Andrián Pertout

La Homa Kanto

for Harmonically Tuned Synthesizer Quartet

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Composed between August and October, 2005

Hommage à Lou Harrison (1917-2003)

'Acousmatic' Premier: 27 April, 2007 (St. Neighborhood Unaitarian Church, Los Angeles Sonic Odyssey: Electronic and Computer Music Concert Series 2007, 26-28 April, 2007, Pasadena, California, USA)

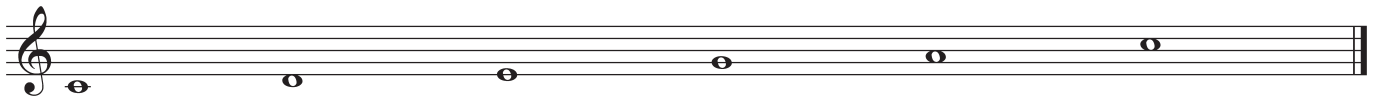
Duration: 11'50"

PROGRAMME NOTES

In order to understand the basic concept of just intonation, one must refer to the natural acoustic phenomenon known as the 'harmonic series'. The overtones of a specific pitch are generally referred to as the 'harmonic series', and the musical scale derived from this series is constructed around pure (or just) intervals. This system of just intonation is strikingly dissimilar to the 'twelve-tone equally-tempered division of the octave', which is based on the division of the octave into twelve equal intervals – the frequency ratio of each semitone (or tempered half-tone) being the twelfth root of 2. In *Lou Harrison: Composing a World* Leta E. Miller and Fredric Lieberman describes just intonation thus: "Pure intervals arise when the frequencies of the individual tones reflect the precise mathematical proportions that occur in the series: 3/2 for the fifth, 4/3 for the fourth, etc." Intervals manifested naturally within the harmonic series are particularly favourable in just intonation, and certainly ones with "superparticular vibration ratios", where the "numerator exceeds the denominator by one" such as the just perfect fifth (3/2), perfect fourth (4/3), major third (5/4) and minor third (6/5).

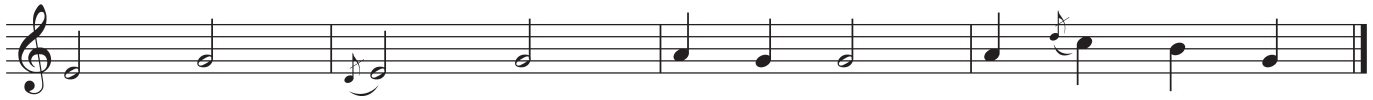
'La Homa Kanto' or 'The Human Song' in Esperanto is a dedication to the late American composer Lou Harrison (1917-2003), and its pitch material has been derived directly from Harrison's five-tone scales, presented in *Lou Harrison's Music Primer: Various Items About Music to 1970*. Included are the first five in the series, with the first – the diatonic or major pentatonic scale – acknowledged by Harrison as the "prime pentatonic", and "practically the Human Song." According to Harrison, "These first five are the most widespread, the core, the principal modes of 'Human Music'. They also constitute the bone-work, the firmest compositional basis for seven-tone music." Modes one, two and five may be considered to be anhemitonic pentatonic forms (scales incorporating half steps, or semitones), while three and four, hemitonic pentatonic forms (scales not incorporating half steps, or semitones). Harrison's five pentatonic scales include the diatonic or major pentatonic, minor pentatonic (or fifth mode major pentatonic), Japanese *Hirajoshi*, fifth mode Indonesian *Pélog*, as well as the Indonesian *Sléndro* (or second mode major pentatonic). The consideration of their complements presents the third mode major pentatonic, fourth mode major pentatonic, third mode Indonesian *Pélog*, fourth mode Japanese *Hirajoshi*, as well as the Indonesian *Sléndro* (or second mode major pentatonic).

Major Pentatonic Scale "The Human Song"

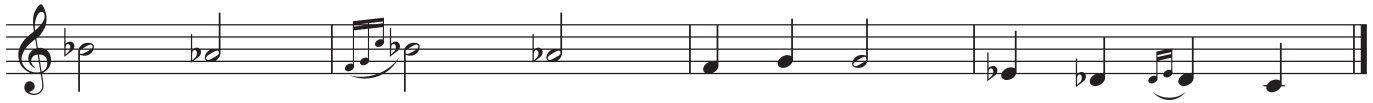


The compositional strategy for the work involves the creation of two complimentary sets of melodic material, consisting of what is essentially a four-bar melodic sentence based on Harrison's first pentatonic (or major pentatonic), with an additional four-bar variant based on its complement (or third mode major pentatonic). In some aspects, this second sentence could be considered an almost comparable inversion, although it does not represent an 'authentic' inversion in the serial sense of the word, but rather an inversion of contour utilizing the inverted pitch material of the original major pentatonic. The third bar of both versions represents the only literal inversion of intervals. A further observation reveals the respective major and minor tonalities of the two four-bar melodic sentences.

Four-bar melodic sentence



Complimentary sentence



The work also features ten distinct tuning modulations: three-limit, five-limit, seven-limit, eleven-limit, thirteen-limit, seventeen-limit, nineteen-limit, twenty-three-limit, twenty-nine-limit, and thirty-one-limit just intonation systems, based on the third, fifth, seventh, eleventh, thirteenth, seventeenth, nineteenth, twenty-third, twenty-ninth, and thirty-first partials of the harmonic series – each system adding its own microtonal nuances to the recurring melodic material, which is further transformed via the introduction of alternative scalar material, as well as via harmonic development pertinent to each individual just intonation system. The structural framework of the composition is directly related to the primary motive of the four-bar melodic sentence. In five-limit terms, the primary motive denotes the following intervals: 5/4, 3/2, and 9/8, and 5/4, and 3/2; and is expressed in the score as section one (rehearsal letters A and B – incorporating Lou Harrison Pentatonic #1, and both three-limit and five-limit just intonation), which is designated a 5/4 metrical structure; section 2 (rehearsal letters C and D – incorporating Lou Harrison Pentatonic #2, and both seven-limit and eleven-limit just intonation), a 3/2 metrical structure; section 3 (rehearsal letters E and F – incorporating Lou Harrison Pentatonic #3, and both thirteen-limit and seventeen-limit just intonation), a 9/8 metrical structure; section 4 (rehearsal letters G and H – incorporating Lou Harrison Pentatonic #4, and both nineteen-limit and twenty-three-limit just intonation), a 5/4 metrical structure; and section 5 (rehearsal letters I and J – incorporating Lou Harrison Pentatonic #5, and both twenty-nine-limit and thirty-one-limit just intonation), a 12/8 metrical structure (equal to 3/2). A sequential series of metrical structures is therefore utilized in the work to reflect the primary motive and its frequency ratios of 5/4, 3/2, 9/8, 5/4, and 3/2.

Saturday, 3 February, 2001 (Our Colleague Lou Harrison)

Dear Fellow SCI Members:

“I just received very sad news from my colleague and fellow SCI member Donald Harris. He reports that Lou Harrison, noted American composer, passed away last night.

“Lou Harrison had appeared at several of our National Conferences. His cheerful, luminous personality endeared him to and will be remembered by all who knew him. Lou was en route to Ohio State for our annual New Music Festival which honours him and features his music.

“I include the message I received from Don Harris, who related the sad news to our faculty.”

Thomas Wells (President, Society of Composers, Inc.), Professor of Music, Director, Sound Synthesis Studios, Ohio State University, Columbus, Ohio, USA

Saturday, 3 February, 2001 (Our Colleague Lou Harrison)

"Last night, while travelling from Chicago to Columbus, Lou Harrison passed away. We had sent Adam Schweigert and Joe Panzner, two students in Composition and Theory, to Chicago with a University van to greet Lou and his travelling companion, Todd Burlingame, and drive them back to campus for the Festival. Lou does not like to fly and took the train, the California Zephyr, from near San Francisco to Chicago. The train arrived at about 5:15 PM. While en route to Indianapolis, their overnight destination, Adam, Joe, Lou and Todd decided to stop at a Denny's restaurant in Lafayette, Indiana, for some dinner. Lou stumbled and fell upon getting out of the vehicle and apparently suffered a heart attack. He had great difficulty breathing. Paramedics were called and they arrived within minutes. Lou was transported to the hospital but was unable to be revived. He passed away around 9 or 9:30 PM.

"This is a great tragedy for the entire world of music. Lou was as excited about the Festival as we were. Our sympathies go out to all in the world of music and dance who treasured his great gift. I will always remember the joy in his voice when we spoke over the telephone about the Festival. He was an active participant in planning the concerts. He had also prepared a special seminar for OSU students in composition. He was very much looking forward to the CSO performances of his Third Symphony in a final revision that he had just completed. He told me how honoured he felt to have so many of his compositions performed on the Festival. Let everyone know that the Festival performances will go on as planned as a tribute to this legendary American musician.

"I must also at this time offer our sincere thanks to Adam and Joe. As you might imagine, they were devastated by what took place. Yet they remained calm at all times, stayed in close touch with me, and were of great comfort to Todd Burlingame. We can be proud of the way they represented Ohio State and the School of Music. Adam and Joe will return to Columbus today. When you see them, please thank them for their calm and measured reactions under such tragic circumstances.

"Lou Harrison will be cremated today; his remains shipped back to California. He was eighty-five years old."

Donald Harris, Professor of Composition and Theory, School of Music, Ohio State University, Columbus, Ohio, USA

Thursday, 6 February, 2003 (Death of Lou Harrison)

Dear Thomas Wells,

“Thank you very much for sharing the sad information about Lou Harrison. And what a beautiful tribute by long-time SCI member, Donald Harris. Lou attended symposia in his honour many times here in Portland, Oregon, Lou's place of birth. Two recent ones in particular stand out when Lou was aged 79 and 82. The first was at Lewis & Clark College in Portland with Bill Colvig, his late partner. Lou gave numerous inspiring lecture presentations that took your breath away, and when his music was performed by L&C students to a large public audience, Lou signed CD's late into the night despite his need to get up early the next morning to present again and again for several days. His music was, and continues to be, performed often in Portland on many of the instruments Lou invented with Bill Colvig.

“Do you remember how Lou would title many of his musical compositions in Esperanto?! Lou was passionate about keeping this rarely used universal language alive. Lou also designed numerous letter fonts, many of which we now select on the internet when writing our documents. Remember his beautiful calligraphic handwriting and the painstaking care with which he wrote each letter?

“At aged 82, Lou again came to Oregon and was honoured in a Symposium at the University of Oregon in Eugene where he taught a roomful of young composers for several days. Lou was a lively and brilliant presenter at these events. His eyes and whole body lit up when he spoke, and his ideas were often more controversial than those of students 60 years younger! Despite his exceptional brilliance, he never boasted of his intelligence or of anything else, instead inspiring the listener to invent and create as he did, living life to the fullest. Even into his 80's, the cogency of his ideas, his wit, passion, and joy of learning were as strong as that of a young person. Your choice of the word ‘luminous’ to describe Lou is perfect. He was a wonderful, brilliant human being, and we will all miss him greatly. I can only imagine what your New Music Festival is like with the aura of Lou Harrison hovering in the room. The music must be exceptional and every word spoken charged with power. I'm sure Lou is there with you and I wish I could be there too.

“Warm remembrances, and thank you for writing.”

Linda Hathaway Bunza, Director, Columbia Research Institute for the Arts and Humanities, Portland, Oregon, USA.

Lou Harrison, Beloved Icon and Pioneer

By Fredric Lieberman

The musical world was stunned by the death, on Sunday, February 2, of Lou Harrison, the distinguished and much beloved composer and humanitarian. In his delightful *Music Primer* (1971) Lou wrote, 'Someone has said that music is to be recommended because the Angels practice it.' Self-proclaimed a 'glandular optimist,' certainly Lou is now cherishing the songs of that Angelic choir, and I imagine he's already started teaching them to sing in Just Intonation.

Harrison, who celebrated his 85th birthday this year, was on his way to a week-long festival of his music in Columbus, Ohio, when an accidental fall apparently brought on a heart attack. The performances will go on as a memorial tribute. Lou had recently completed revisions to his *Third Symphony* – he continually revised works until they 'stopped itching' – and was enthusiastically looking forward to the premiere of the new version next Friday. (The *Third Symphony* was first performed in 1982, though its diverse movements include material from as early as 1937.)

Lou met his life-partner, William Colvig, in 1967; they lived and worked together until Bill's death in 2000. Lou's younger brother Bill also predeceased him. He is survived by his sister-in-law Dorothy, of Reno, Nevada, and two nephews Brad and Barry.

Though beset by bouts of illness, sometimes quite painful, Lou never stopped working, teaching, and learning. He recently completed a new book *Poems and Pieces*, currently in press, which juxtaposes poetry with a selection of works for the Javanese gamelan. In addition to revising the *Third Symphony*, Lou completed revisions and additions to his second opera *Young Caesar*; completed the construction of an ecologically-friendly straw-bale house of his own design in Joshua Tree, California; bought a used Mercedes diesel auto, which he had converted to run on bio-diesel fuel (that is, any form of vegetable oil); and was preparing once again to teach his course on Javanese gamelan for Cabrillo College in Santa Cruz.

As pianist Sarah Cahill pointed out, 'Lou's passing is so symbolic of the end of an era. His deep connections to Schoenberg, Ives, Cowell, and Cage made him a real icon, even beyond his own compositional career.' Born in Portland, Oregon, in 1917, Lou grew up in the San Francisco Bay area, studied music at San Francisco State College, composition with Henry Cowell and Arnold Schoenberg, and pioneered with John Cage in creating and performing works for percussion ensemble. Moving to New York in 1943, Harrison worked as a music critic for the Herald Tribune, hired by Virgil Thomson, and wrote also for *Modern Music* and *New Music Quarterly*.

Lou had previously corresponded with Charles Ives, and during this New York period conducted the premiere of Ives's *Third Symphony*, which won the Pulitzer Prize. Ives wrote to Lou 'As you are very much to blame for getting me into that Pulitzer Prize street, and for having a bushel of letters to answer and for having a check of $500 thrown over by the Trustees of Colum-Uni-, you have got to help me by taking 1/2 of this (somewhere enclosed)…'

Fusing Asian with Western music

Lou returned to California in 1953, where he settled in Aptos, near Santa Cruz. Life in California, though difficult for a struggling composer, brought him into close contact with Asian musics, which inspired melodic and modal experiments, leading to a panoply of works fusing Asian with Western music in unique and beautiful ways. Some of these works are composed directly for traditional Asian instruments, such as the many compositions for Javanese gamelan; others combine Asian and Western instruments, one of the most successful being *Pacifika Rondo* (1963); and still others, such as the magnificent *Piano Concerto* (1985) borrow musical forms or styles from Asian sources, so thoroughly integrated into the musical texture that their diverse origins are buried beneath the surface of Lou's melodic magic. Harrison's major works include four symphonies, two operas, the *Piano Concerto*, major dance scores including *Solstice* (for Jean Erdman) and *Rhymes With Silver* (for Mark Morris), the *Strict Songs* which, when recorded by the Louisville Symphony, introduced many listeners to pure intonation, and many chamber works of great power and beauty, such as the *Suite for Piano*, the *Grand Duo* for vn and pf, the *Varied Trio* for vn, pf, and percussion, and the *String Quartet Set*. These works will, I'm sure, stand the test of time.

Harrison pioneered in many fields: music for percussion orchestra; the use of pure or Just Intonation rather than equal temperament; the creation of new instruments; the introduction of gamelan music and new composition for that ensemble; and teaching world music, which he did for decades at Mills College, San Jose State, and Cabrillo College.

Lou was a founding spirit of the Cabrillo Music Festival, which has grown to be one of the most important venues for new music. In 2001, under the baton of Marin Alsop, the Cabrillo Festival performed Lou's first opera, *Rapunzel* that had been premiered at the 92nd St. Y in New York City in 1959; over the years other conductors including Gerhard Samuel, Carlos Chavez, and Dennis Russell Davies have led the Cabrillo Festival orchestra in presenting Harrison's music, along with that of hundreds of other contemporary composers.

A fearless pacifist, outspoken environmentalist

On social issues Lou was fearless and outspoken. A pacifist, he protested both in words and music against atomic testing, the Vietnam War, and militarism in general. He was an early supporter of environmental causes, championing the use of renewable fuels, paper recycled, or even better made from fast-growing, easily renewable hemp or kenaf. An advocate for Gay Rights, Lou never hesitated to make his views public. In 1963, at the University of Hawaii, Lou fired off a letter to the student paper, protesting one previously published: 'In the present population explosion, calling homosexuals sick strikes this reader as a case of pots and kettles.'

Mr. Ricardo Trimillos, then a graduate student, recalls: 'Lou was not only a wonderful artist; he was a passionate and committed citizen. I remember his letter defending gay rights back in '63 when being gay was hardly on anyone's radar screen. He signed it as 'Composer in Residence' for the contemporary festival, which upset some faculty members. However, for me he brought home the 'ideology' of understanding music in its cultural context in a very dramatic way. For me that was an important lesson, not taught, but learned.'

Harrison left a voluminous musical legacy of over 300 compositions. Over the past decade, his work has been rapidly growing in international acclaim. New CDs appear regularly; festivals and performances have been increasingly abundant. As of this writing, a memorial tribute in Santa Cruz is being organized, and others will follow.

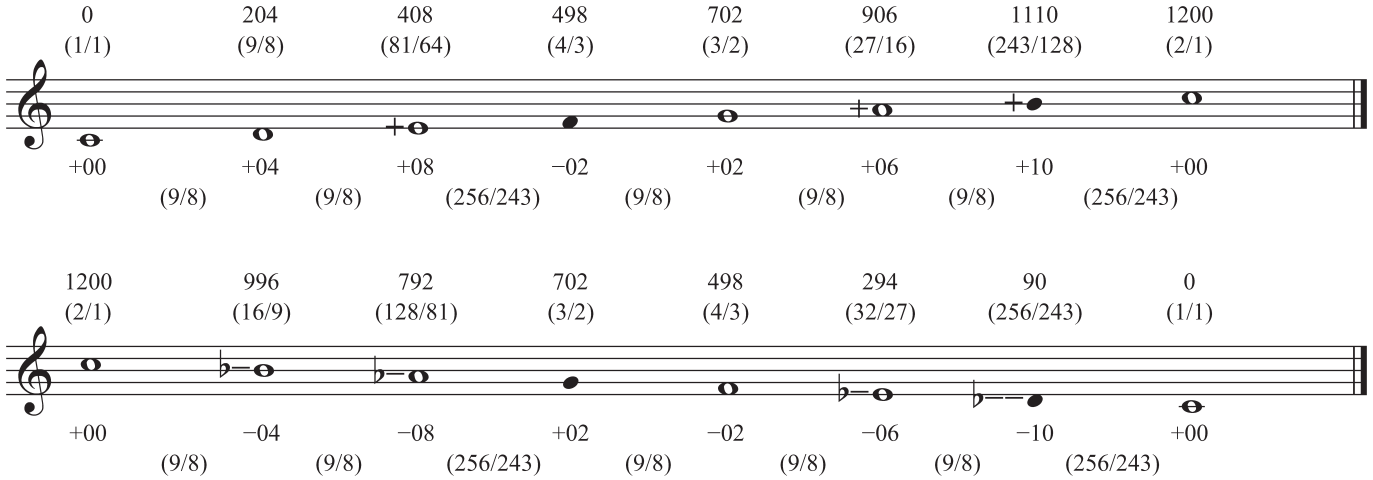
Contagious enthusiasm, generosity, and love

For me, Lou inspired not only through his music, with its continuous search for beauty heedless of current styles or fads, but also through his contagious enthusiasm, generosity, and love. Seldom would I come away from a visit to Lou's Aptos home without the exciting feeling of having learned something remarkable, whether about music, architecture, politics, or literature. Lou filled his place in the world fully and energetically – it's hard to imagine what the world will feel like without him.

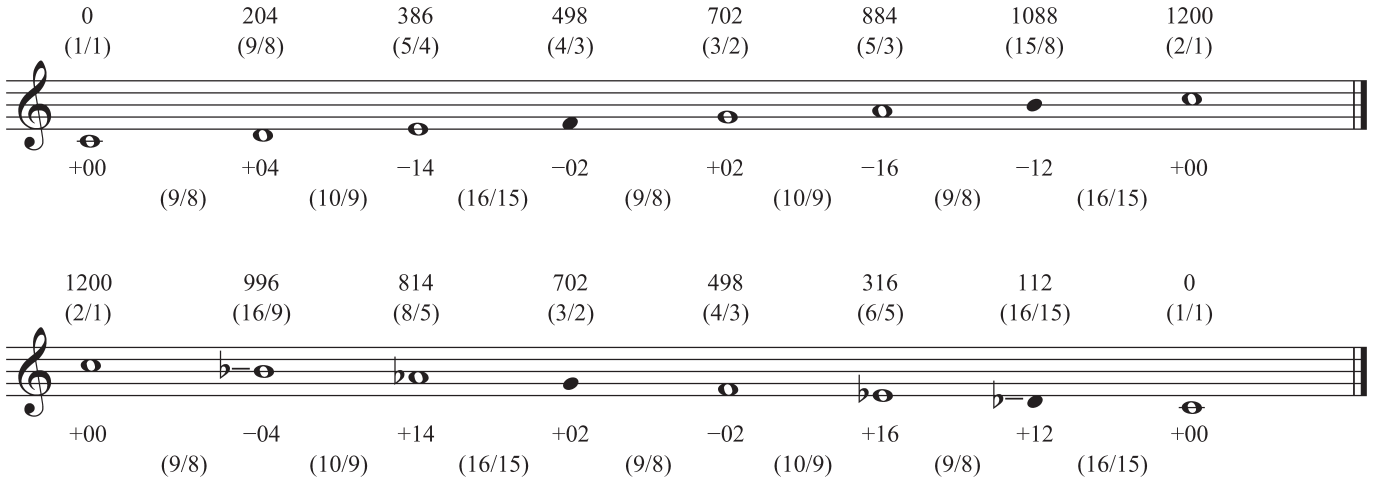
(Fredric Lieberman, composer and ethnomusicologist, teaches at the University of California, Santa Cruz. With co-author Leta Miller, he has written *Lou Harrison: Composing a World* (1998) and a second book on Lou Harrison is forthcoming from the U. of Illinois.)

