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DocMus Applied Study Scientific / Artistic Research
First Doctoral Presentation, 19.10.24, Organo

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Chords, melodies: a look at harmony by numbers

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Tuning Bach — an experimental recomposition

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Chords, melodies: a look at harmony by numbers

Sara Cubarsi and Xenia Gogu, violins

Streams barely in winter (2019) *1. Cold* *2. Sun* *3. Stones*
three beginnings for Walter played before Bach for two violins

Sei Bach-Intonazioni per Violino Solo (2000–17) *Ia* *IIa* *IIIa*
version in just intonation for violin solo with violin bordun counterpoint

Chords, melodies: a look at harmony by numbers

Sara Cubarsi and Xenia Gogu, violins

Harmony by numbers

- harmony ?

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- numbers ?

Harmony by numbers | *"armonia"* = fitting together

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- numbers ?

Harmony by numbers | *"armonia"* = fitting together

- harmony = relations between pitches other than higher / lower (Tenney)
- numbers ?

Harmony by numbers | *"overtones"* = aliquot divisions

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- numbers

Harmony by numbers | *"overtones"* = aliquot divisions

- harmony = relations between pitches other than higher / lower
- numbers = harmonic partial row (Aristotle, Mersenne, Sauveur, Helmholtz, et al.)

Harmony by numbers | *"overtones"* = aliquot divisions

- harmony = relations between pitches other than higher / lower
- numbers = harmonic partial row; ratios of partials = rational intervals (Partch et al.)

Harmony by numbers = relations of harmonic partials

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- numbers = harmonic partial row; ratios of partials = rational intervals

Harmony by numbers = rational intonation (JI)

- harmony = relations between pitches other than higher / lower
- numbers = harmonic partial row; ratios of partials = rational intervals

Harmony by numbers: research questions

- What is rational intonation or JI?

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- What does it sound like? *intervals, chords, timbres, melodies …*

Harmony by numbers: research questions

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- Repertoire?

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- How does JI relate to historically aware performance practices of earlier music? *pythagorean, meantone, well-tempered tuning systems*
- What new forms of music are emerging from JI practices? How can knowledge about intonation shape the creation of new music?

Case Study 1: Tuning Bach

Tuning Bach features an experimental recomposition of J.S. Bach's three solo violin sonatas: an adaptation for two violins in rational intonation by Marc Sabat.

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In the mid 2010's, I began composing a second violin part, with the intention of providing sustaining tones that allow JI intervals to be tuned more precisely by ear; gradually this evolved into a contrapuntal conversation with Bach's music.

Case Study 1: Streams barely in winter

Tuning Bach features an experimental recomposition of J.S. Bach's three solo violin sonatas, an adaptation for two violins in rational intonation by Marc Sabat.

In 2019, after making the Bach intonations, three short preludes were composed, one for each sonata. These miniatures for two violins take emblematic JI elements of the respective Bach sonatas as points of departure, introducing the sounds of various kinds of JI intervals.

Case Study 1: recording and live concert

Tuning Bach features an experimental recomposition of J.S. Bach's three solo violin sonatas, an adaptation for two violins in rational intonation by Marc Sabat.

In 2019, after making the Bach intonations, three short preludes were composed, one for each sonata. These miniatures for two violins take emblematic JI elements of the respective Bach sonatas as points of departure, introducing the sounds of various kinds of JI intervals.

Both the preludes and the adaptations were recorded in a studio setting and edited for upcoming release. This lecture-concert, presented as part of my doctoral research, marks the first live performance of the complete project.

Harmony by numbers: a brief tour of JI Fundamentals

- the harmonic partial row

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- the harmonic partial row
- HEJI Notation

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- the harmonic partial row
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- JI intervals and chords
- listening techniques for tuning JI sounds

Harmony by numbers: harmonic partials

form a sequence of frequencies which are whole-number multiples of a generating pitch, called the fundamental.

Harmony by numbers: harmonic partials

form a sequence of frequencies which are whole-number multiples of a generating pitch, called the fundamental. Each new harmonic partial fits into the vibrating period of the fundamental, creating a fused harmonic sound. As partials are added, the colour or *timbre* of the sound is enriched or brightened. As lower partials disappear, the sense of fundamental (or periodicity pitch) lingers, creating a *virtual fundamental* enhanced by *combination* or *summation and difference tones*. These *psychoacoustic* phenomena form the basis for how combinations of pitches, even the slightly detuned ones found in the equal tempered system, form harmonies (intervals, chords, aggregates, scales and modes). The concept of *just* or *rational intonation* (JI) is based on the untempered tunings found in the harmonic partial row. *Extended JI* refers to harmonies including the microtonal higher prime partials, 7°, 11°, 13°, etc.

Harmony by numbers: notating JI (HEJI)

Every partial that is a multiple of only 2′s and 3′s is part of a sequence of perfect fifths and fourths, commonly called “Pythagorean” tuning (with a history dating back to Ancient Mesopotamia). It is written with “normal” flats, naturals, or sharps.

Harmony by numbers: odd partials = new pitch-classes

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Multiplying partials by 2 transposes them up an octave. Therefore, *even-numbered* partials are octave transpositions of pitches occurring previously, while *odd-numbered* partials represent the first (and lowest) occurrences of new pitch classes.

Harmony by numbers: prime partials = new accidentals

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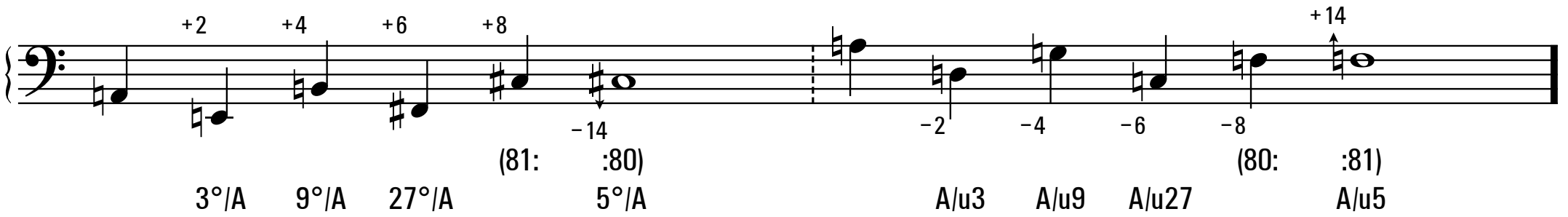
Odd partials that are *prime* numbers always need an additional *modifying* accidental to notate microtonal deviation from a nearby "normal" note. The inverted version of an accidental shows the same deviation occurring *below* a reference pitch.

Harmony by numbers: the Syntonic Comma

Every partial that is a multiple of only 2′s and 3′s is part of a sequence of perfect fifths and fourths, commonly called “Pythagorean” tuning (with a history dating back to Ancient Mesopotamia). It is written with “normal” flats, naturals, or sharps.

Odd partials that are *prime* numbers always need an additional *modifying* accidental to notate microtonal deviation from a nearby “normal” note. The inverted version of an accidental shows the same deviation occurring *below* a reference pitch.

Notation of 5° partial and its inversion u5 as deviations of a Syntonic Comma from the nearby Pythagorean notes



The Helmholtz-Ellis JI Pitch Notation (HEJI) | 2020

Harmonic / Subharmonic series 1–49 notated by modifications of Pythagorean notes

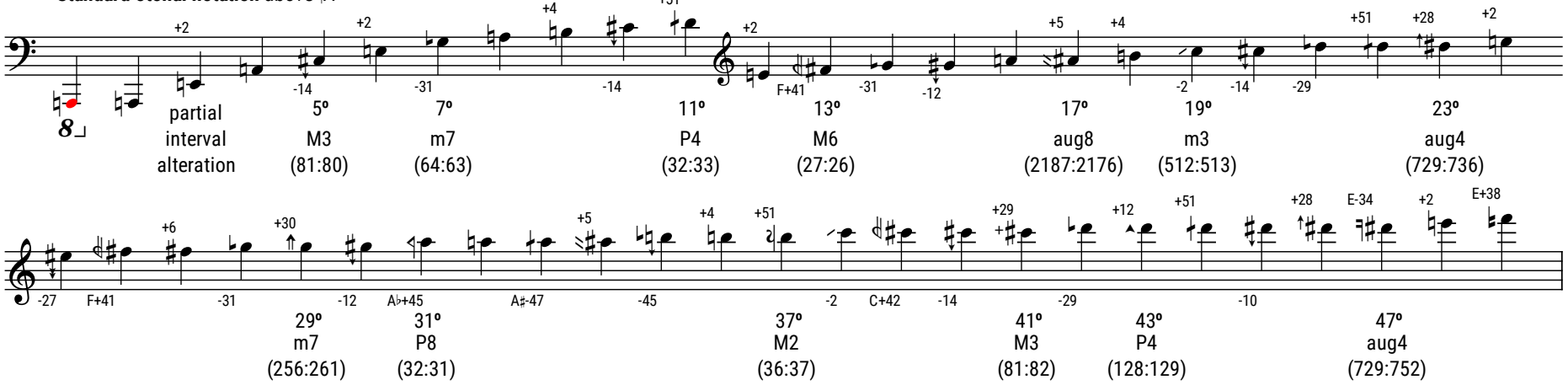
with dedicated microtonal accidental symbols for primes 5 through 47

revised by Marc Sabat & Thomas Nicholson

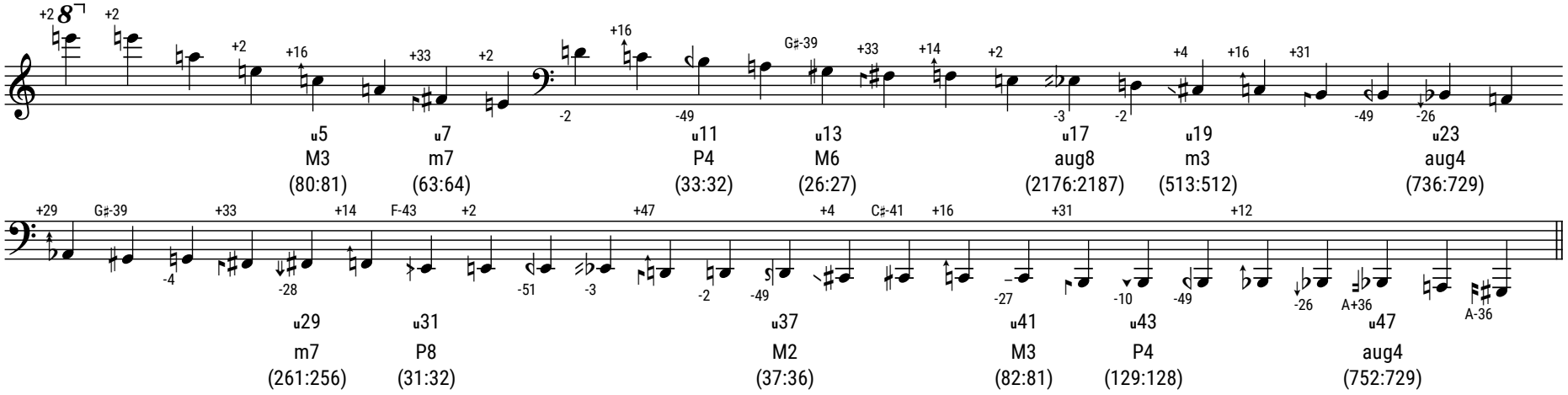
in collaboration with Wolfgang von Schweinitz, Catherine Lamb and M.O. Abbott
building upon the original HEJI devised by Marc Sabat and Wolfgang von Schweinitz

Ratios represent the amount of modification of the Pythagorean notes by each additional symbol,
cents indications are deviations that would be shown on a tuning meter with A = 0 cents

Standard otonal notation above ♮A



Standard utonal notation below ♮E



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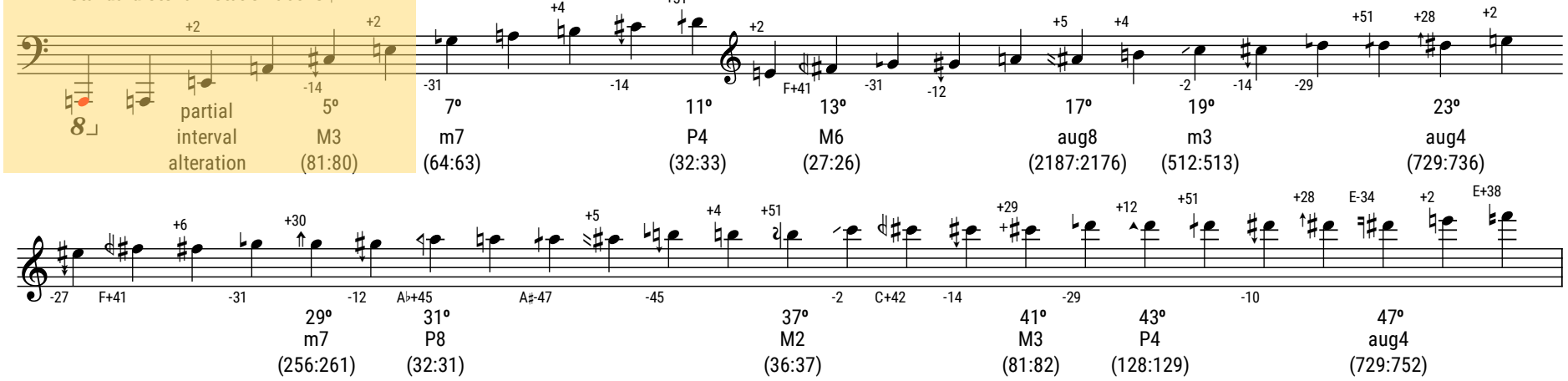

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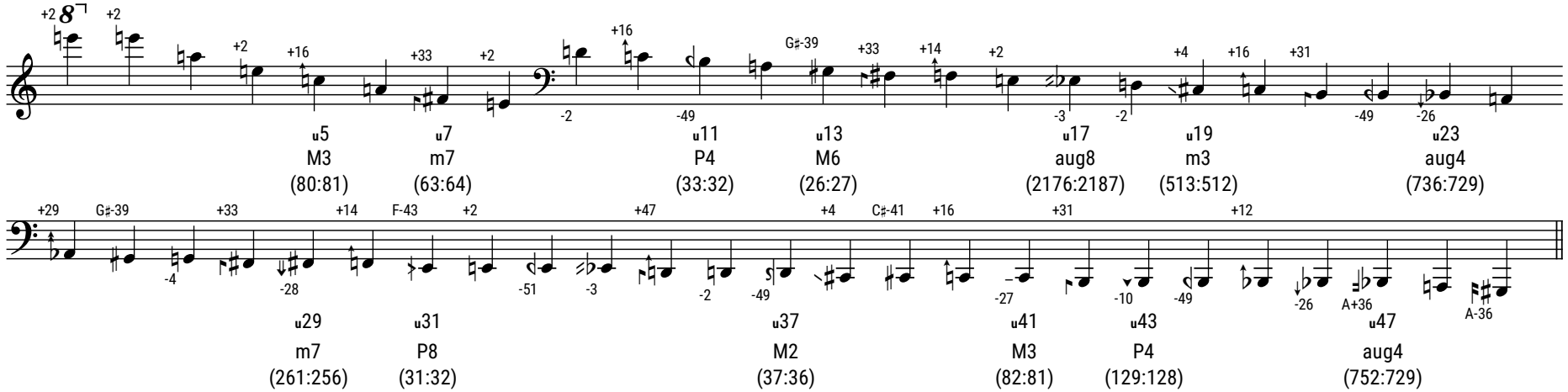

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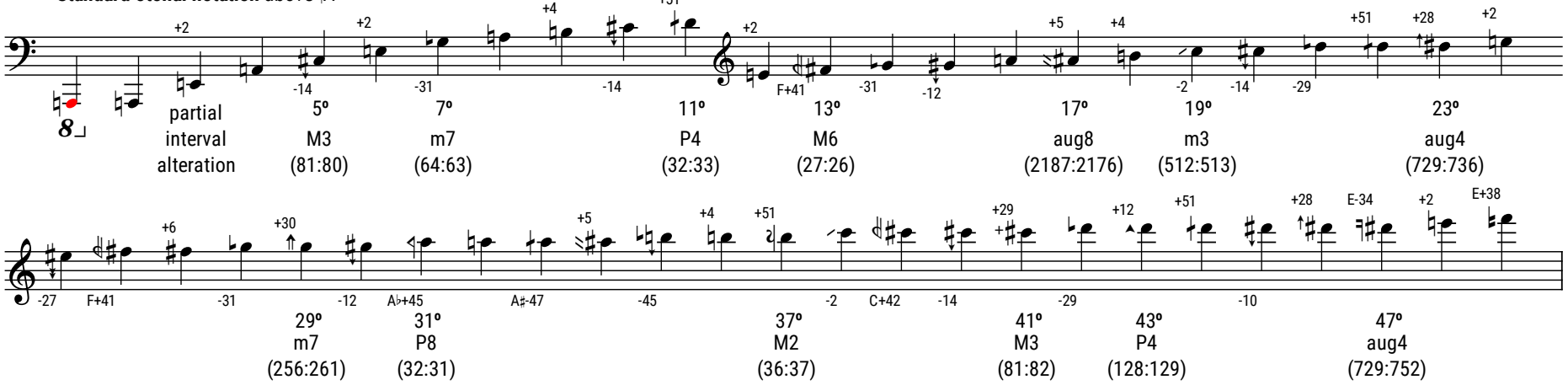

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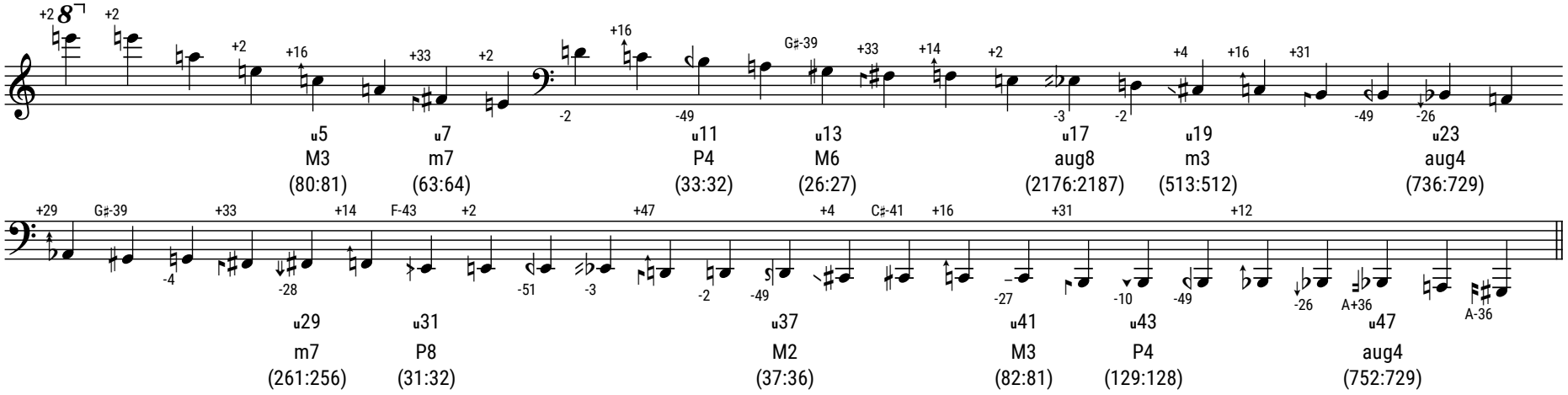

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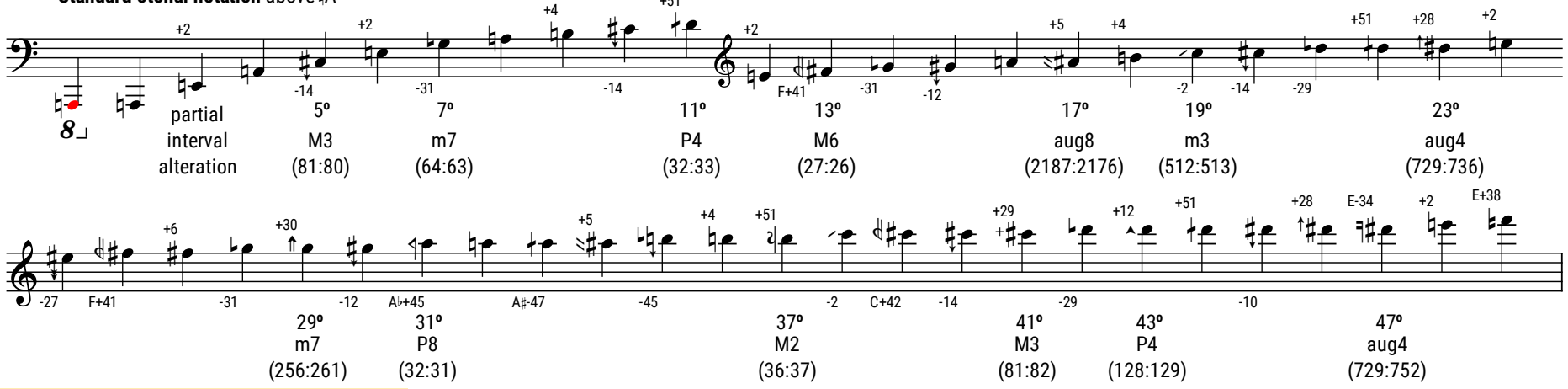

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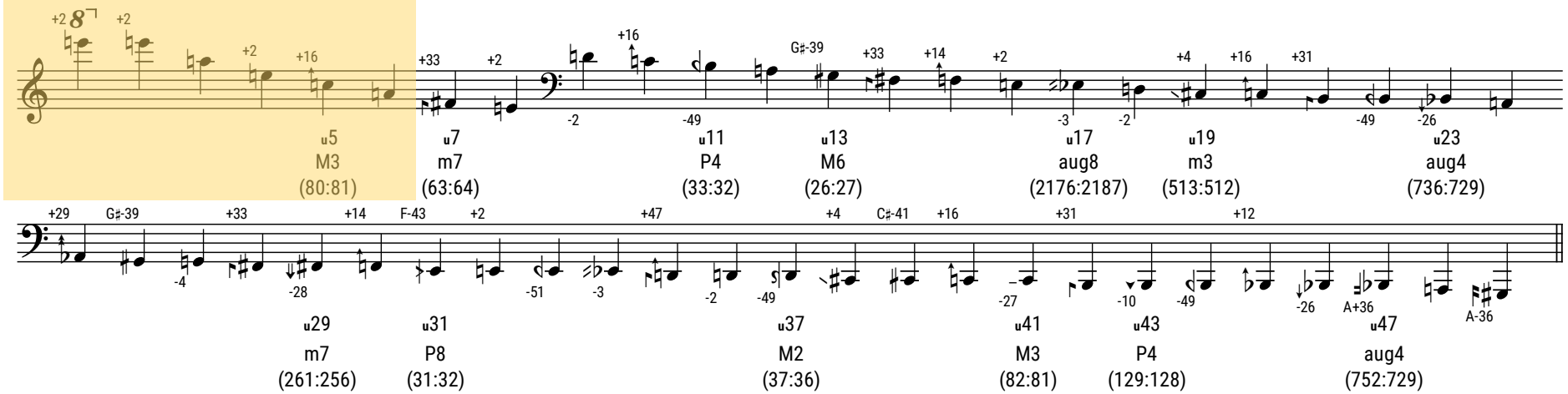

