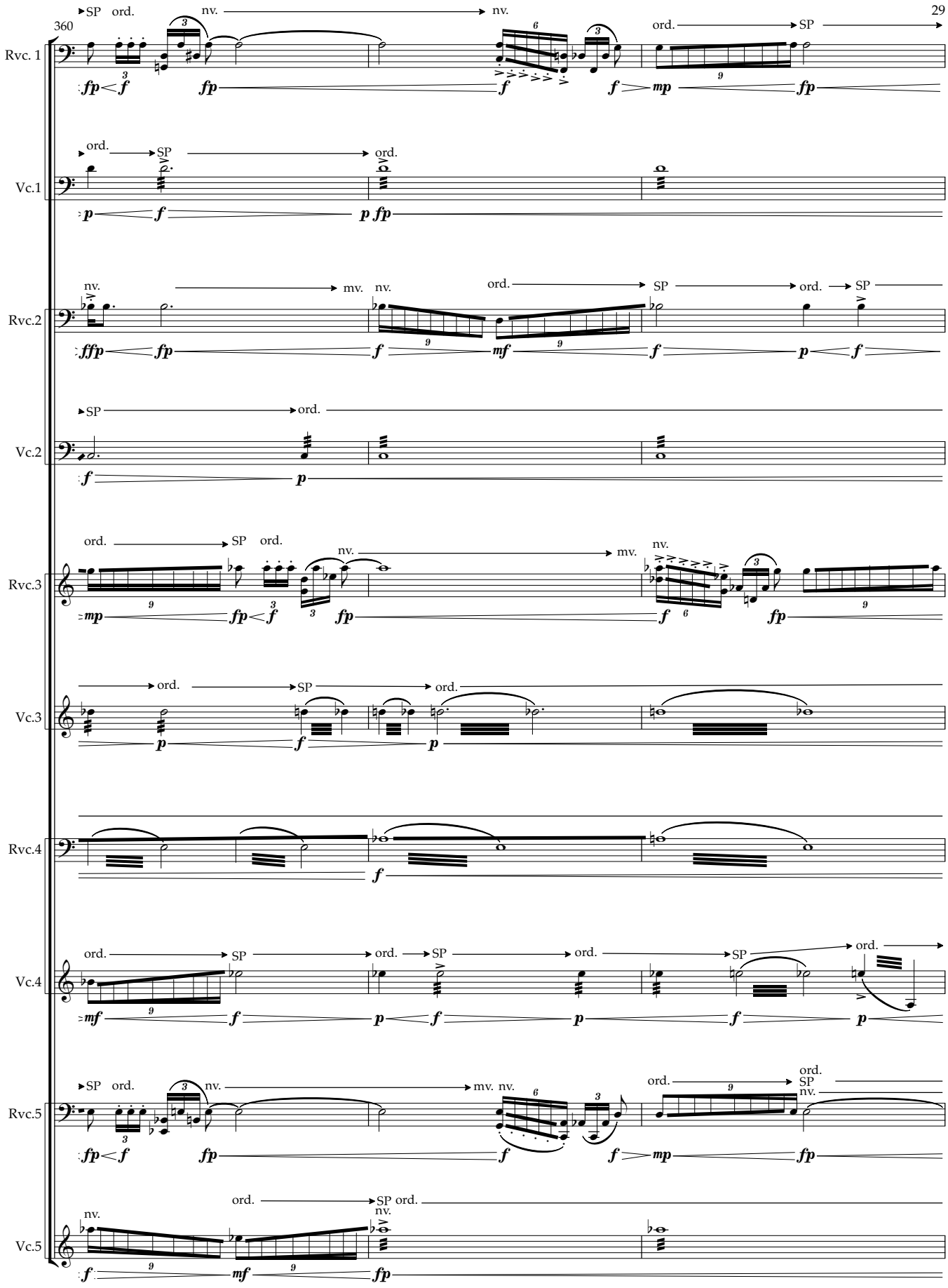

344
Actu.1
Vc.1
Vc.2
Vc.3
Rvc.4
Vc.4
Vc.5
SP
ord.
nv.
mv.
347

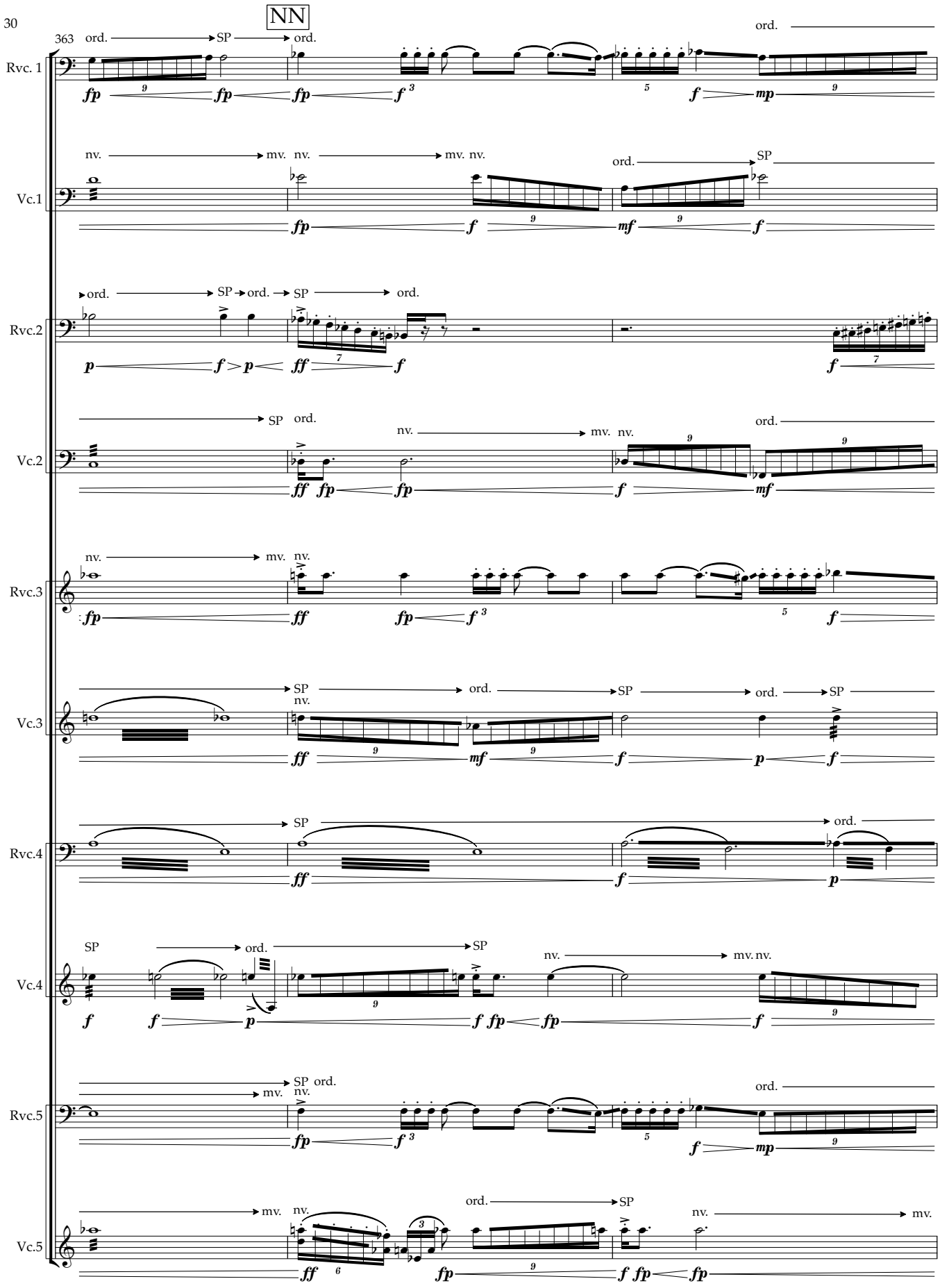
LL




354
Rvc. 1
Vc.1
Rvc.2
Vc.2
Rvc.3
Vc.3
Rvc.4
Vc.4
Rvc.5
Vc.5
ord.
SP
nv.
mv.
III


MM
357
Rvc. 1
Vc.1
Rvc.2
Vc.2
Rvc.3
Vc.3
Rvc.4
Vc.4
Rvc.5
Vc.5
ord.
mv.
nv.
SP


360
Rvc. 1
Vc.1
Rvc.2
Vc.2
Rvc.3
Vc.3
Rvc.4
Vc.4
Rvc.5
Vc.5
SP
ord.
nv.
mv.


NN
363
Rvc. 1
Vc.1
Rvc.2
Vc.2
Rvc.3
Vc.3
Rvc.4
Vc.4
Rvc.5
Vc.5
ord.
SP
nv.
mv.
fp
ff
f
mf
mp
p