San Francisco Classical Voice, Oakland, California, USA

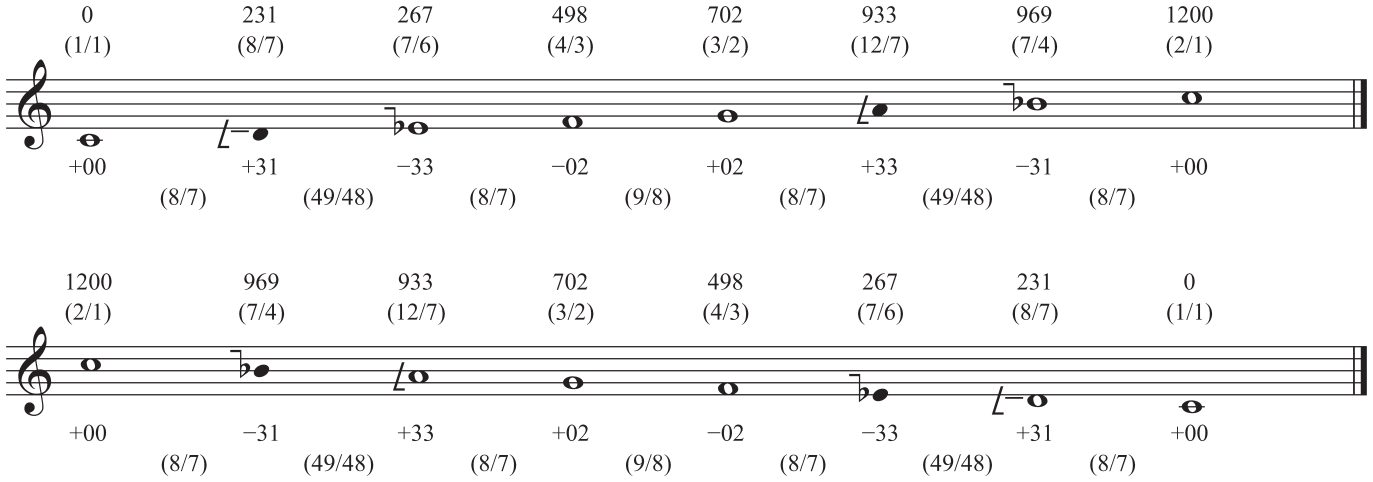
Lou Harrison Pentatonic #1
3-limit Intonation



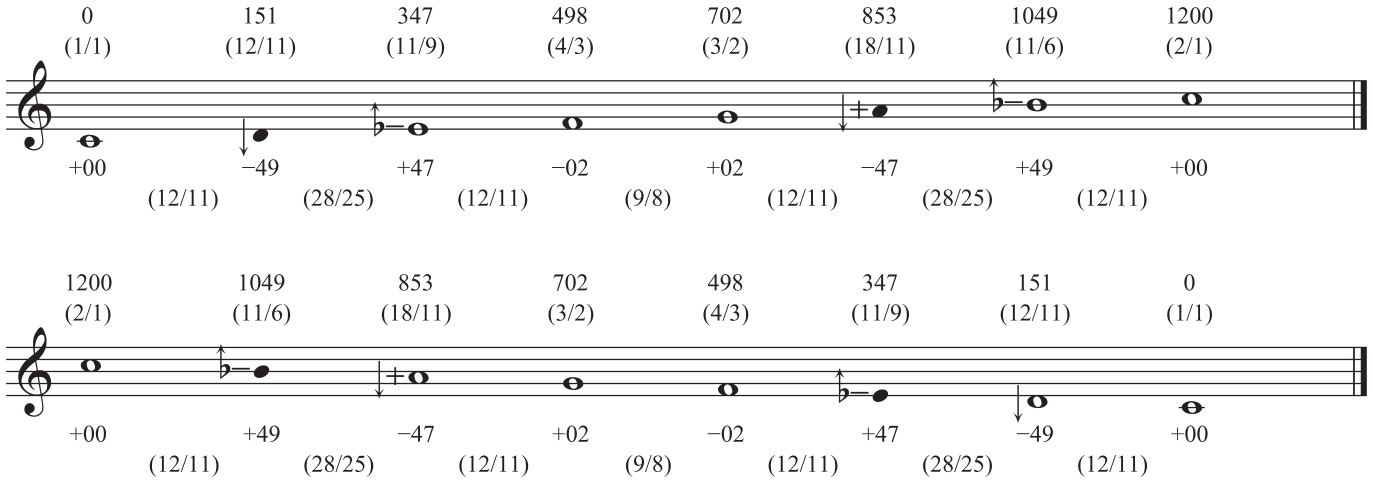
Lou Harrison Pentatonic #1
5-limit Intonation



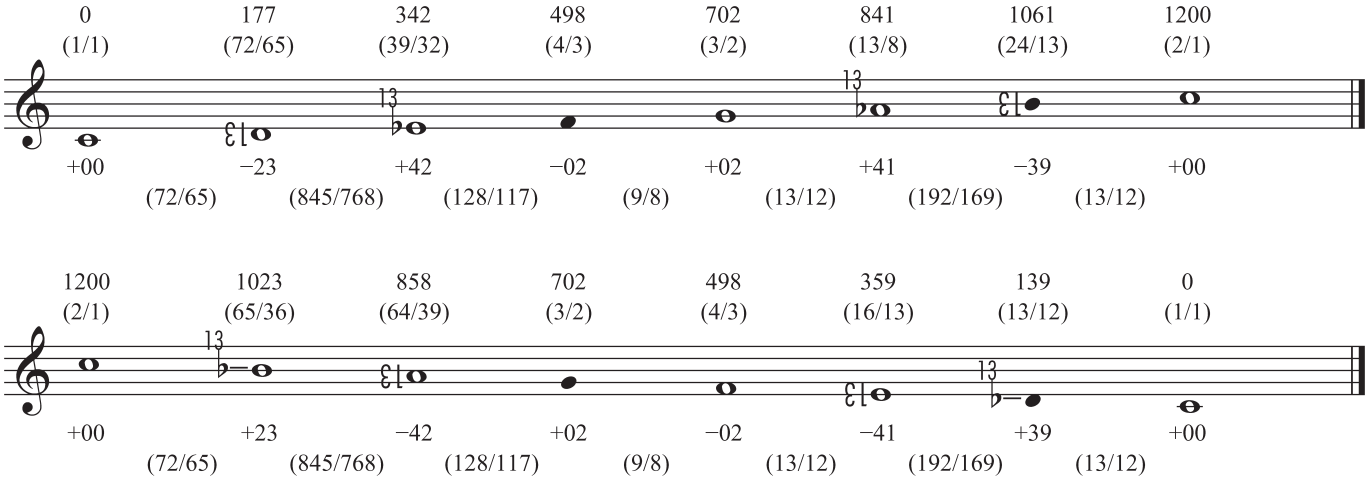
Lou Harrison Pentatonic #2
7-limit Intonation



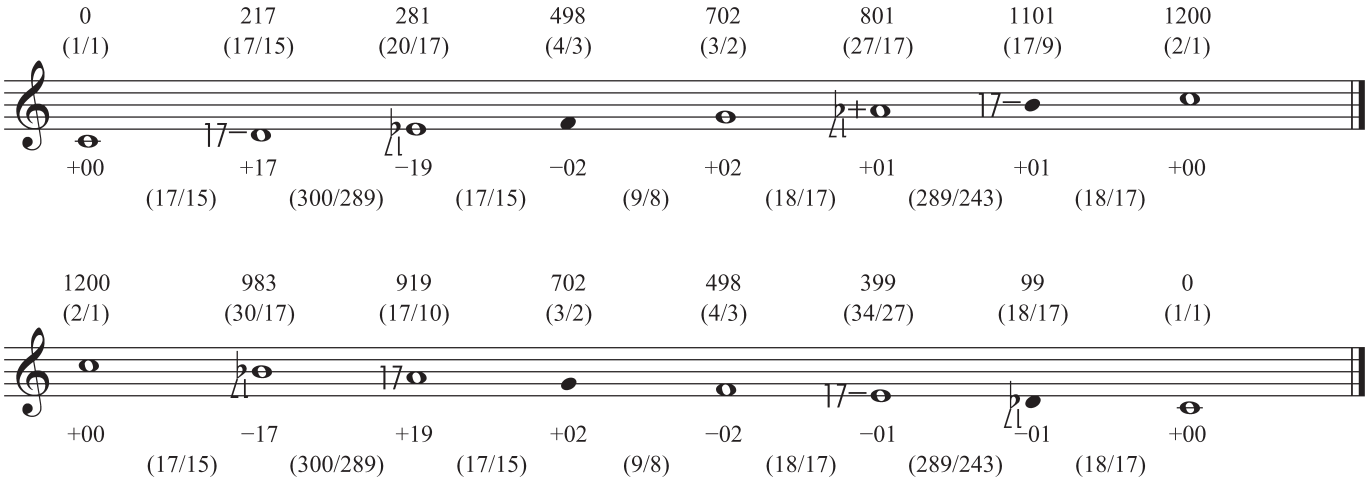
Lou Harrison Pentatonic #2
11-limit Intonation



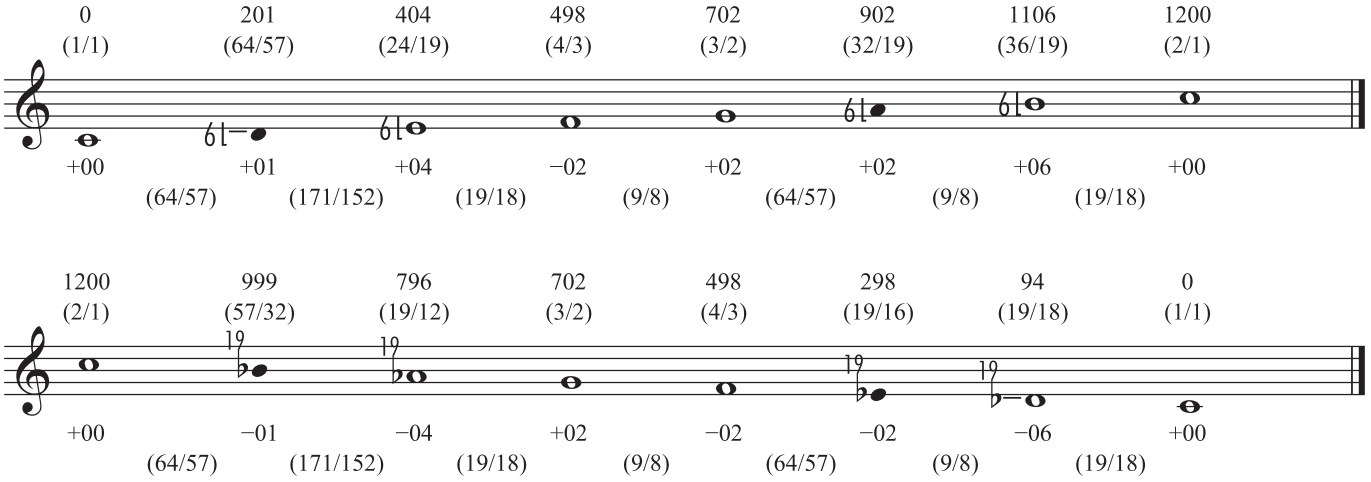
Lou Harrison Pentatonic #3
13-limit Intonation



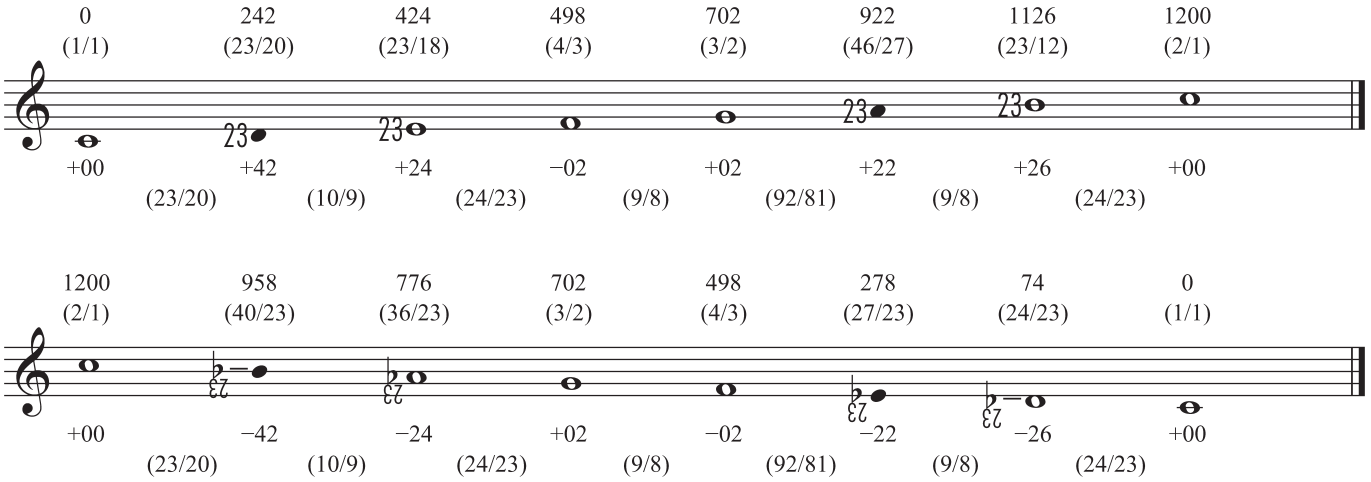
Lou Harrison Pentatonic #3
17-limit Intonation



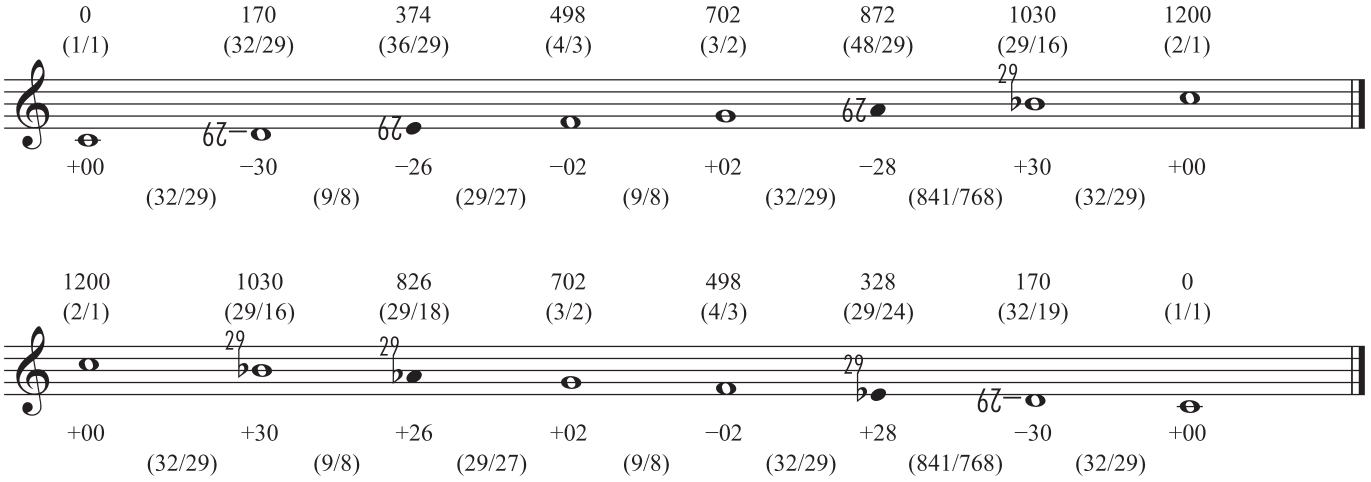
Lou Harrison Pentatonic #4
19-limit Intonation



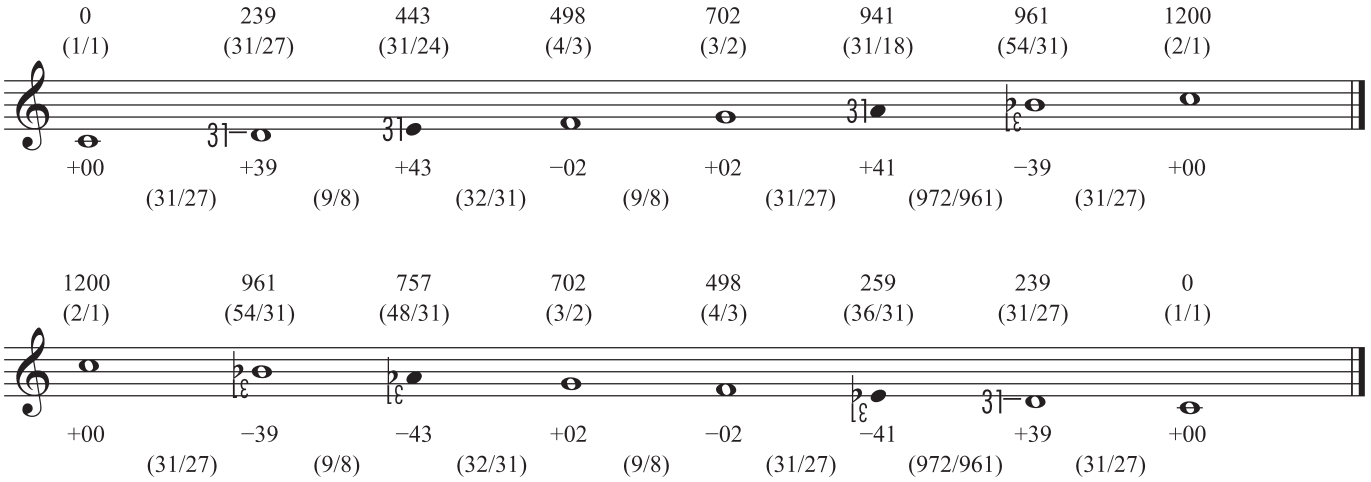
Lou Harrison Pentatonic #4
23-limit Intonation



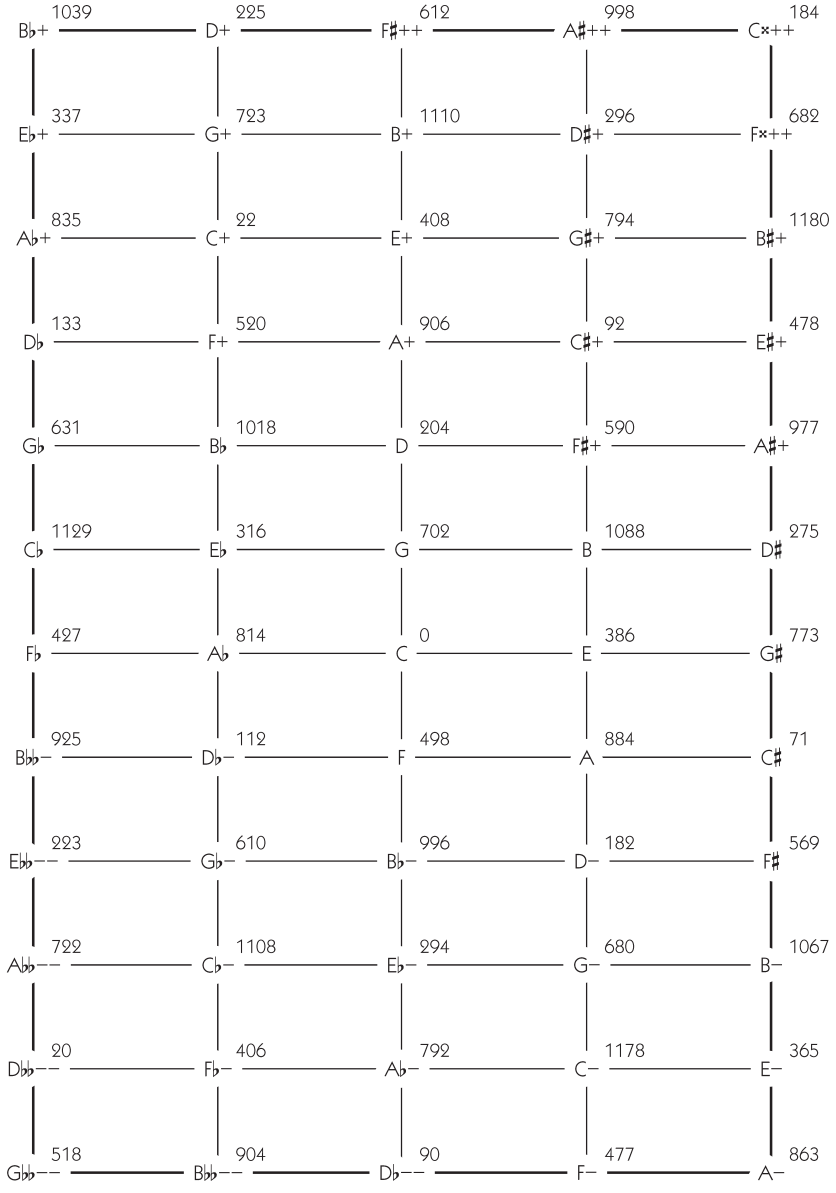
Lou Harrison Pentatonic #5
29-limit Intonation

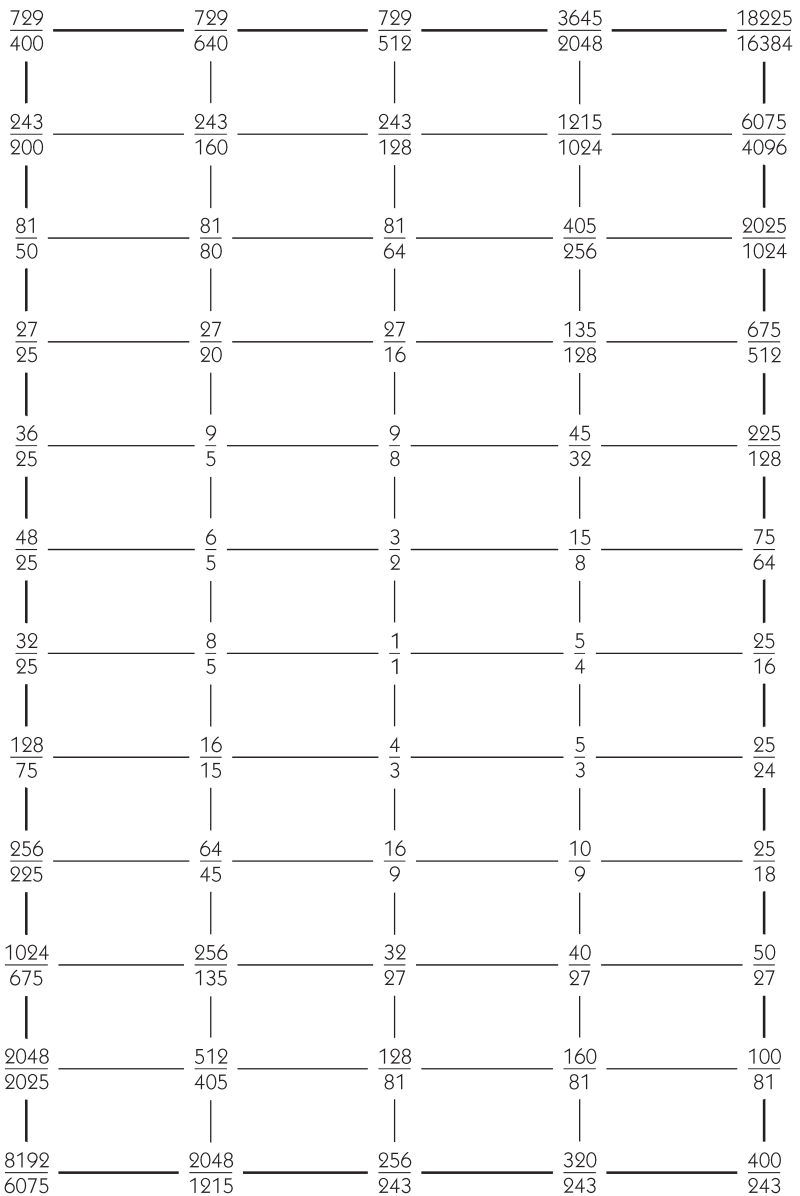


Lou Harrison Pentatonic #5
31-limit Intonation



2, 3, 5-limit Pitch Lattice (Notation, Ratio and Cent Values)