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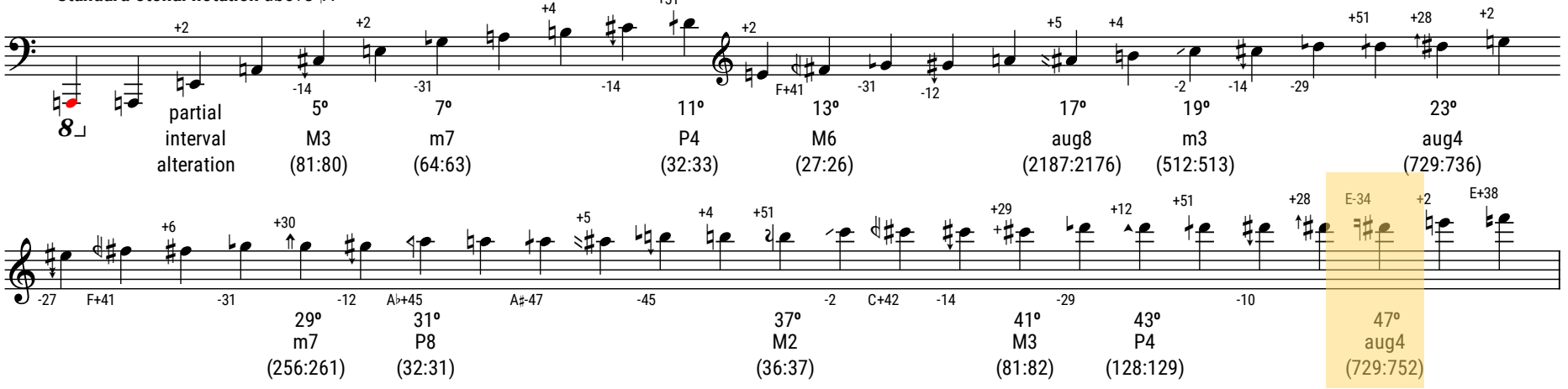

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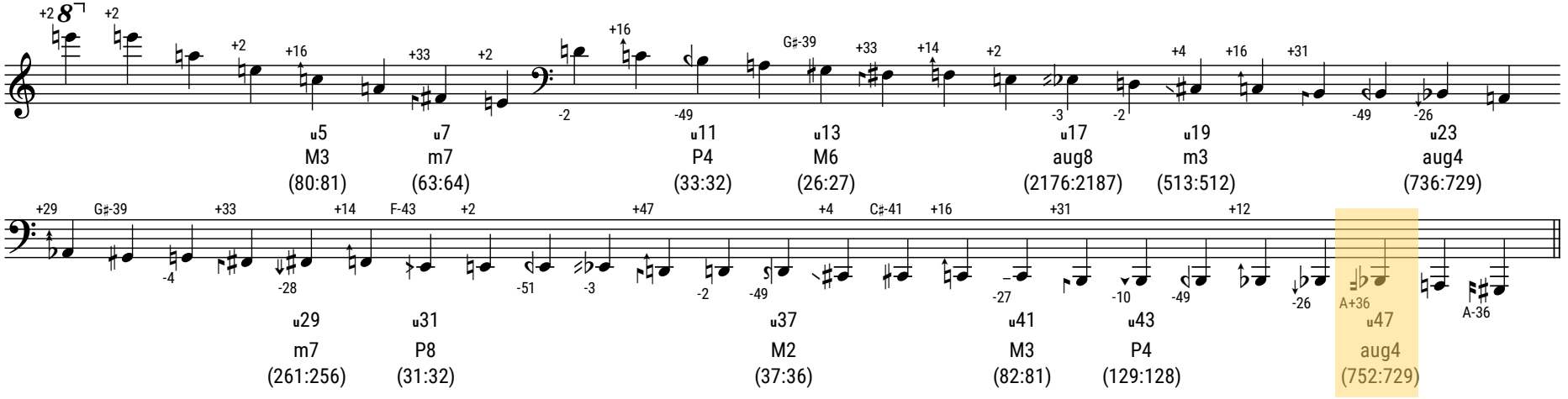

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Notes with “normal” accidentals are tuned in pure fifths

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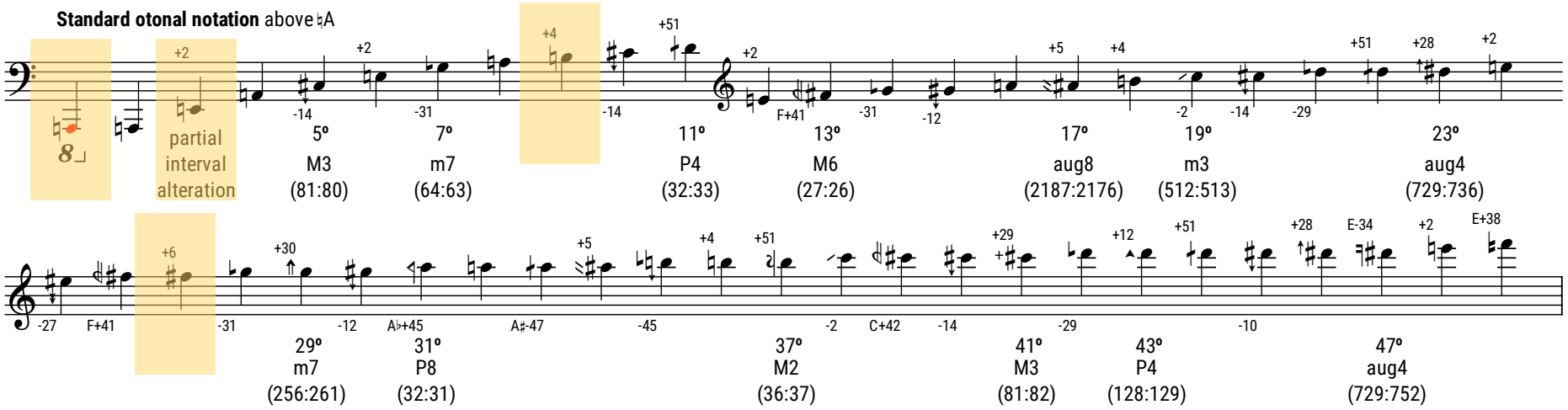

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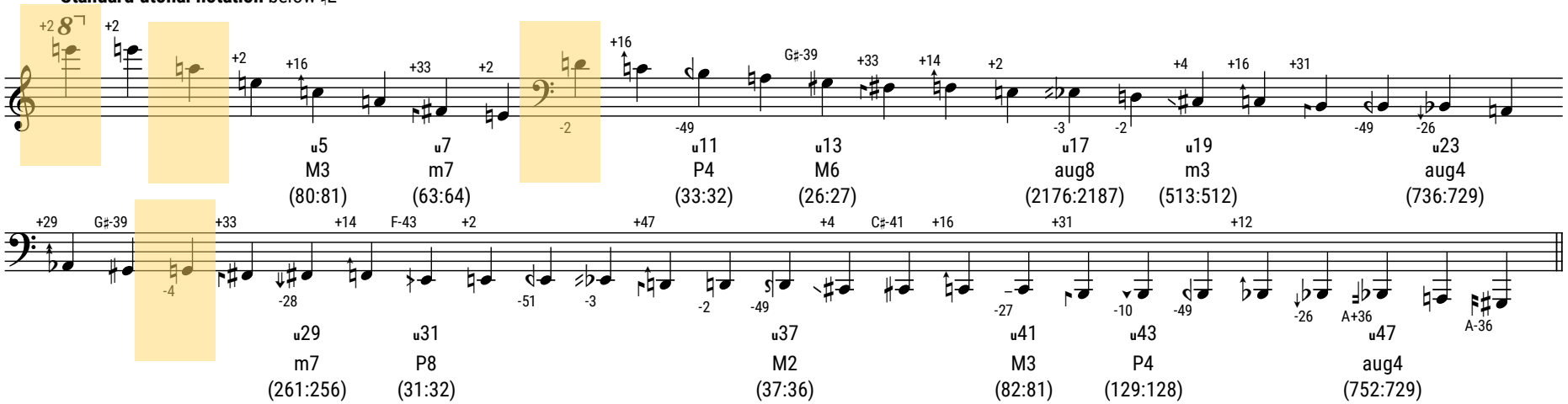

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Harmonic / Subharmonic series 1–49 notated by modifications of Pythagorean notes

with dedicated microtonal accidental symbols for primes 5 through 47

partial 5° and its multiples are indicated by an arrow

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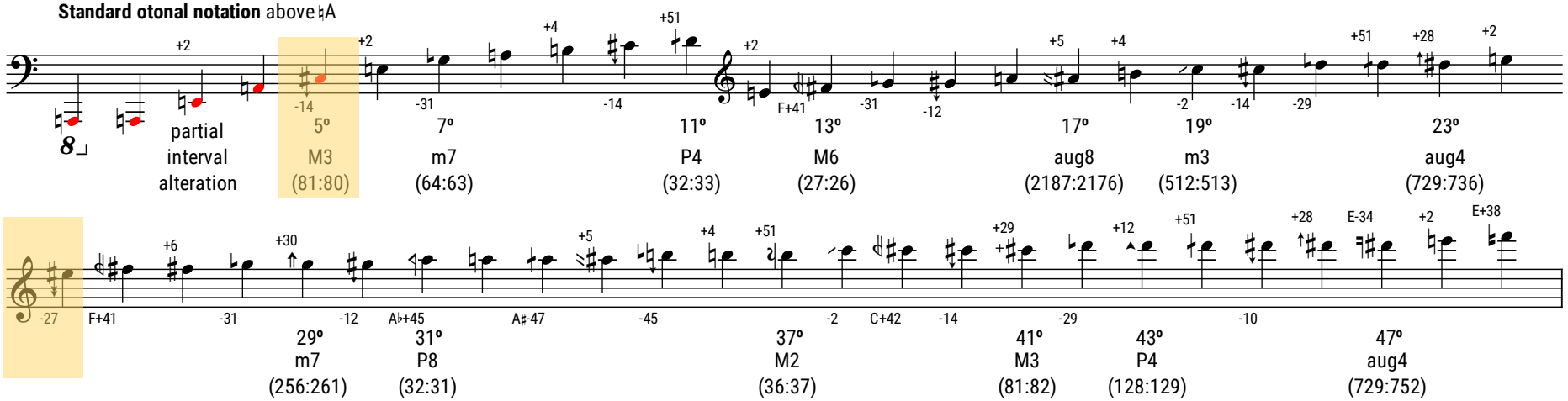
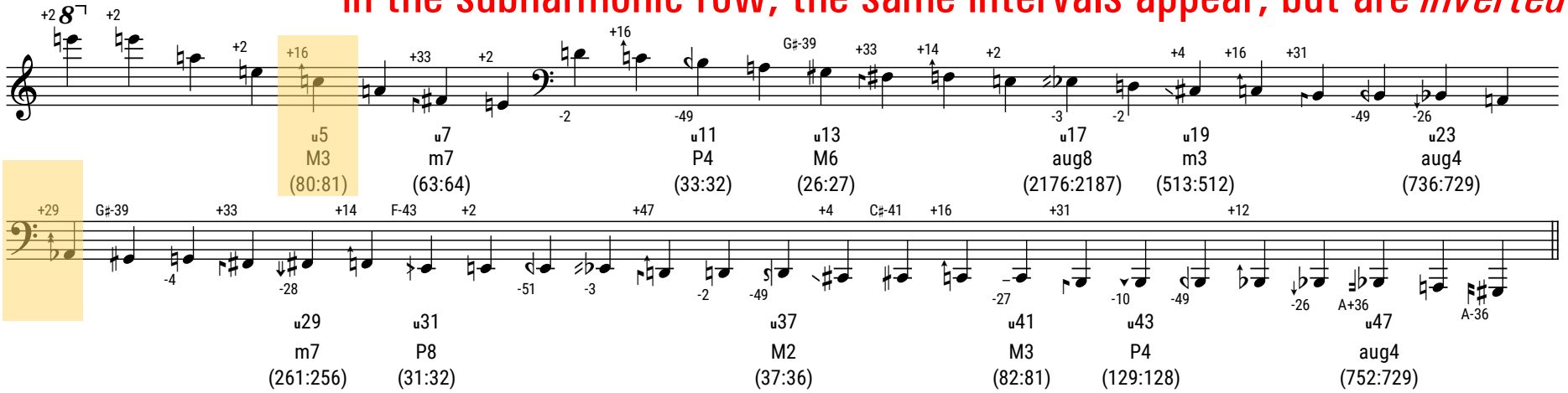


Standard utonal notation below ♮E

in the subharmonic row, the same intervals appear, but are *inverted*



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Harmonic / Subharmonic series 1–49 notated by modifications of Pythagorean notes

with dedicated microtonal accidental symbols for primes 5 through 47

partial 7° and its multiples (septimal notes) are indicated by Tartini's hook

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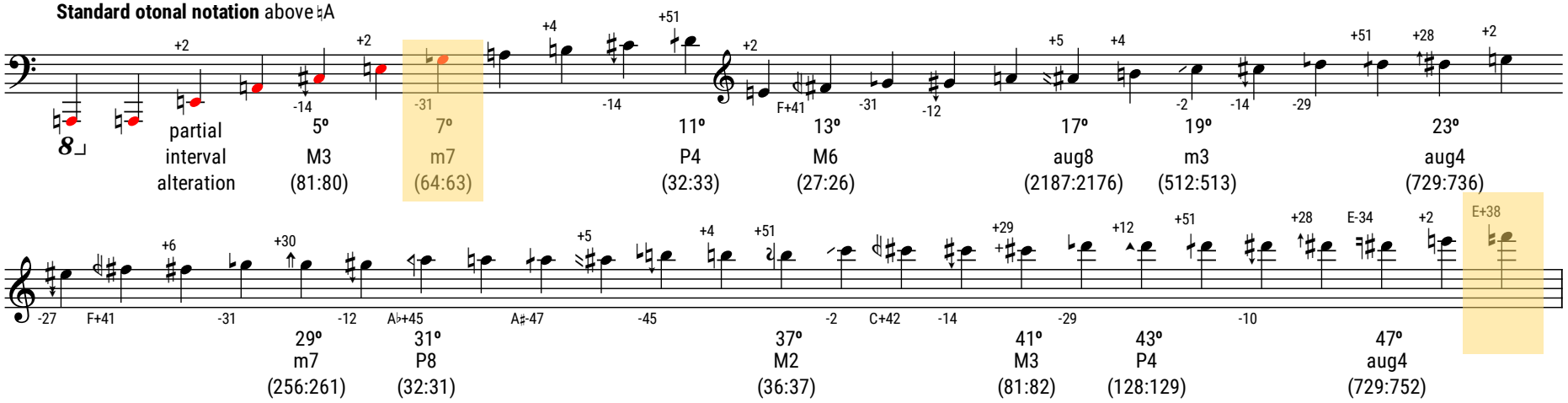

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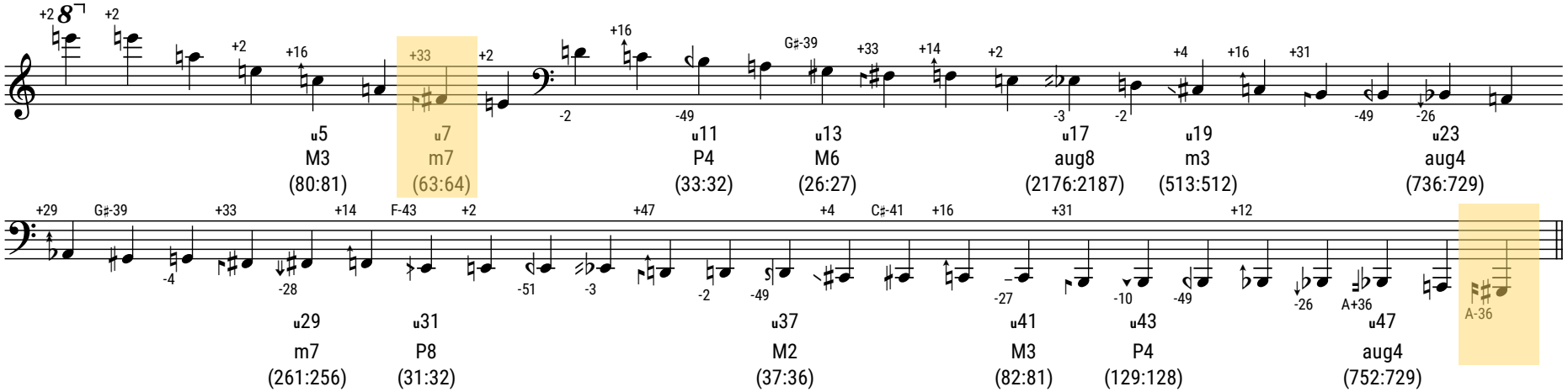

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partial 9° is *odd* (new pitch-class) but it isn't *prime*...

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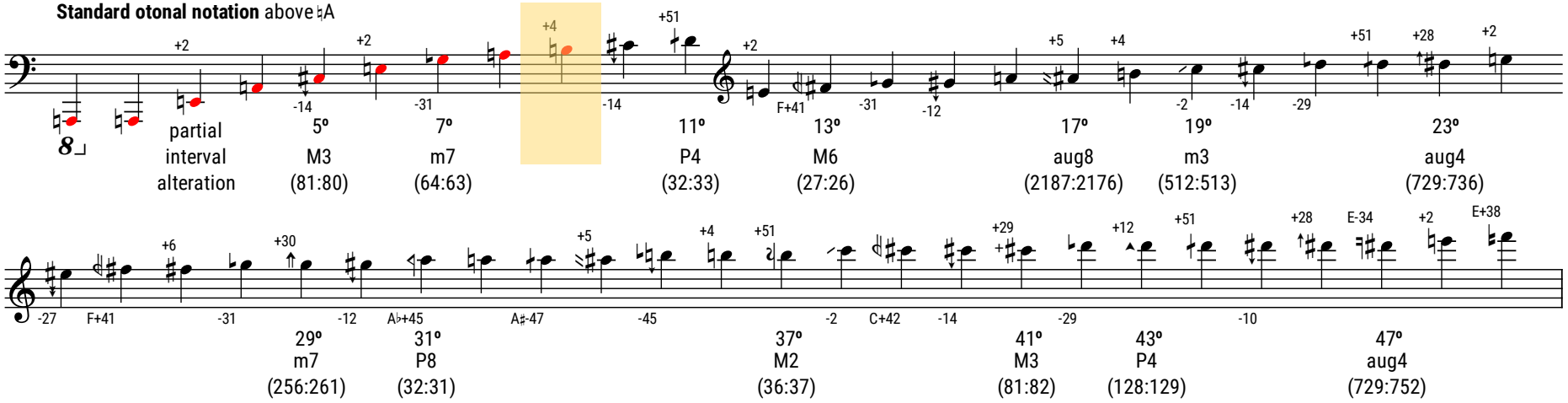

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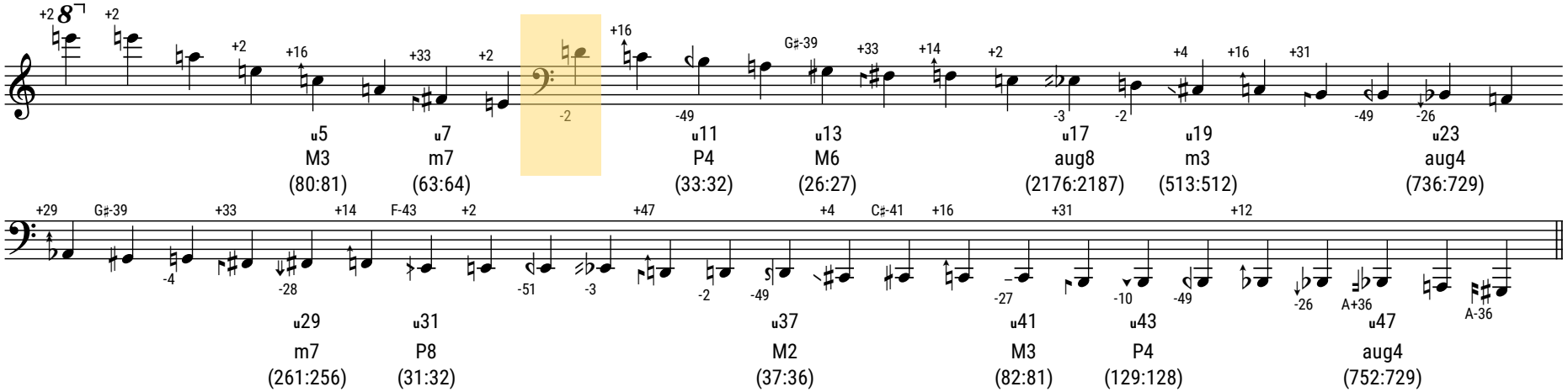

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undecimal notes:

partial 11° and its multiples are indicated by a 2-stroke cross

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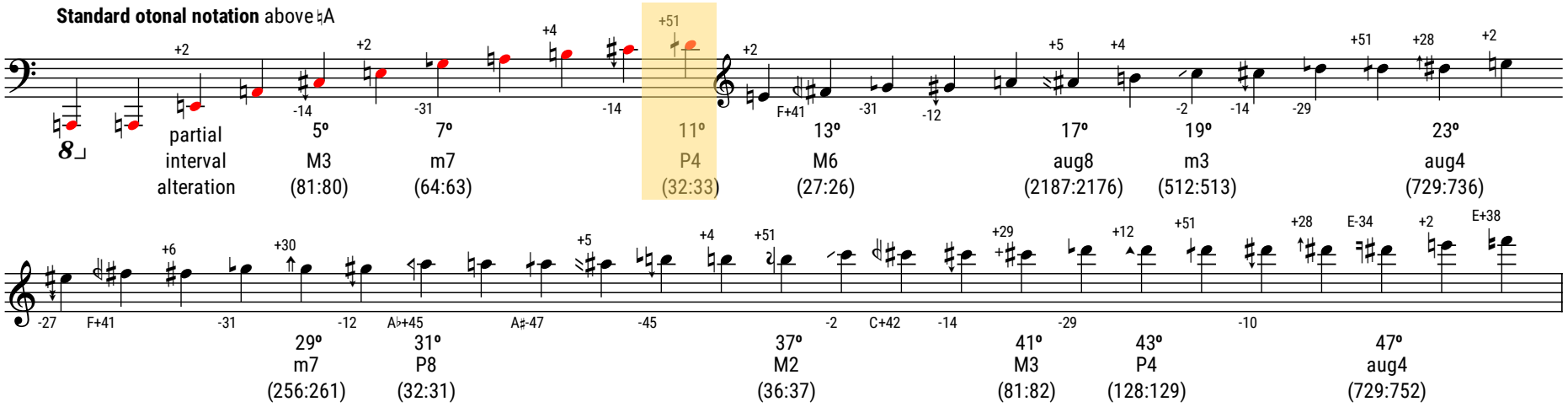
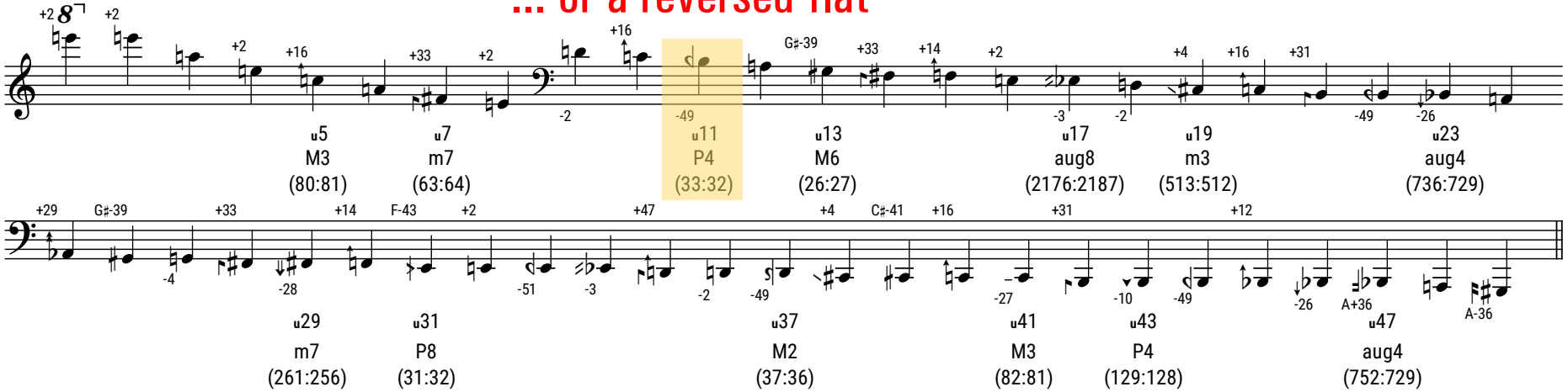
cents indications are deviations that would be shown on a tuning meter with A = 0 cents