366

Rvc. 1

Vc.1

Rvc.2

Vc.2

Rvc.3

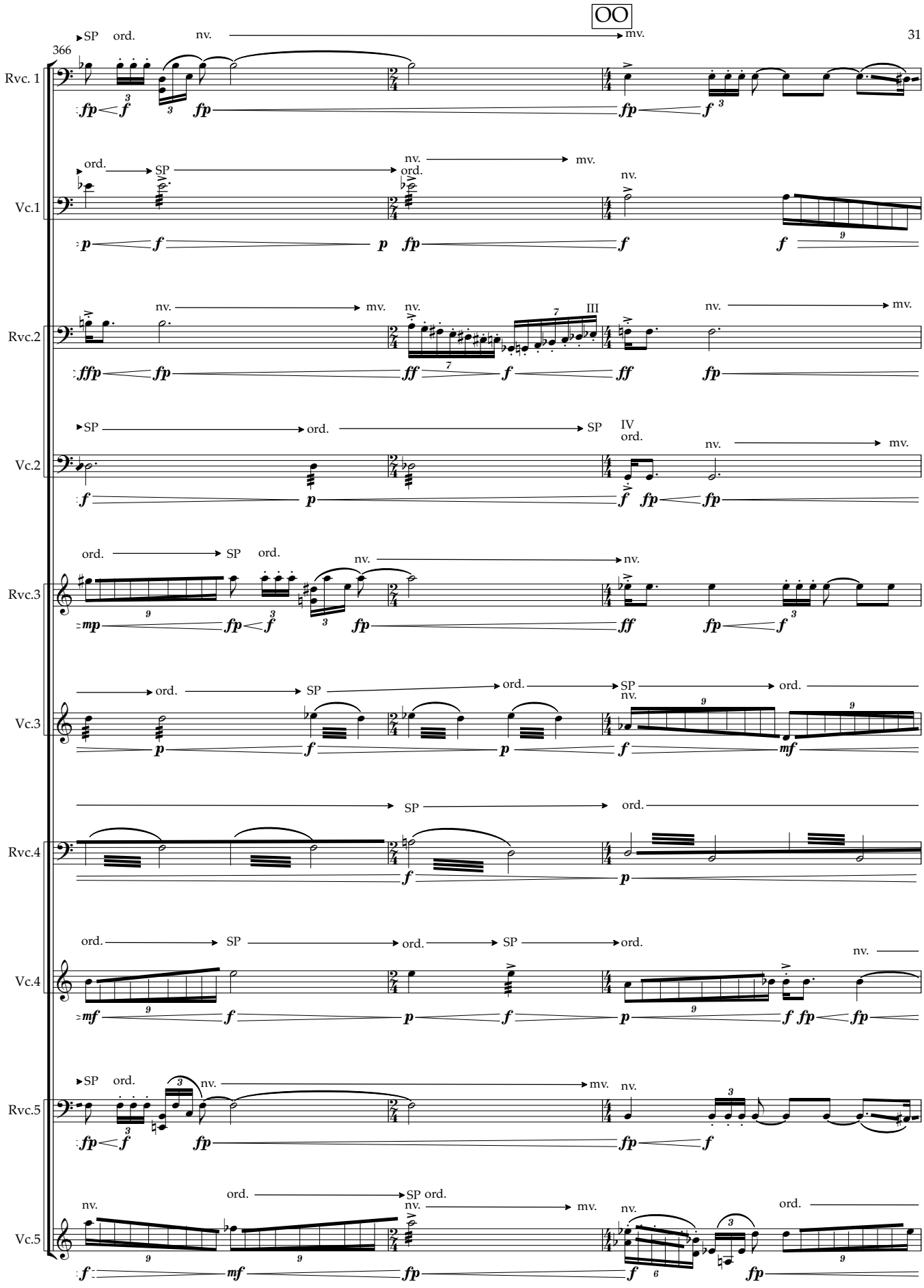
Vc.3

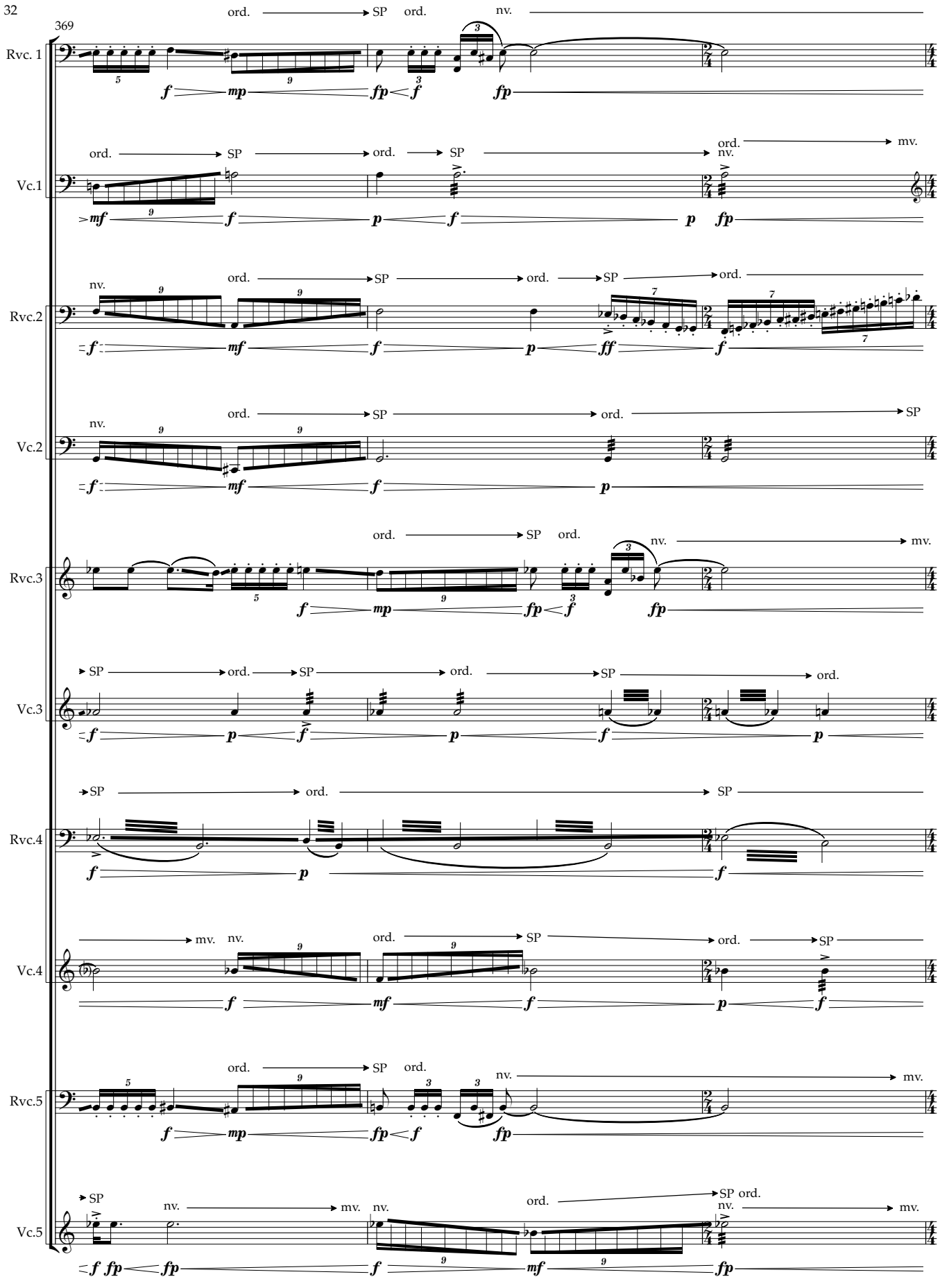
Rvc.4

Vc.4

Rvc.5

Vc.5




369
Rvc. 1
Vc.1
Rvc.2
Vc.2
Rvc.3
Vc.3
Rvc.4
Vc.4