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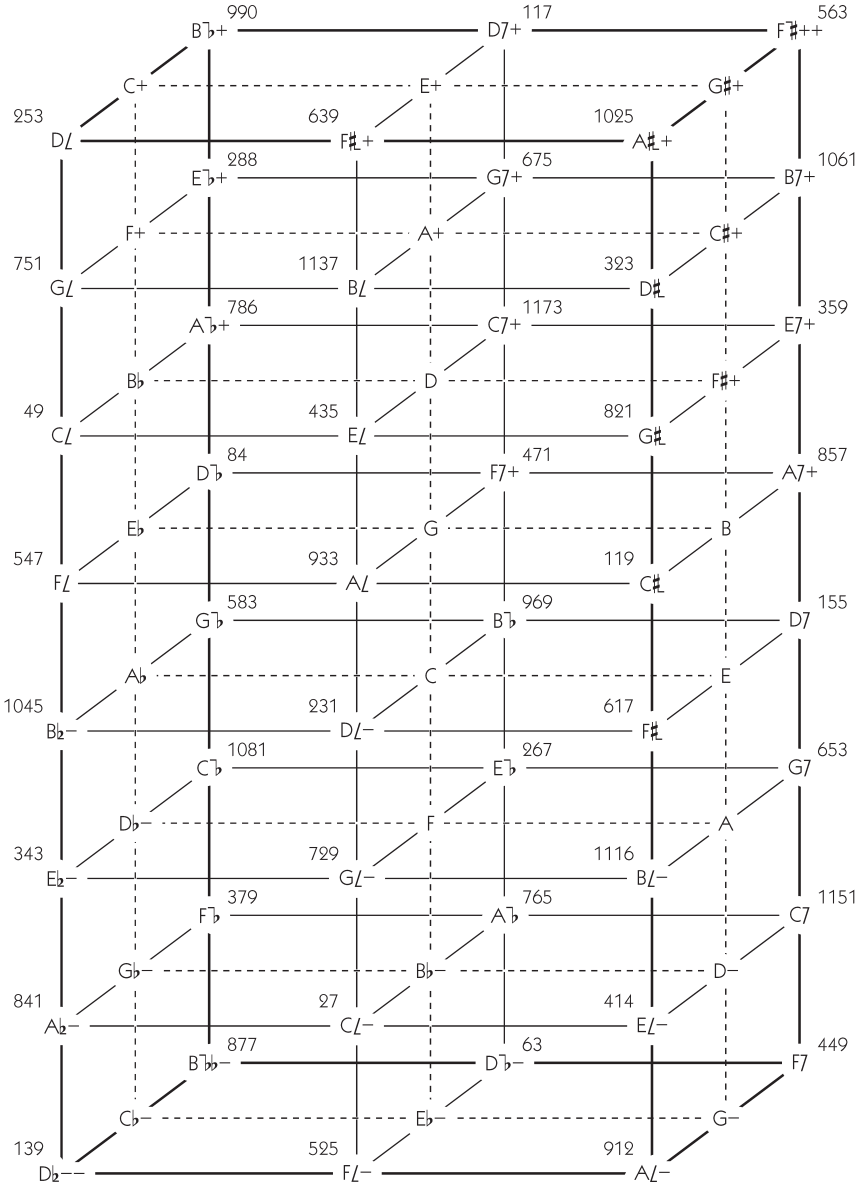
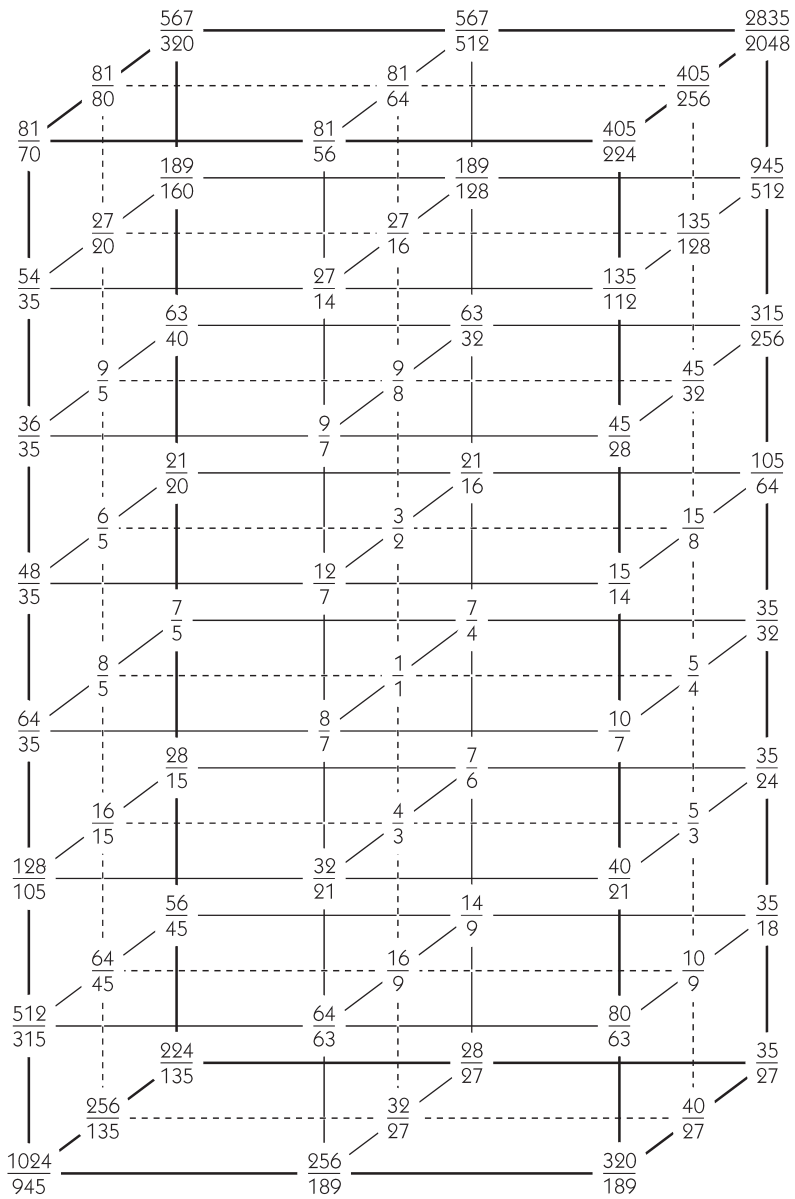
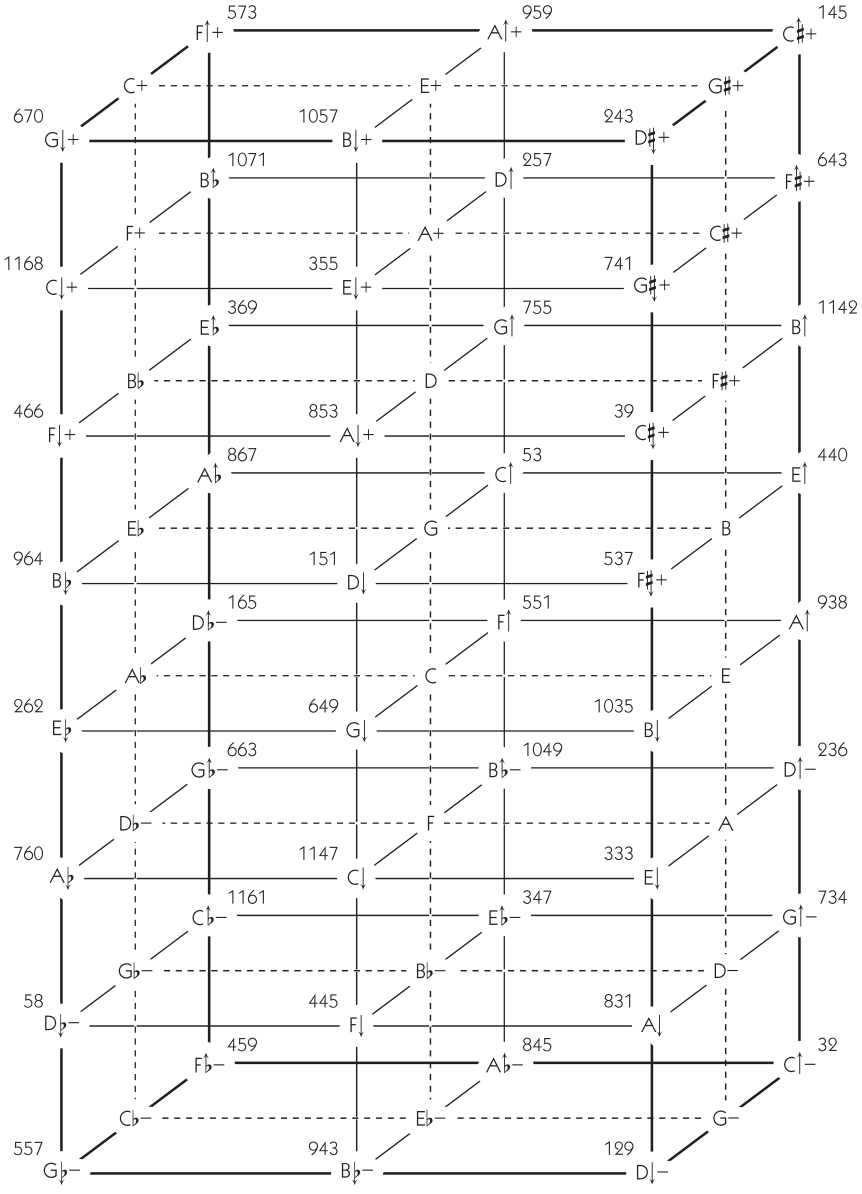
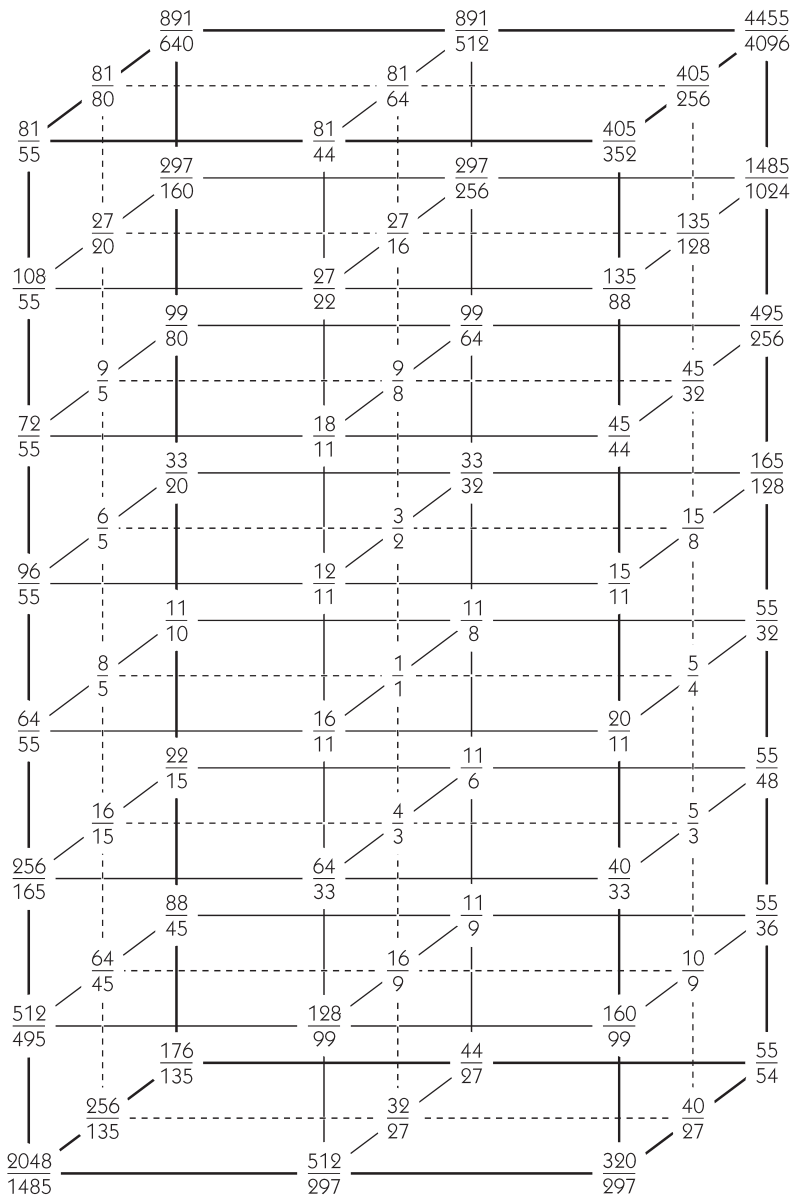


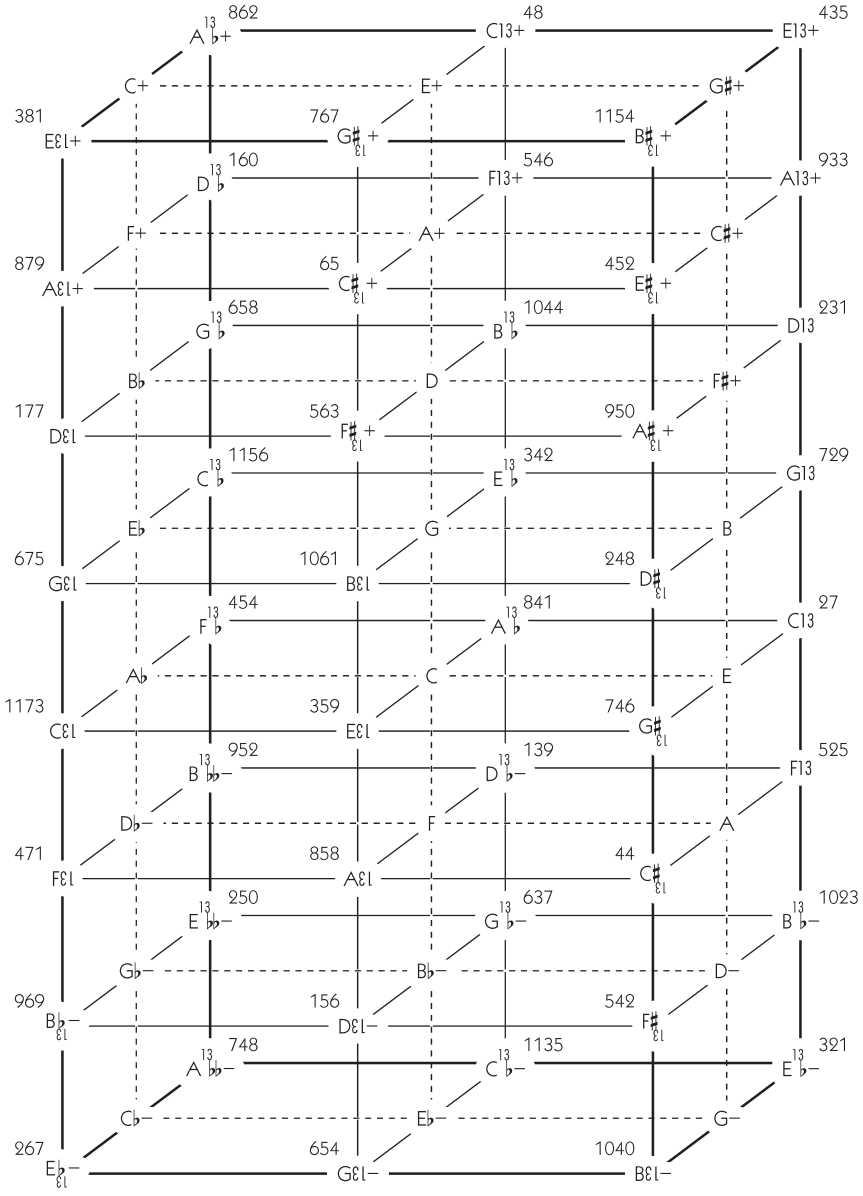


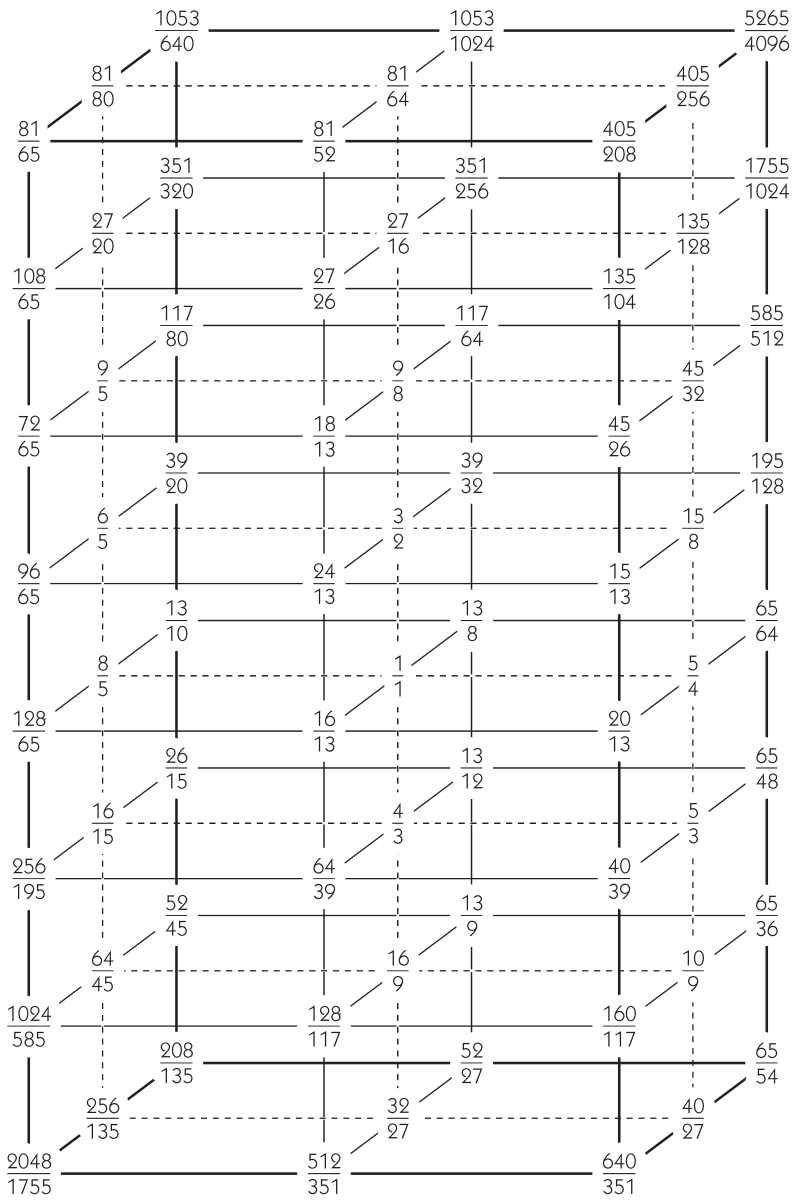
2, 3, 5, 11-limit Pitch Lattice (Notation, Ratio and Cent Values)



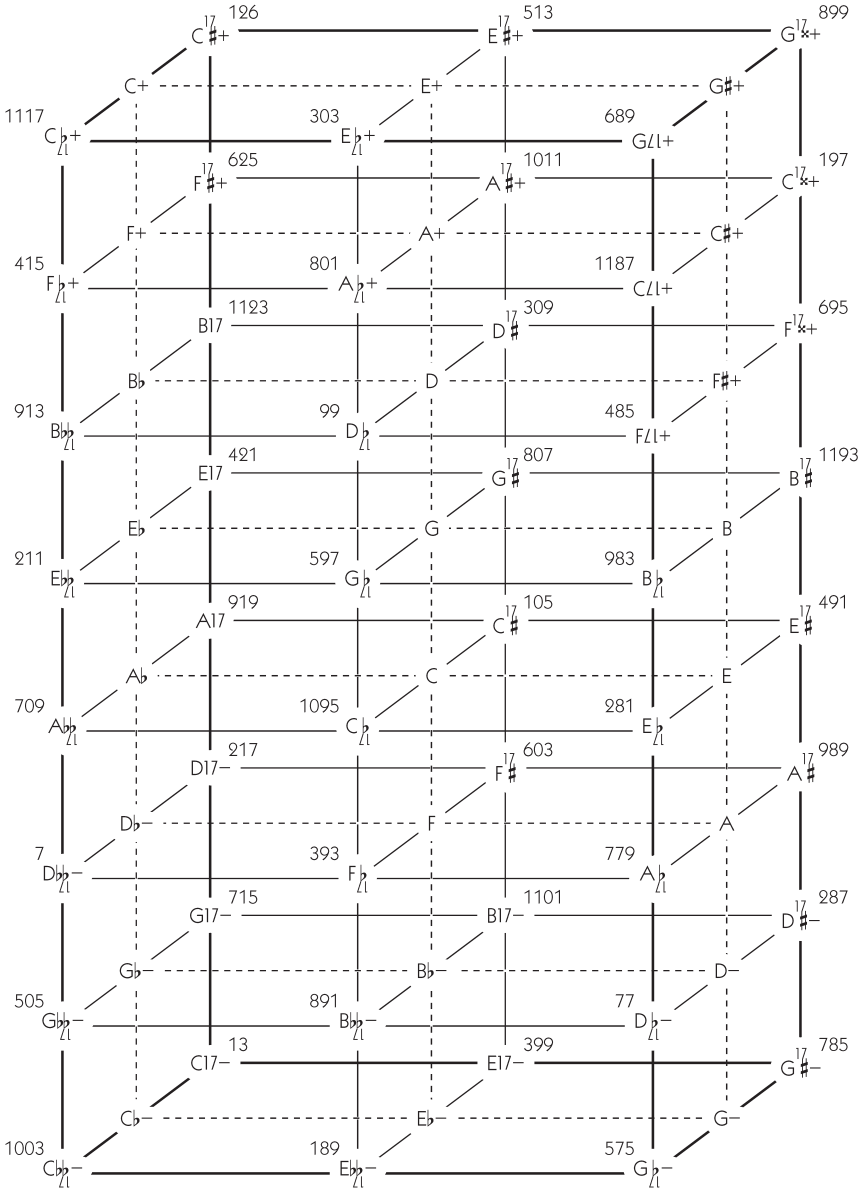


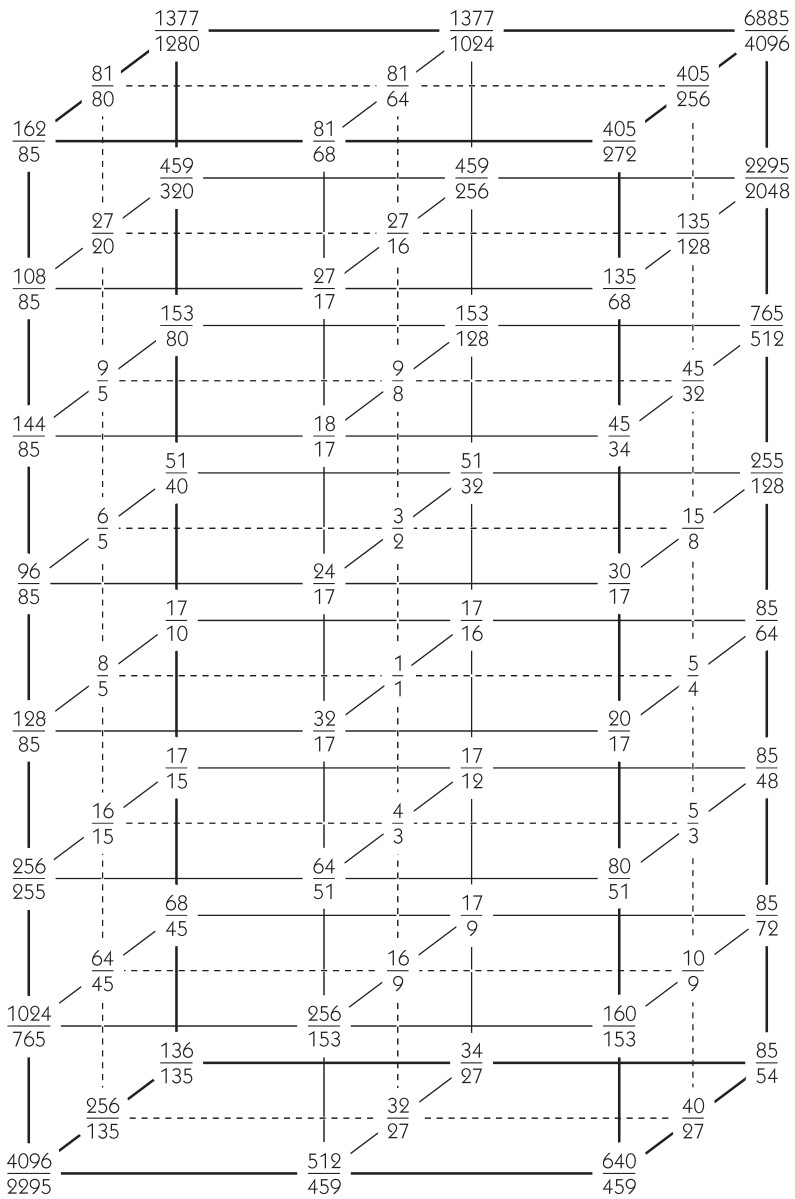
2, 3, 5, 13-limit Pitch Lattice (Notation, Ratio and Cent Values)



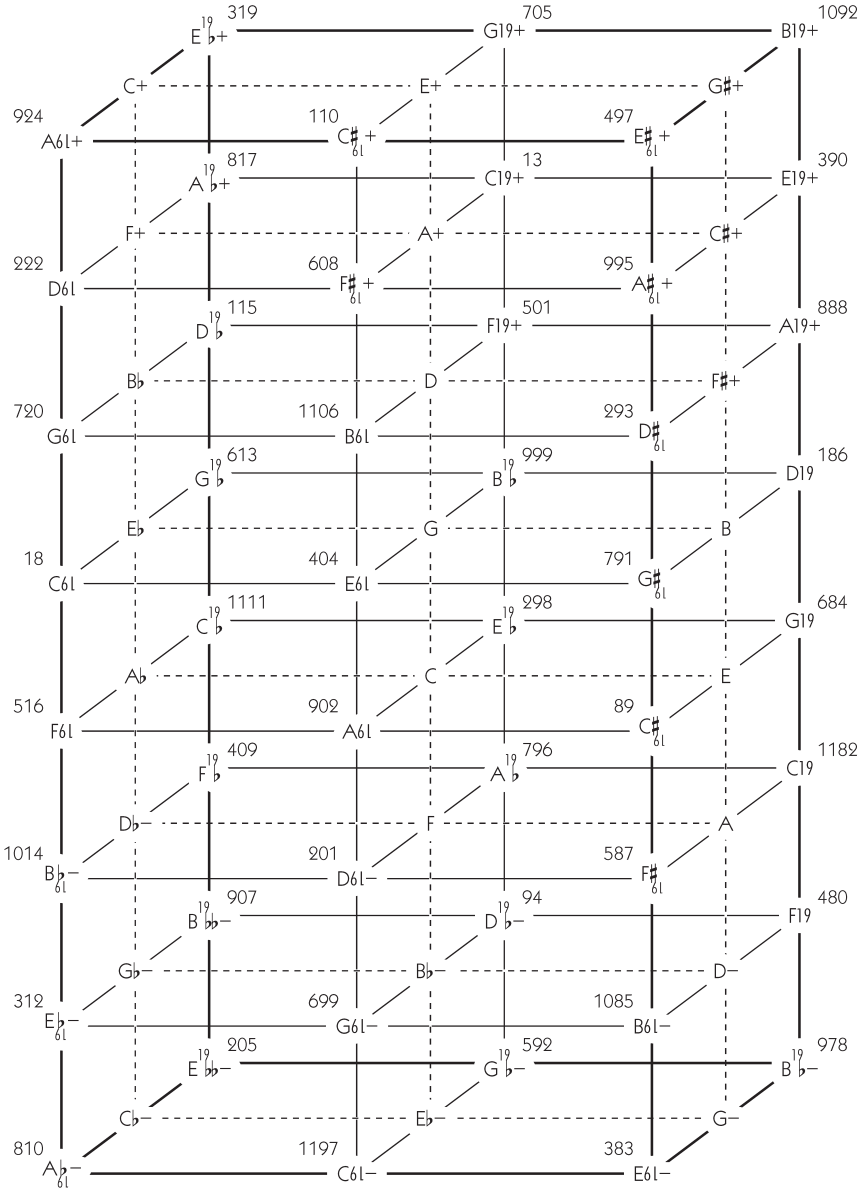


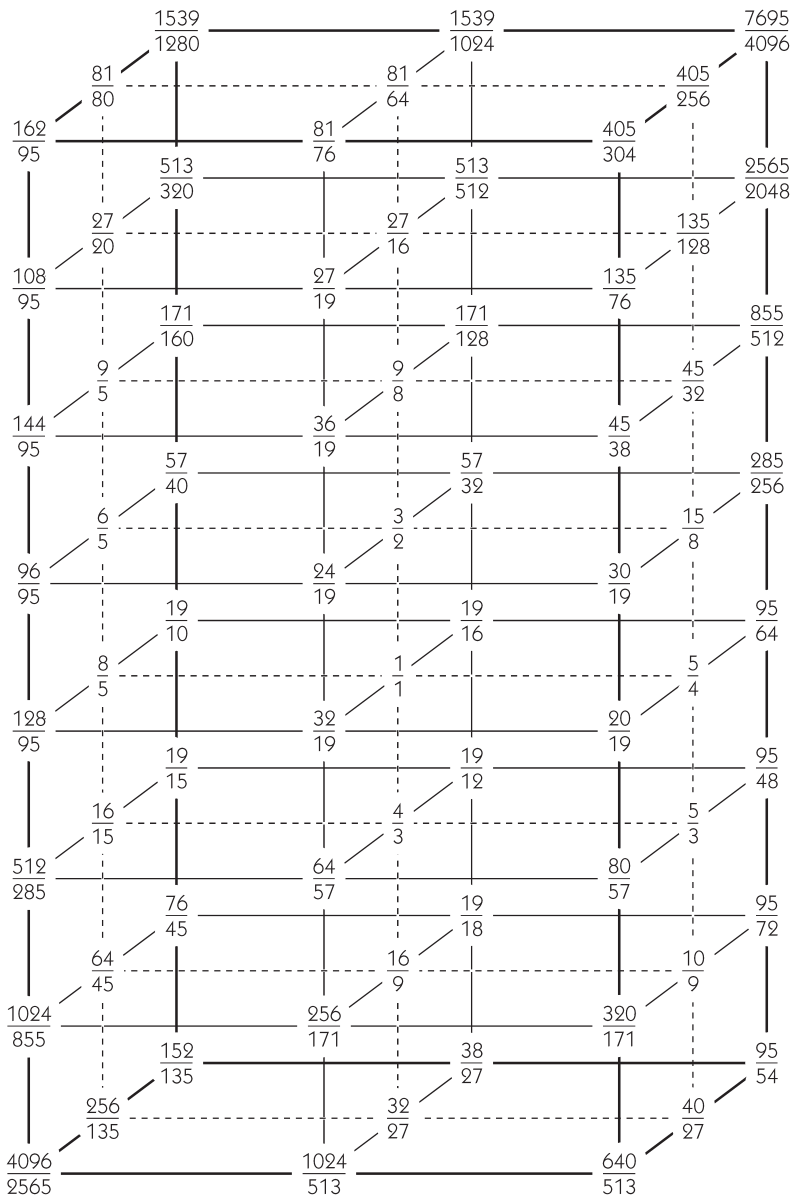
2, 3, 5, 17-limit Pitch Lattice (Notation, Ratio and Cent Values)