Standard otonal notation above ♮A



Standard utonal notation below ♮E

... or a reversed flat



The Helmholtz-Ellis JI Pitch Notation (HEJI) | 2020

Harmonic / Subharmonic series 1–49 notated by modifications of Pythagorean notes

with dedicated microtonal accidental symbols for primes 5 through 47

tridecimal notes:

partial 13° and its multiples are indicated by a 3-stroke reverse flat

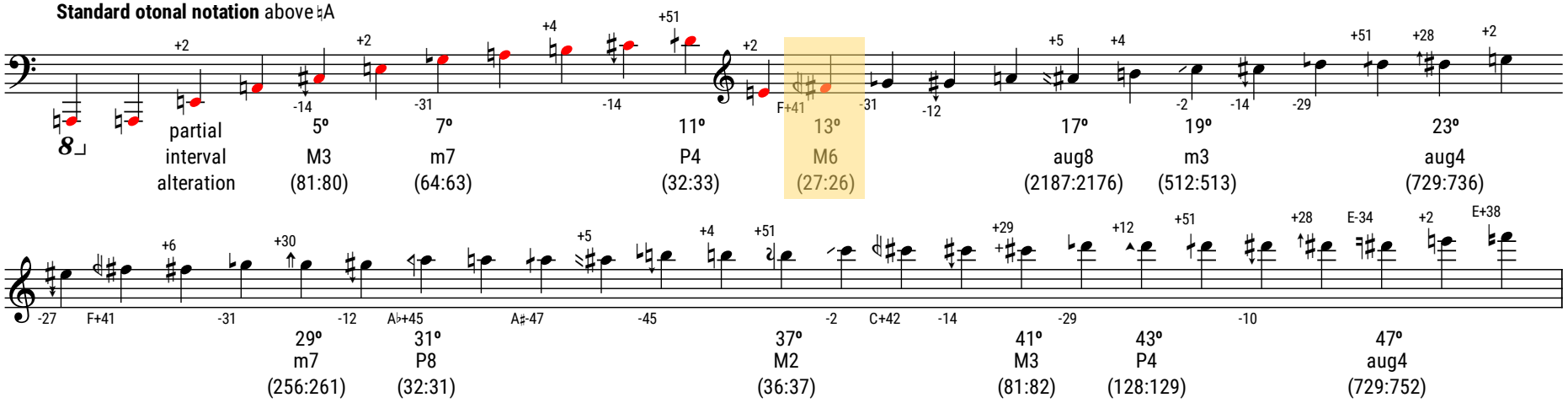
revised by Marc Sabat & Thomas Nicholson

in collaboration with Wolfgang von Schweinitz, Catherine Lamb and M.O. Abbott

building upon the original HEJI devised by Marc Sabat and Wolfgang von Schweinitz

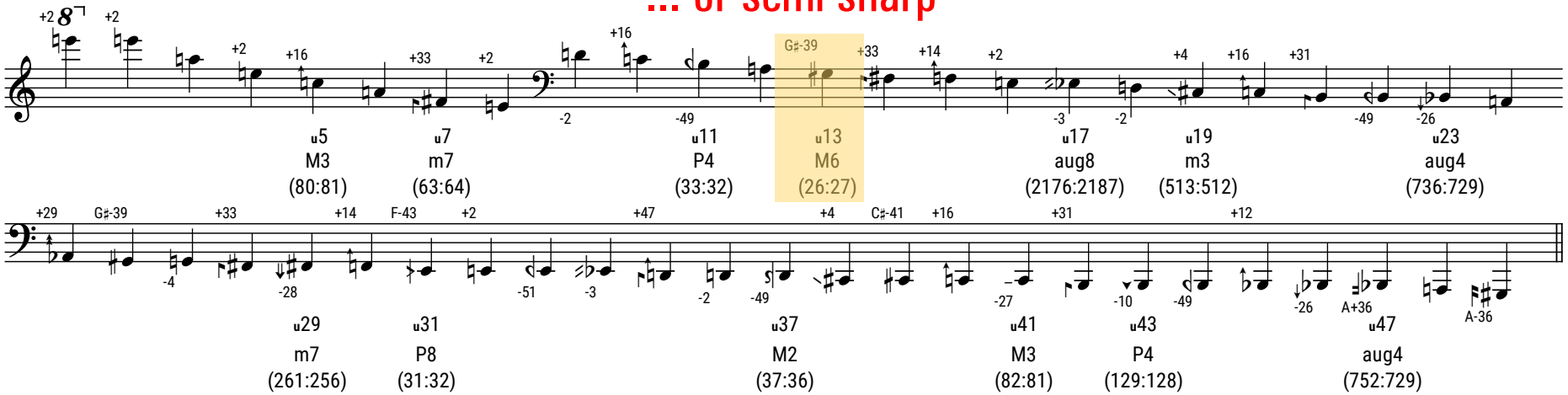
Ratios represent the amount of modification of the Pythagorean notes by each additional symbol, cents indications are deviations that would be shown on a tuning meter with A = 0 cents

Standard otonal notation above ♮A



Standard utonal notation below ♮E

… or semi-sharp



The Helmholtz-Ellis JI Pitch Notation (HEJI) | 2020

Harmonic / Subharmonic series 1–49 notated by modifications of Pythagorean notes

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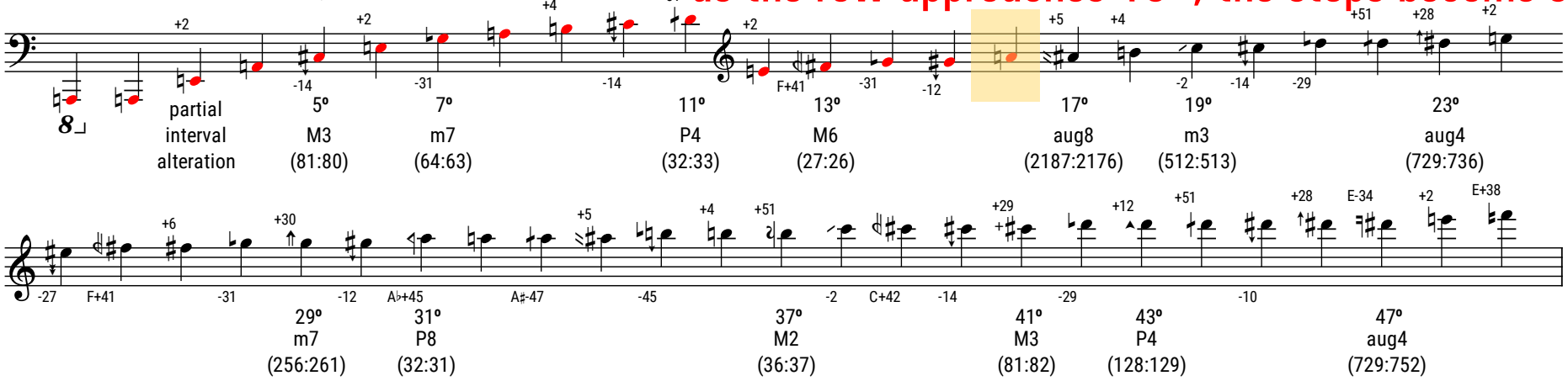
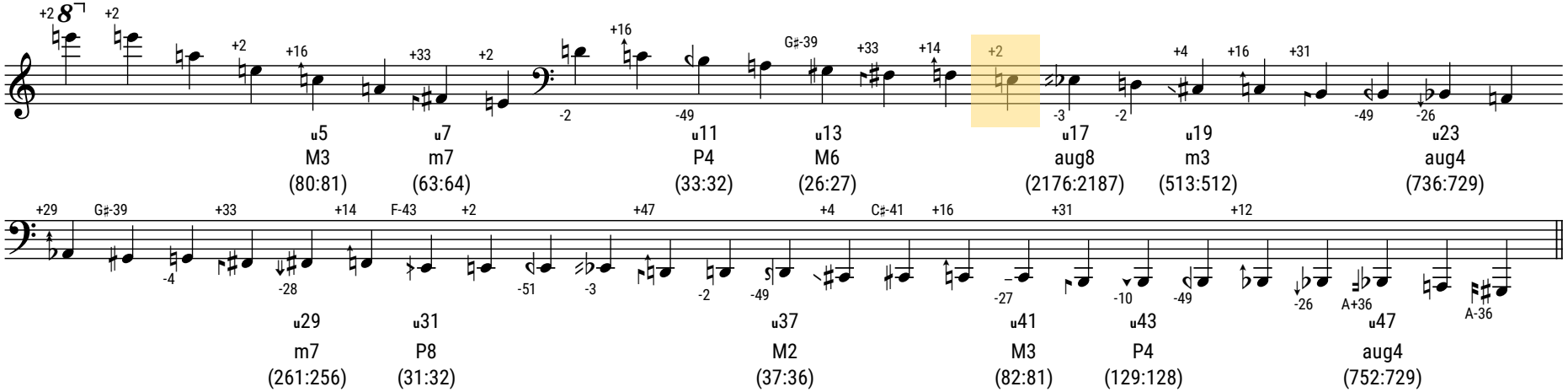
Ratios represent the amount of modification of the Pythagorean notes by each additional symbol,
cents indications are deviations that would be shown on a tuning meter with A = 0 cents

as the row approaches 16°, the steps become semitones

Standard otonal notation above ♮A



Standard utonal notation below ♮E



The Helmholtz-Ellis JI Pitch Notation (HEJI) | 2020

Harmonic / Subharmonic series 1–49 notated by modifications of Pythagorean notes

with dedicated microtonal accidental symbols for primes 5 through 47

The harmonic partial row is a source for intervals used in music:

revised by Marc Sabat & Thomas Nicholson

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building upon the original HEJI devised by Marc Sabat and Wolfgang von Schweinitz

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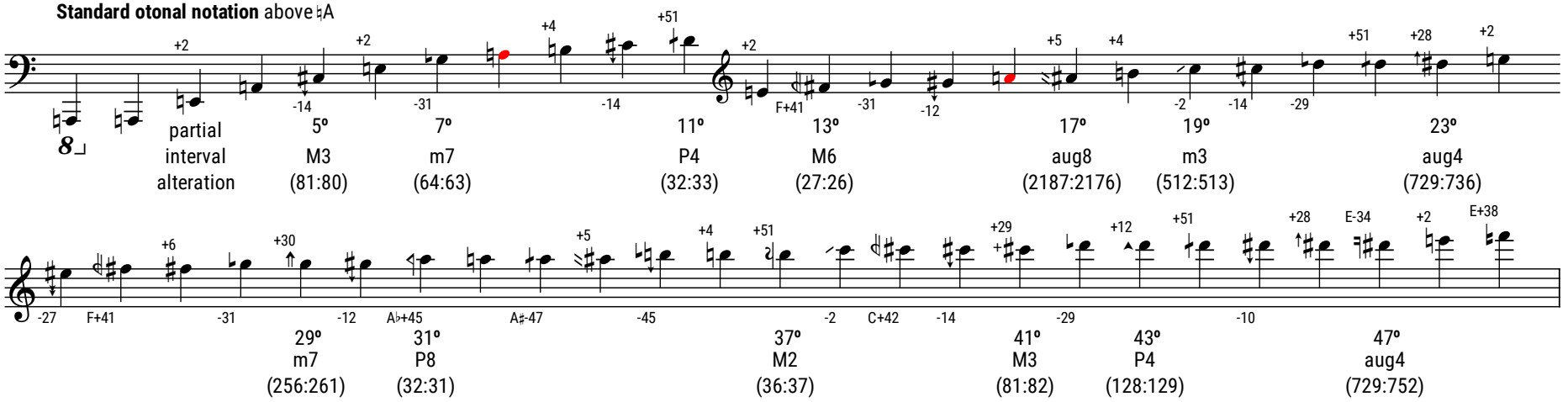
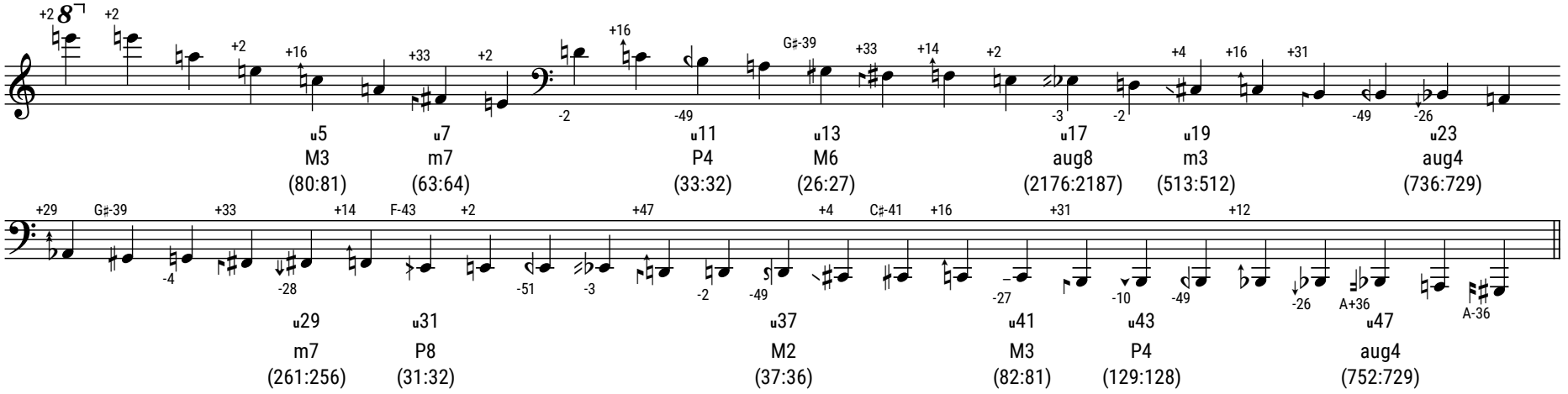
Standard otonal notation above ♮A



Standard utonal notation below ♮E



The Helmholtz-Ellis JI Pitch Notation (HEJI) | 2020

Harmonic / Subharmonic series 1–49 notated by modifications of Pythagorean notes

with dedicated microtonal accidental symbols for primes 5 through 47

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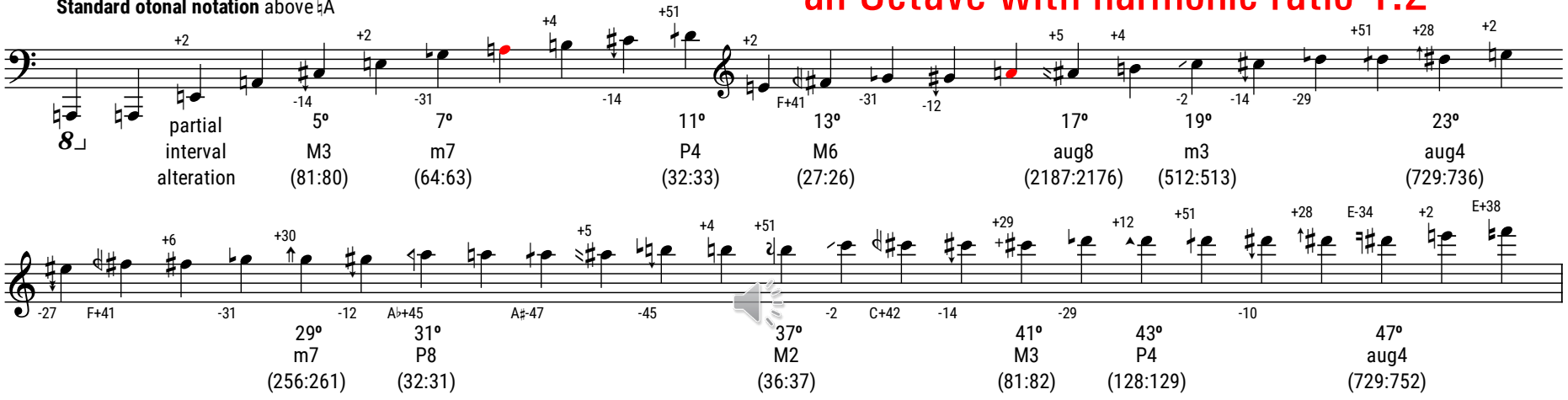
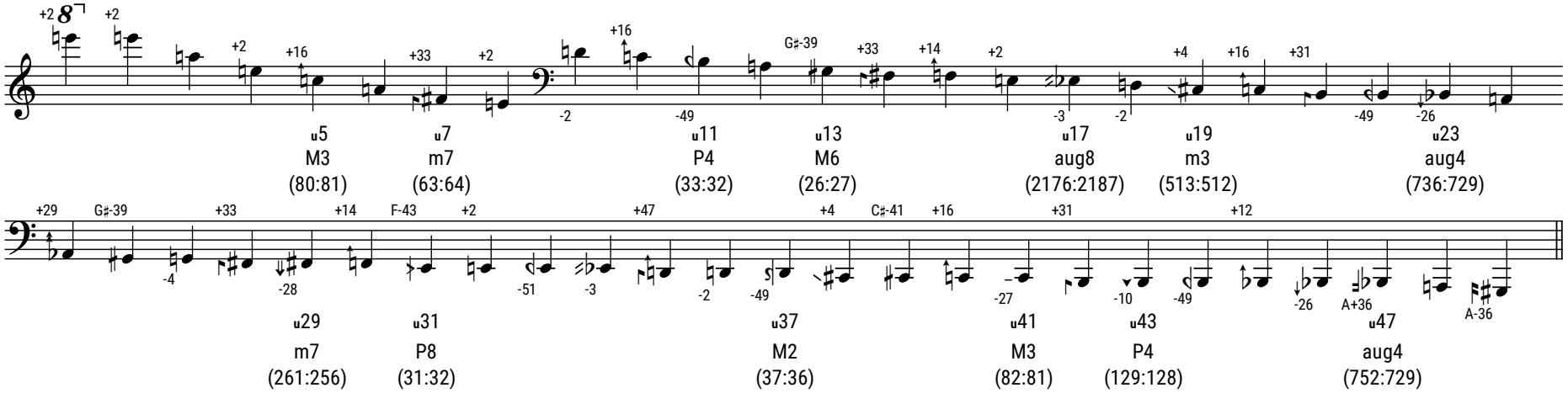
an Octave with harmonic ratio 1:2

Standard otonal notation above ♮A



Standard utonal notation below ♮E



The Helmholtz-Ellis JI Pitch Notation (HEJI) | 2020

Harmonic / Subharmonic series 1–49 notated by modifications of Pythagorean notes

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Ratios represent the amount of modification of the Pythagorean notes by each additional symbol,
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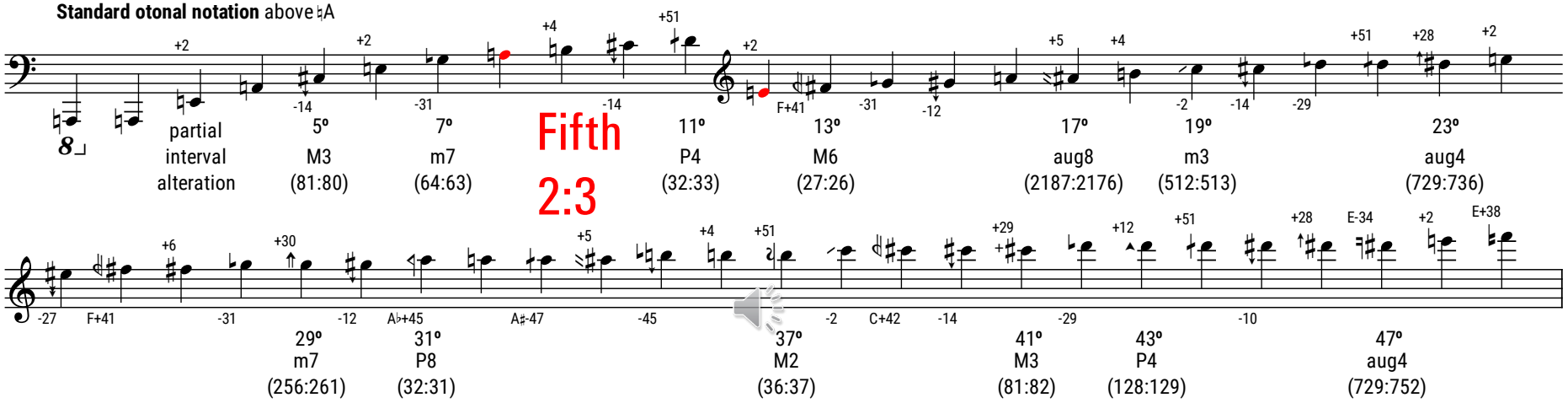
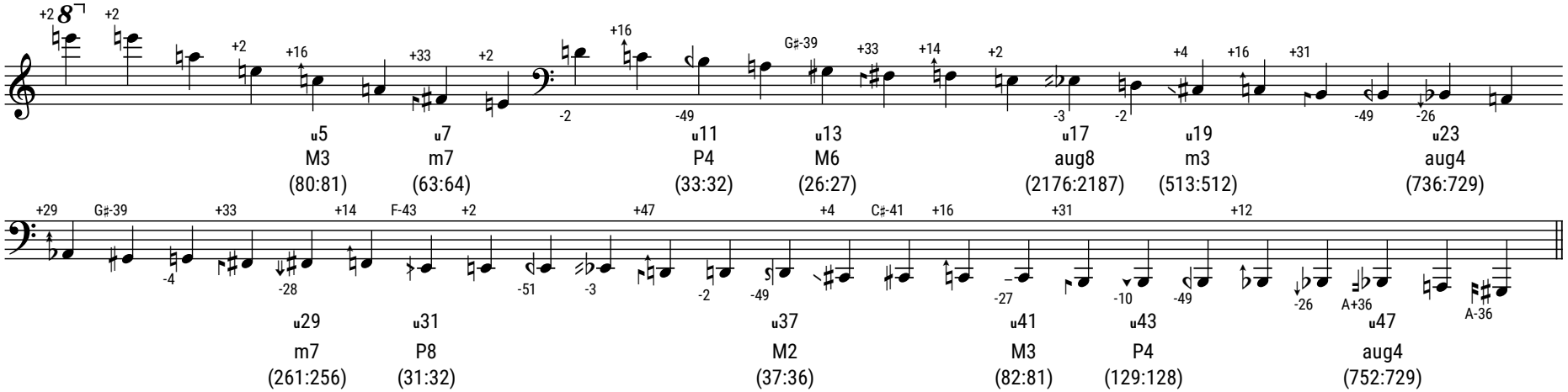
Standard otonal notation above ♮A