Rvc.5
Vc.5
ord.
SP
nv.
mv.

PP

372

Rvc. 1

Vc.1

Rvc.2

Vc.2

Rvc.3

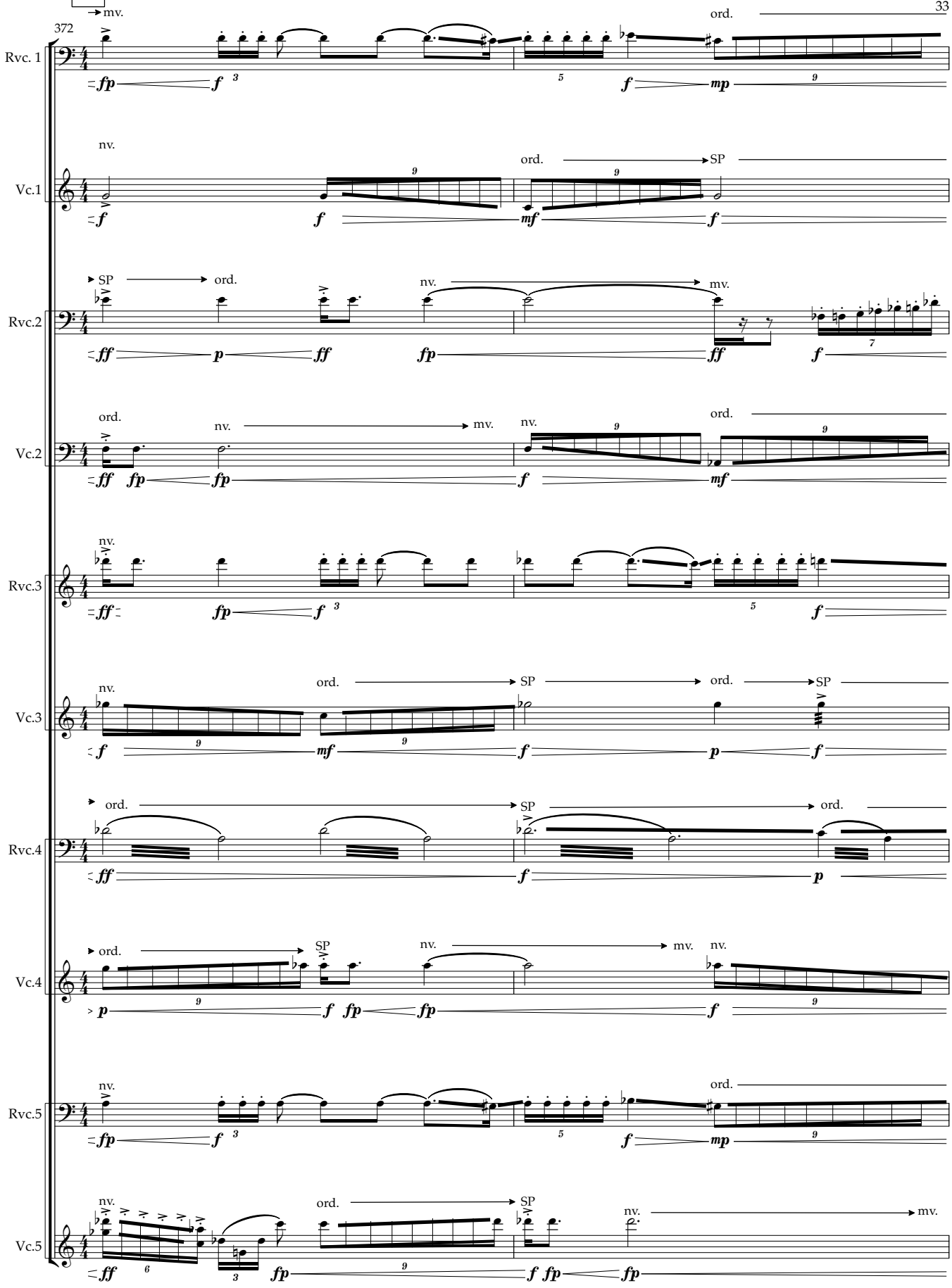
Vc.3

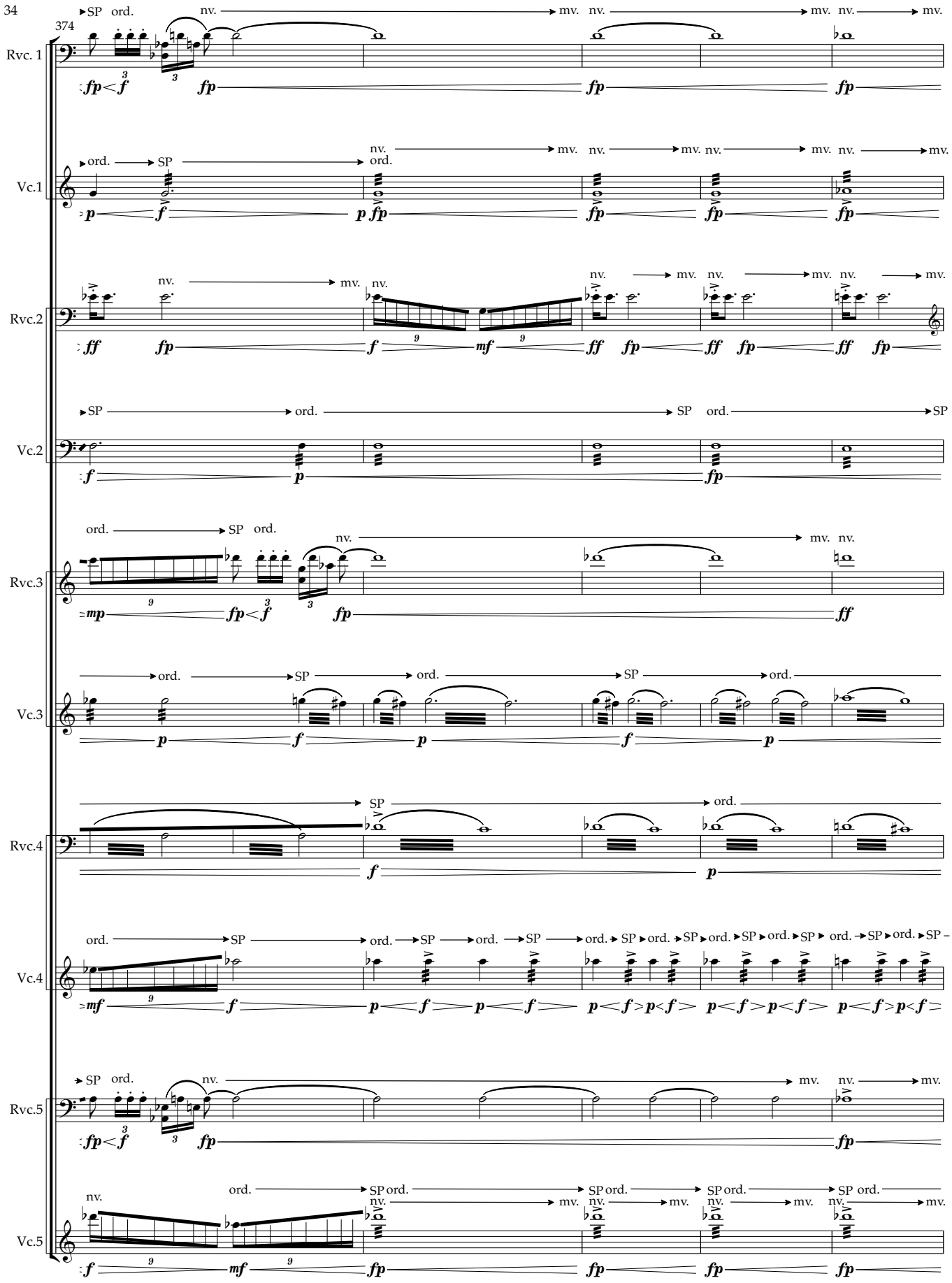
Rvc.4

Vc.4

Rvc.5

Vc.5




374
Rvc. 1
Vc.1
Rvc.2
Vc.2
Rvc.3
Vc.3
Rvc.4
Vc.4
Rvc.5
Vc.5
SP
ord.
nv.
mv.

QQ

379

Rvc. 1

Vc.1

Rvc.2

Vc.2

Rvc.3

Actu.3

Vc.3

Rvc.4

Actu.4

Vc.4

Rvc.5

Actu.5

Vc.5

Mime as if playing the bracket notes.