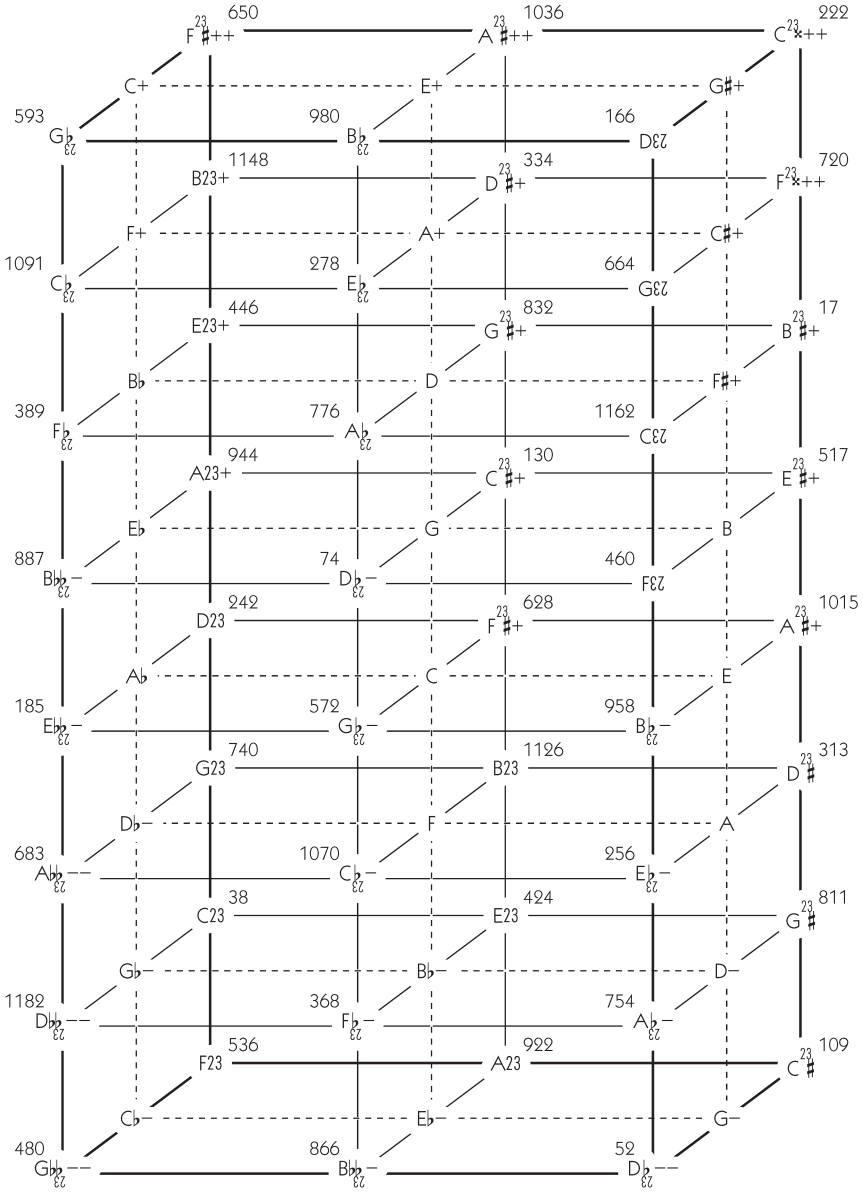


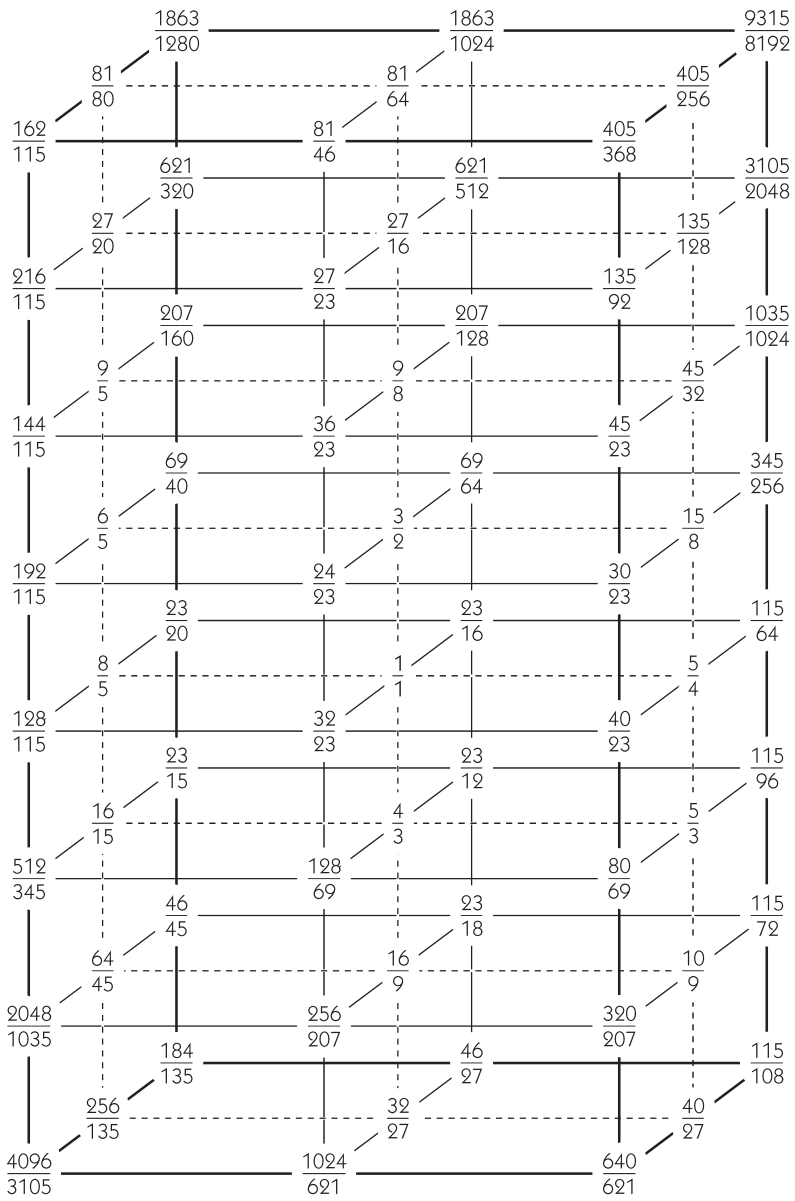
2, 3, 5, 19-limit Pitch Lattice (Notation, Ratio and Cent Values)



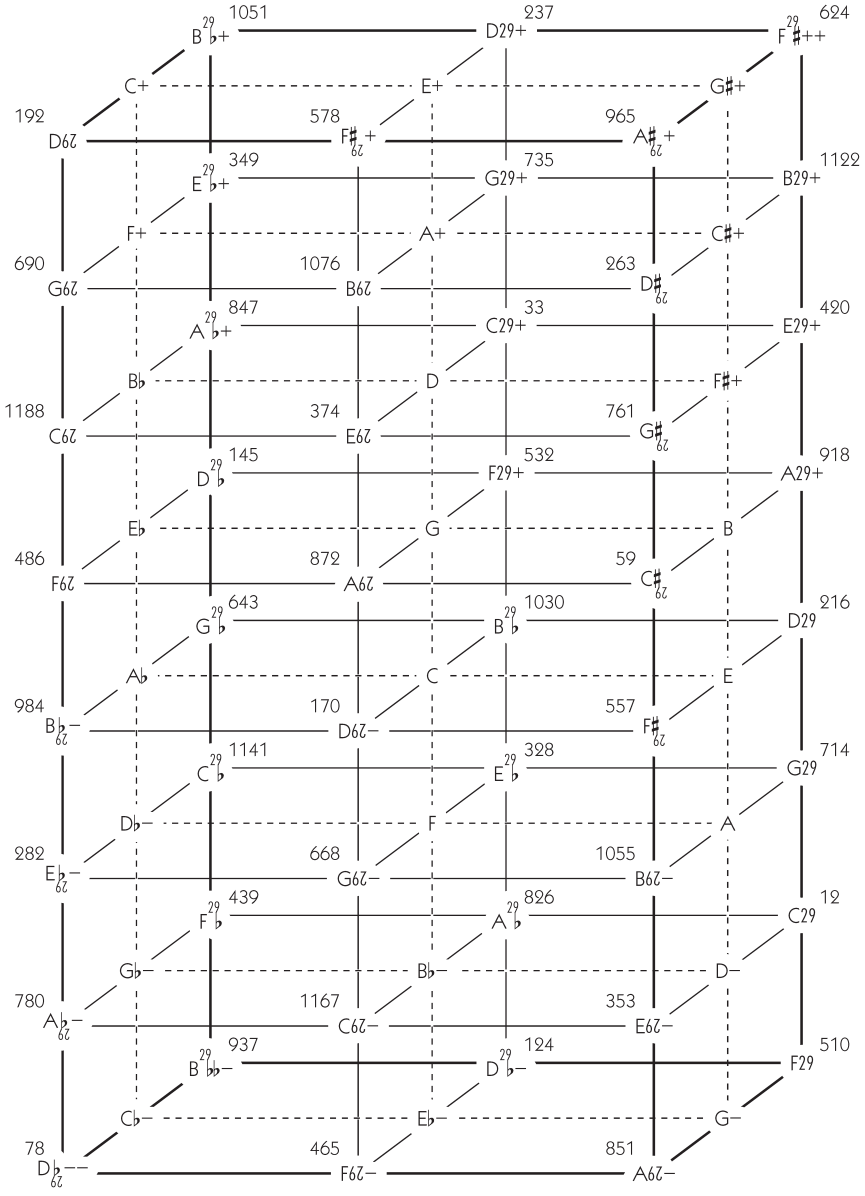


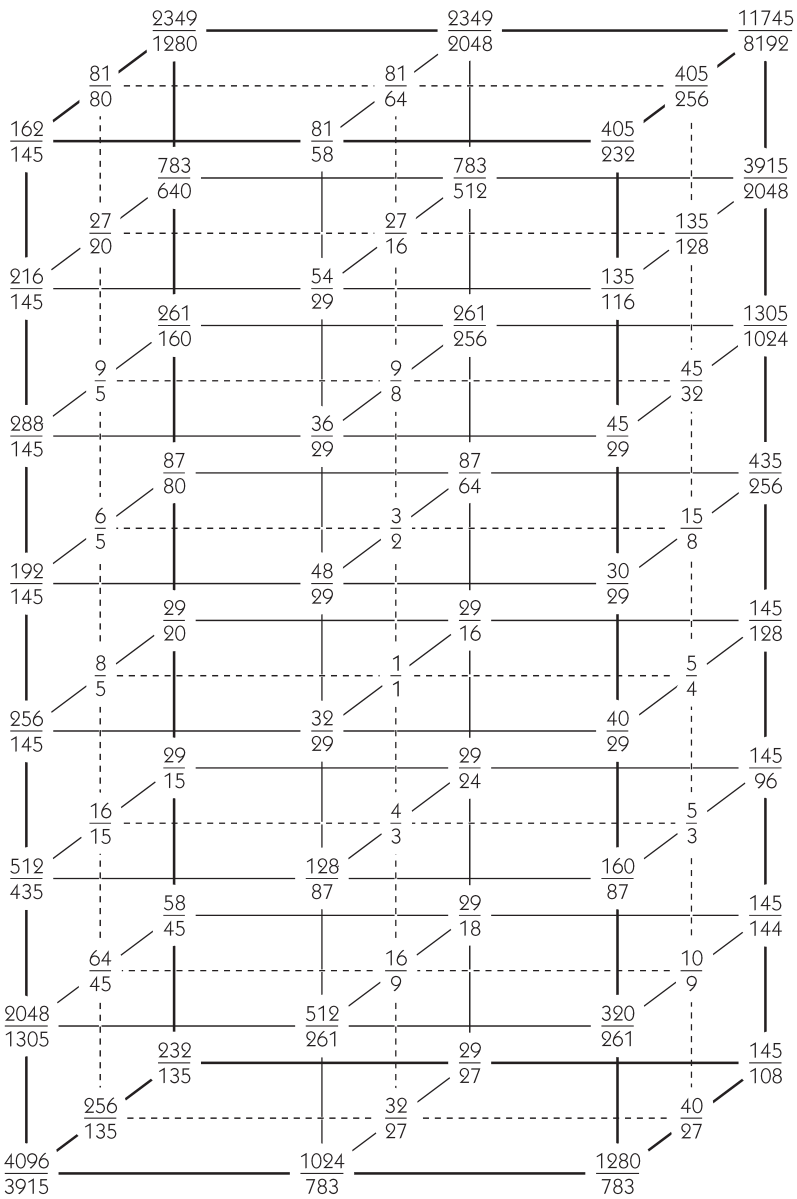
2, 3, 5, 23-limit Pitch Lattice (Notation, Ratio and Cent Values)



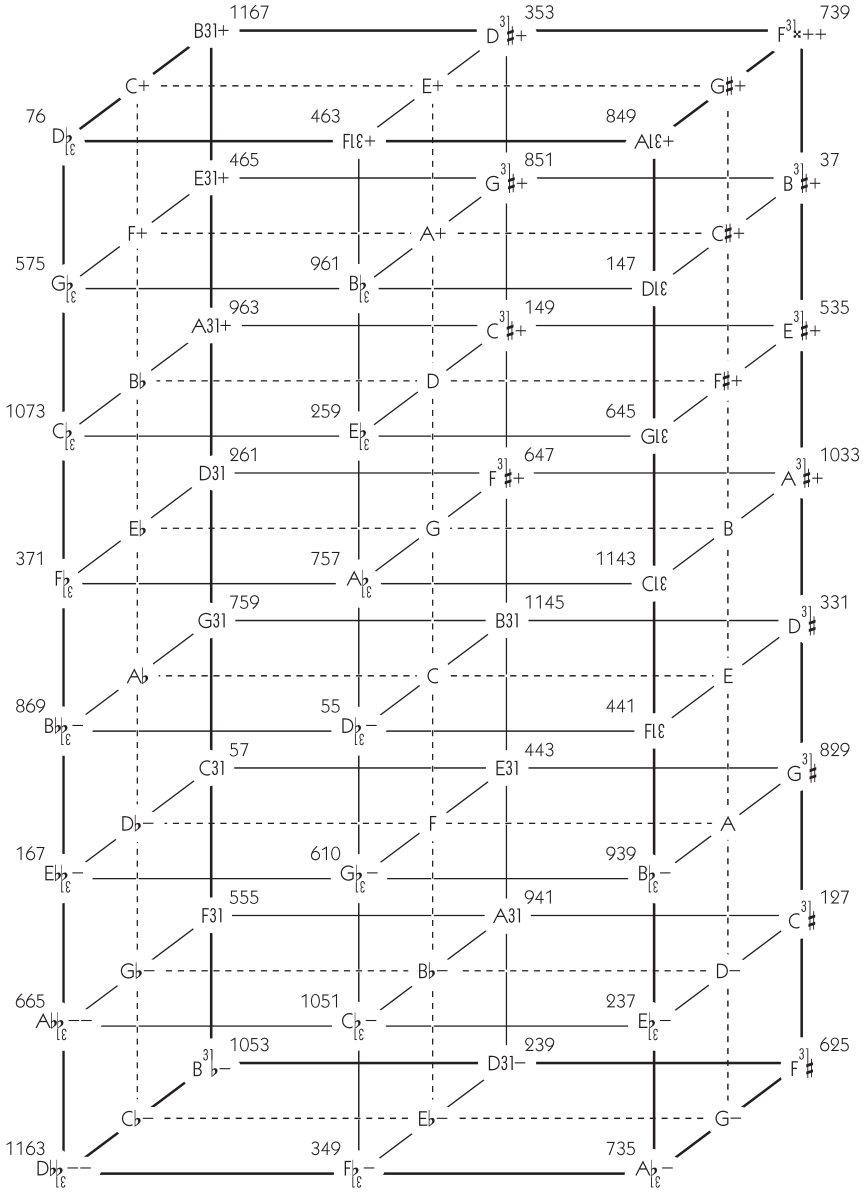


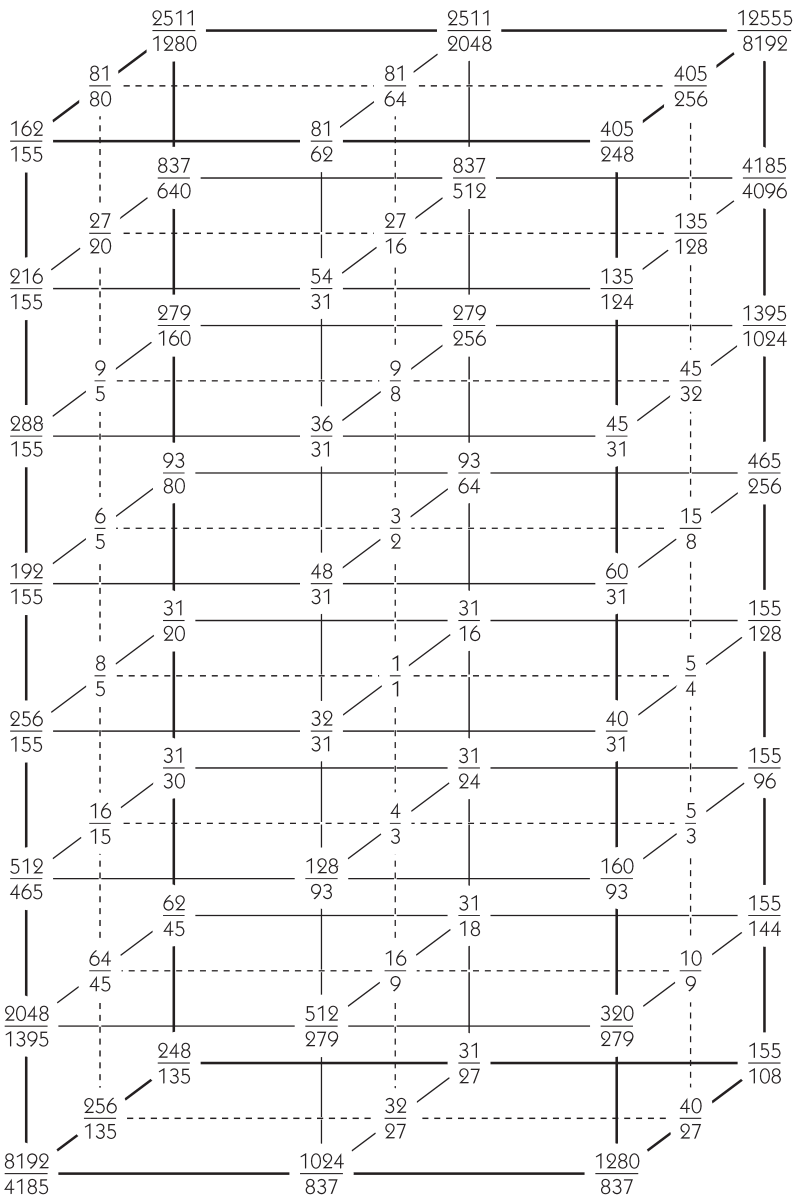
2, 3, 5, 29-limit Pitch Lattice (Notation, Ratio and Cent Values)





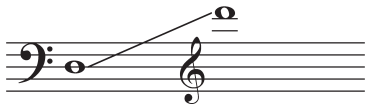
2, 3, 5, 31-limit Pitch Lattice (Notation, Ratio and Cent Values)



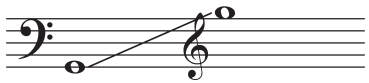


INSTRUMENTATION

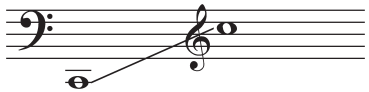
Ludisto Unu (Player One)



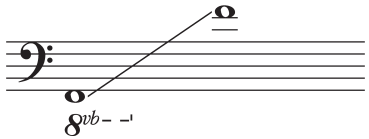
Ludisto Du (Player Two)



Ludisto Tri (Player Three)



Ludisto Kvar (Player Four)



Player 1 to 4 (Sampled '1967 William Dowd French Double Harpsichord' – Akai S3000XL Midi Stereo Digital Sampler and four 61-key Midi Keyboards)

Transposed score

PERFORMANCE NOTES

In this score, accidentals apply only to the subsequent note in sections utilizing proportional notation, whereby in sections utilizing standard metric notation, accidentals apply throughout the bar.

 fermata (approximately 2”)

// long comma (approximately 1”)

, short comma (approximately 0.5”)

The notation utilized in the score is based on Benjamin Johnston’s ‘Extended Just Intonation’. It contains 23 unique symbols, which may be combined in any manner – 5 identical to conventional sharp (♯), flat (♭), double sharp (𝄪), double flat (𝄫), and natural (♮) accidentals (raising, lowering or neutralizing a tone by 25/24 and 625/576, or 70.672 and 141.345 cents). Additional symbols include (+) and (−), raising or lowering a tone by 81/80 (one syntonic comma), or 21.506 cents, as well as the following utonal and otonal sets of symbols for each partial chroma up to the thirty-first harmonic: (7) and (𝍪), lowering or raising a tone by 36/35 (one septimal comma), or 48.770 cents; (↑) and (↓), raising or lowering a tone by 33/32 (one undecimal comma), or 53.273 cents; (13) and (𝍩), raising or lowering a tone by 65/64 (one tridecimal comma), or 26.841 cents; (17) and (𝍫), raising or lowering a tone by 51/50 (one septendecimal comma), or 34.283 cents; (19) and (𝍬), lowering or raising a tone by 96/95 (one nonadecimal comma), or 18.128 cents; (23) and (𝍭), raising or lowering a tone by 46/45 (one trivigesimal comma), or 38.051 cents; (29) and (𝍮), raising or lowering a tone by 145/144 (one nonavigesimal comma), or 11.981 cents; and finally, (31) and (𝍯), raising or lowering a tone by 31/30 (one untrigesimal comma), or 56.767 cents.

 raised by 25/24, or one small just chromatic semitone (70.672 cents)

 lowered by 25/24, or one small just chromatic semitone (70.672 cents)

raised by 25/24 plus 25/24, or 625/576 (141.345 cents)

lowered by 25/24 minus 25/24, or 625/576 (141.345 cents)

raised or lowered to natural tone

raised by 81/80, or one syntonic comma (21.506 cents)

lowered by 81/80, or one syntonic comma (21.506 cents)

raised by 25/24 plus 81/80, or 135/128 (92.179 cents)

lowered by 25/24 minus 81/80, or 135/128 (92.179 cents)

raised by 25/24 plus 81/80 plus 81/80, or 2187/2048 (113.685 cents)

lowered by 25/24 minus 81/80 minus 81/80, or 2187/2048 (113.685 cents)

lowered by 36/35, or one septimal comma (48.770 cents)

raised by 36/35, or one septimal comma (48.770 cents)

lowered by 36/35 plus 81/80, or 729/700 (70.277 cents)

raised by 36/35 minus 81/80, or 729/700 (70.277 cents)

lowered by 25/24 minus 36/35, or 15/14 (119.443 cents)

 raised by 25/24 plus 36/35, or 15/14 (119.443 cents)

 lowered by 25/24 minus 36/35 plus 81/80, or 243/224 (140.949 cents)

 raised by 25/24 plus 36/35 minus 81/80, or 243/224 (140.949 cents)

 raised by 33/32, or the 33rd harmonic (53.273 cents)

 lowered by 33/32, or the 33rd harmonic (53.273 cents)

 raised by 33/32 minus 81/80, or 55/54 (31.767 cents)

 lowered by 33/32 plus 81/80, or 55/54 (31.767 cents)

 lowered by 25/24 plus 33/32, or 100/99 (17.399 cents)

 raised by 25/24 plus 33/32, or 100/99 (17.399 cents)

 lowered by 25/24 plus 33/32 minus 81/80, or 45/44 (38.906 cents)

 raised by 25/24 minus 33/32 plus 81/80, or 45/44 (38.906 cents)

 raised by 65/64 (26.841 cents)

 lowered by 65/64 (26.841 cents)

 raised by 65/64 plus 81/80, or 1053/1024 (48.348 cents)

lowered by 65/64 minus 81/80, or 1053/1024 (48.348 cents)

raised by 65/64 minus 81/80, or 325/324 (5.335 cents)

lowered by 65/64 plus 81/80, or 325/324 (5.335 cents)

lowered by 25/24 plus 65/64, or 40/39 (43.831 cents)

raised by 25/24 minus 65/64, or 40/39 (43.831 cents)

lowered by 25/24 plus 65/64 minus 81/80, or 27/26 (65.337 cents)

raised by 25/24 minus 65/64 plus 81/80, or 27/26 (65.337 cents)

raised by 51/50 (34.283 cents)

lowered by 51/50 (34.283 cents)

raised by 51/50 minus 81/80, or 136/135 (12.777 cents)

lowered by 51/50 plus 81/80, or 136/135 (12.777 cents)

raised by 25/24 plus 51/50, or 17/16 (104.955 cents)

lowered by 25/24 minus 51/50, or 17/16 (104.955 cents)

raised by 25/24 plus 51/50 minus 81/80, or 85/81 (83.449 cents)

lowered by 25/24 minus 51/50 plus 81/80, or 85/81 (83.449 cents)

lowered by 96/95 (18.128 cents)

raised by 96/95 (18.128 cents)

lowered by 96/95 plus 81/80, or 512/513 (−3.378 cents)

raised by 96/95 minus 81/80, or 512/513 (−3.378 cents)

lowered by 96/95 minus 81/80, or 486/475 (39.635 cents)

raised by 96/95 plus 81/80, or 486/475 (39.635 cents)

lowered by 25/24 minus 96/95, or 20/19 (88.801 cents)

raised by 25/24 plus 96/95, or 20/19 (88.801 cents)

lowered by 25/24 minus 96/95 minus 81/80, or 81/76 (110.307 cents)

raised by 25/24 plus 96/95 plus 81/80, or 81/76 (110.307 cents)

raised by 46/45 (38.051 cents)

lowered by 46/45 (38.051 cents)

raised by 46/45 plus 81/80, or 207/200 (59.557 cents)

lowered by 46/45 minus 81/80, or 207/200 (59.557 cents)

raised by 46/45 minus 81/80, or 736/729 (16.544 cents)

lowered by 46/45 plus 81/80, or 736/729 (16.544 cents)

raised by 25/24 plus 46/45, or 115/108 (108.723 cents)

lowered by 25/24 minus 46/45, or 115/108 (108.723 cents)

raised by 25/24 plus 46/45 plus 81/80, or 69/64 (130.229 cents)