Standard utonal notation below ♮E



The Helmholtz-Ellis JI Pitch Notation (HEJI) | 2020

Harmonic / Subharmonic series 1–49 notated by modifications of Pythagorean notes

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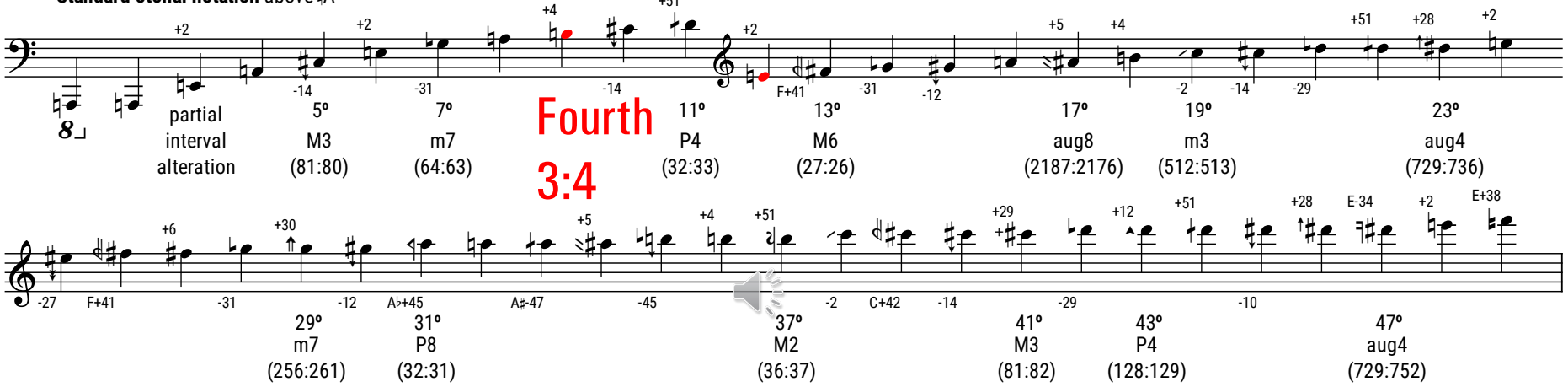
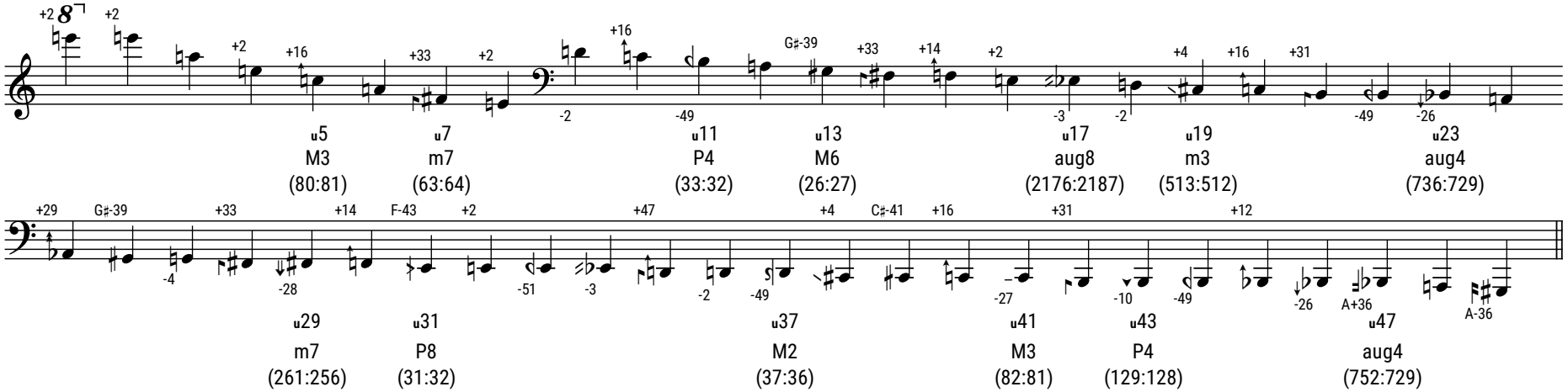
Standard otonal notation above ♮A



Standard utonal notation below ♮E



The Helmholtz-Ellis JI Pitch Notation (HEJI) | 2020

Harmonic / Subharmonic series 1–49 notated by modifications of Pythagorean notes

with dedicated microtonal accidental symbols for primes 5 through 47

and the row also contains chords, i.e. the Major Triad 4:5:6

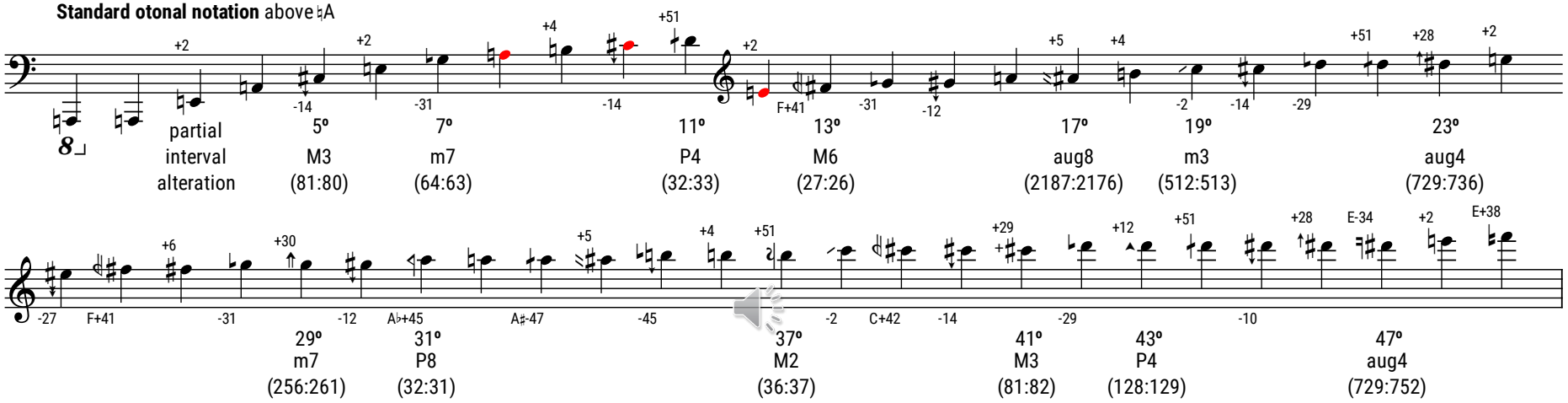
revised by Marc Sabat & Thomas Nicholson

in collaboration with Wolfgang von Schweinitz, Catherine Lamb and M.O. Abbott

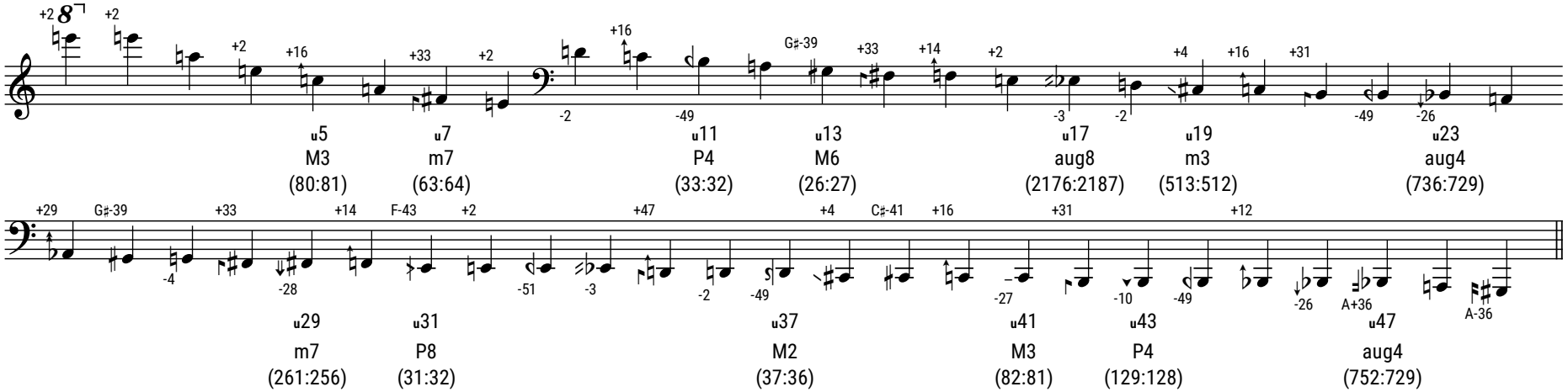
building upon the original HEJI devised by Marc Sabat and Wolfgang von Schweinitz

Ratios represent the amount of modification of the Pythagorean notes by each additional symbol, cents indications are deviations that would be shown on a tuning meter with A = 0 cents

Standard otonal notation above ♮A



Standard utonal notation below ♮E



The Helmholtz-Ellis JI Pitch Notation (HEJI) | 2020

Harmonic / Subharmonic series 1–49 notated by modifications of Pythagorean notes

with dedicated microtonal accidental symbols for primes 5 through 47

Major Triad inversion 5:6:8

revised by Marc Sabat & Thomas Nicholson

in collaboration with Wolfgang von Schweinitz, Catherine Lamb and M.O. Abbott

building upon the original HEJI devised by Marc Sabat and Wolfgang von Schweinitz

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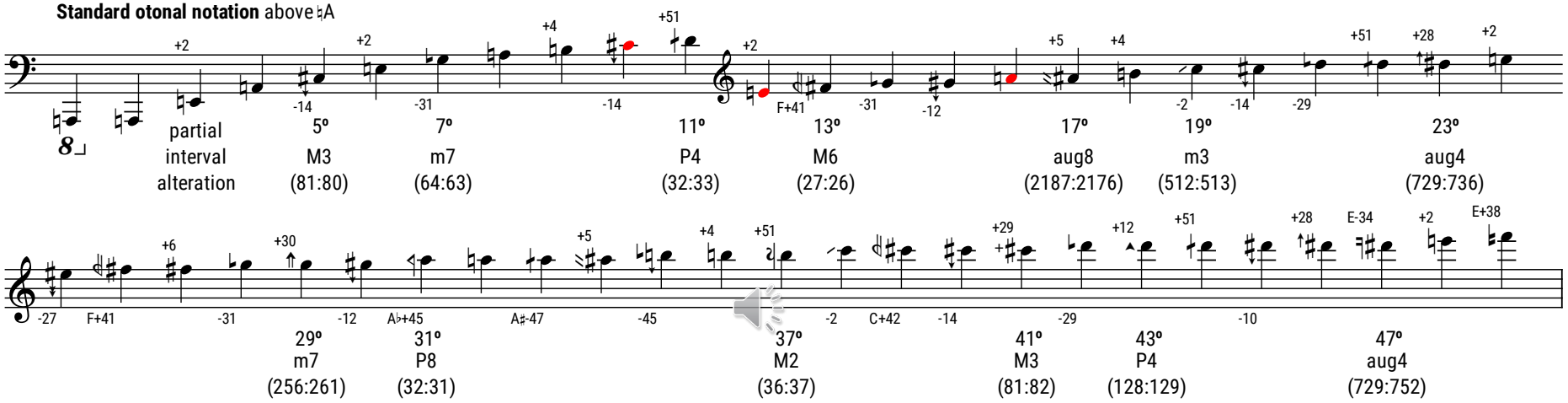
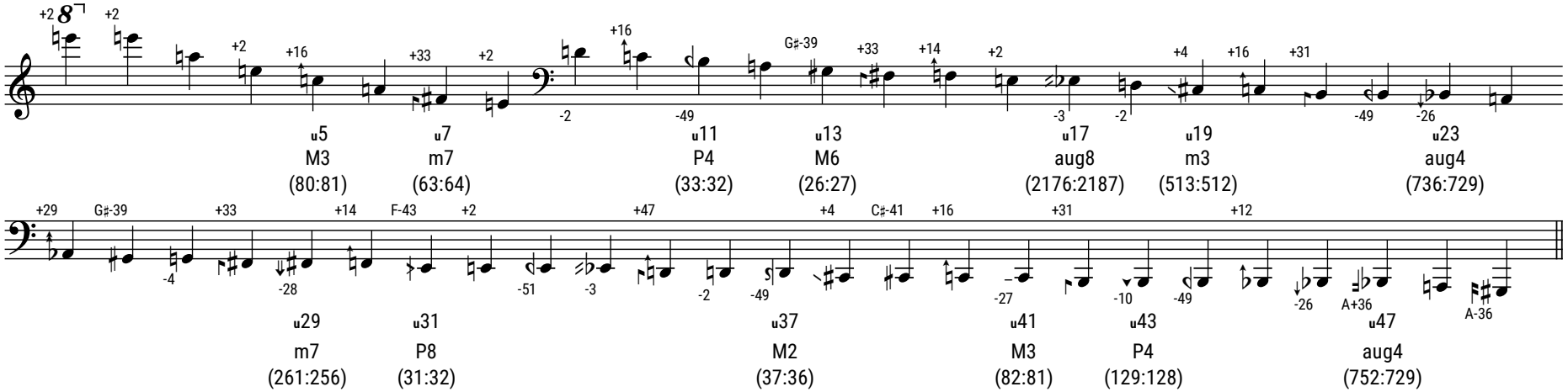
Standard otonal notation above ♮A



Standard utonal notation below ♮E



The Helmholtz-Ellis JI Pitch Notation (HEJI) | 2020

Harmonic / Subharmonic series 1–49 notated by modifications of Pythagorean notes

with dedicated microtonal accidental symbols for primes 5 through 47

Minor Triad 10:12:15

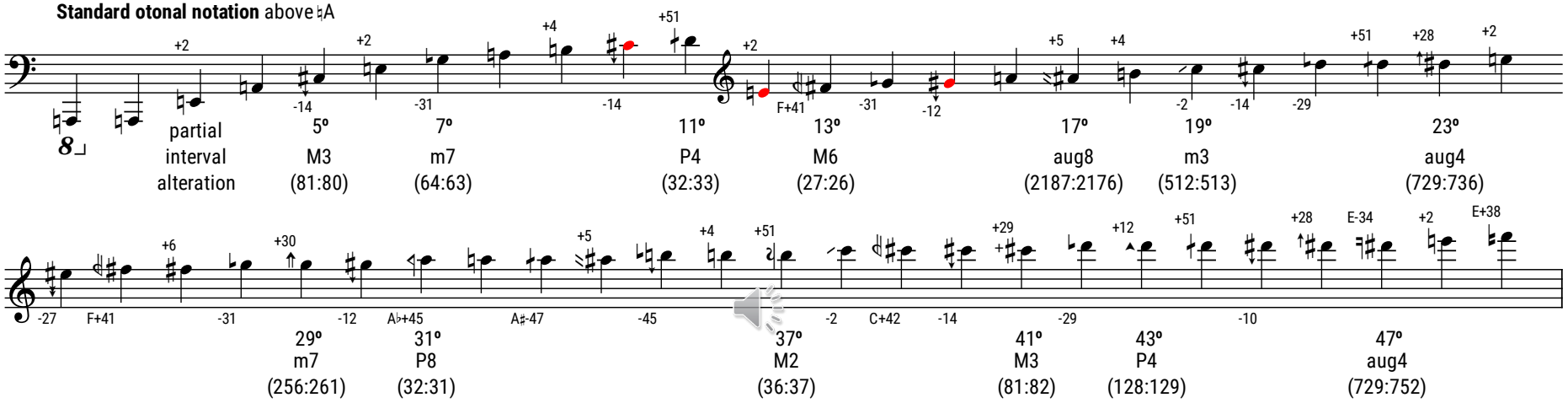
revised by Marc Sabat & Thomas Nicholson

in collaboration with Wolfgang von Schweinitz, Catherine Lamb and M.O. Abbott

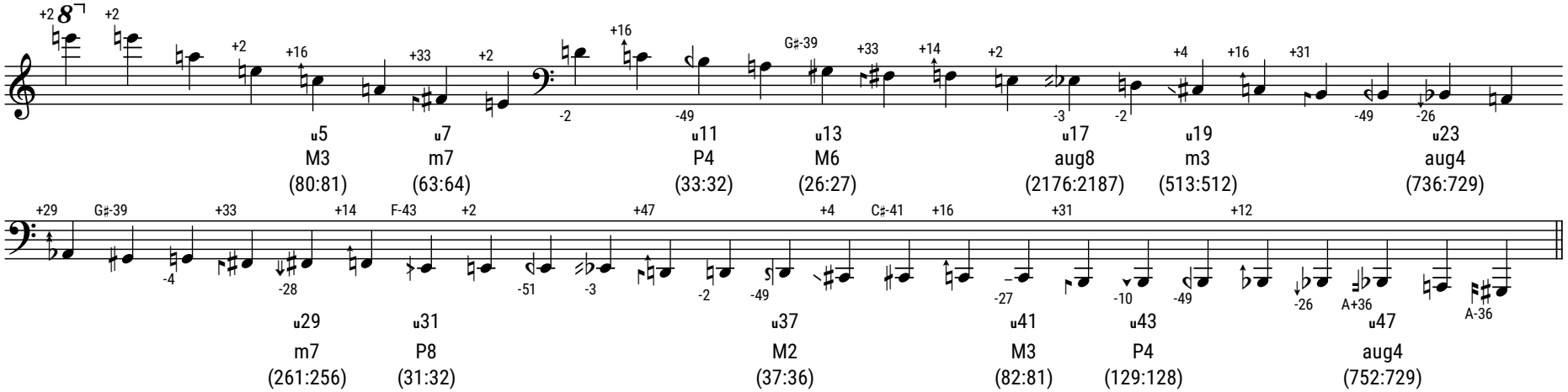
building upon the original HEJI devised by Marc Sabat and Wolfgang von Schweinitz

Ratios represent the amount of modification of the Pythagorean notes by each additional symbol, cents indications are deviations that would be shown on a tuning meter with A = 0 cents

Standard otonal notation above ♮A



Standard utonal notation below ♮E



The Helmholtz-Ellis JI Pitch Notation (HEJI) | 2020

Harmonic / Subharmonic series 1–49 notated by modifications of Pythagorean notes

with dedicated microtonal accidental symbols for primes 5 through 47

Diminished Triad 5:6:7

revised by Marc Sabat & Thomas Nicholson

in collaboration with Wolfgang von Schweinitz, Catherine Lamb and M.O. Abbott

building upon the original HEJI devised by Marc Sabat and Wolfgang von Schweinitz

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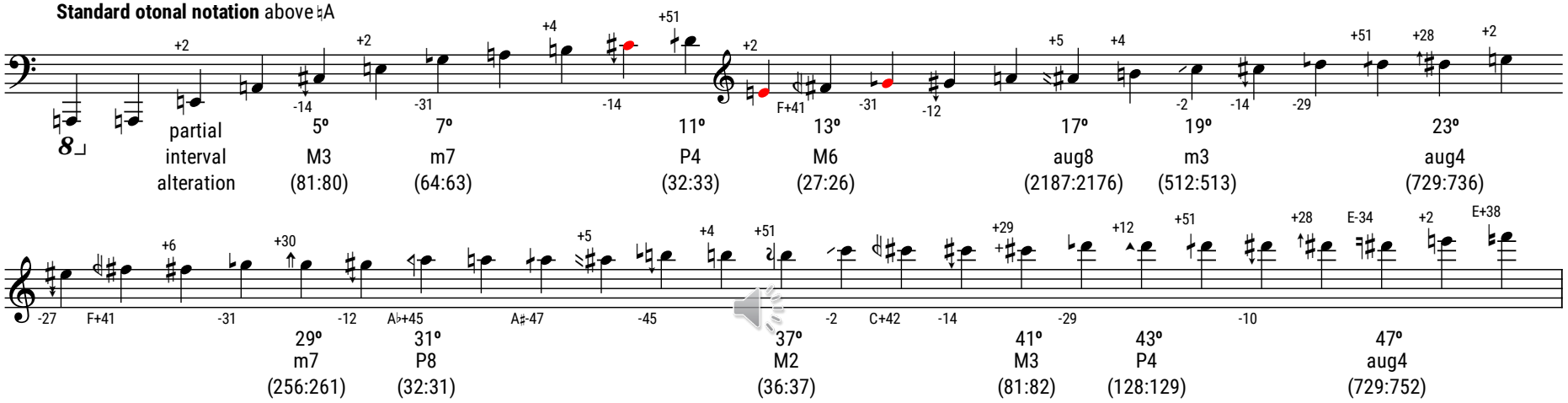
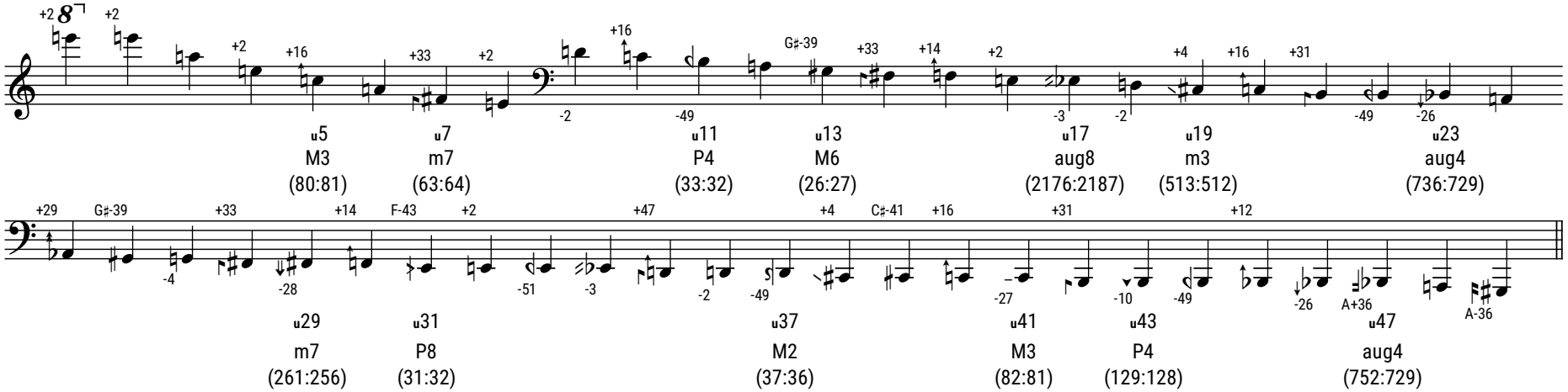
cents indications are deviations that would be shown on a tuning meter with A = 0 cents