RR

381

Rvc. 1

Actu.1

Vc.1

Rvc.2

Actu.2

Vc.2

Rvc.3

Actu.3

Vc.3

Rvc.4

Actu.4

Vc.4

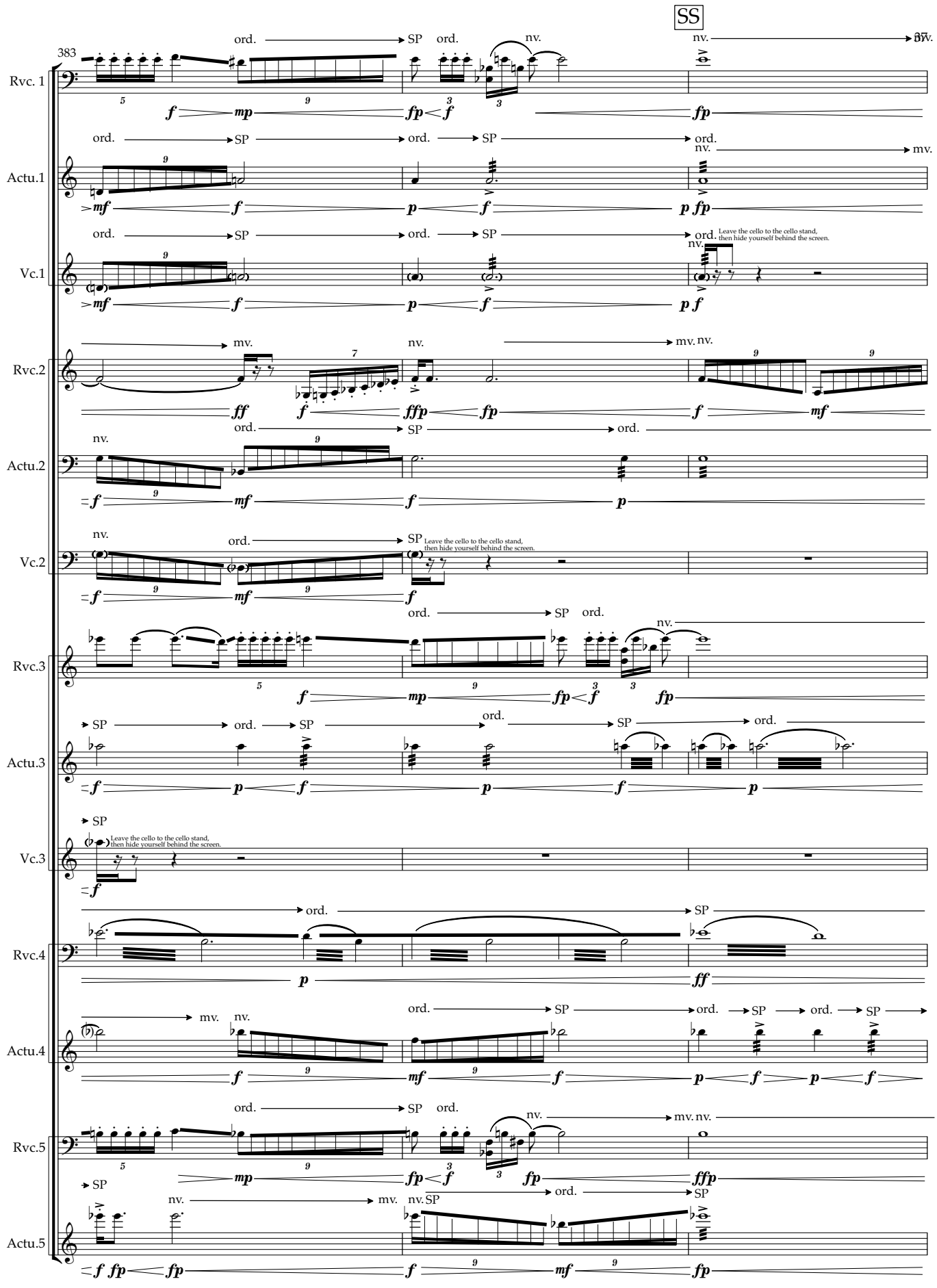
Rvc.5

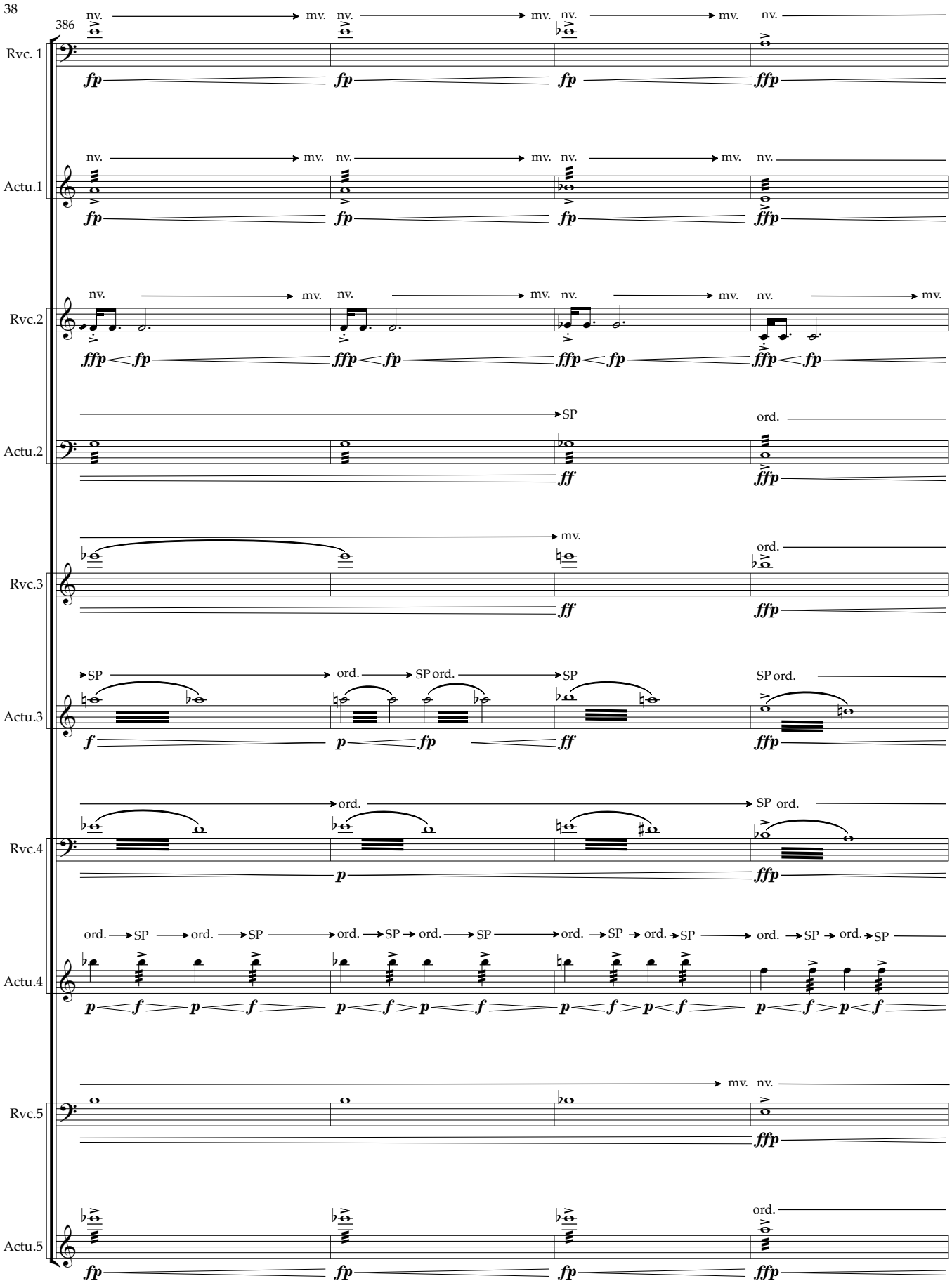
Actu.5

Vc.5

Mime as if playing the bracket notes.

Leave the cello to the cello stand, then hide yourself behind the screen.


SS
383
Rvc. 1
Actu.1
Vc.1
Rvc.2
Actu.2
Vc.2
Rvc.3
Actu.3
Vc.3
Rvc.4
Actu.4
Rvc.5
Actu.5
ord.
SP
nv.
mv.
Leave the cello to the cello stand, then hide yourself behind the screen.


386
Rvc. 1
Actu.1
Rvc.2
Actu.2
Rvc.3
Actu.3
Rvc.4
Actu.4
Rvc.5
Actu.5
nv.
mv.
ord.
SP
SP ord.
fp
ffp
ff
f
p

Section IV

390

TT

UU

40 sec.

♩=42

El.

ff

mp

Rvc. 1

mv.

ff

40 sec.

Actu.1

mv.

ff

40 sec.

Vc.1

40 sec.

Walk to the cello slowly.

Rvc.2

nv. mv. nv. mv.

fffp fp fffp fp ff

40 sec.

Actu.2

SP

ff

40 sec.

Vc.2

40 sec.

Walk to the cello slowly.

Rvc.3

SP

ff

40 sec.

Actu.3

SP

ff

40 sec.

Vc.3

40 sec.

Walk to the cello slowly.

Rvc.4

SP

ff

40 sec.

Actu.4

ord. SP ord. SP ord. SP ord. SP

p f p f p f p ff

40 sec.

Vc.4

40 sec.

Walk to the cello slowly.

Rvc.5

mv.

ff

40 sec.