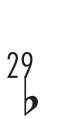
lowered by 25/24 minus 46/45 minus 81/80, or 69/64 (130.229 cents)

raised by 145/144 (11.981 cents)

lowered by 145/144 (11.981 cents)

raised by 145/144 plus 81/80, or 261/256 (33.487 cents)

lowered by 145/144 minus 81/80, or 261/256 (33.487 cents)



lowered by 25/24 plus 145/144, or 30/29 (58.692 cents)

raised by 25/24 minus 145/144, or 30/29 (58.692 cents)

lowered by 25/24 plus 145/144 minus 81/80, or 243/232 (80.198 cents)

raised by 25/24 minus 145/144 plus 81/80, or 243/232 (80.198 cents)

raised by 31/30 (56.767 cents)

lowered by 31/30 (56.767 cents)

raised by 31/30 plus 81/80, or 837/800 (78.273 cents)

lowered by 31/30 minus 81/80, or 837/800 (78.273 cents)

raised by 31/30 minus 81/80, or 248/243 (35.261 cents)

lowered by 31/30 plus 81/80, or 248/243 (35.261 cents)

raised by 25/24 plus 31/30, or 155/144 (127.439 cents)

lowered by 25/24 minus 31/30, or 155/144 (127.439 cents)

raised by 25/24 plus 31/30 plus 81/80, or 279/256 (148.946 cents)

lowered by 25/24 minus 31/30 minus 81/80, or 279/256 (148.946 cents)

raised by 25/24 plus 31/30 plus 81/80 plus 81/80, or 22599/20480 (170.452 cents)

lowered by 25/24 minus 31/30 minus 81/80 minus 81/80, or 22599/20480 (170.452 cents)

3-limit tuning matrix no. 1 'key of C' (Program 01)

NOTE	C	D♭−−	D	E♭−	E+	F	−−	G	A♭−	A+	B♭−	B+
KEY	C	C♯	D	D♯	E	F	F♯	G	G♯	A	A♯	B
CENTS	+00	−10	+04	−06	+08	−02	+00	+02	−08	+06	−04	+10

5-limit tuning matrix no. 1 'key of C' (Program 02)

NOTE	C	D♭−	D	E♭	E	F	−−	G	A♭	A	B♭−	B
KEY	C	C♯	D	D♯	E	F	F♯	G	G♯	A	A♯	B
CENTS	+00	+12	+04	+16	−14	−02	+00	+02	+14	−16	−04	−12

5-limit tuning matrix no. 2 'key of C' (Program 03)

NOTE	C	D♭−	D	E♭	E	F	−−	G	A♭	A	B♭	B
KEY	C	C♯	D	D♯	E	F	F♯	G	G♯	A	A♯	B
CENTS	+00	+12	+04	+16	−14	−02	+00	+02	+14	−16	+18	−12

7-limit tuning matrix no. 1 'key of G' (Program 04)

NOTE	C	C𝄲	D	E𝄭	E𝄳	F7+	F𝄲	G	A𝄭 +	A𝄳	B𝄭	B𝄳
KEY	C	C♯	D	D♯	E	F	F♯	G	G♯	A	A♯	B
CENTS	+00	+19	+04	−33	+35	−29	+17	+02	−14	+33	−31	+37

7-limit tuning matrix no. 2 'key of G' (Program 05)

NOTE	C	C♯	D	E♭	E	F7+	F♯	G	A♭+	A	B♭	B
KEY	C	C♯	D	D♯	E	F	F♯	G	G♯	A	A♯	B
CENTS	+00	+19	+04	−33	+35	−29	+17	+02	−14	+33	−31	−12

11-limit tuning matrix no. 1 'key of G' (Program 06)

NOTE	C	C↑	D	−−	E↓+	F♯↓+	F↑	G	−−	A↓+	B♭↕−	−−
KEY	C	C♯	D	D♯	E	F	F♯	G	G♯	A	A♯	B
CENTS	+00	−47	+04	+00	−45	+37	−49	+02	+00	−47	+49	+00

11-limit tuning matrix no. 2 'key of G' (Program 07)

NOTE	C	C↑	D	−−	E↓+	F7+	F↑	G	−−	A+	B♭↕−	B
KEY	C	C♯	D	D♯	E	F	F♯	G	G♯	A	A♯	B
CENTS	+00	−47	+04	+00	−45	−29	−49	+02	+00	+06	+49	−12

11-limit tuning matrix no. 3 'key of G' (Program 08)

NOTE	C♯↓+	−−	D	−−	E↕♭	F♯↓+	F↑	G	−−	A↓+	B↓	−−
KEY	C	C♯	D	D♯	E	F	F♯	G	G♯	A	A♯	B
CENTS	+39	+00	+04	+00	−31	+37	−49	+02	+00	−47	+35	+00

11-limit tuning matrix no. 4 ‘key of G’ (Program 09)

NOTE	C	C↑	D	−−	E↓+	F♯↕+	F↑	G	−−	A↕♭	B↕♭−	−−
KEY	C	C♯	D	D♯	E	F	F♯	G	G♯	A	A♯	B
CENTS	+00	−47	+04	+00	−45	+37	−49	+02	+00	−33	+49	+00

13-limit tuning matrix no. 1 ‘key of D’ (Program 10)

NOTE	C13	C♯13+	D	E13♭	E♯13+	F13+	F♯13+	G	G♯13+	A+	B13♭	B♯13
KEY	C	C♯	D	D♯	E	F	F♯	G	G♯	A	A♯	B
CENTS	+27	−35	+04	+42	−19	+46	−37	+02	−33	+06	+44	−39

13-limit tuning matrix no. 2 ‘key of D’ (Program 11)

NOTE	C13	C♯13+	D	E13♭	E♯13+	F13+	F♯13+	G	A13♭	A+	B13♭	B♯13
KEY	C	C♯	D	D♯	E	F	F♯	G	G♯	A	A♯	B
CENTS	+27	−35	+04	+42	−19	+46	−37	+02	+41	+06	+44	−39

17-limit tuning matrix no. 1 ‘key of D’ (Program 12)

NOTE	C♯17+	C17♯	D	E♭17+	E17	F♯17+	F17♯	G	G17♯	A+	B♭17+	B17
KEY	C	C♯	D	D♯	E	F	F♯	G	G♯	A	A♯	B
CENTS	−13	+05	+04	+03	+21	−15	+03	+02	+07	+06	+05	+23

17-limit tuning matrix no. 2 ‘key of D’ (Program 13)

NOTE	C17+	D17♭	D	E17♭+	E17	F17+	F17♯	G	A17♭+	A+	B17♭+	B17
KEY	C	C♯	D	D♯	E	F	F♯	G	G♯	A	A♯	B
CENTS	−13	−01	+04	+03	+21	−15	+03	+02	+01	+06	+05	+23

19-limit tuning matrix no. 1 ‘key of A’ (Program 14)

NOTE	C19+	C19♯+	D	D19♯+	E+	F19+	F19♯+	G19+	G19♯+	A+	B19♭	B19
KEY	C	C♯	D	D♯	E	F	F♯	G	G♯	A	A♯	B
CENTS	+13	+10	+04	+14	+08	+01	+08	+05	+12	+06	−01	+06

23-limit tuning matrix no. 1 ‘key of A’ (Program 15)

NOTE	C23+	C23♯+	D	D23♯+	E+	F23+	F23♯+	G23	G23♯+	A+	B23♭	B23+
KEY	C	C♯	D	D♯	E	F	F♯	G	G♯	A	A♯	B
CENTS	−17	+30	+04	+34	+08	−18	+28	−36	+32	+06	−20	+48

23-limit tuning matrix no. 2 ‘key of A’ (Program 16)

NOTE	C23+	C23♯+	D	D23♯+	E+	F23+	F23♯+	G23+	G23♯+	A+	B23♭	B23+
KEY	C	C♯	D	D♯	E	F	F♯	G	G♯	A	A♯	B
CENTS	−17	+30	+04	+34	+08	−18	+28	−15	+32	+06	−20	+48

29-limit tuning matrix no. 1 ‘key of E’ (Program 17)

NOTE	C29+	C♯29+	D29+	D♯29+	E+	F29+	F♯29+	G29+	G♯29+	A+	A♯29+	B+
KEY	C	C♯	D	D♯	E	F	F♯	G	G♯	A	A♯	B
CENTS	+33	−20	+37	−16	+08	+32	−22	+35	−18	+06	−35	+10

31-limit tuning matrix no. 1 ‘key of E’ (Program 18)

NOTE	C𝄲+	C♯31]+	D𝄲+	D♯31]+	E+	F𝄲+	F♯31]+	G𝄲+	G♯31]+	A+	– –	B+
KEY	C	C♯	D	D♯	E	F	F♯	G	G♯	A	A♯	B
CENTS	−35	+49	−31	+53	+08	−37	+47	−33	+51	+06	+00	+10

31-limit tuning matrix no. 2 ‘key of E’ (Program 19)

NOTE	C𝄲+	C♯31]+	D𝄲+	D♯31]+	E+	F𝄲+	F♯31]+	G𝄲+	G♯31]+	A+	– –	A♯31]++
KEY	C	C♯	D	D♯	E	F	F♯	G	G♯	A	A♯	B
CENTS	−35	+49	−31	+53	+08	−37	+47	−33	+51	+06	+00	−45

Ben Johnston's Fifty-Three-Tone Just Division of the Octave

Relative Pitch: A_4=440Hz / C_4 (middle C)=261.6255654Hz

DEGREE NUMBER	NOTE	INTERVAL	RATIO (FRACTION)	RATIO (DECIMAL)	FREQUENCY (HERTZ)	CENTS	TUNING
01	C	unison	1/1	1.000000	261.626	0.000	+00
02	C+	syntonic comma	81/80	1.012500	264.896	21.506	+22
03	D𝄫−	diminished second, or great diesis	128/125	1.024000	267.905	41.059	+41
04	C♯	grave or small just chromatic semitone, or minor half-tone	25/24	1.041667	272.527	70.672	−29
05	C♯+	Pythagorean acute or large limma	135/128	1.054688	275.933	92.179	−08
06	D♭−	just diatonic semitone, or major half-tone	16/15	1.066667	279.067	111.731	+12
07	D♭	great limma, acute or large half-tone	27/25	1.080000	282.556	133.238	+33
08	C𝄪+	acute or large double augmented octave	1125/1024	1.098633	287.430	162.851	−37
09	D−	just minor tone	10/9	1.111111	290.695	182.404	−18
10	D	just major tone (9th harmonic)	9/8	1.125000	294.329	203.910	+04
11	D+	acute or large tone	729/640	1.139063	298.008	225.416	+25
12	E𝄫	diminished third	144/125	1.152000	301.393	244.969	+45
13	D♯	augmented second (75th harmonic)	75/64	1.171875	306.592	274.582	−25
14	E♭−	Pythagorean minor third, or trihemitone	32/27	1.185185	310.075	294.135	−06
15	E♭	just minor third	6/5	1.200000	313.951	315.641	+16
16	D𝄪	double augmented second	625/512	1.220703	319.367	345.255	+45
17	E−	grave or small major third	100/81	1.234568	322.995	364.807	−35
18	E	just major third (5th harmonic)	5/4	1.250000	327.032	386.314	−14
19	E+	Pythagorean major third, or ditone (81st harmonic)	81/64	1.265625	331.120	407.820	+08
20	F♭	diminished fourth	32/25	1.280000	334.881	427.373	+27
21	E♯	augmented third	125/96	1.302083	340.658	456.986	−43
22	F−	grave or small fourth	320/243	1.316872	344.527	476.539	−23
23	F	just and Pythagorean perfect fourth	4/3	1.333333	348.834	498.045	−02
24	F+	acute or large fourth	27/20	1.350000	353.195	519.551	+20
25	G𝄫−	grave or small double diminished fifth	512/375	1.365333	357.206	539.104	+39
26	F♯	grave or small augmented fourth	25/18	1.388889	363.369	568.717	−31

DEGREE NUMBER	NOTE	INTERVAL	RATIO (FRACTION)	RATIO (DECIMAL)	FREQUENCY (HERTZ)	CENTS	TUNING
27	F♯+	just tritone, or augmented fourth (45th harmonic)	45/32	1.406250	367.911	590.224	−10
28	G♭−	diminished fifth	64/45	1.422222	372.090	609.776	+10
29	G♭	acute or large diminished fifth	36/25	1.440000	376.741	631.283	+31
30	F×+	acute or large double augmented fourth	375/256	1.464844	383.241	660.896	−39
31	G−	grave or small fifth	40/27	1.481481	387.593	680.449	−20
32	G	just and Pythagorean perfect fifth (3rd harmonic)	3/2	1.500000	392.438	701.955	+02
33	G+	acute or large fifth	243/160	1.518750	397.344	723.014	+23
34	A𝄫	diminished sixth	192/125	1.536000	401.857	743.014	+43
35	G♯	augmented fifth (25th harmonic)	25/16	1.562500	408.790	772.627	−27
36	A♭−	Pythagorean minor sixth	128/81	1.580247	413.433	792.180	−08
37	A♭	just minor sixth	8/5	1.600000	418.601	813.686	+14
38	G×	double augmented fifth	625/384	1.627604	425.823	843.300	+43
39	A−	grave or small major sixth	400/243	1.646091	430.659	862.852	−37
40	A	just major sixth	5/3	1.666667	436.043	884.359	−16
41	A+	Pythagorean major sixth (27th harmonic)	27/16	1.687500	441.493	905.865	+06
42	B𝄫−	diminished seventh	128/75	1.706667	446.508	925.418	+25
43	A♯	augmented sixth	125/72	1.736111	454.211	955.031	−45
44	A♯+	acute or large augmented sixth	225/128	1.757813	459.889	976.537	−23
45	B♭−	Pythagorean minor seventh	16/9	1.777778	465.112	996.090	−04
46	B♭	acute or large minor seventh	9/5	1.800000	470.926	1017.596	+18
47	A×+	acute or large double augmented sixth	1875/1024	1.831055	479.051	1047.210	+47
48	B−	grave or small major seventh	50/27	1.851852	484.492	1066.762	−33
49	B	just diatonic major seventh (15th harmonic)	15/8	1.875000	490.548	1088.269	−12
50	B+	Pythagorean major seventh	243/128	1.898438	496.680	1109.775	+10
51	C♭	diminished octave	48/25	1.920000	502.321	1129.328	+29
52	B♯	meantone augmented seventh (125th harmonic)	125/64	1.953125	510.987	1158.941	−41
53	C−	grave or small octave	160/81	1.975309	516.791	1178.494	−22
01	C	octave	2/1	2.000000	523.251	1200.000	+00

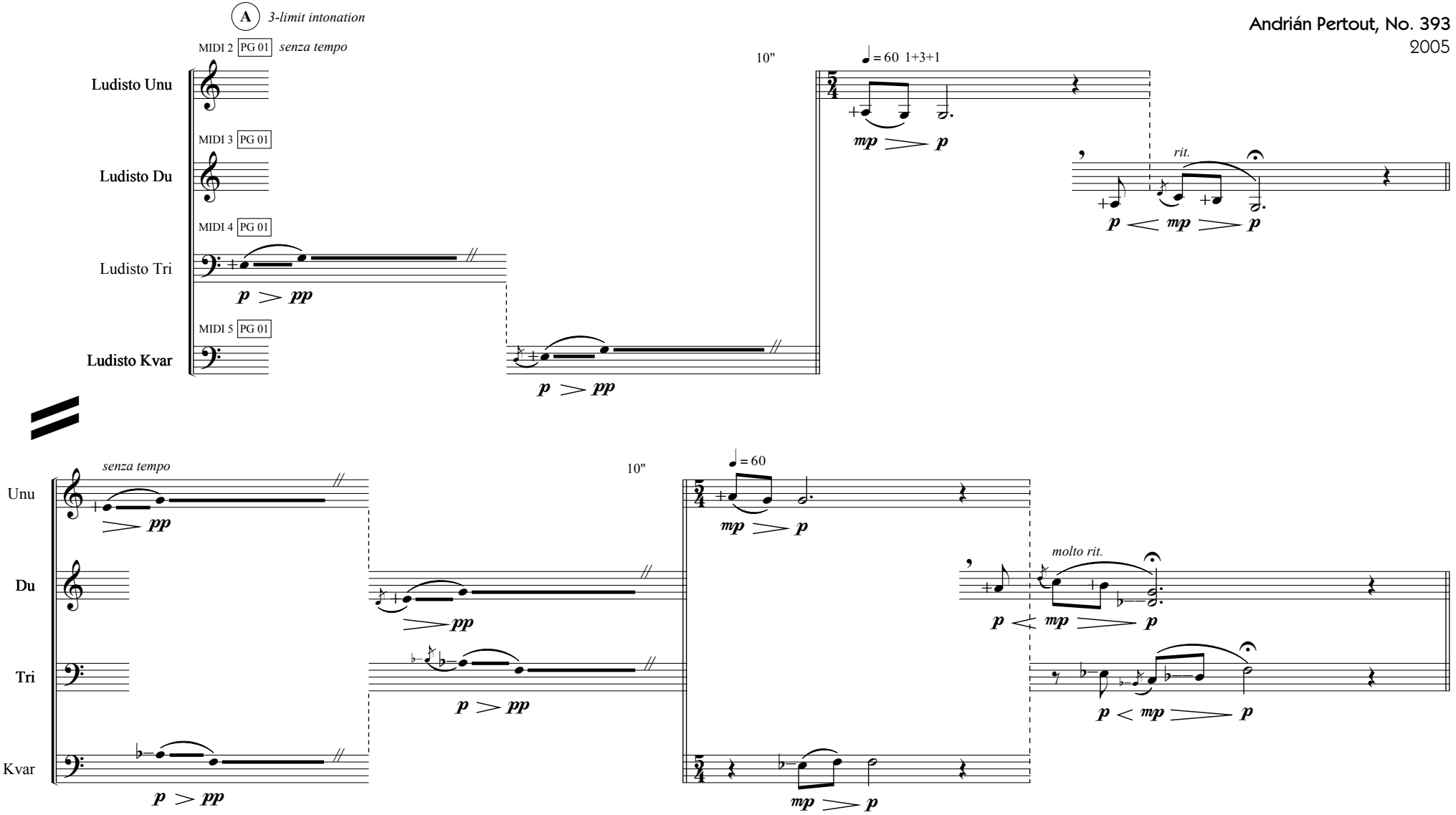
Hommage à Lou Harrison (1917-2003)

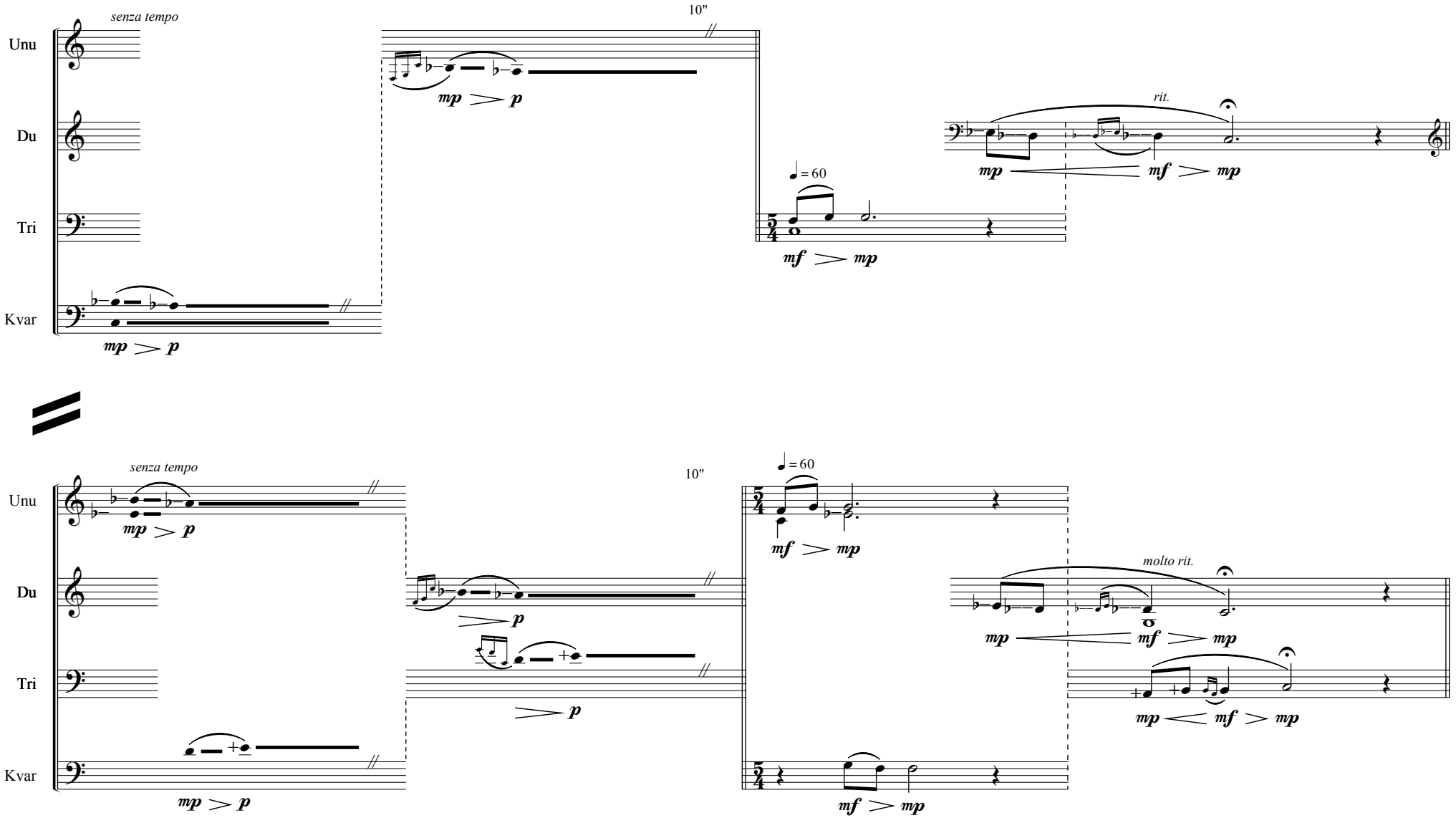
La Homa Kanto

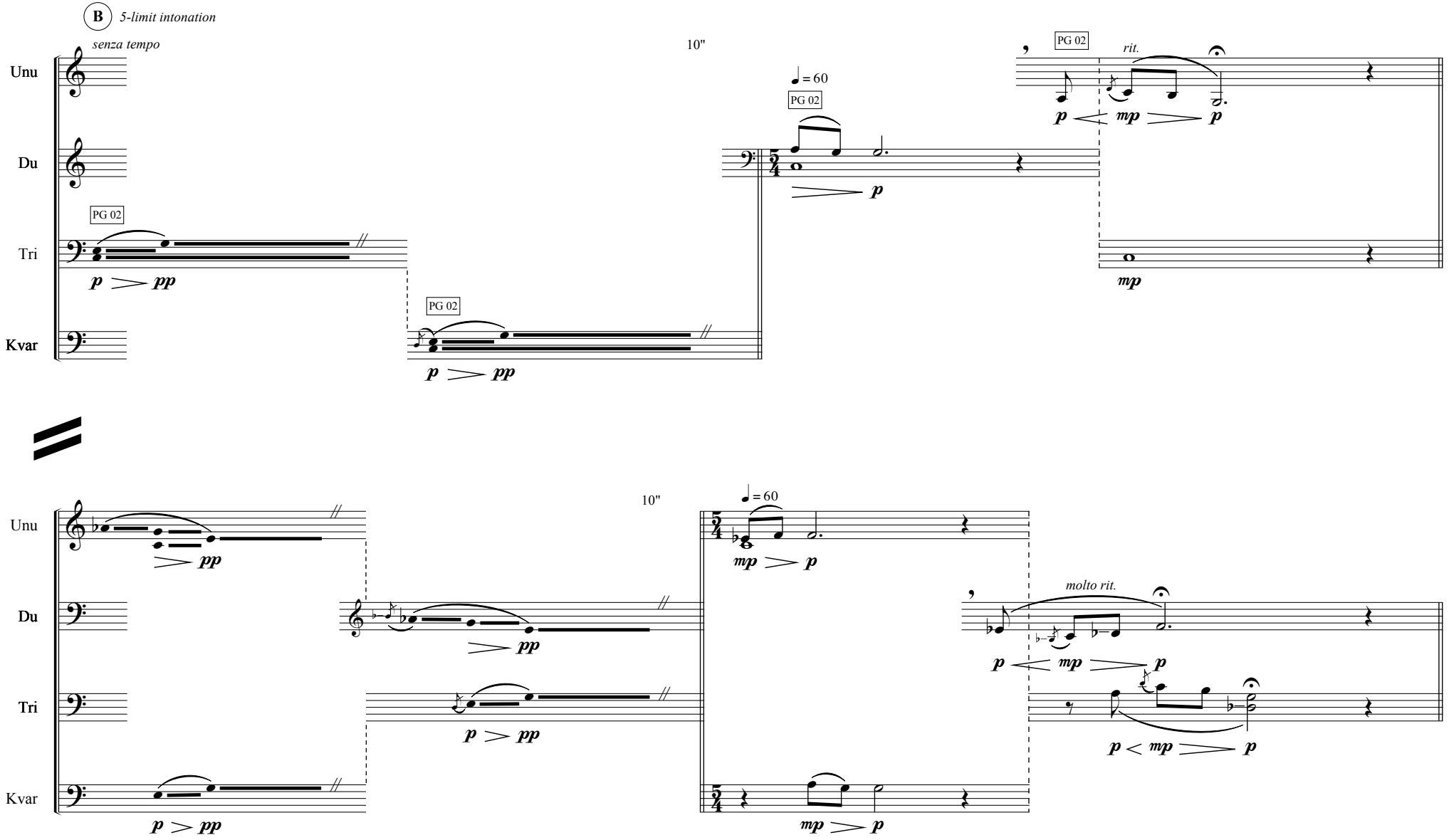
for Harmonically Tuned Synthesizer Quartet