Standard otonal notation above ♮A



Standard utonal notation below ♮E



The Helmholtz-Ellis JI Pitch Notation (HEJI) | 2020

Harmonic / Subharmonic series 1–49 notated by modifications of Pythagorean notes

with dedicated microtonal accidental symbols for primes 5 through 47

and aggregates of four or more notes, i.e. the Dominant 7th

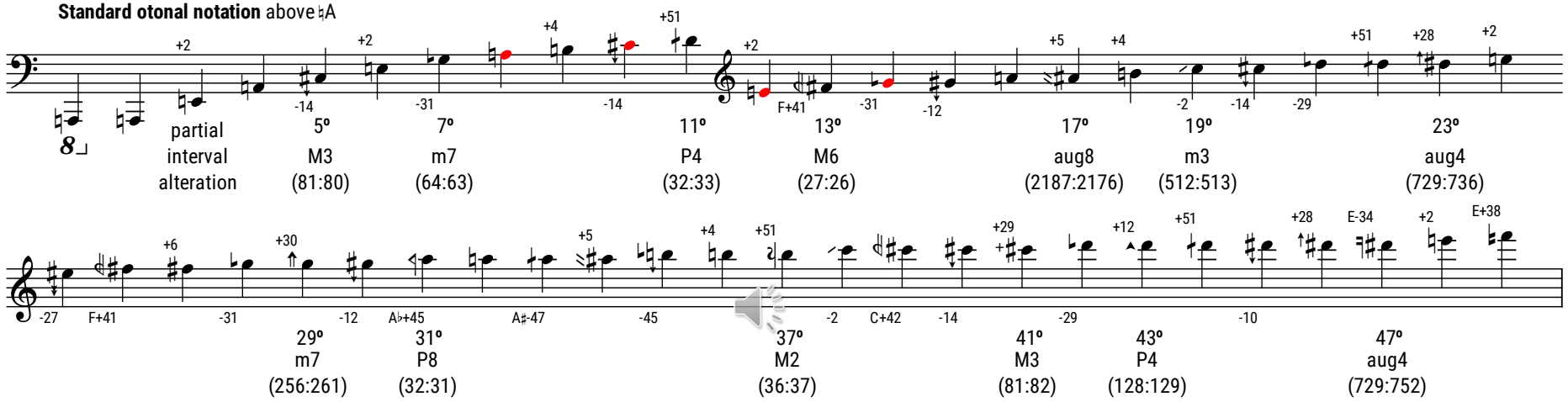
revised by Marc Sabat & Thomas Nicholson

in collaboration with Wolfgang von Schweinitz, Catherine Lamb and M.O. Abbott

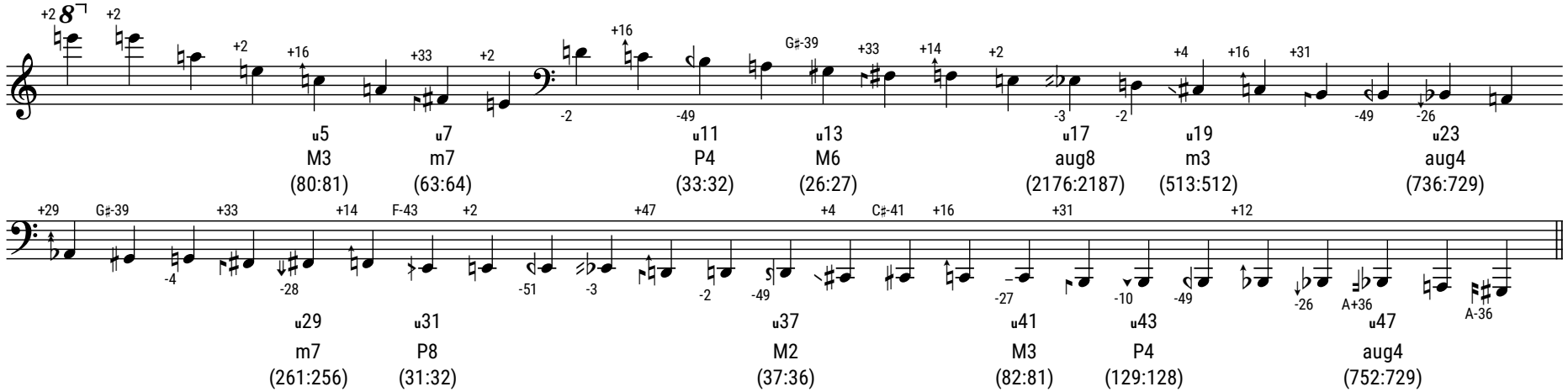
building upon the original HEJI devised by Marc Sabat and Wolfgang von Schweinitz

Ratios represent the amount of modification of the Pythagorean notes by each additional symbol,
cents indications are deviations that would be shown on a tuning meter with A = 0 cents

Standard otonal notation above ♮A



Standard utonal notation below ♮E



The Helmholtz-Ellis JI Pitch Notation (HEJI) | 2020

Harmonic / Subharmonic series 1–49 notated by modifications of Pythagorean notes

with dedicated microtonal accidental symbols for primes 5 through 47

Dominant 7 flat 9 using 17° !

revised by Marc Sabat & Thomas Nicholson

in collaboration with Wolfgang von Schweinitz, Catherine Lamb and M.O. Abbott

building upon the original HEJI devised by Marc Sabat and Wolfgang von Schweinitz

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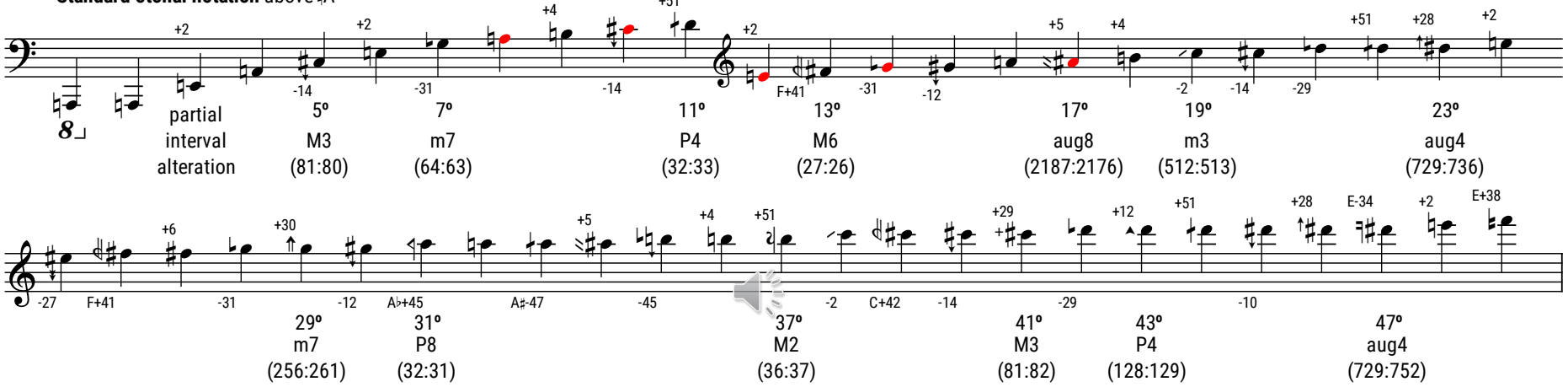
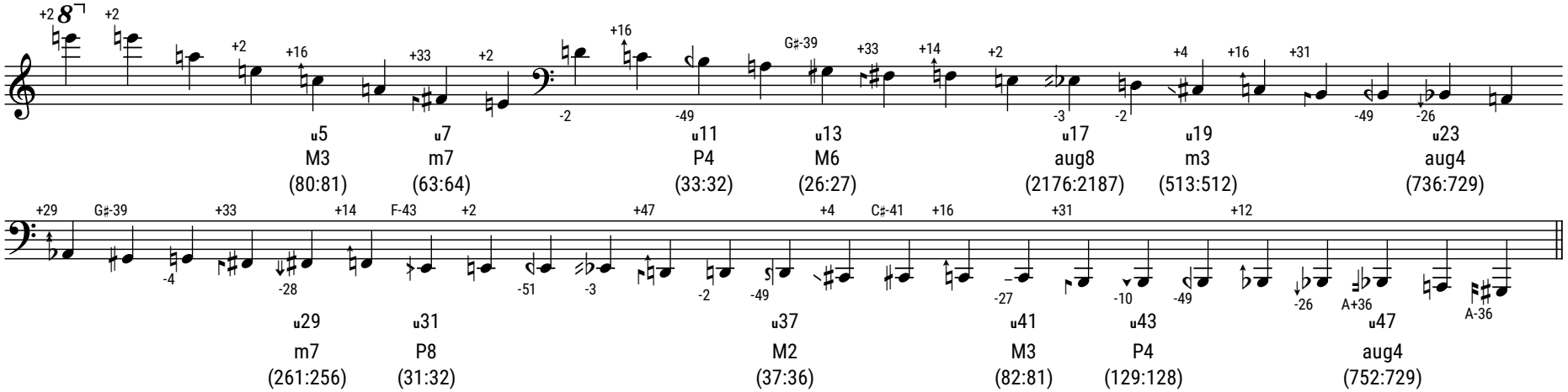
Standard otonal notation above ♮A



Standard utonal notation below ♮E



The Helmholtz-Ellis JI Pitch Notation (HEJI) | 2020

Harmonic / Subharmonic series 1–49 notated by modifications of Pythagorean notes

with dedicated microtonal accidental symbols for primes 5 through 47

Diminished Chord

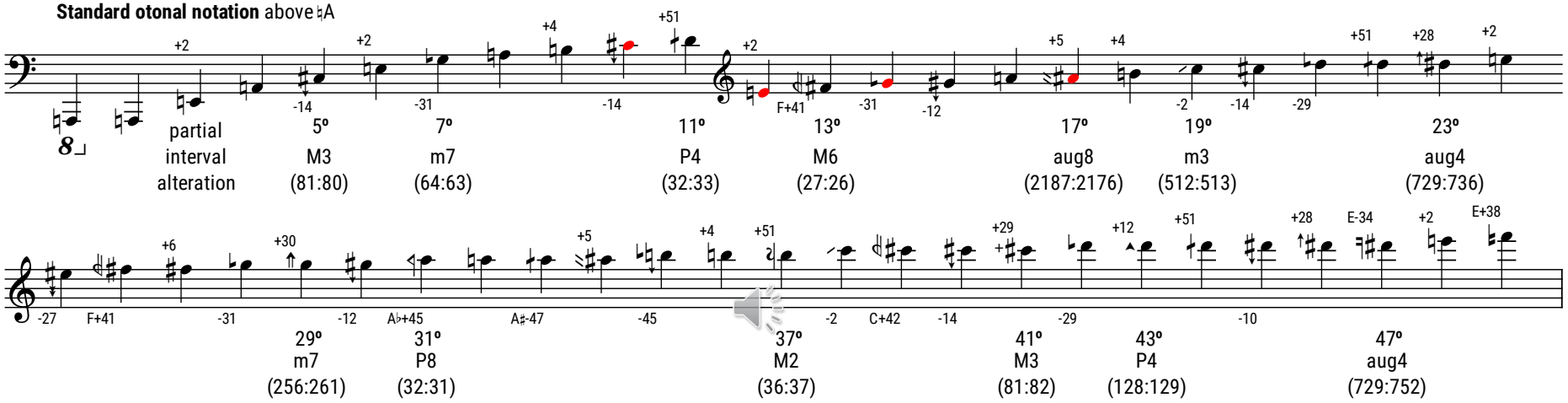
revised by Marc Sabat & Thomas Nicholson

in collaboration with Wolfgang von Schweinitz, Catherine Lamb and M.O. Abbott

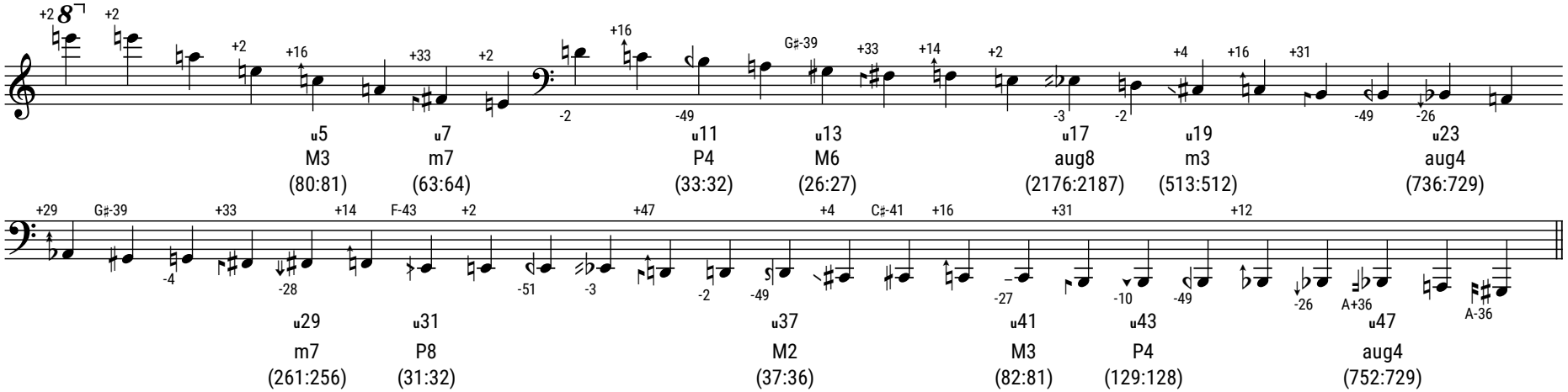
building upon the original HEJI devised by Marc Sabat and Wolfgang von Schweinitz

Ratios represent the amount of modification of the Pythagorean notes by each additional symbol, cents indications are deviations that would be shown on a tuning meter with A = 0 cents

Standard otonal notation above ♮A



Standard utonal notation below ♮E



The Helmholtz-Ellis JI Pitch Notation (HEJI) | 2020

Harmonic / Subharmonic series 1–49 notated by modifications of Pythagorean notes

with dedicated microtonal accidental symbols for primes 5 through 47

and new microtonal chords, i.e. Septimal Chord 6:7:8:9

revised by Marc Sabat & Thomas Nicholson

in collaboration with Wolfgang von Schweinitz, Catherine Lamb and M.O. Abbott

building upon the original HEJI devised by Marc Sabat and Wolfgang von Schweinitz

Ratios represent the amount of modification of the Pythagorean notes by each additional symbol,
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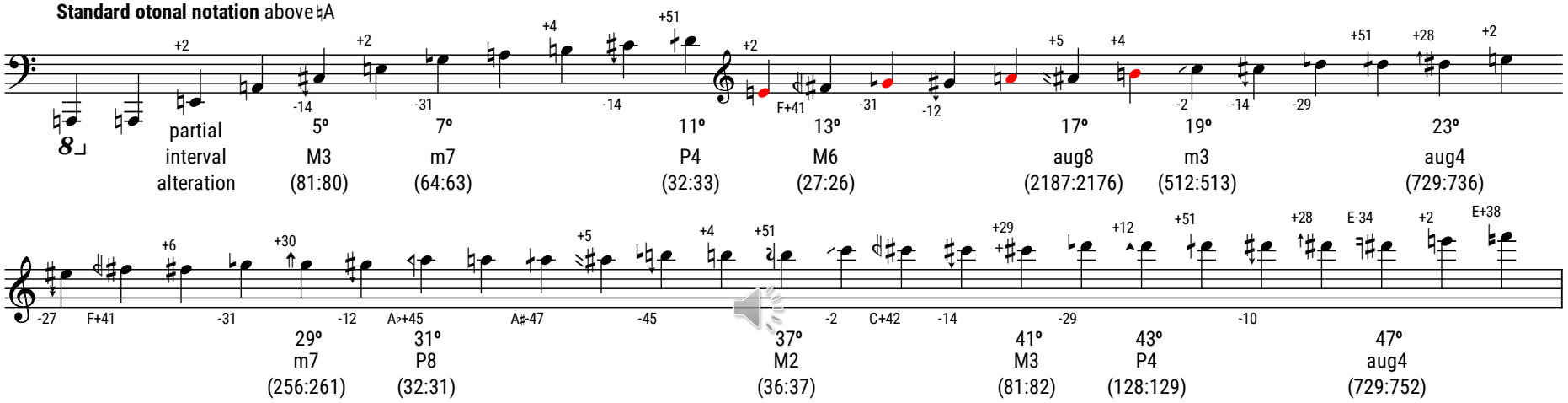
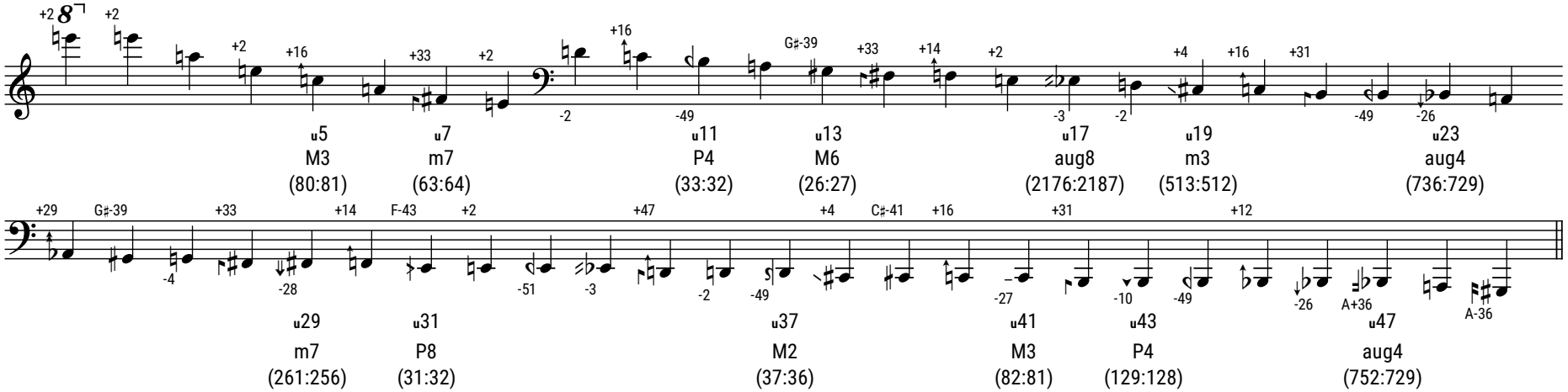
Standard otonal notation above ♮A



Standard utonal notation below ♮E



The Helmholtz-Ellis JI Pitch Notation (HEJI) | 2020

Harmonic / Subharmonic series 1–49 notated by modifications of Pythagorean notes

with dedicated microtonal accidental symbols for primes 5 through 47

compare the Septimal Chord 6:7:8:9 an octave lower

revised by Marc Sabat & Thomas Nicholson

in collaboration with Wolfgang von Schweinitz, Catherine Lamb and M.O. Abbott

building upon the original HEJI devised by Marc Sabat and Wolfgang von Schweinitz

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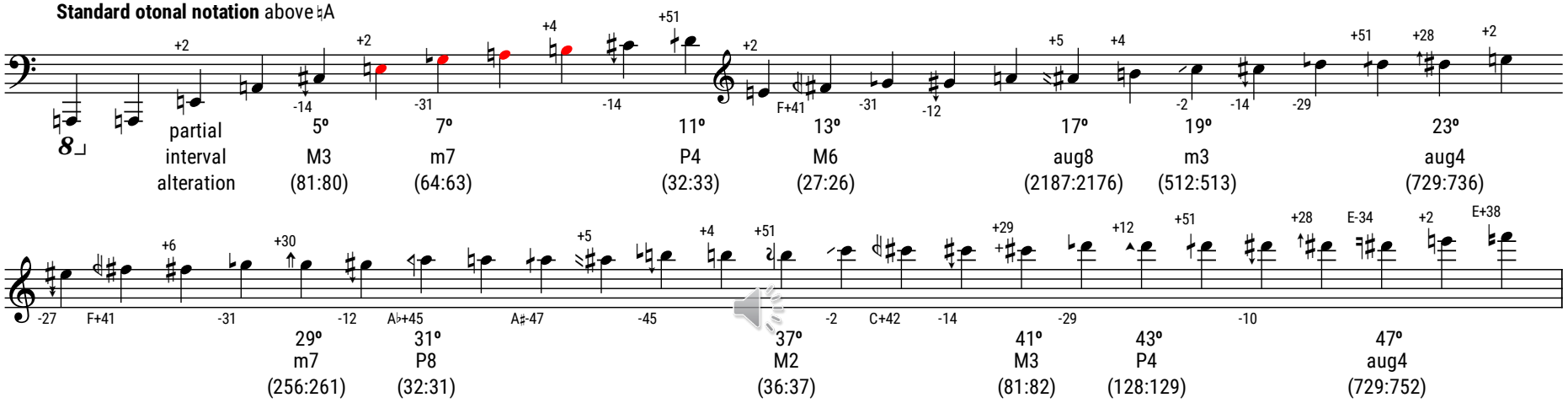
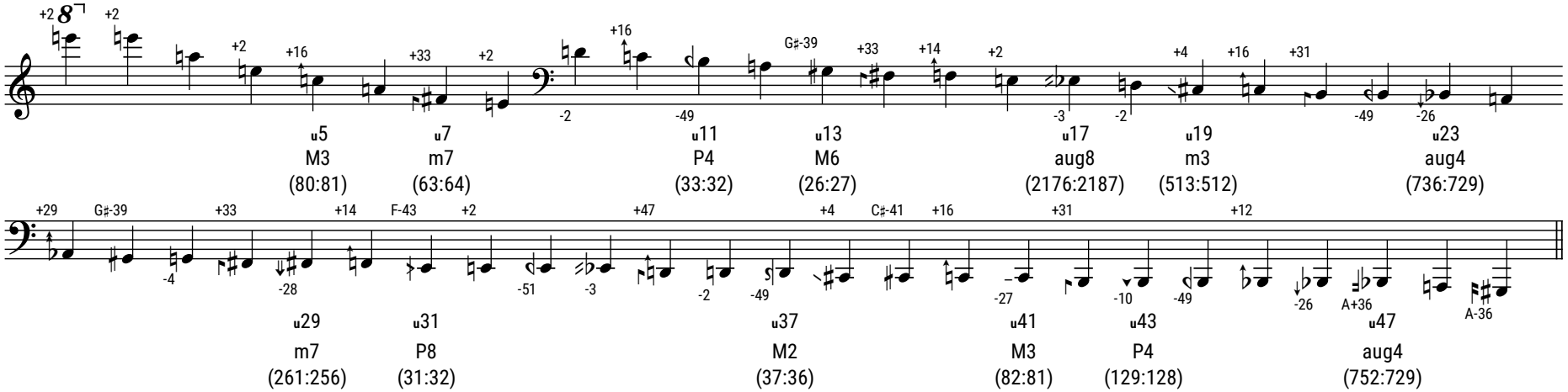
Standard otonal notation above ♮A



Standard utonal notation below ♮E



The Helmholtz-Ellis JI Pitch Notation (HEJI) | 2020

Harmonic / Subharmonic series 1–49 notated by modifications of Pythagorean notes

with dedicated microtonal accidental symbols for primes 5 through 47

Undecimal Chord 8:9:11:12

revised by Marc Sabat & Thomas Nicholson

in collaboration with Wolfgang von Schweinitz, Catherine Lamb and M.O. Abbott

building upon the original HEJI devised by Marc Sabat and Wolfgang von Schweinitz

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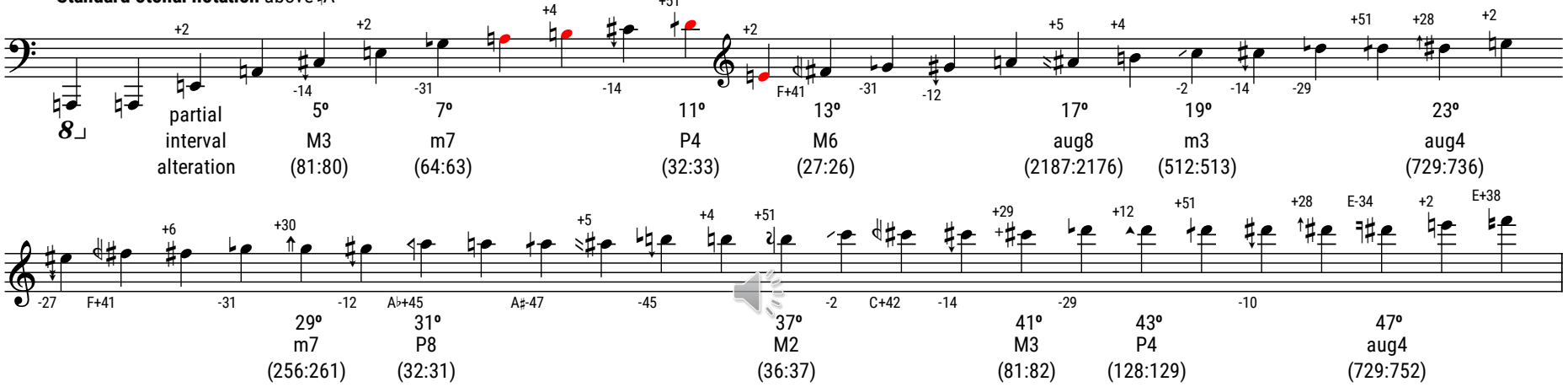
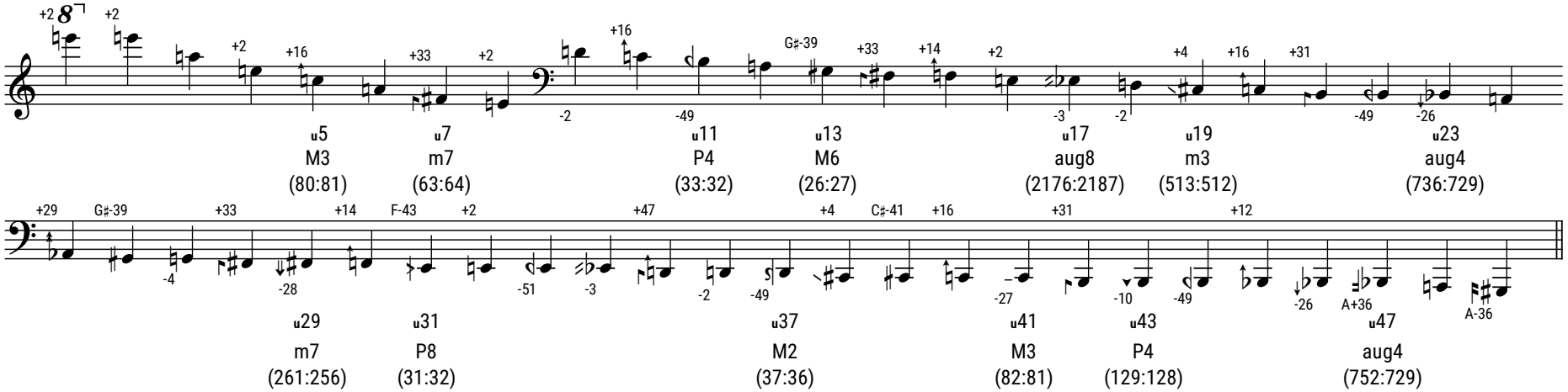
Standard otonal notation above ♮A