Actu.5

SP

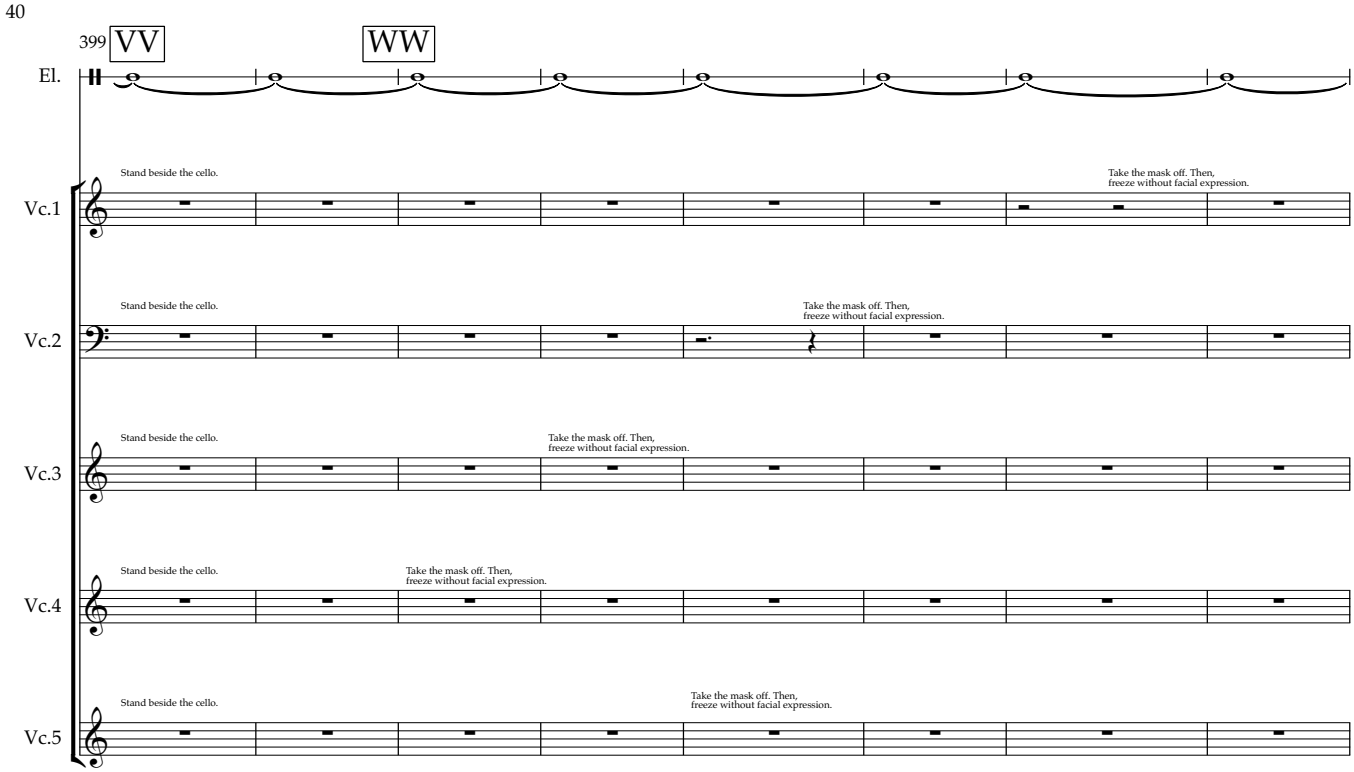
ff

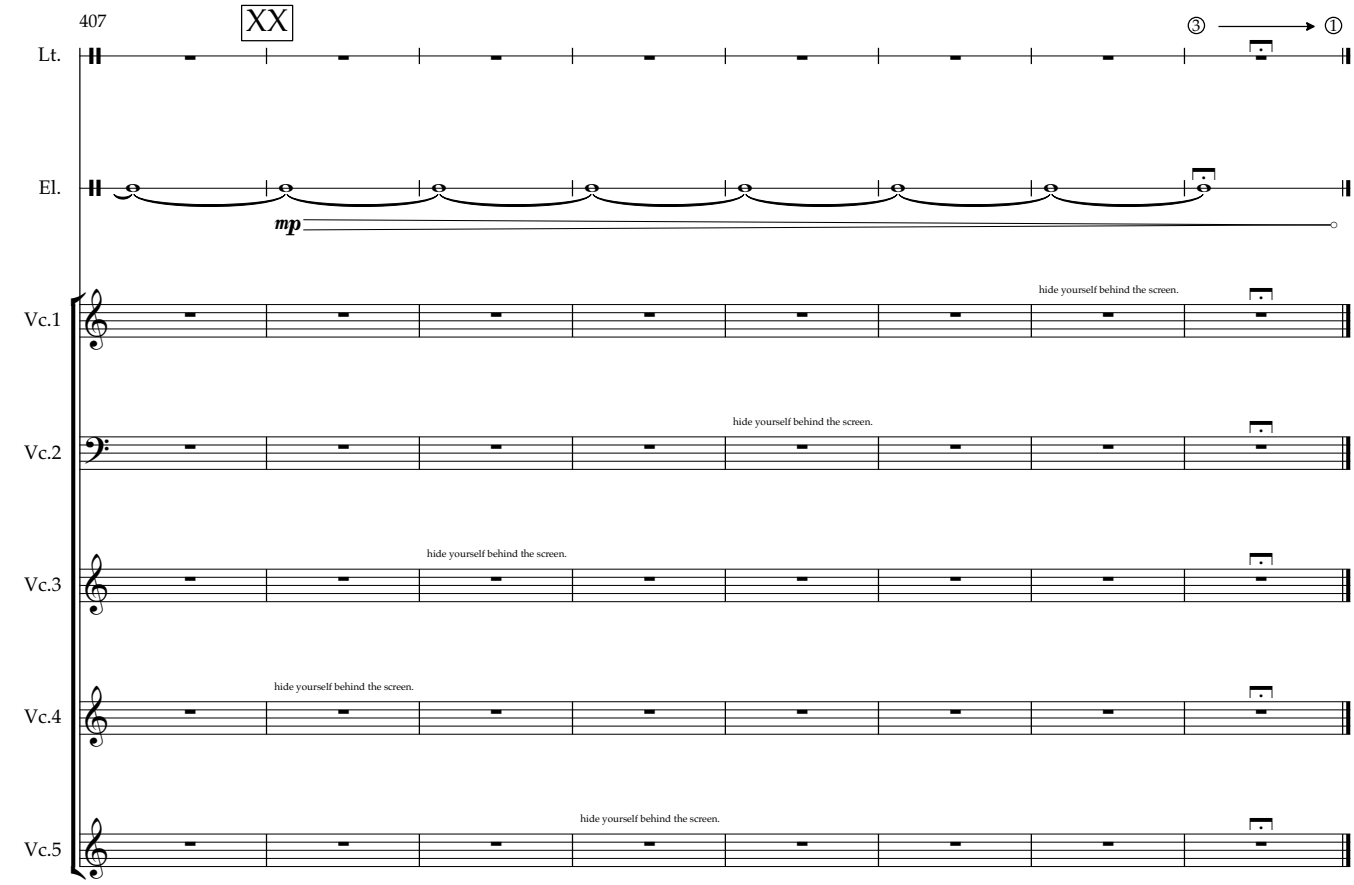
40 sec.

Vc.5

40 sec.

Walk to the cello slowly.


399
VV
WW
El.
Vc.1
Stand beside the cello.
Take the mask off. Then,
freeze without facial expression.
Vc.2
Stand beside the cello.
Take the mask off. Then,
freeze without facial expression.
Vc.3
Stand beside the cello.
Take the mask off. Then,
freeze without facial expression.
Vc.4
Stand beside the cello.
Take the mask off. Then,
freeze without facial expression.
Vc.5
Stand beside the cello.
Take the mask off. Then,
freeze without facial expression.


407
XX
③
①
Lt.
El.
mp
Vc.1
hide yourself behind the screen.
Vc.2
hide yourself behind the screen.
Vc.3
hide yourself behind the screen.
Vc.4
hide yourself behind the screen.
Vc.5
hide yourself behind the screen.