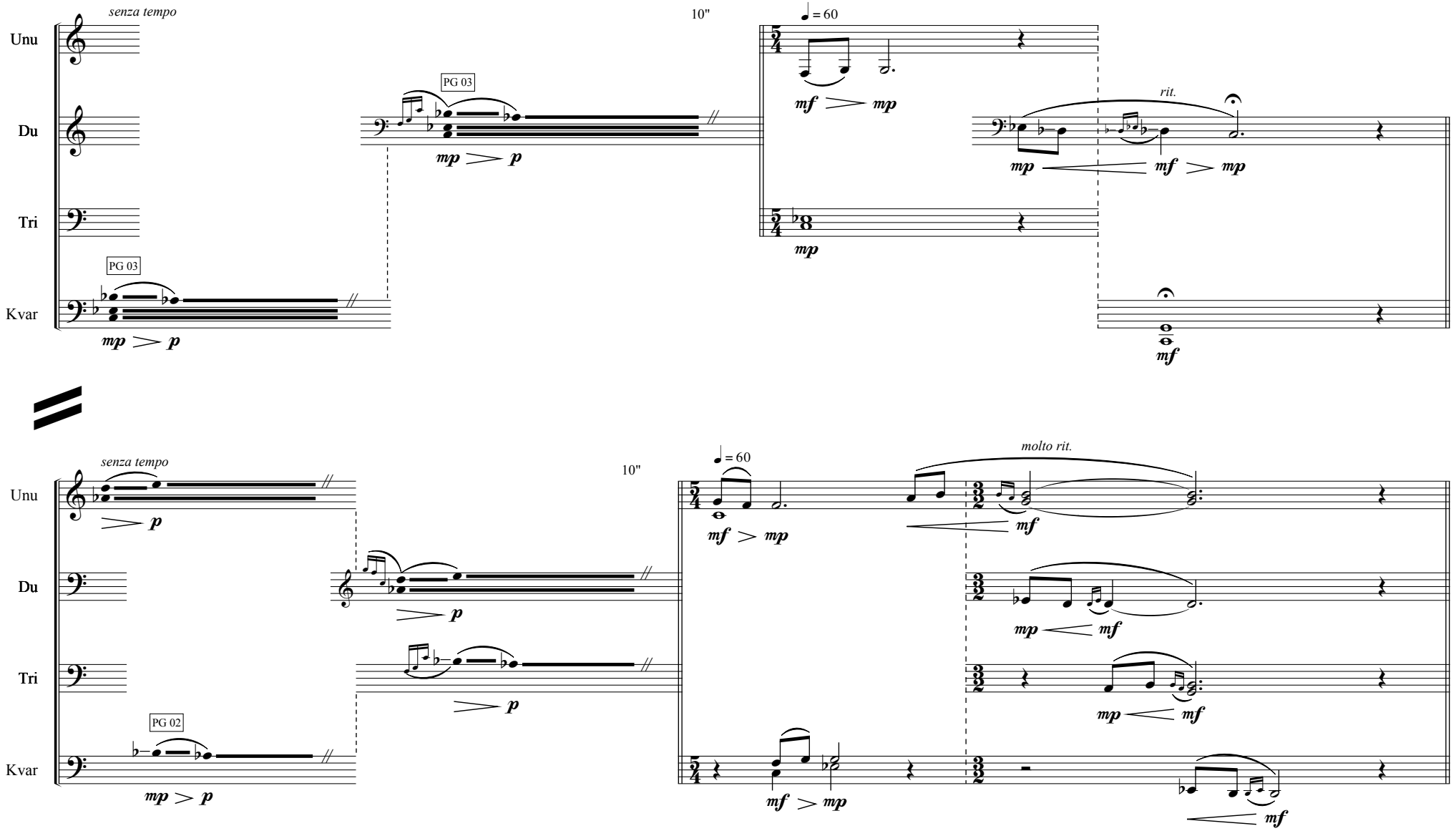
Andrián Pertout, No. 393
2005

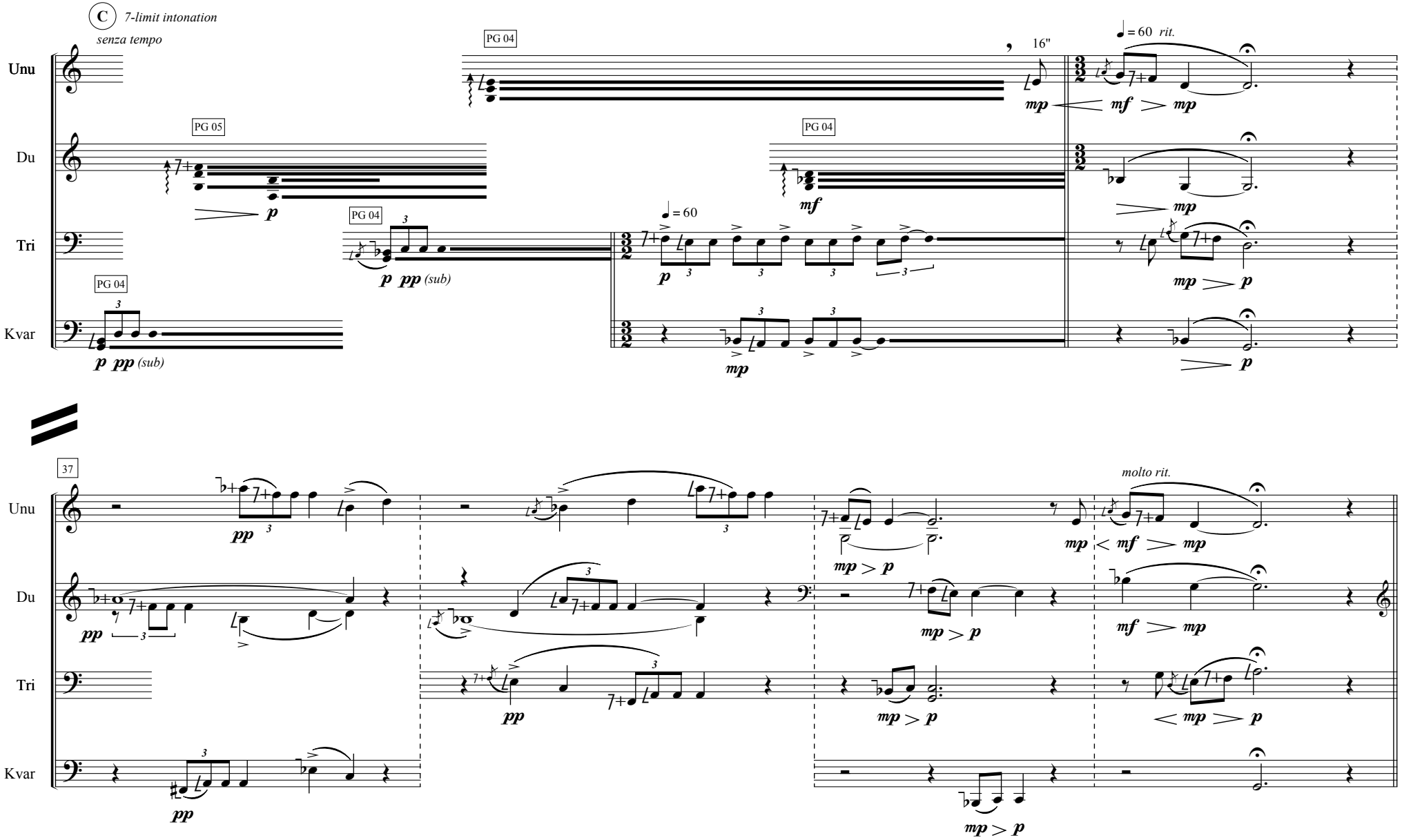
This whole round living world – the Human Music – rouses &
– delights me, it stirs me to a "trans-ethnic", a planetary music.
Lou Harrison's Music Primer, 1971

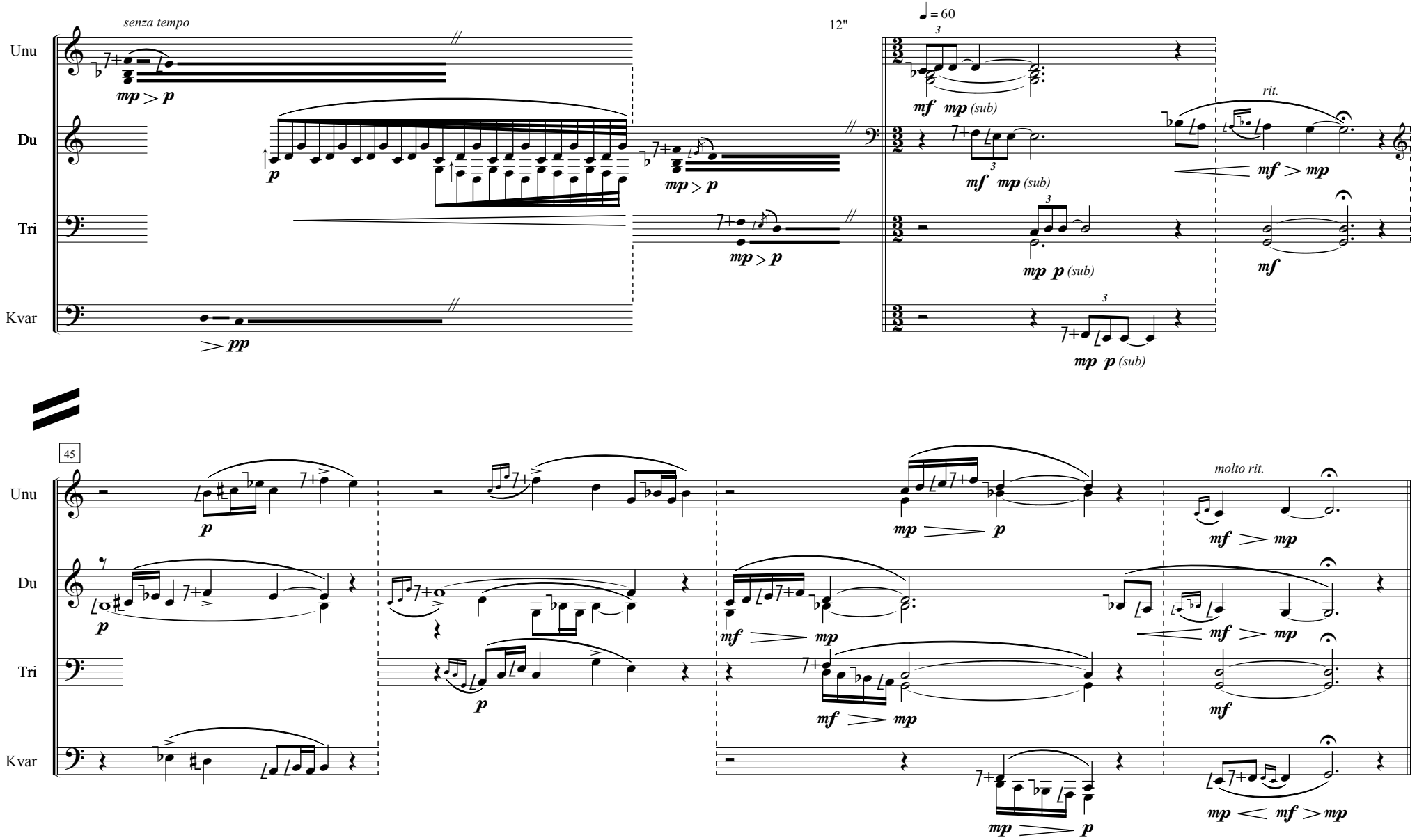


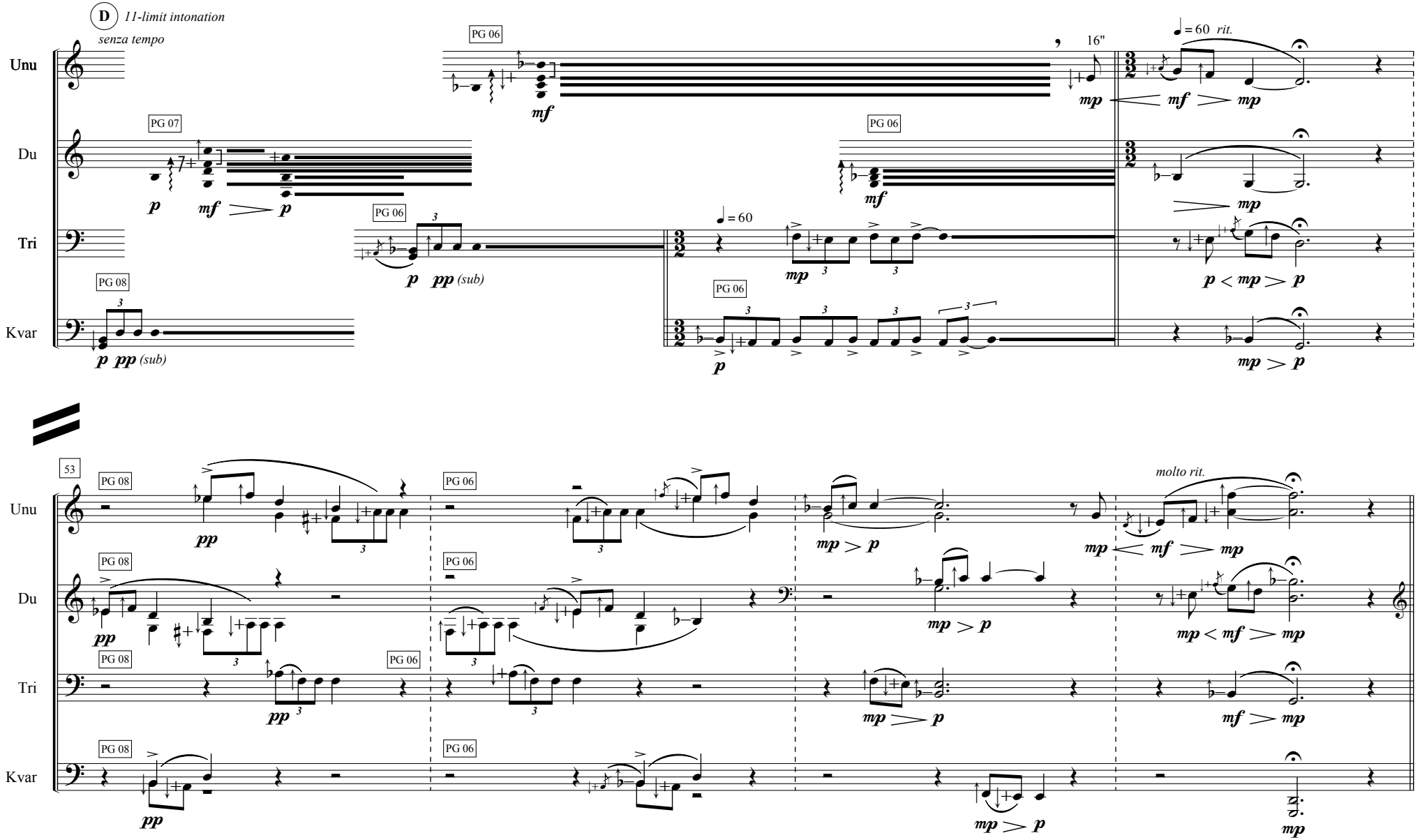

senza tempo
10"
rit.
= 60
Unu
Du
Tri
Kvar
mp > p
mf > mp
molto rit.

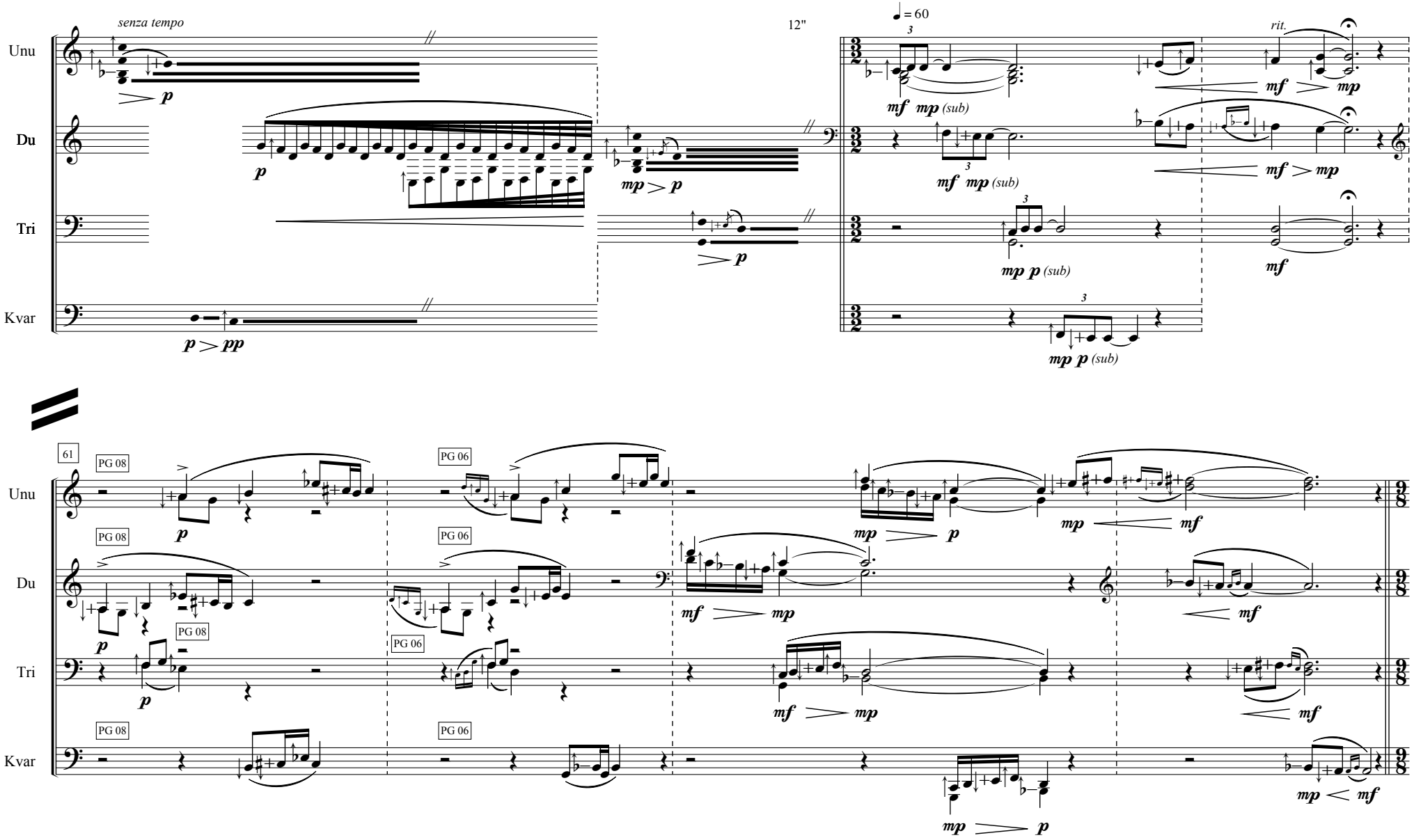

B
5-limit intonation
senza tempo
Unu
Du
Tri
Kvar
PG 02
p > pp
10"
♩= 60
mp
rit.
molto rit.

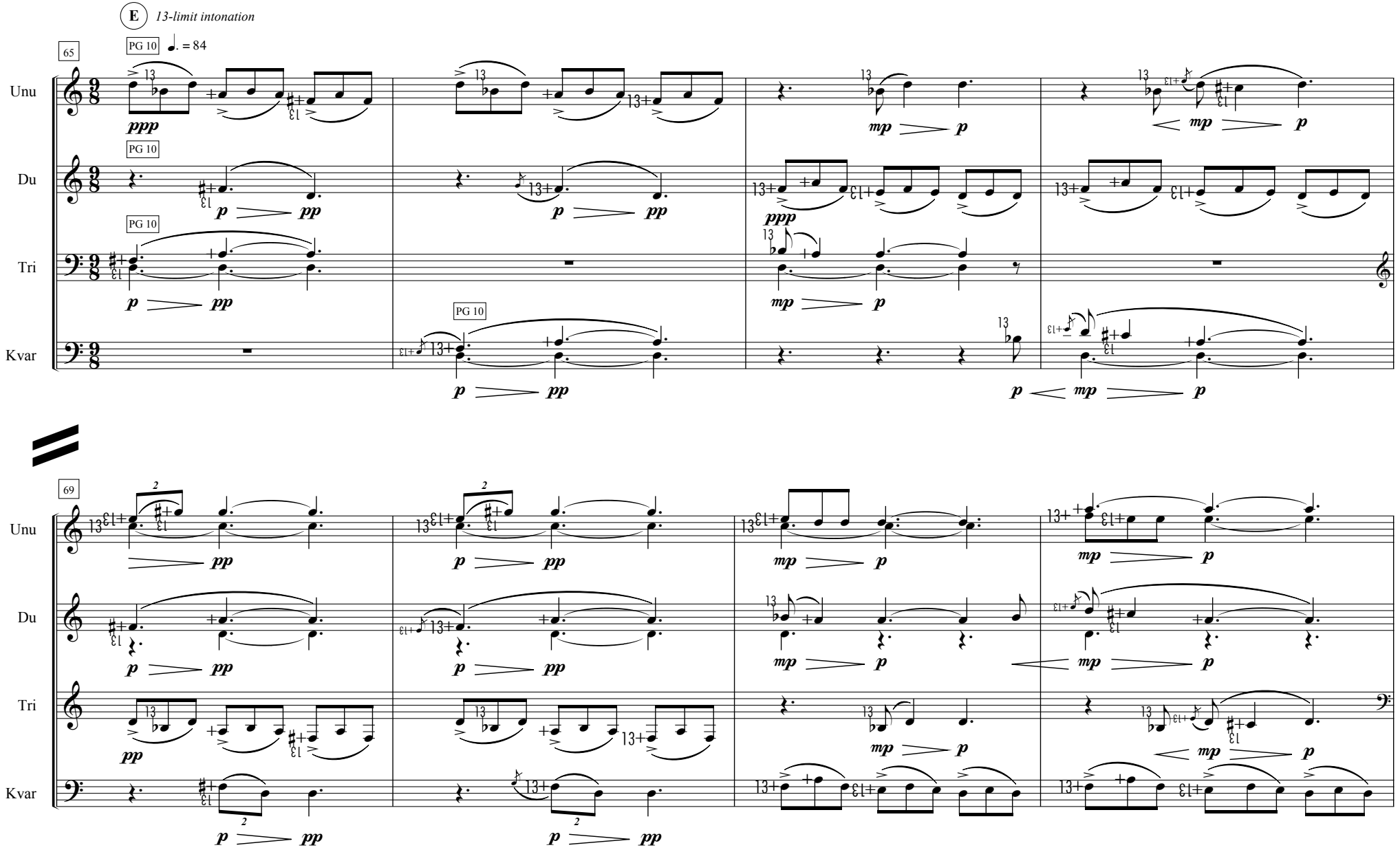

senza tempo
Unu
Du
Tri
Kvar
PG 03
PG 03
PG 02
10"
10"
♩= 60
♩= 60
rit.
molto rit.
mp > p
mf > mp
mp < mf
mf