Standard utonal notation below ♮E



The Helmholtz-Ellis JI Pitch Notation (HEJI) | 2020

Harmonic / Subharmonic series 1–49 notated by modifications of Pythagorean notes

with dedicated microtonal accidental symbols for primes 5 through 47

Tridecimal Chord 10:12:13:15

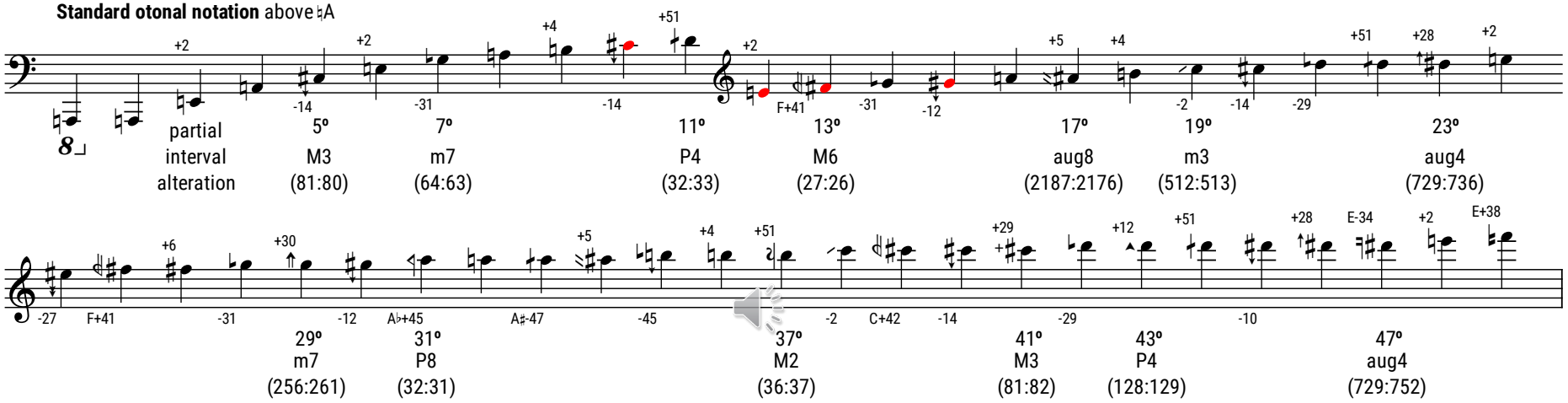
revised by Marc Sabat & Thomas Nicholson

in collaboration with Wolfgang von Schweinitz, Catherine Lamb and M.O. Abbott

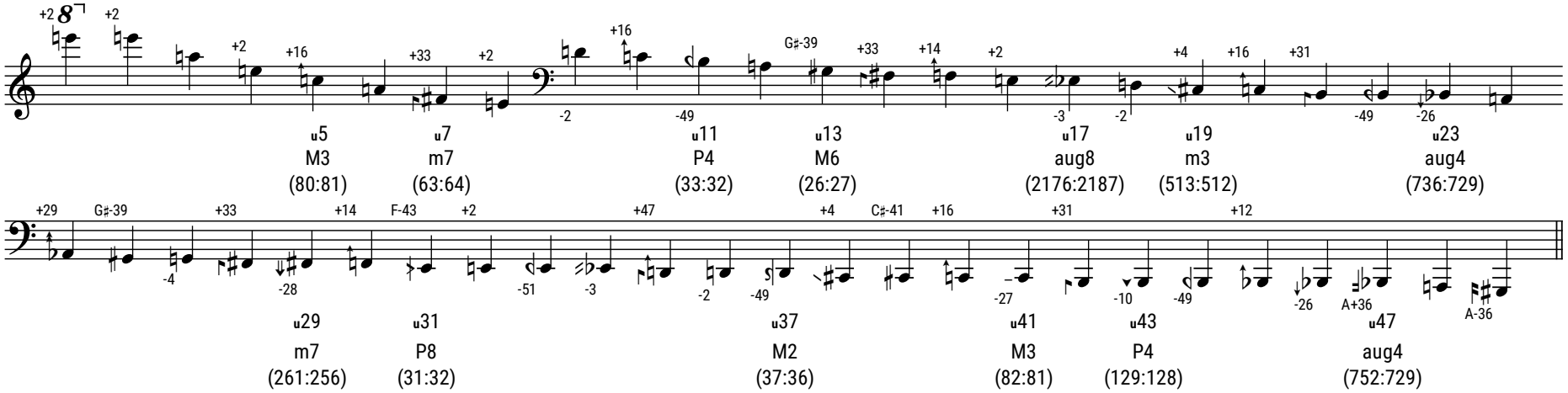
building upon the original HEJI devised by Marc Sabat and Wolfgang von Schweinitz

Ratios represent the amount of modification of the Pythagorean notes by each additional symbol, cents indications are deviations that would be shown on a tuning meter with A = 0 cents

Standard otonal notation above ♮A



Standard utonal notation below ♮E



Harmony by numbers: tuning in practice

- How can a performer learn to hear and play such tunings accurately?

Harmony by numbers: tuning in practice

- How can a performer learn to hear and play such tunings accurately?
  by perceiving acoustic and psychoacoustic phenomena ....

Harmony by numbers: difference (Tartini) tones

When two frequencies interact in the same medium (air, eardrum, brain, etc.) they produce *combination tones*, i.e., distortion at various linear combinations of their frequencies:

$$m \cdot F_1 + n \cdot F_2$$

where m and n are integers. The combination tone most easily perceived is the *difference tone.*

Harmony by numbers: difference (Tartini) tones

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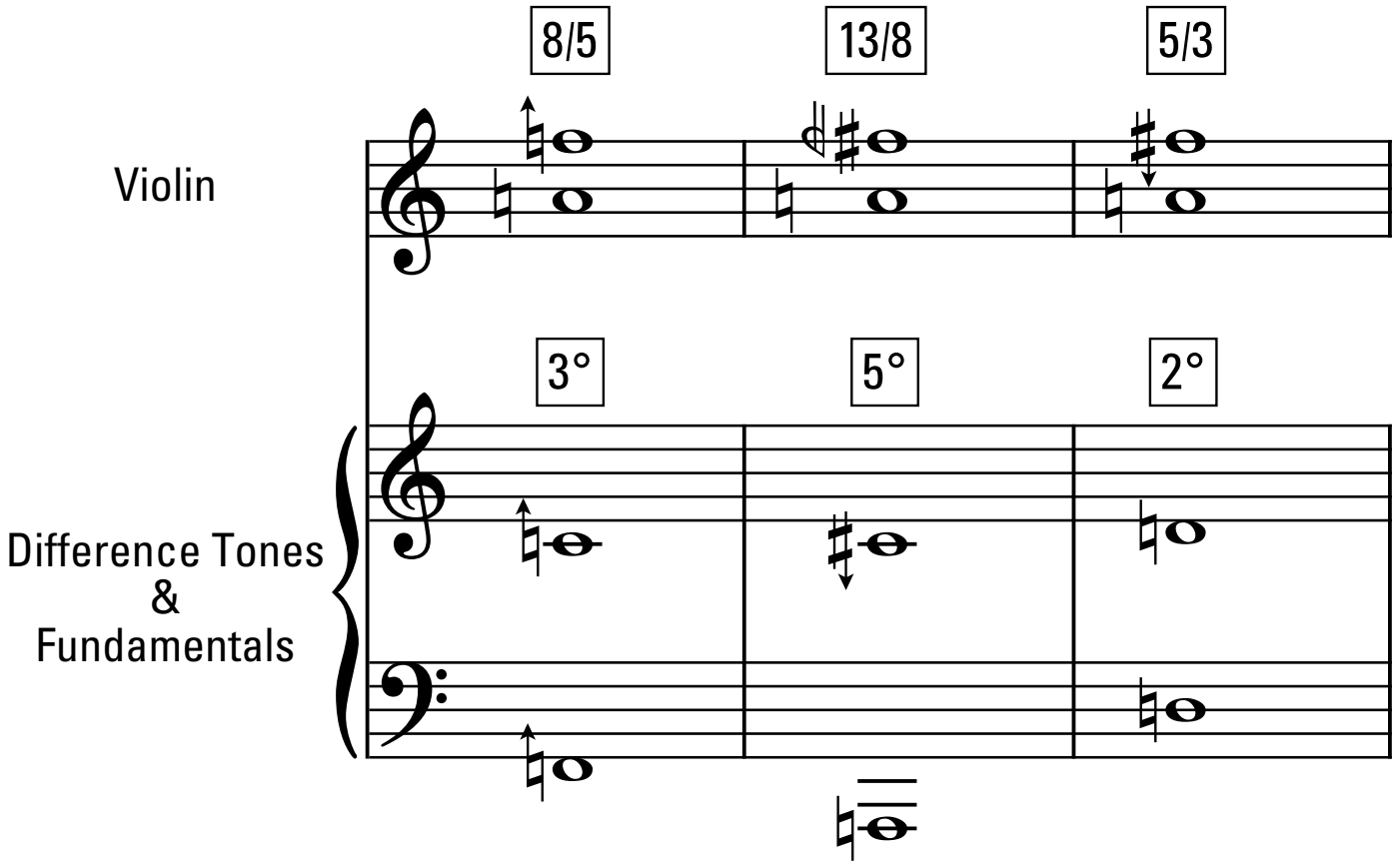
$$m \cdot F_1 + n \cdot F_2$$

where m and n are integers. The combination tone most easily perceived is the *difference tone.*

In many simple ratios between partials, like 1:2 (octave), 2:3 (fifth), 3:4 (fourth), 4:5 (major third), and 3:5 (major sixth), the difference tone reinforces their common fundamental, making a clear, consonant harmony.

Harmony by numbers: difference (Tartini) tones



Harmony by numbers: common partials

When two frequencies are tuned rationally as $a : b$, expressed in lowest terms, they will share some common partials. Namely, the bth partial of a is equal to the ath partial of b. The lowest common partial of the two pitches may be calculated as the *product* of a and b.

$$Common\ partial = a \cdot b$$

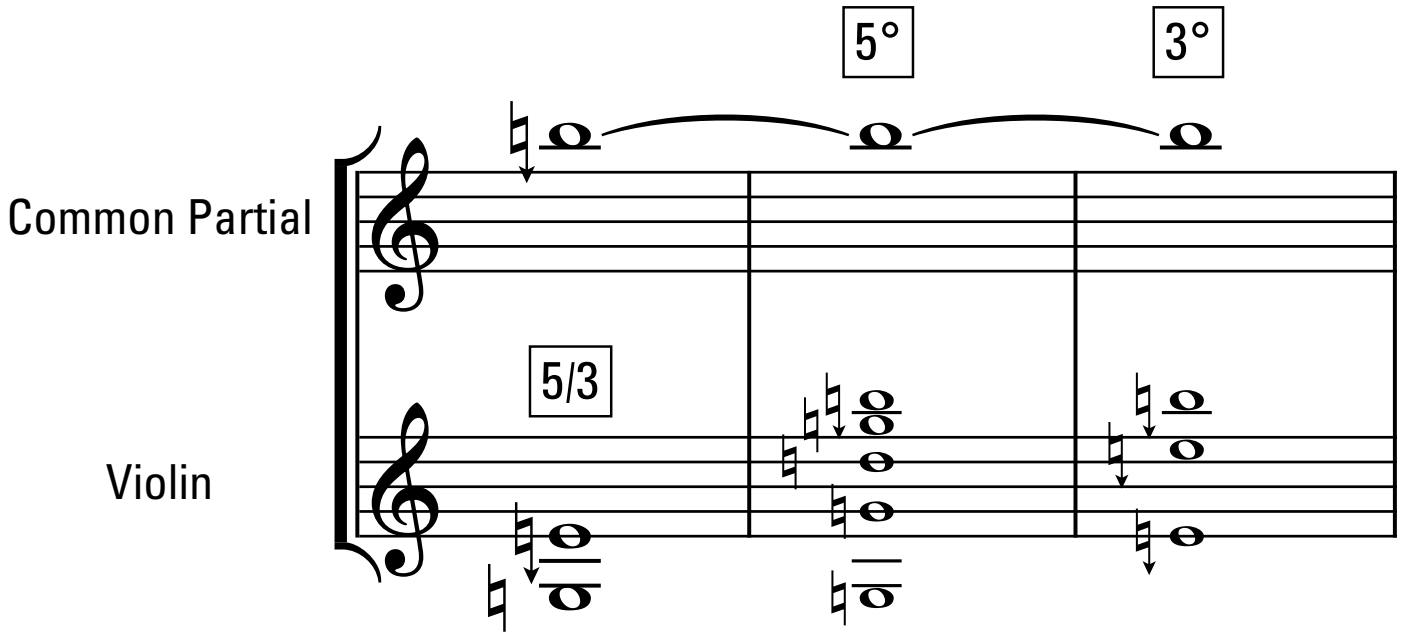
Harmony by numbers: tuning by listening to beating

When two frequencies are tuned rationally as $a : b$, expressed in lowest terms, they will share some common partials. Namely, the bth partial of a is equal to the ath partial of b. The lowest common partial of the two pitches may be calculated as the *product* of a and b.

$$Common\ partial = a \cdot b$$

Beating at the common partial is one of the most commonly perceived phenomena when musicians learn to tune intervals. Eliminating beating to produce so-called "pure" intervals is one way to make JI sounds.

Harmony by numbers: tuning by listening to beating



Harmony by numbers: degrees of tuneability

Small number ratios produce intervals that may be easily identified and tuned. As numbers comprising a ratio become larger, pitch distances to the interval's common fundamental and common partial also increase. Eventually, such intervals are no longer precisely recognisable, and therefore, no longer tuneable by ear.

Harmony by numbers: chords, melodies

Small number ratios produce intervals that may be easily identified and tuned. As numbers comprising a ratio become larger, pitch distances to the interval's common fundamental and common partial also increase. Eventually, such intervals are no longer precisely recognisable, and therefore, no longer tuneable by ear.

In my music for live musicians, I find it useful to work with tuneability, to focus on the experience of hearing and playing the unique sonorities and resonances of rational intonation. Concentrating on intervals and chords making melodies by means of counterpoint, rather than using fixed scales or a single row, allows a free flow of sounds with shifting fundamentals and changing points of reference.

Harmony by numbers: applying JI to music repertoire

- tuning of the open strings

Harmony by numbers: applying JI to music repertoire

- tuning of the open strings *in perfect fifths*

Harmony by numbers: applying JI to music repertoire

- tuning of the open strings *in perfect fifths*
- tuning of major, minor, and diminished chords

Harmony by numbers: applying JI to music repertoire

- tuning of the open strings *in perfect fifths*
- tuning of major, minor, and diminished chords
  1:3:5 (major)

Harmony by numbers: applying JI to music repertoire

- tuning of the open strings *in perfect fifths*
- tuning of major, minor, and diminished chords
  1:3:5 (major); 3:5:15 (minor)

Harmony by numbers: applying JI to music repertoire

- tuning of the open strings *in perfect fifths*
- tuning of major, minor, and diminished chords
  1:3:5 (major); 3:5:15 (minor); 3:5:7 (diminished)

Harmony by numbers: applying JI to music repertoire

- tuning of the open strings *in perfect fifths*
- tuning of major, minor, and diminished chords
  1:3:5 (major); 3:5:15 (minor); 3:5:7 (diminished)
- tuning of scales and modes

Harmony by numbers: applying JI to music repertoire

- tuning of the open strings *in perfect fifths*
- tuning of major, minor, and diminished chords
  1:3:5 (major); 3:5:15 (minor); 3:5:7 (diminished)
- tuning of scales and modes, *major*

Harmony by numbers: applying JI to music repertoire

- tuning of the open strings *in perfect fifths*
- tuning of major, minor, and diminished chords
  1:3:5 (major); 3:5:15 (minor); 3:5:7 (diminished)
- tuning of scales and modes, *major and minor*

Harmony by numbers: applying JI to music repertoire

- tuning of the open strings *in perfect fifths*
- tuning of major, minor, and diminished chords
  1:3:5 (major); 3:5:15 (minor); 3:5:7 (diminished)
- tuning of scales and modes, *major and minor*
- modulation?

Harmony by numbers: applying JI to music repertoire

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Harmony by numbers: applying JI to music

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Harmony by numbers: applying JI to music

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Harmony by numbers: applying JI to music

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- tuning of scales and modes, *major and minor*
- why limit the primes to 7° (and occasionally a 17° as flat 9th)?

Harmony by numbers: applying JI to music repertoire

- tuning of the open strings *in perfect fifths*
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- tuning of scales and modes, *major and minor*
- why limit the primes to 7° (and occasionally a 17° as flat 9th)?
- why two violins? why not electronics, or more compositional interventions?

Harmony by numbers: applying JI to music repertoire

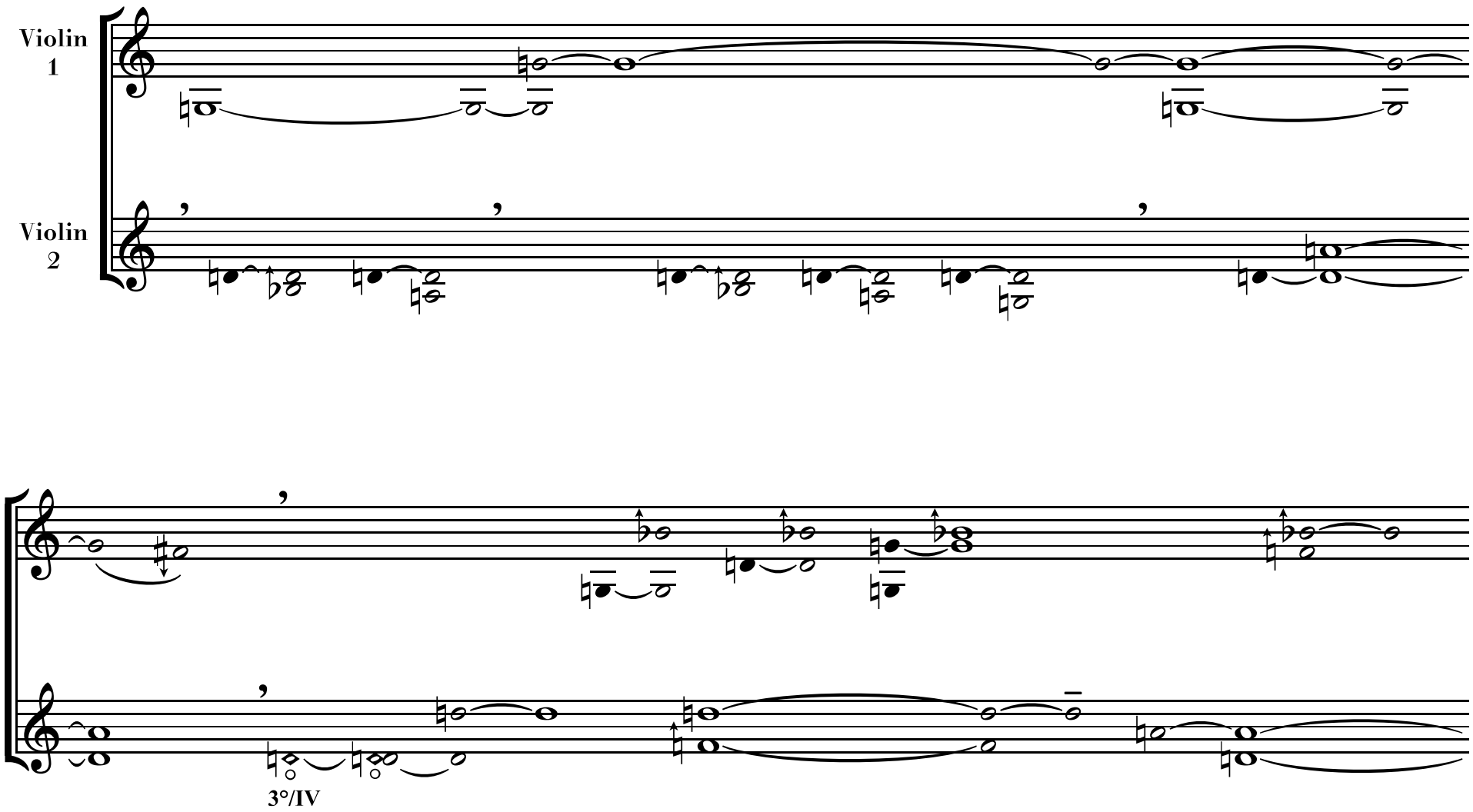
- tuning of the open strings *in perfect fifths*
- tuning of major, minor, and diminished chords
  1:3:5 (major); 3:5:15 (minor); 3:5:7 (diminished)
- tuning of scales and modes, *major and minor*
- why limit the primes to 7° (and occasionally a 17° as flat 9th)?
- why two violins? why not electronics, or more compositional interventions?
- when and how to make choices between pure vertical consonances (introducing more microtonal variation) vs. maintaining melodic simplicity?

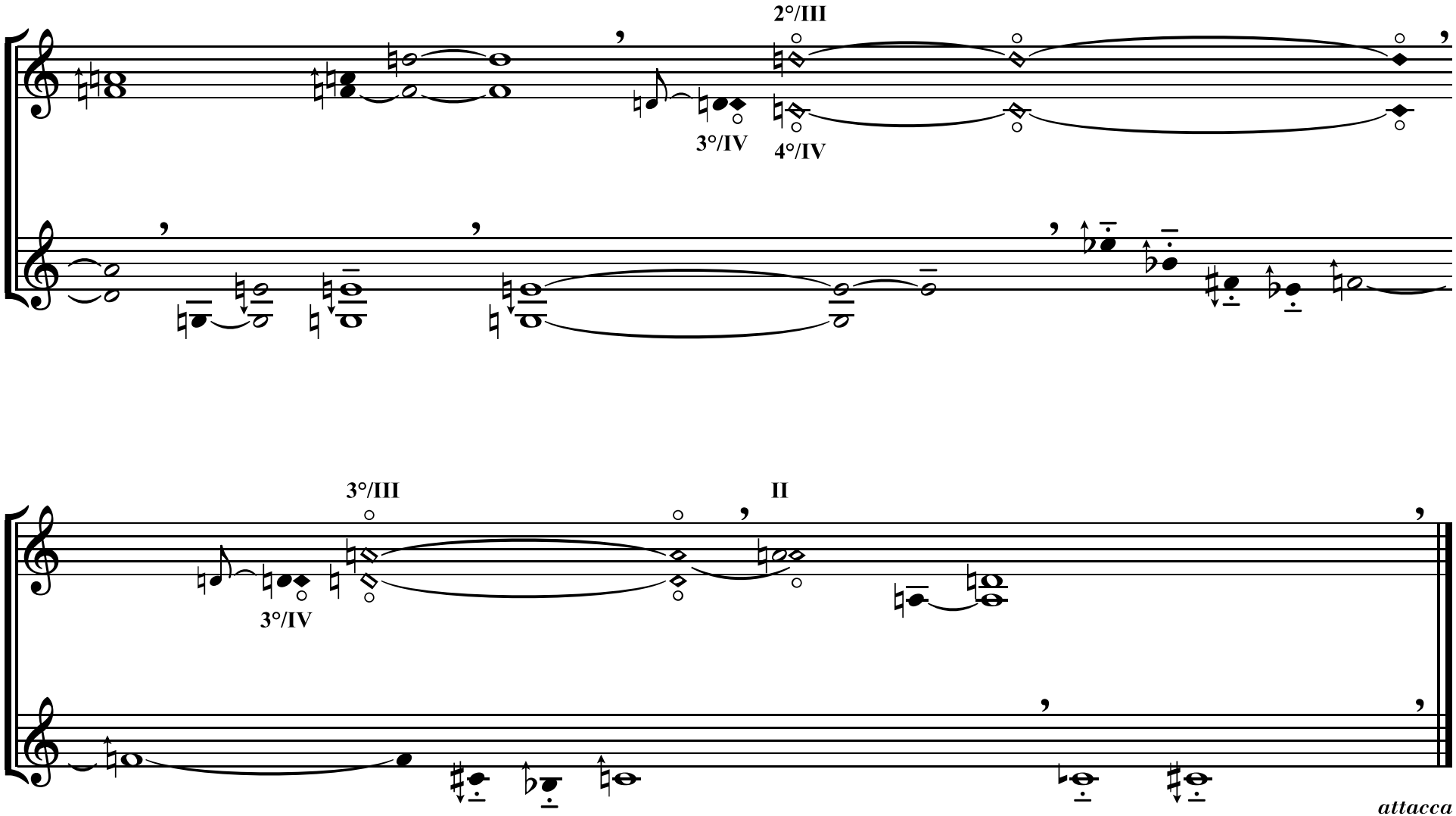
Streams barely in winter

three beginnings for Walter

Marc Sabat

1. Cold





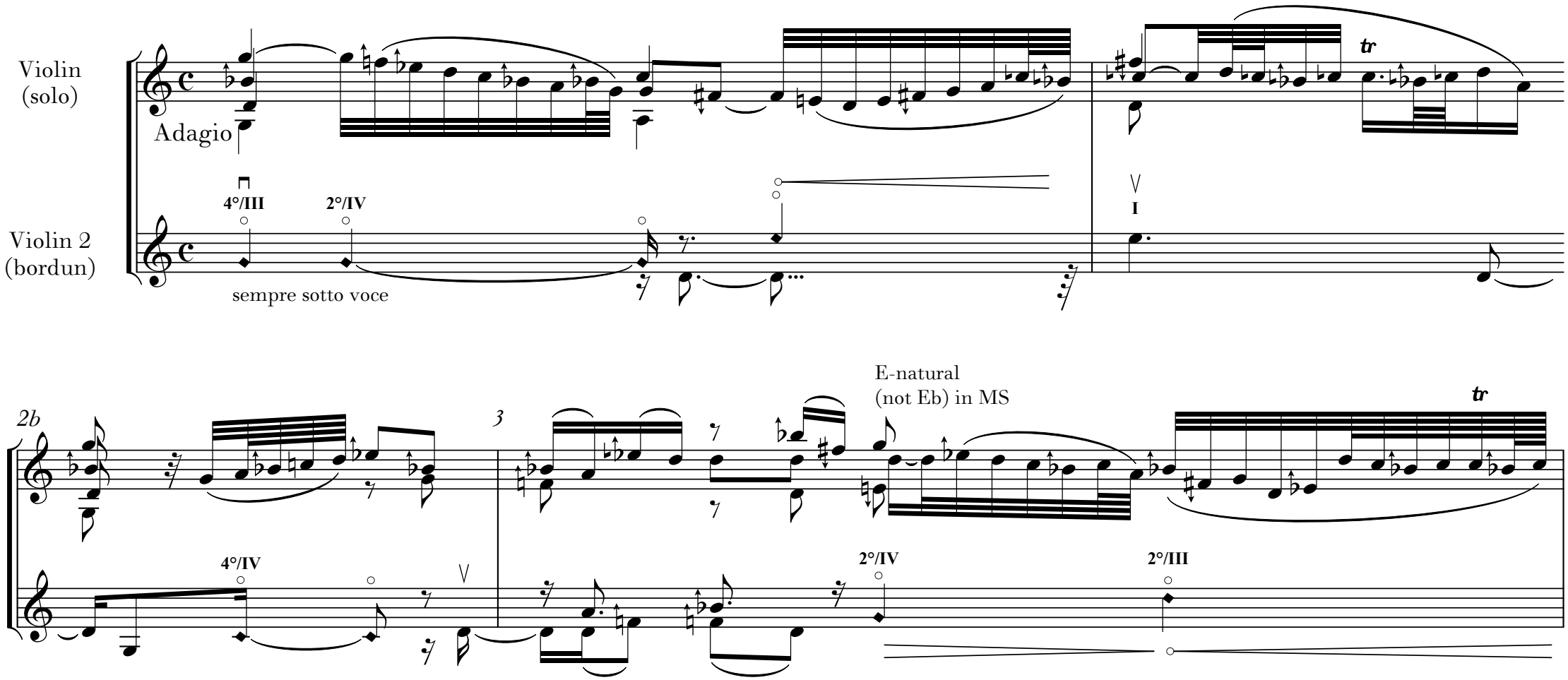
attacca
Sonata Prima per Violino Solo senza Basso
Sei Bach-Intonazioni, Ia

Sonata Prima a Violino Solo senza Basso

Sei Bach-Intonazioni per Violino Solo, Ia

Johann Sebastian Bach

intonation and 2nd voice composed by Marc Sabat



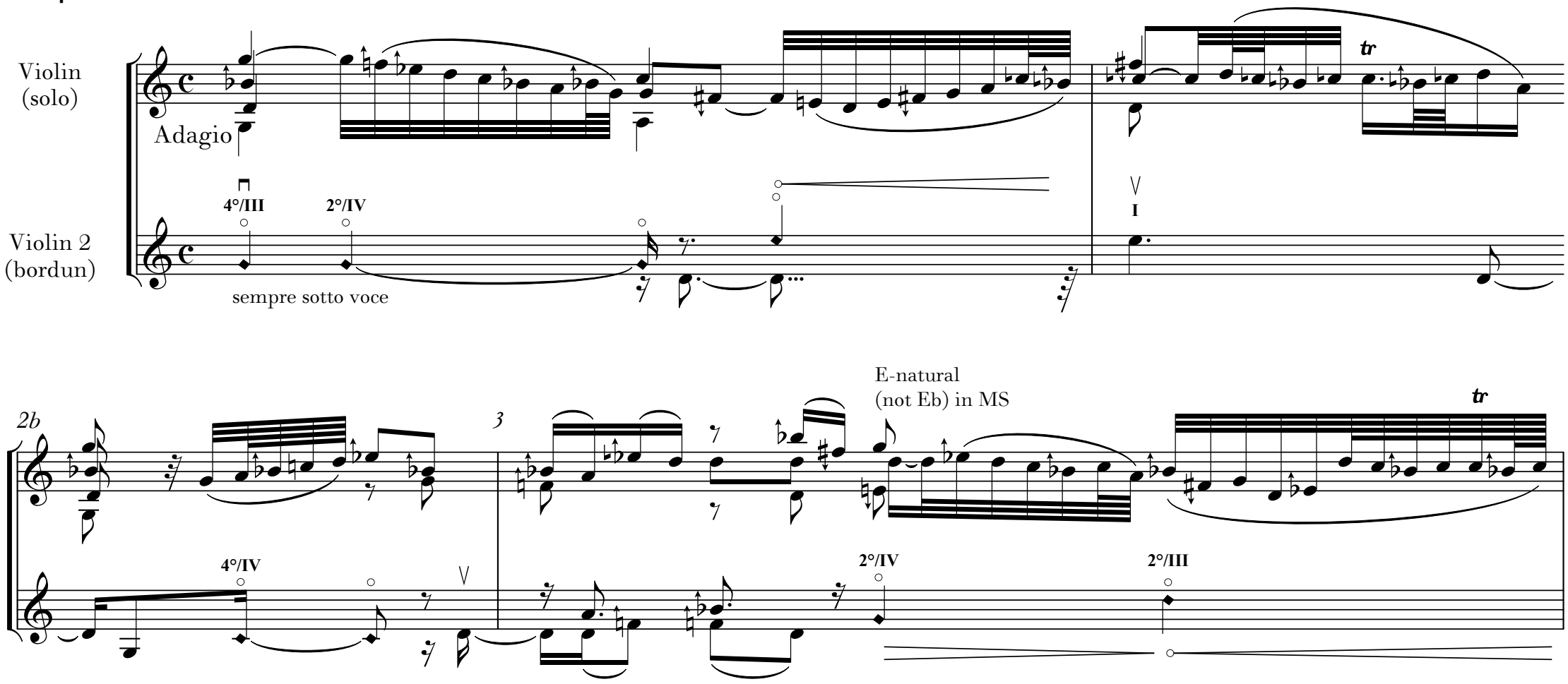
Sonata Prima a Violino Solo senza Basso

Sei Bach-Intonazioni per Violino Solo, Ia

Bach begins by showing the notes, in this case a diatonic scale. The pitches are tuned as simple ratios from G and D.

Johann Sebastian Bach

intonation and 2nd voice composed by Marc Sabat



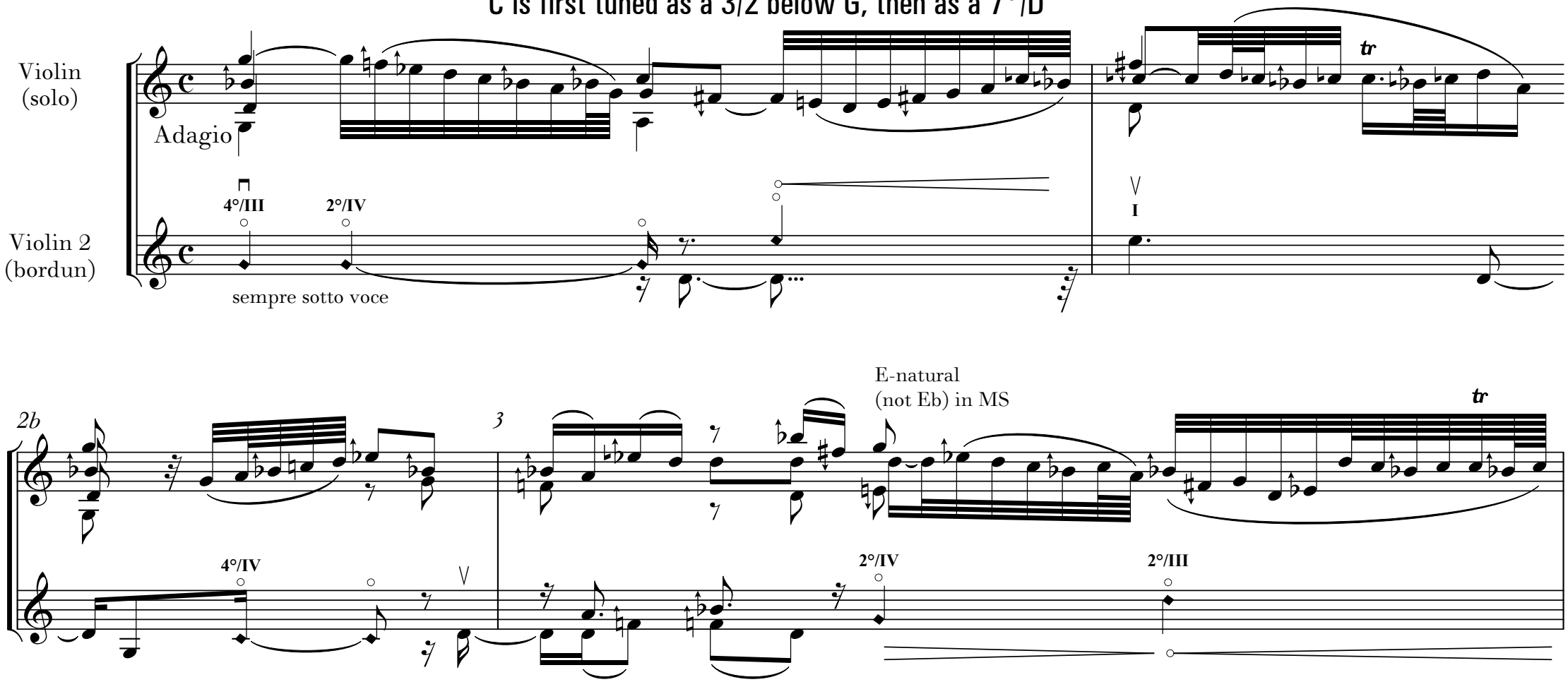
Sonata Prima a Violino Solo senza Basso

Sei Bach-Intonazioni per Violino Solo, Ia

Johann Sebastian Bach

intonation and 2nd voice composed by Marc Sabat

C is first tuned as a 3/2 below G, then as a 7°/D



Streams barely in winter (2019) 1. Cold 2. Sun 3. Stones
three beginnings for Walter played before Bach for two violins

Sei Bach-Intonazioni per Violino Solo (2000–17) Ia IIa IIIa
version in just intonation for violin solo with violin bordun counterpoint

Chords, melodies: a look at harmony by numbers

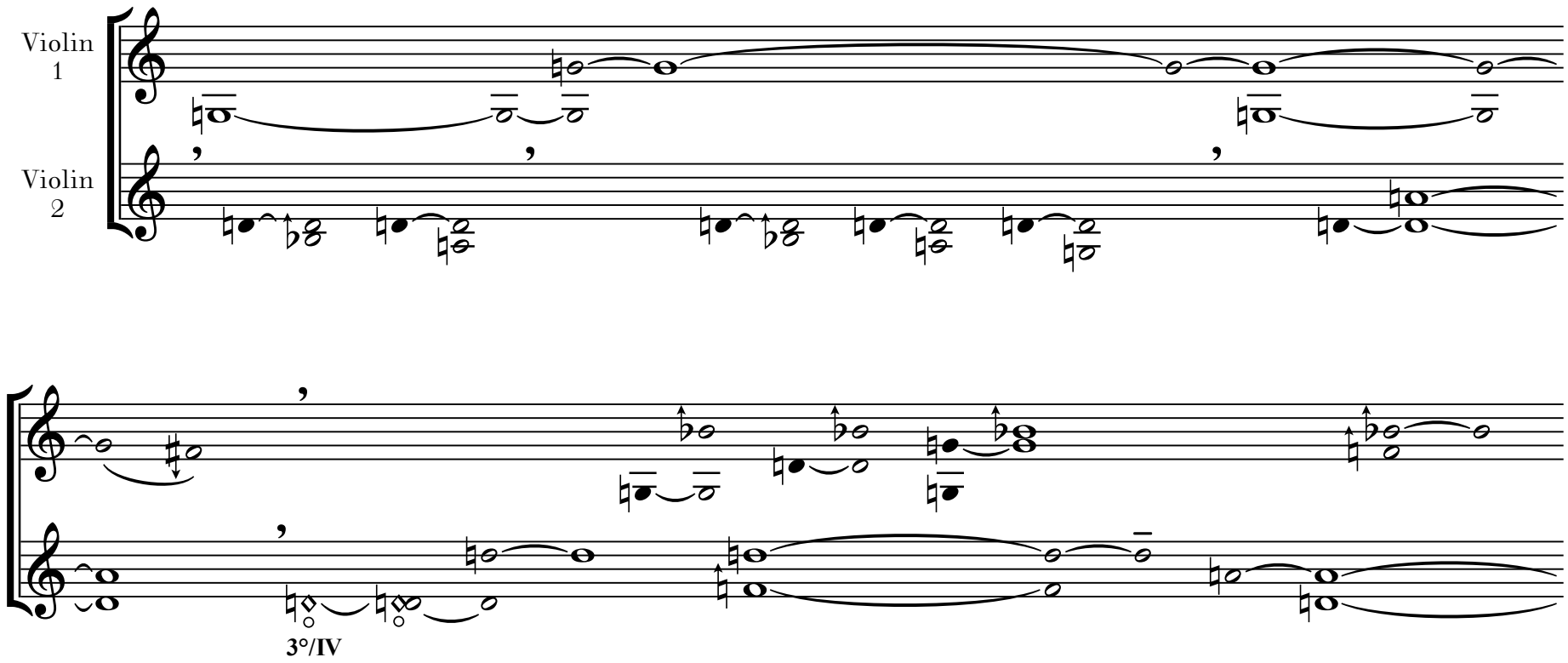
Sara Cubarsi and Xenia Gogu, violins

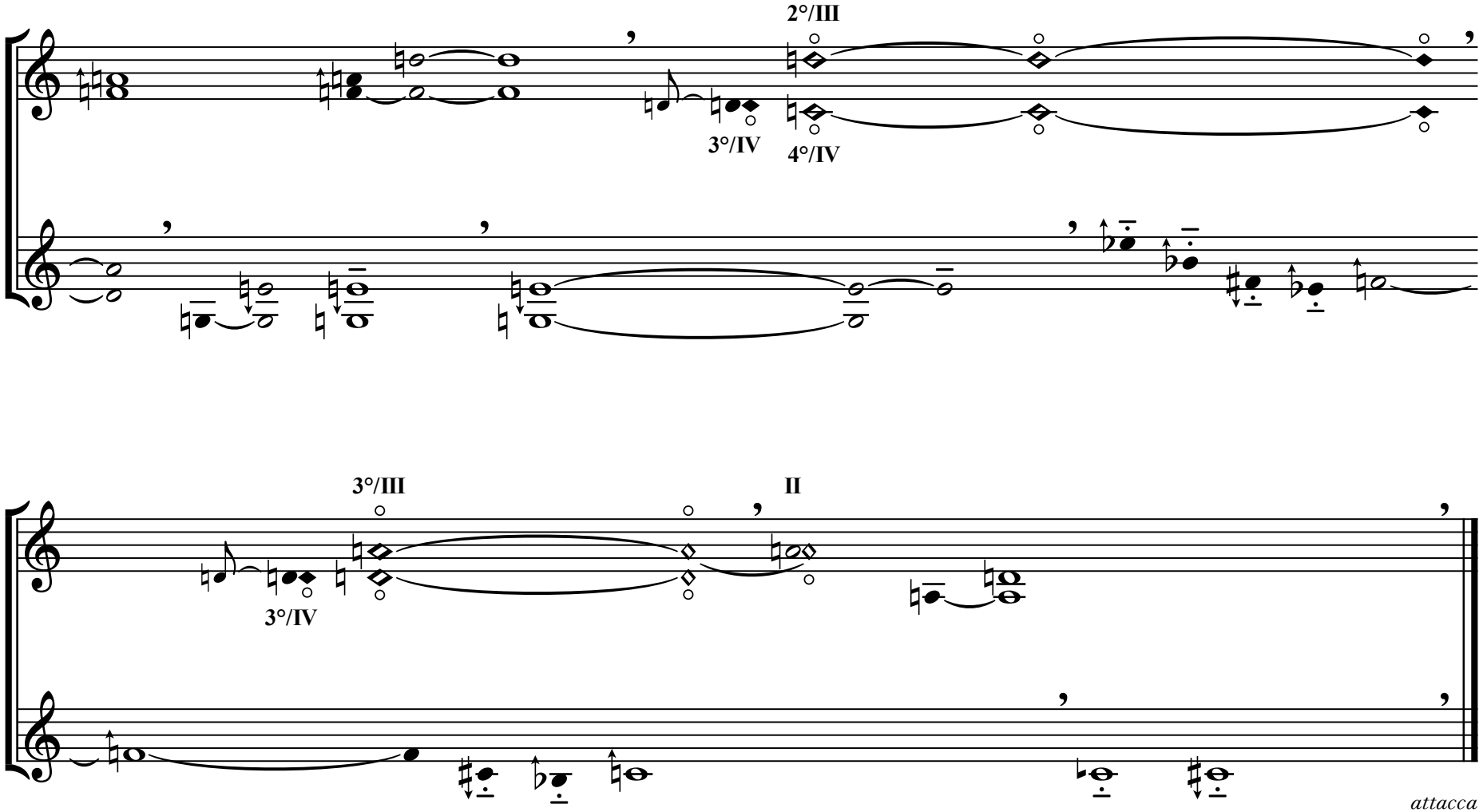
Streams barely in winter

three beginnings for Walter

Marc Sabat

1. Cold





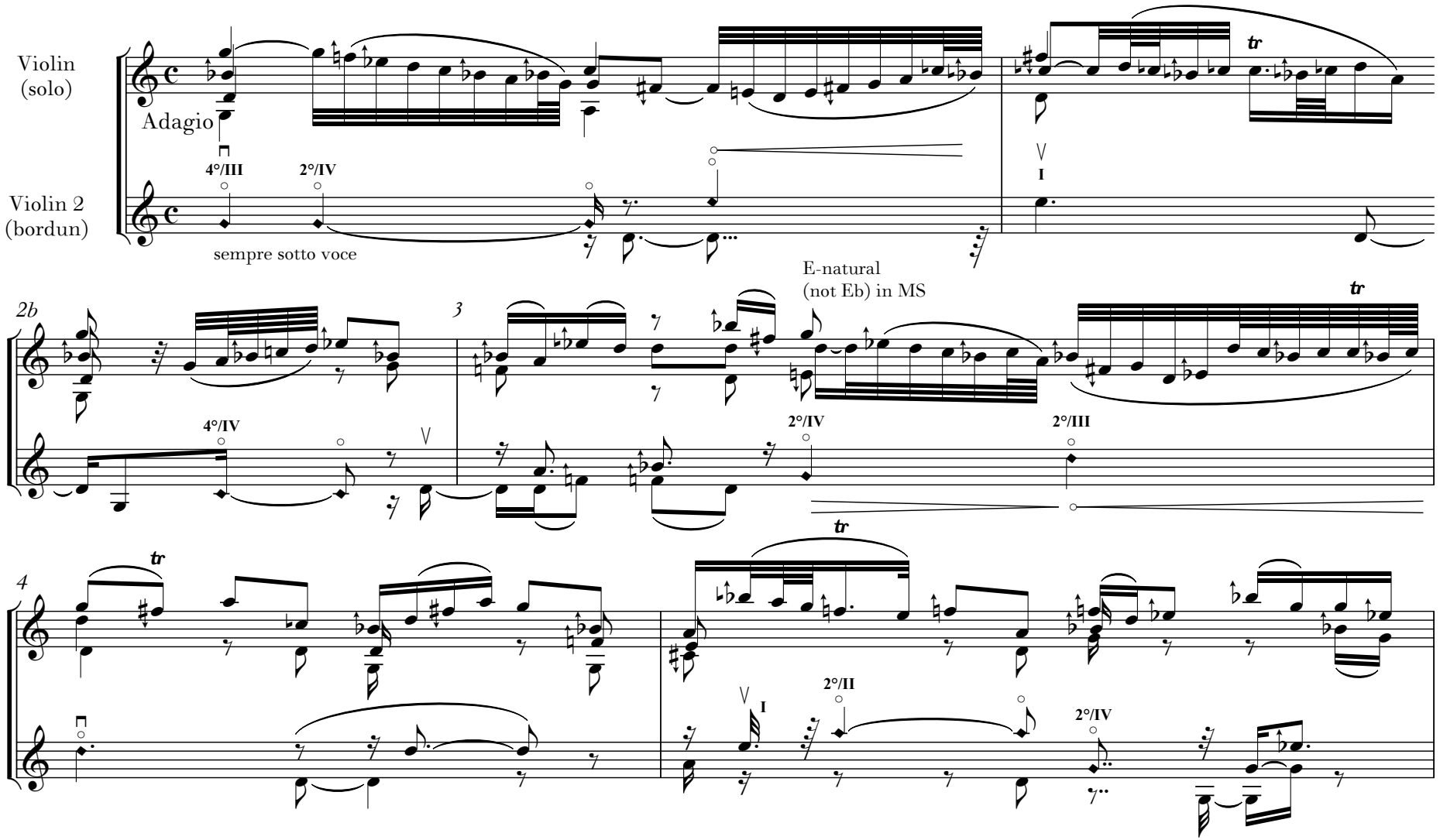
attacca
Sonata Prima per Violino Solo senza Basso
Sei Bach-Intonazioni, Ia