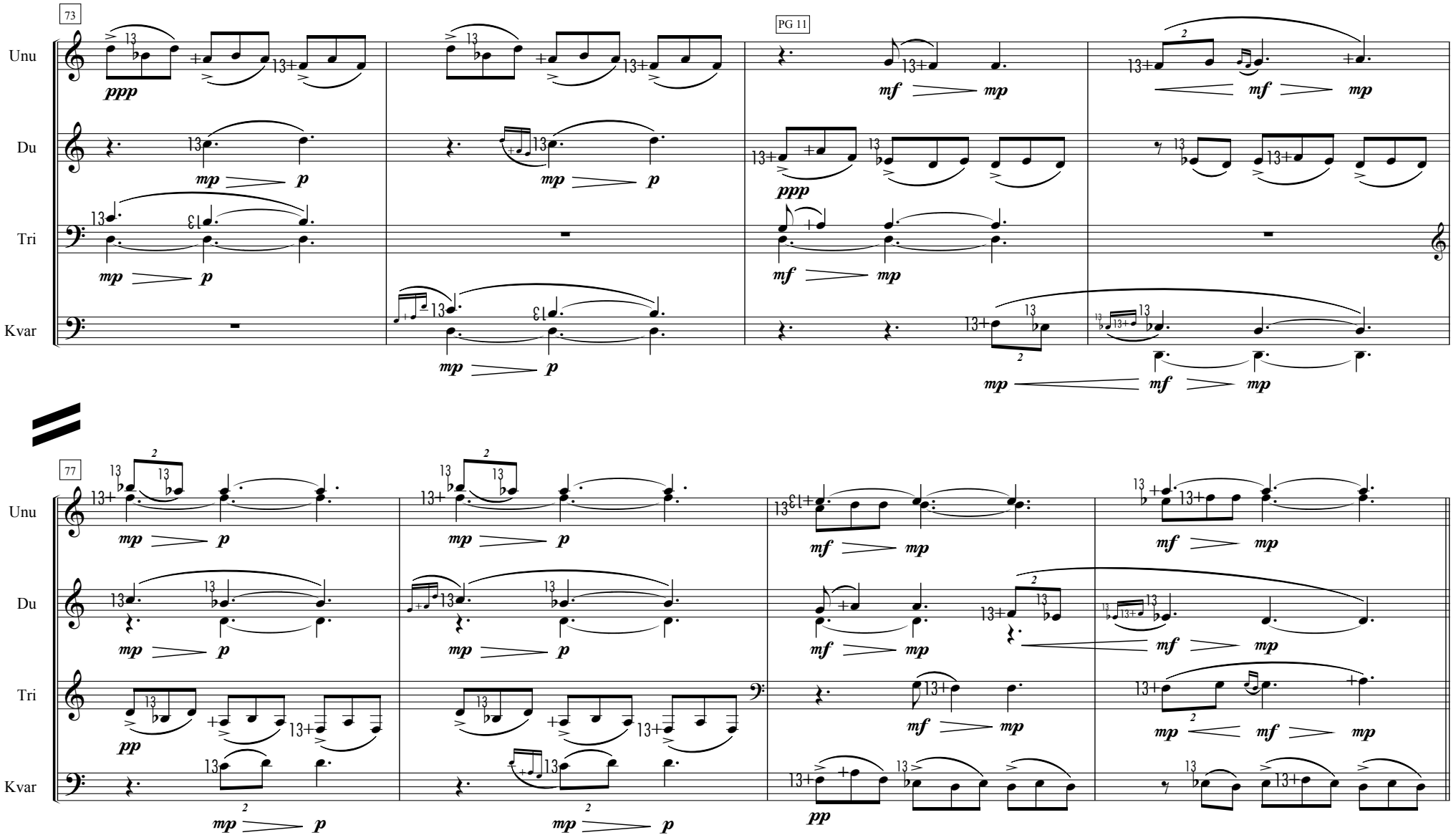

C 7-limit intonation
senza tempo
Unu
Du
Tri
Kvar
PG 04
PG 05
16"
♩= 60 rit.
mp mf > mp
mf
p
p pp (sub)
♩= 60
mp
mp > p
37
molto rit.
pp
mp > p
mf > mp
< mf > mp
< mp > p

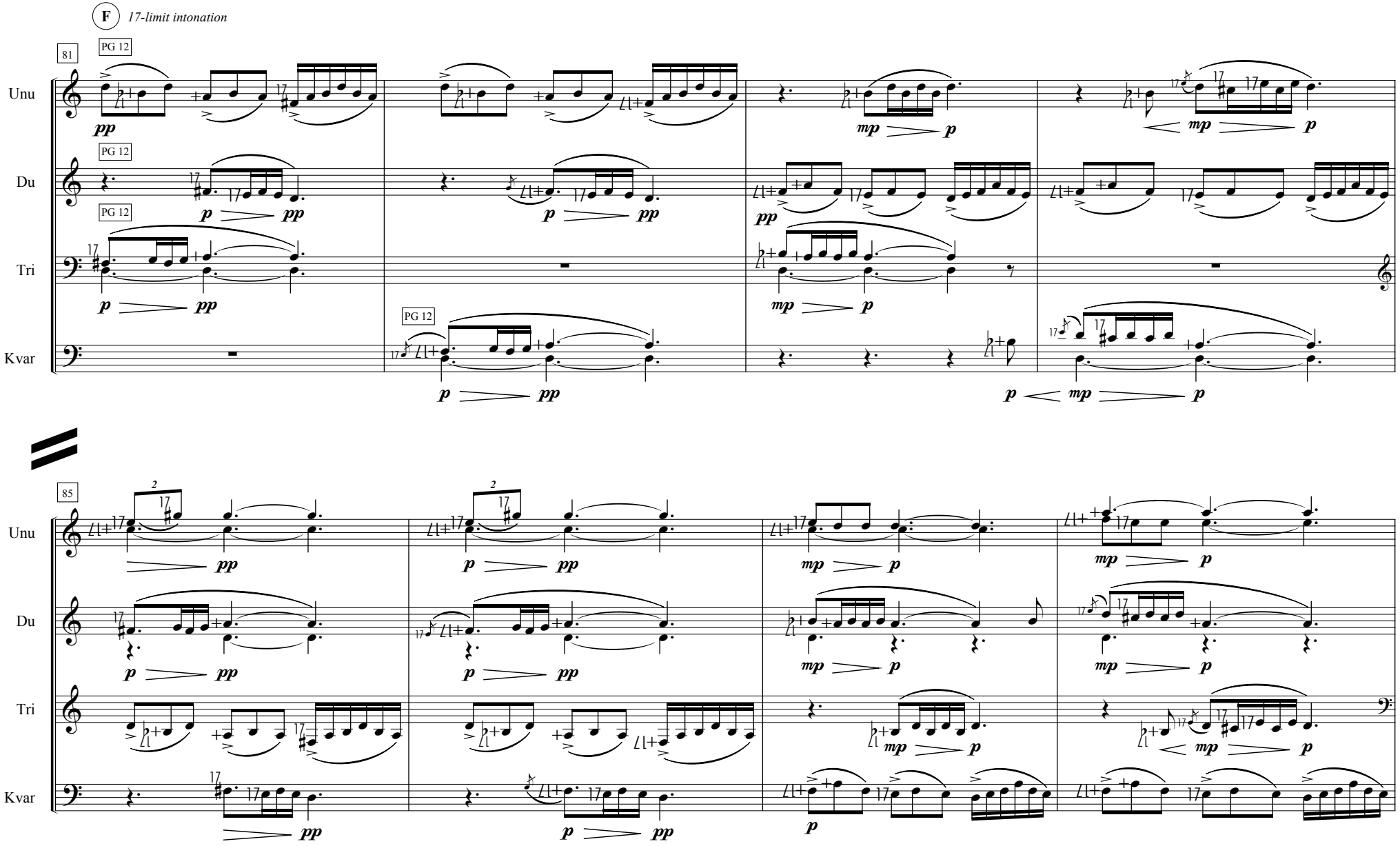

senza tempo
12"
♩ = 60
Unu
Du
Tri
Kvar
rit.
45
molto rit.

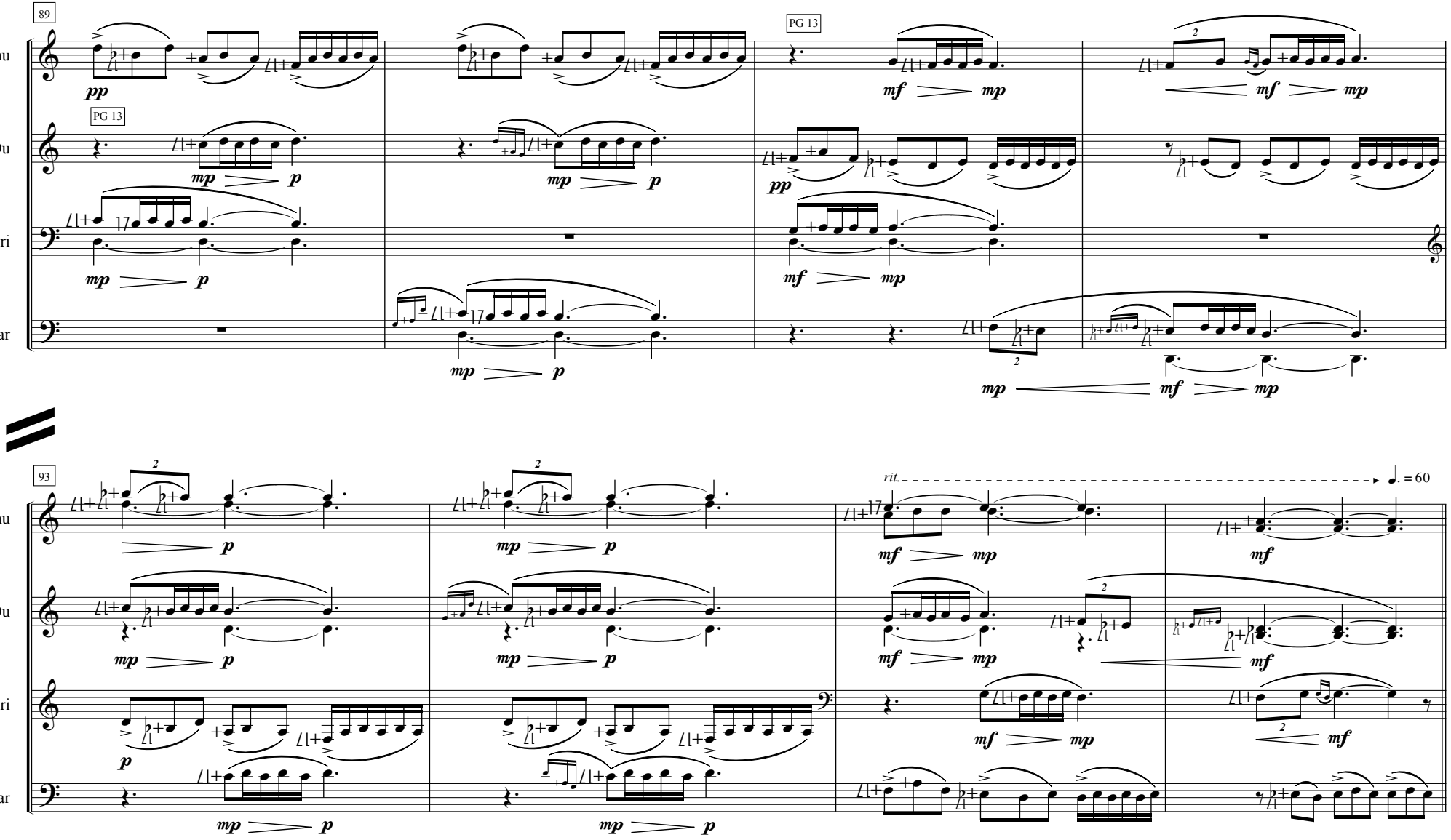

D 11-limit intonation
senza tempo
Unu
Du
Tri
Kvar
PG 06
PG 07
PG 08
16"
= 60 rit.
= 60
53
molto rit.

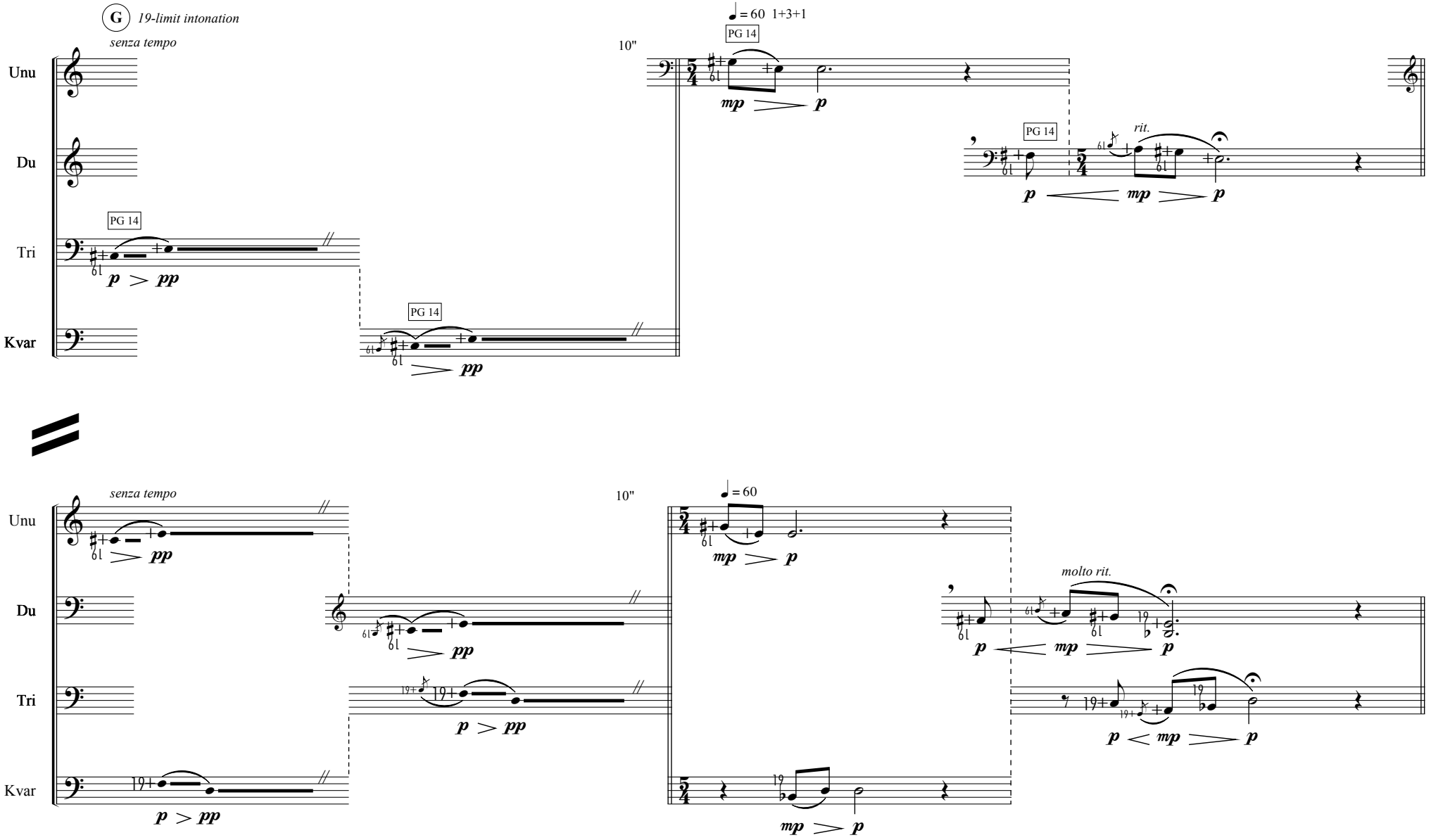

senza tempo
12"
♩ = 60
rit.
Unu
Du
Tri
Kvar
61
PG 08
PG 06

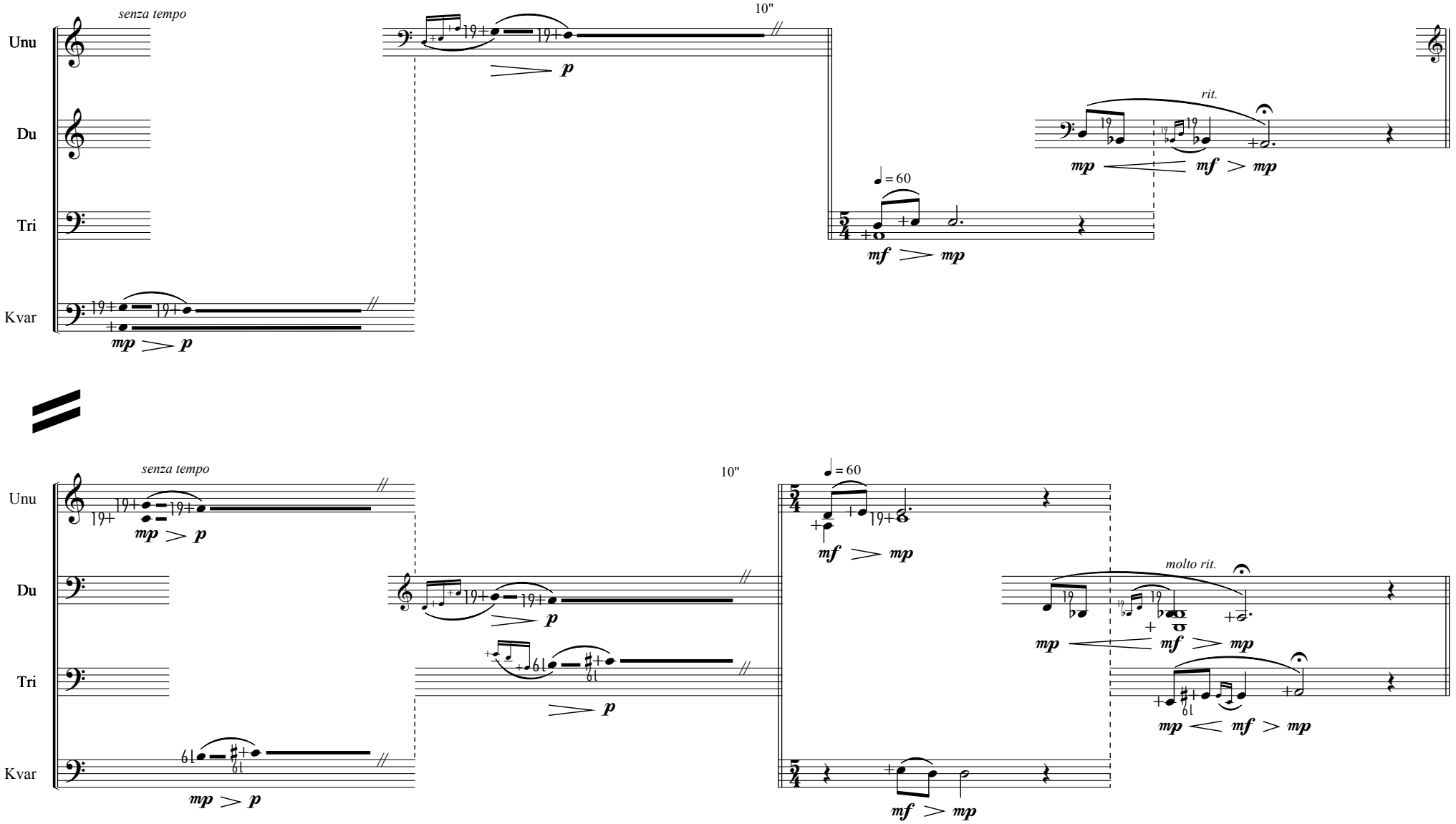

E
13-limit intonation
65
PG 10
♩. = 84
Unu
Du
Tri
Kvar
69

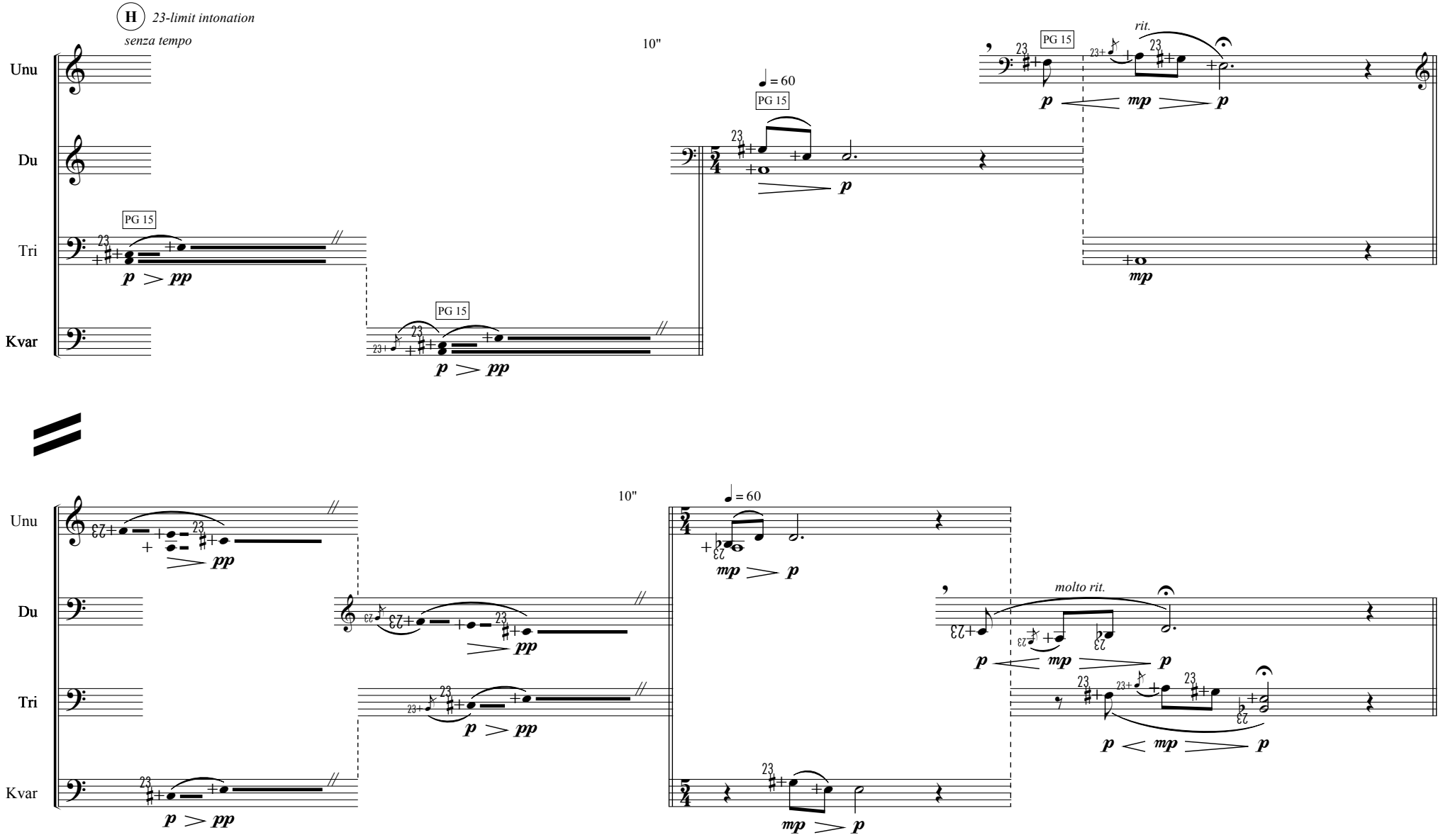

73
PG 11
Unu
Du
Tri
Kvar
77
Unu
Du
Tri
Kvar

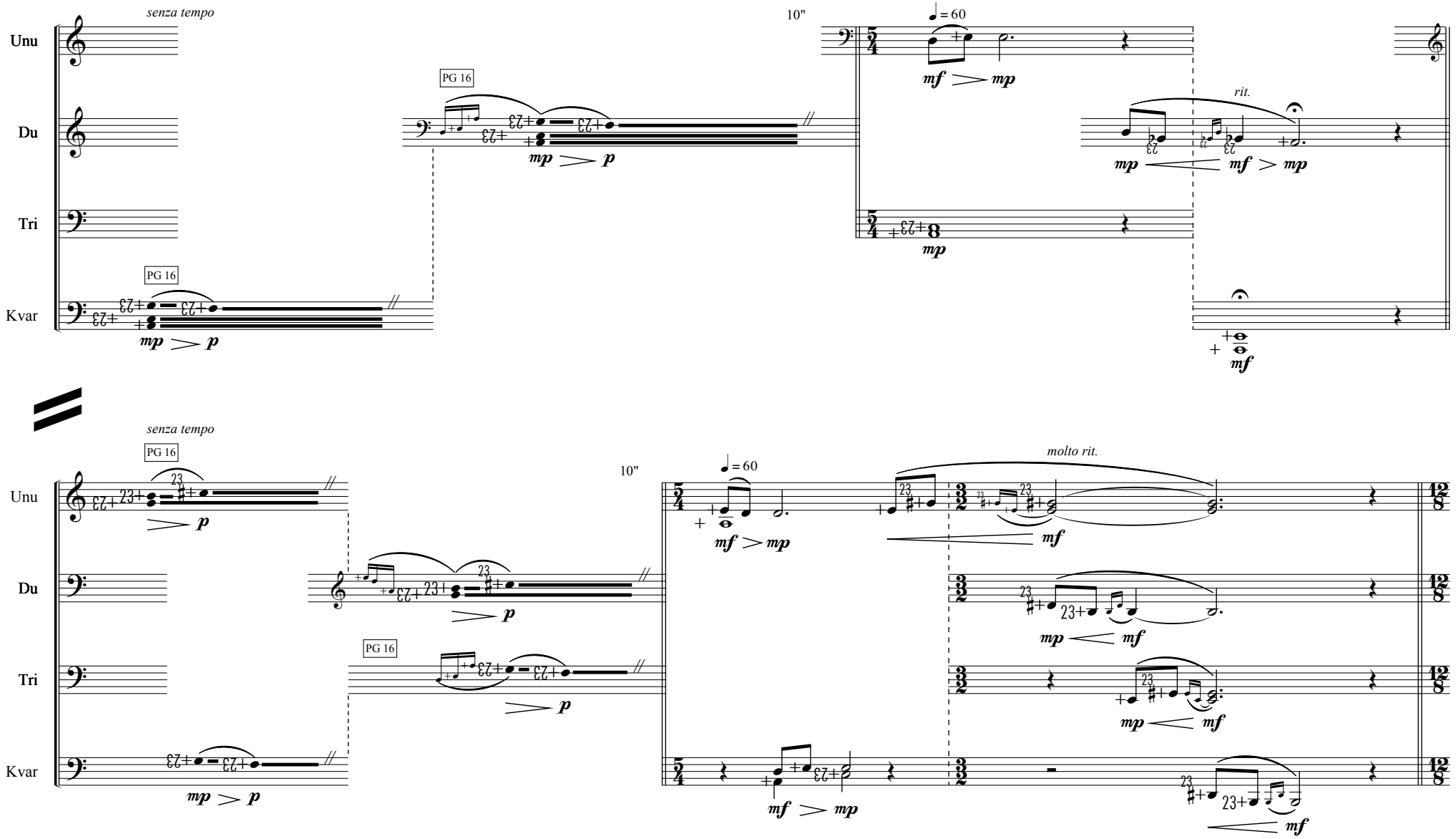

F 17-limit intonation
81
PG 12
Unu
Du
Tri
Kvar
85

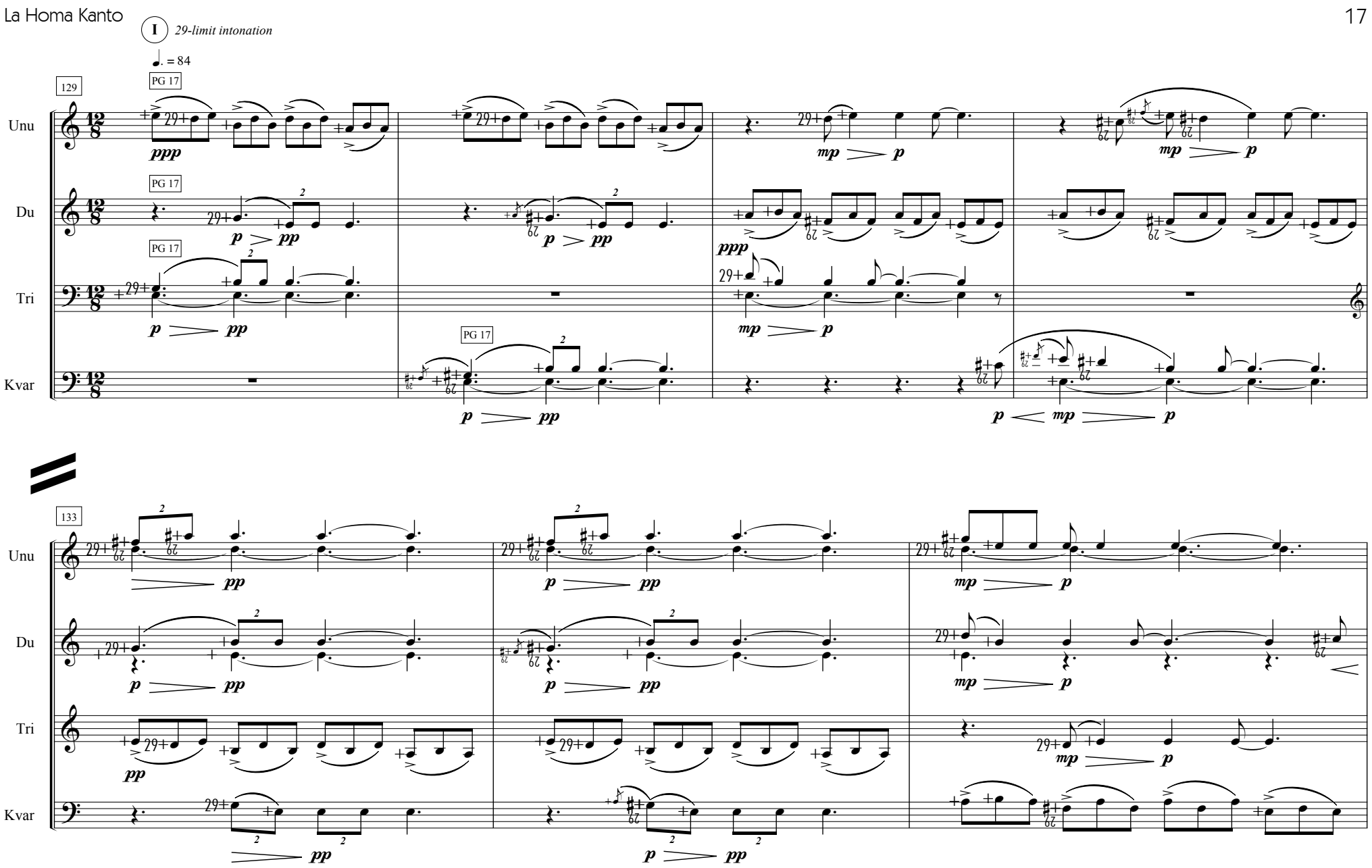

89
PG 13
Unu
Du
Tri
Kvar
pp
mp
p
mf
PG 13
93
rit.
♩. = 60

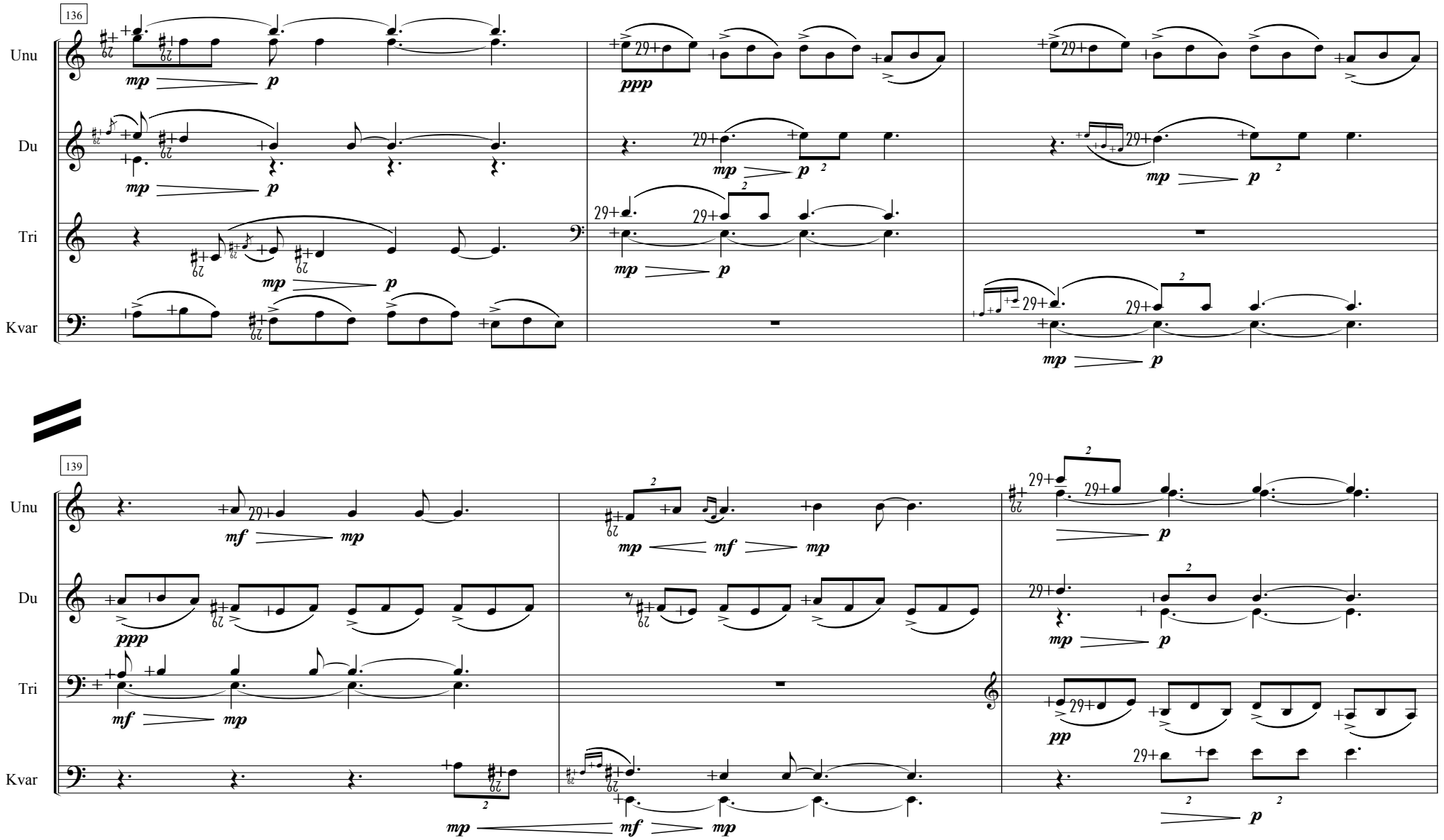

G
19-limit intonation
senza tempo
Unu
Du
Tri
Kvar
PG 14
p > pp
pp
10"
♩= 60 1+3+1
mp p
rit.
molto rit.
♩= 60

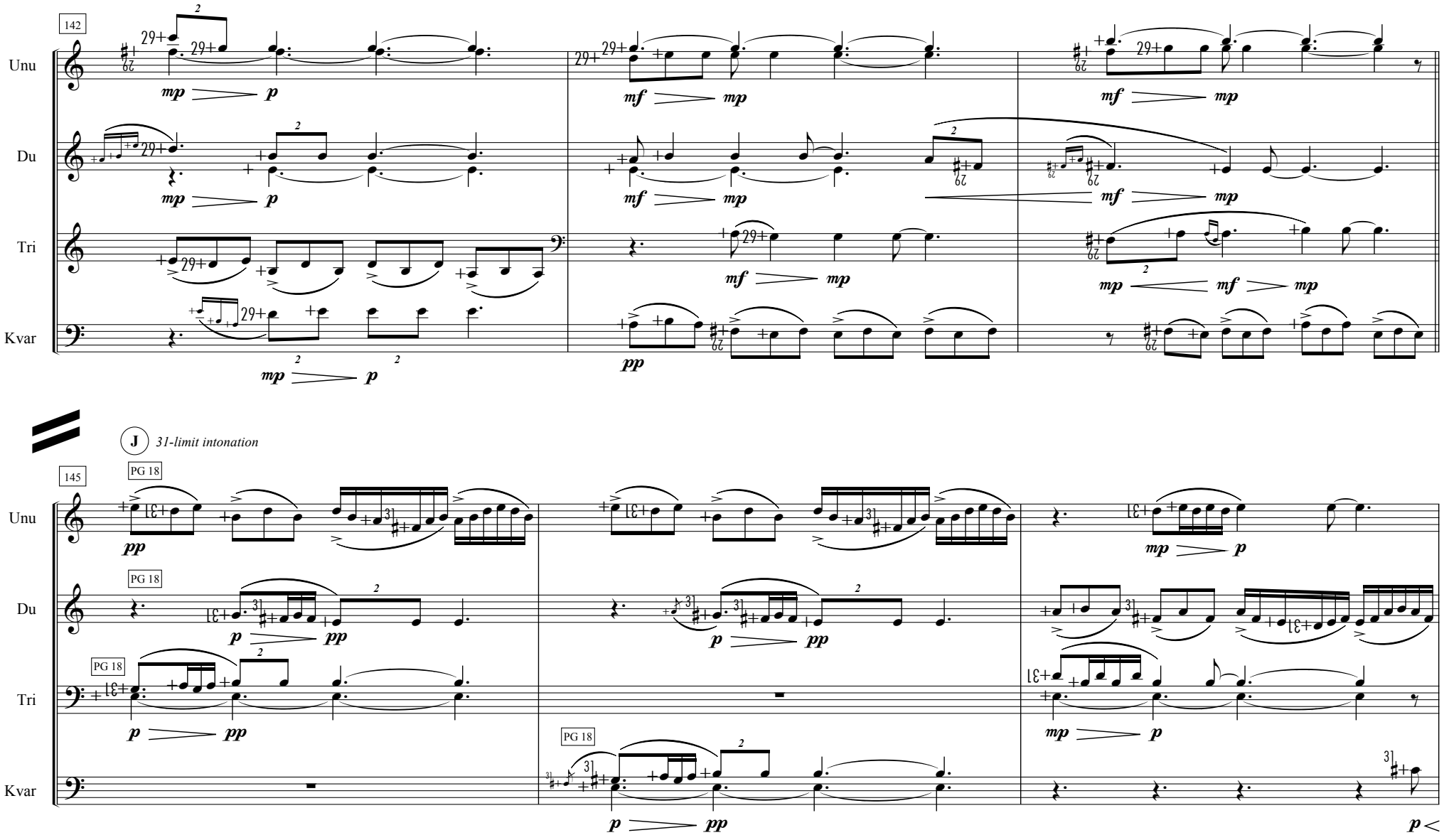

senza tempo
Unu
Du
Tri
Kvar
10"
rit.
= 60
mp p
mf mp
molto rit.

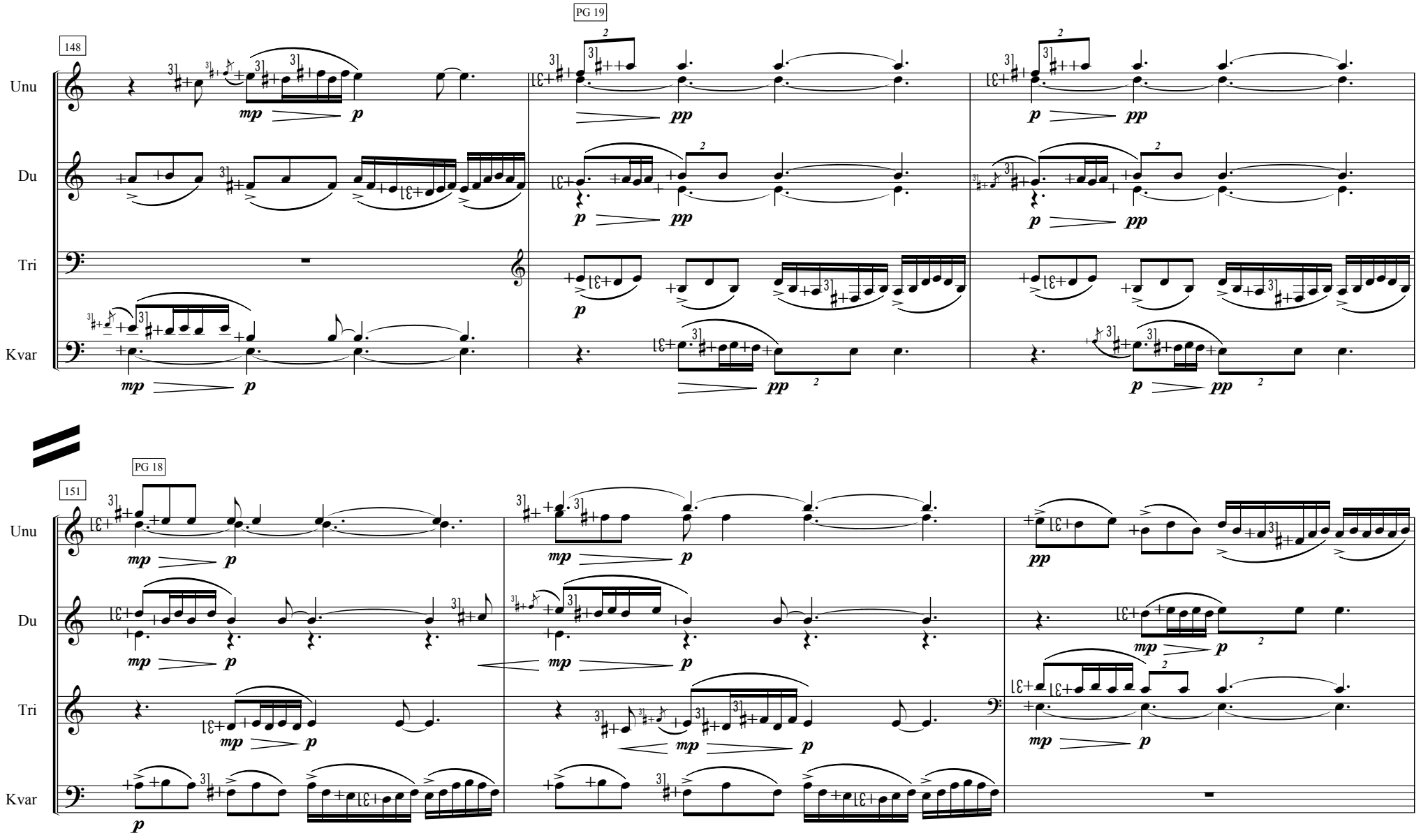

H
23-limit intonation
senza tempo
Unu
Du
Tri
Kvar
PG 15
10"
= 60
rit.
molto rit.
p
mp
pp

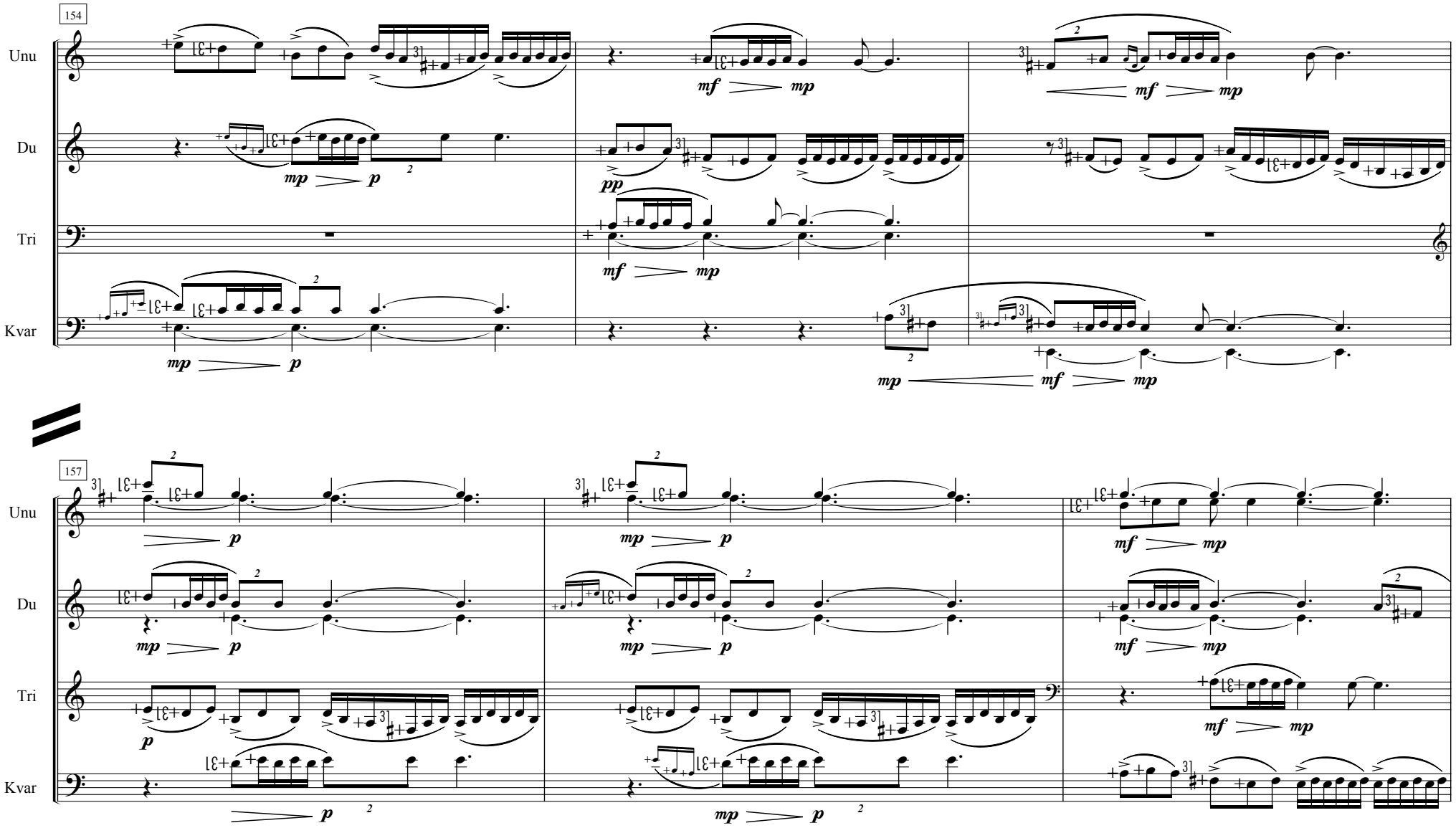

senza tempo
Unu
Du
Tri
Kvar
PG 16
10"
= 60
mf mp
mp p
rit.
mp mf mp
mf
senza tempo
PG 16
molto rit.

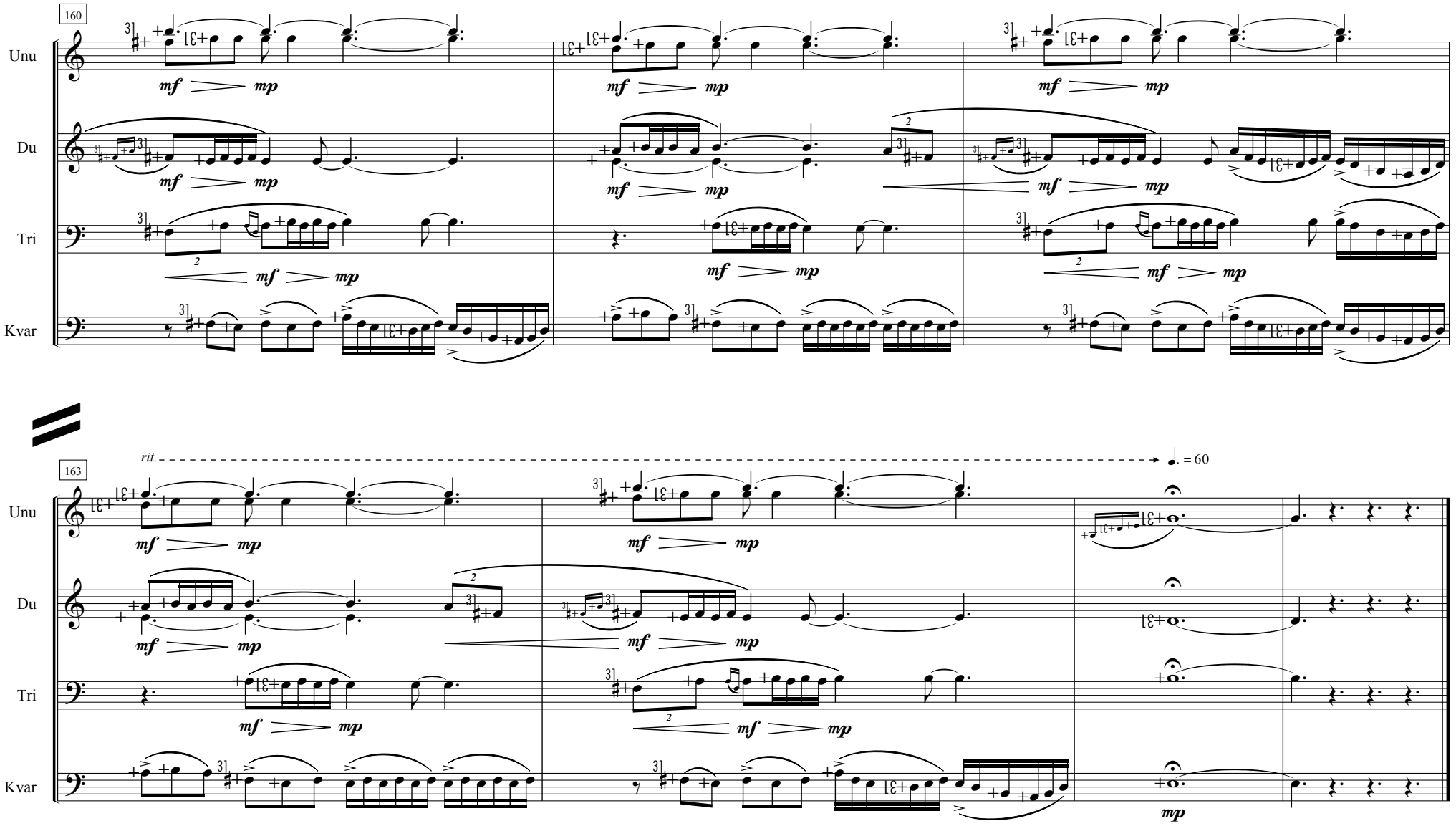

I
29-limit intonation
♩. = 84
129
PG 17
Unu
Du
Tri
Kvar
133


136
Unu
Du
Tri
Kvar
mp
p
ppp
139
mf
pp


142
Unu
Du
Tri
Kvar
J
31-limit intonation
145
PG 18


PG 19
148
Unu
Du
Tri
Kvar
PG 18
151
Unu
Du
Tri
Kvar


154
Unu
Du
Tri
Kvar
157
Unu
Du
Tri
Kvar


160
Unu
Du
Tri
Kvar
mf
mp
163
rit.
♩. = 60