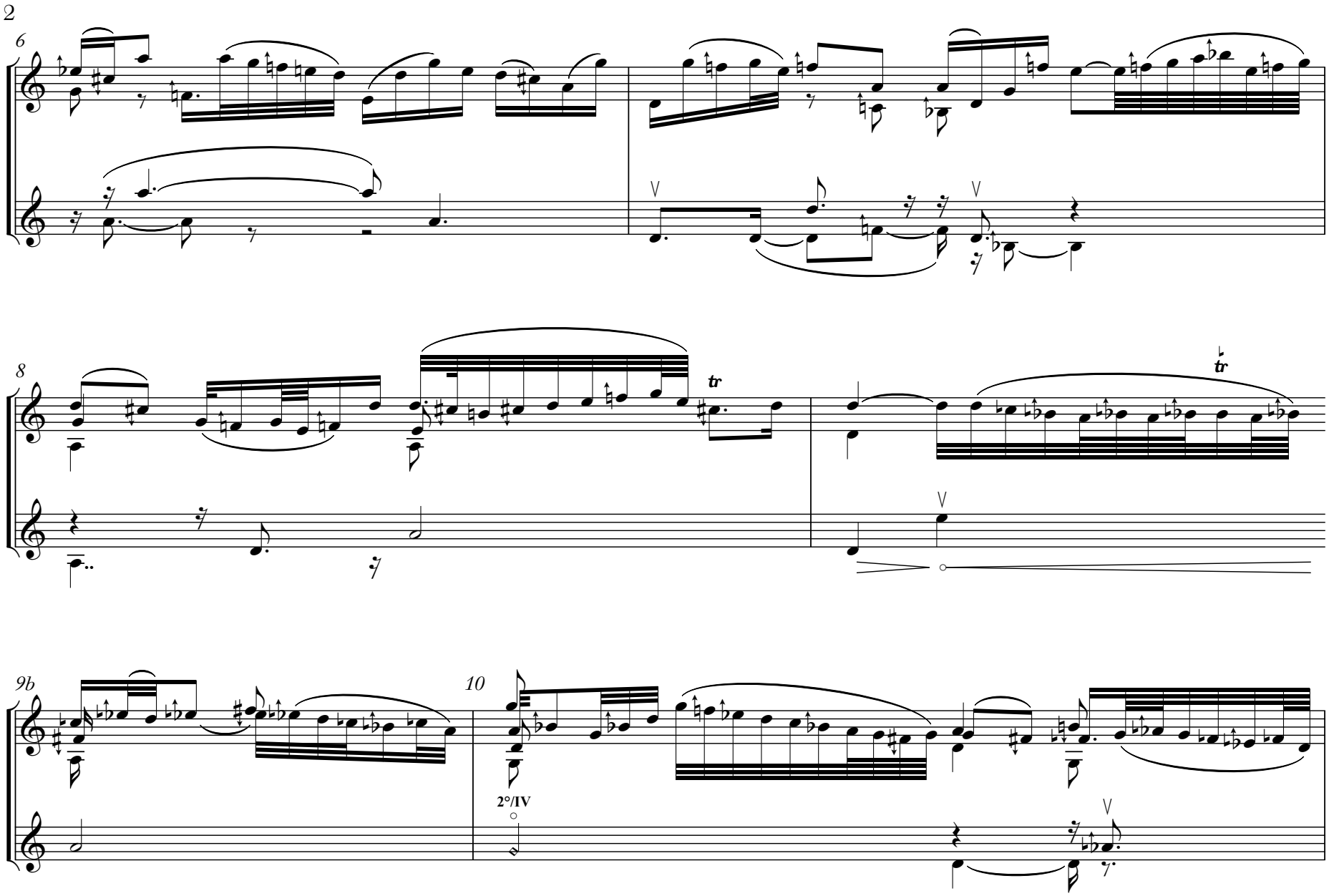
Sonata Prima a Violino Solo senza Basso

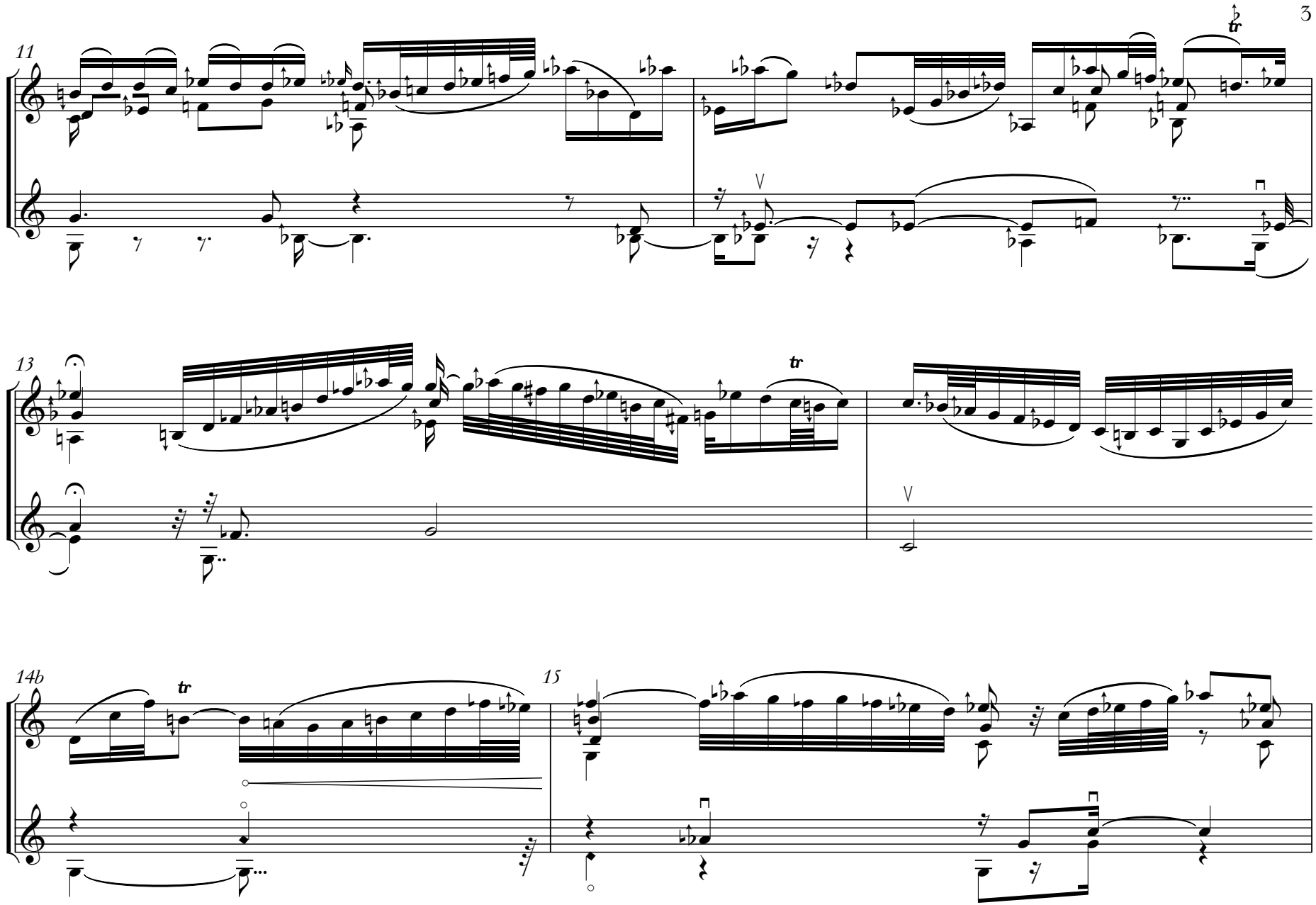
Sei Bach-Intonazioni per Violino Solo, Ia

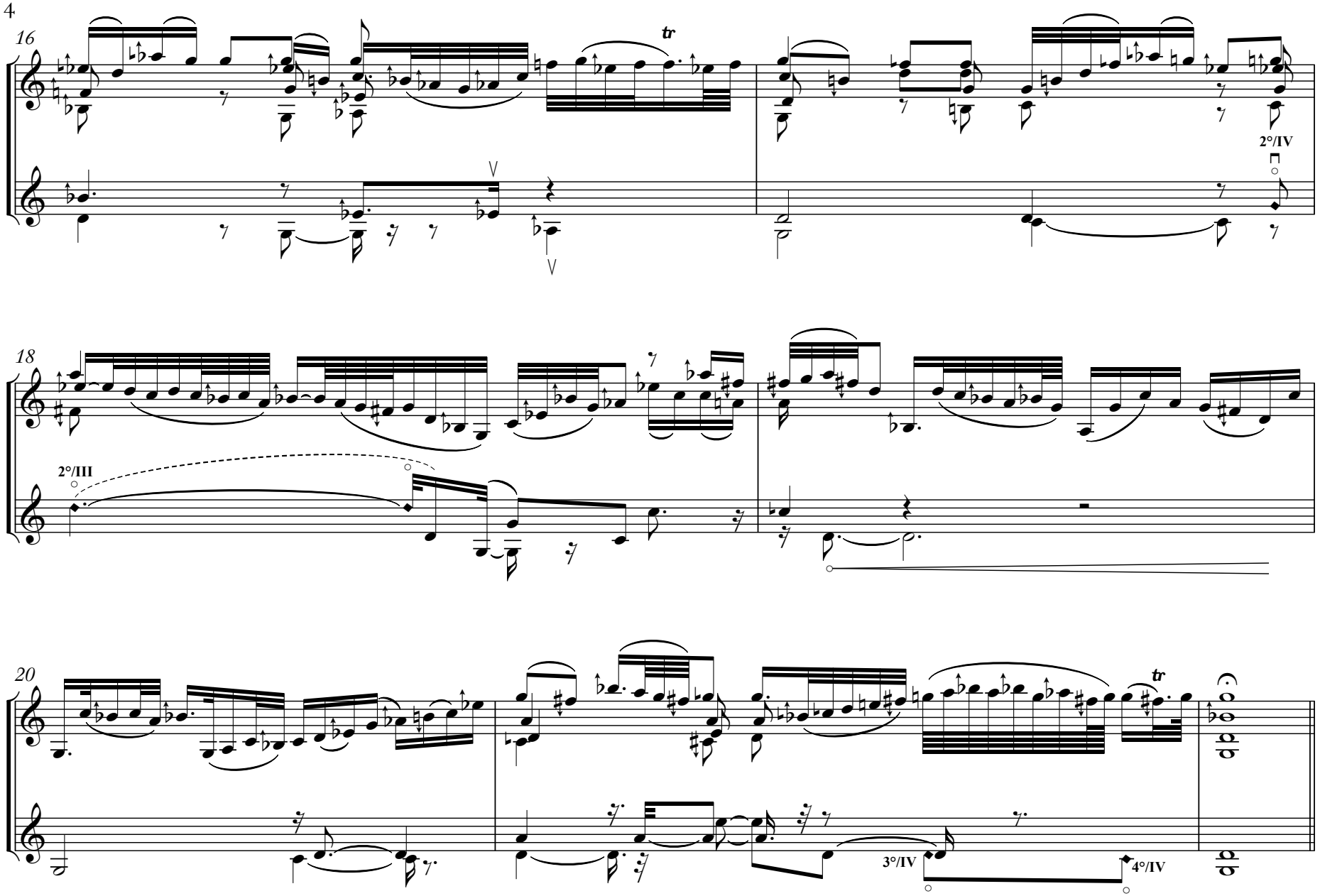
Johann Sebastian Bach

intonation and 2nd voice composed by Marc Sabat




6
8
tr
tr
9b
10
2°/IV

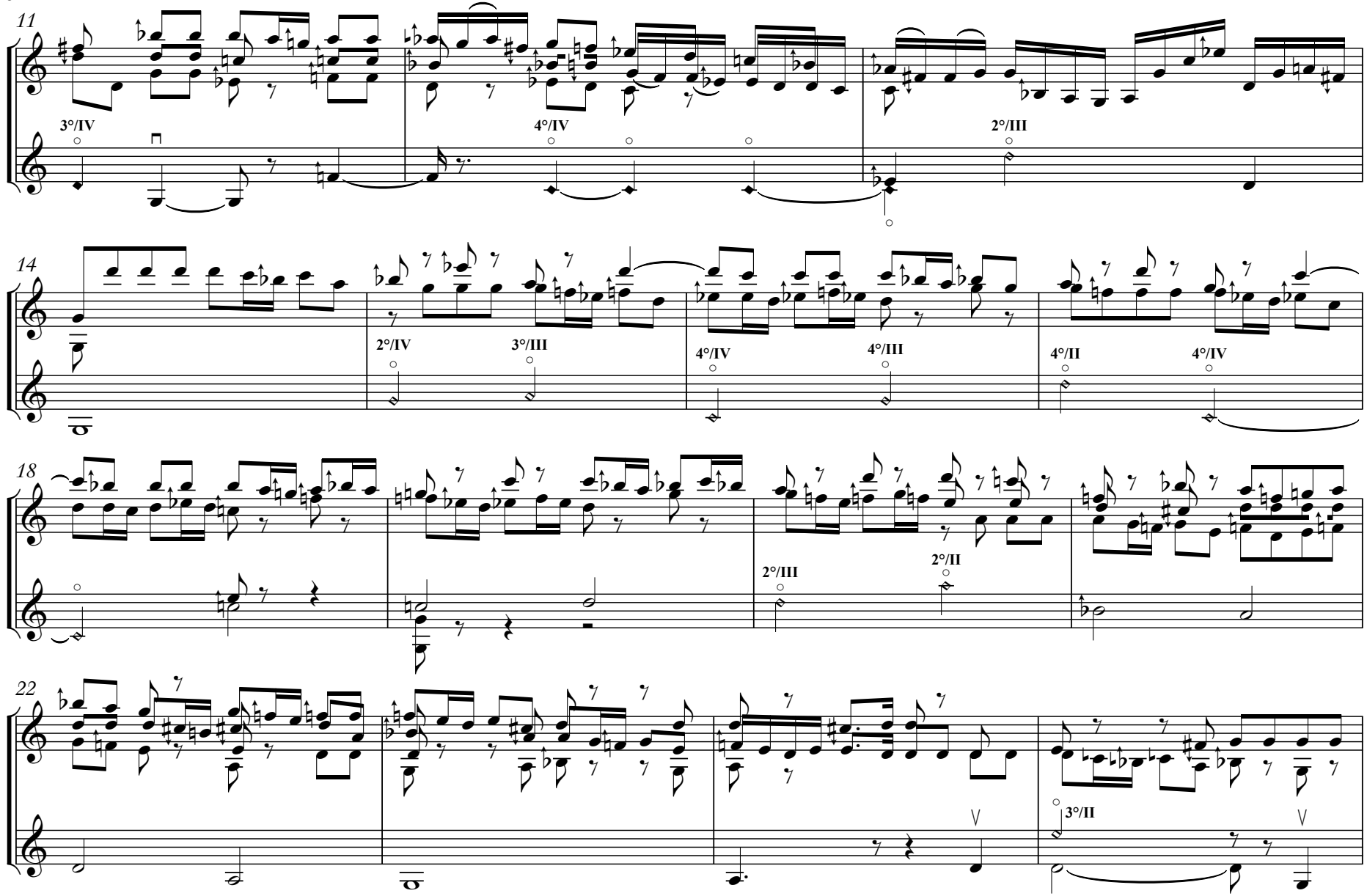

11
tr
V
13
tr
V
14b
tr
15

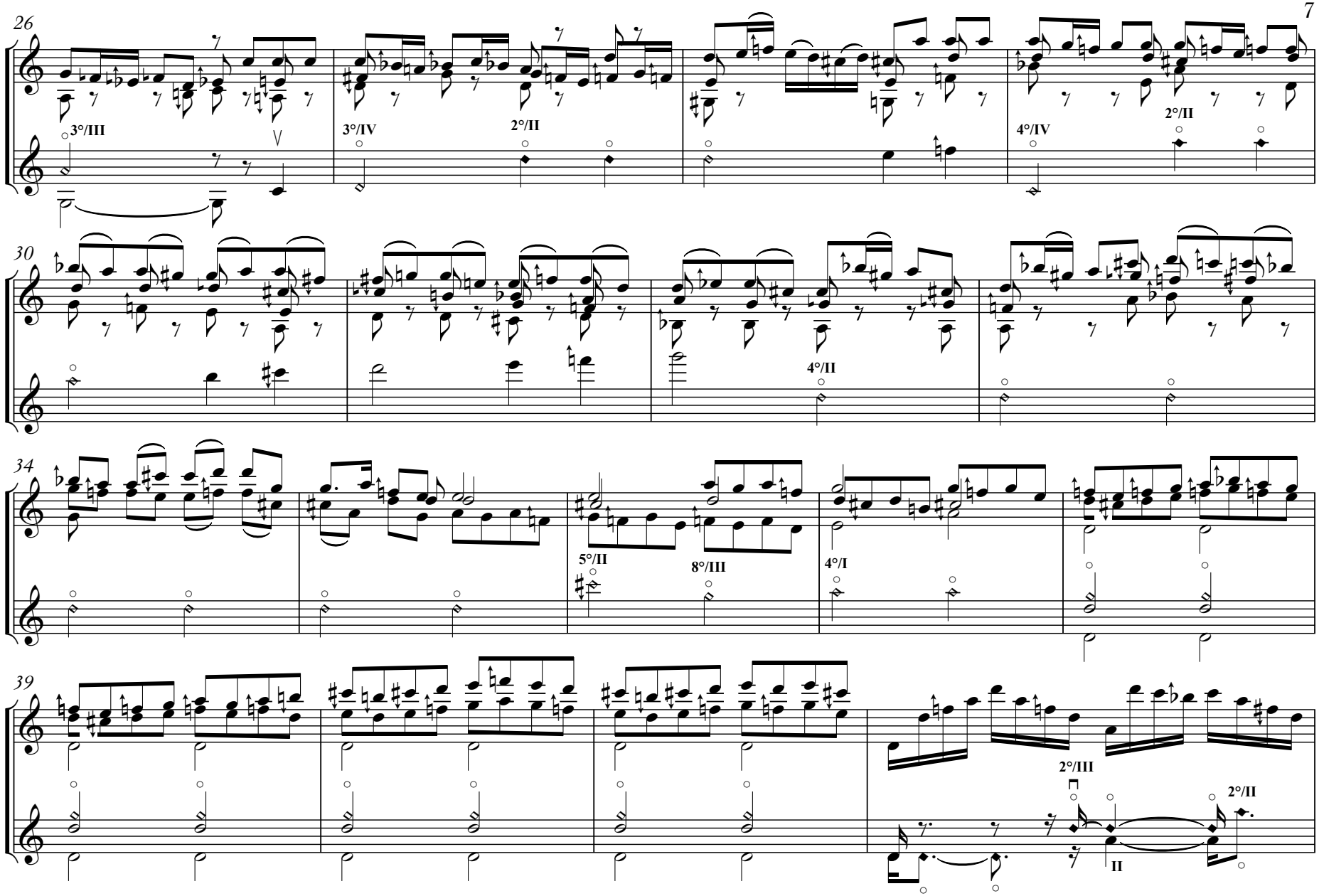

16
tr
V
V
2°/IV
18
2°/III
20
tr
3°/IV
4°/IV

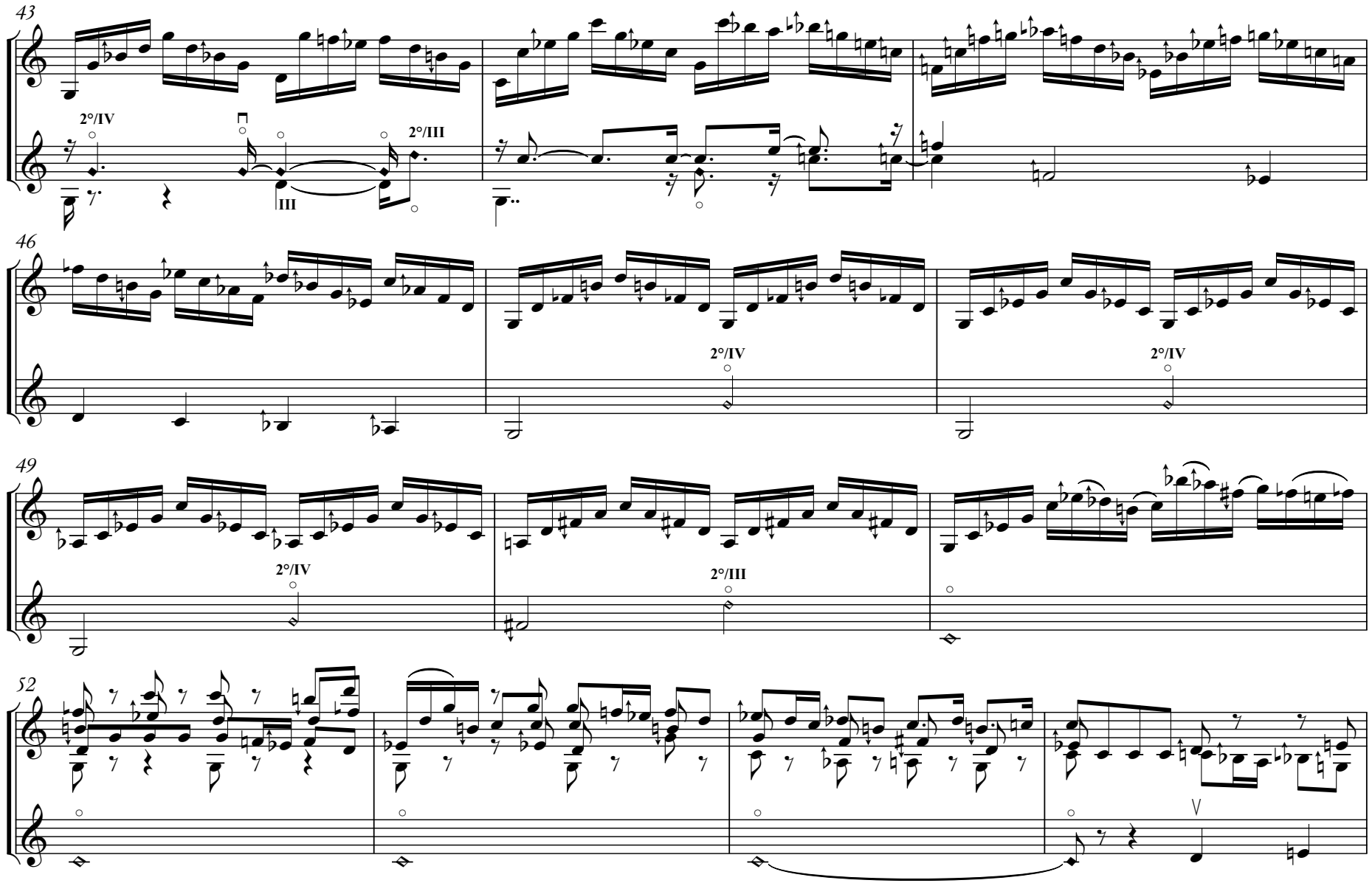
Fuga

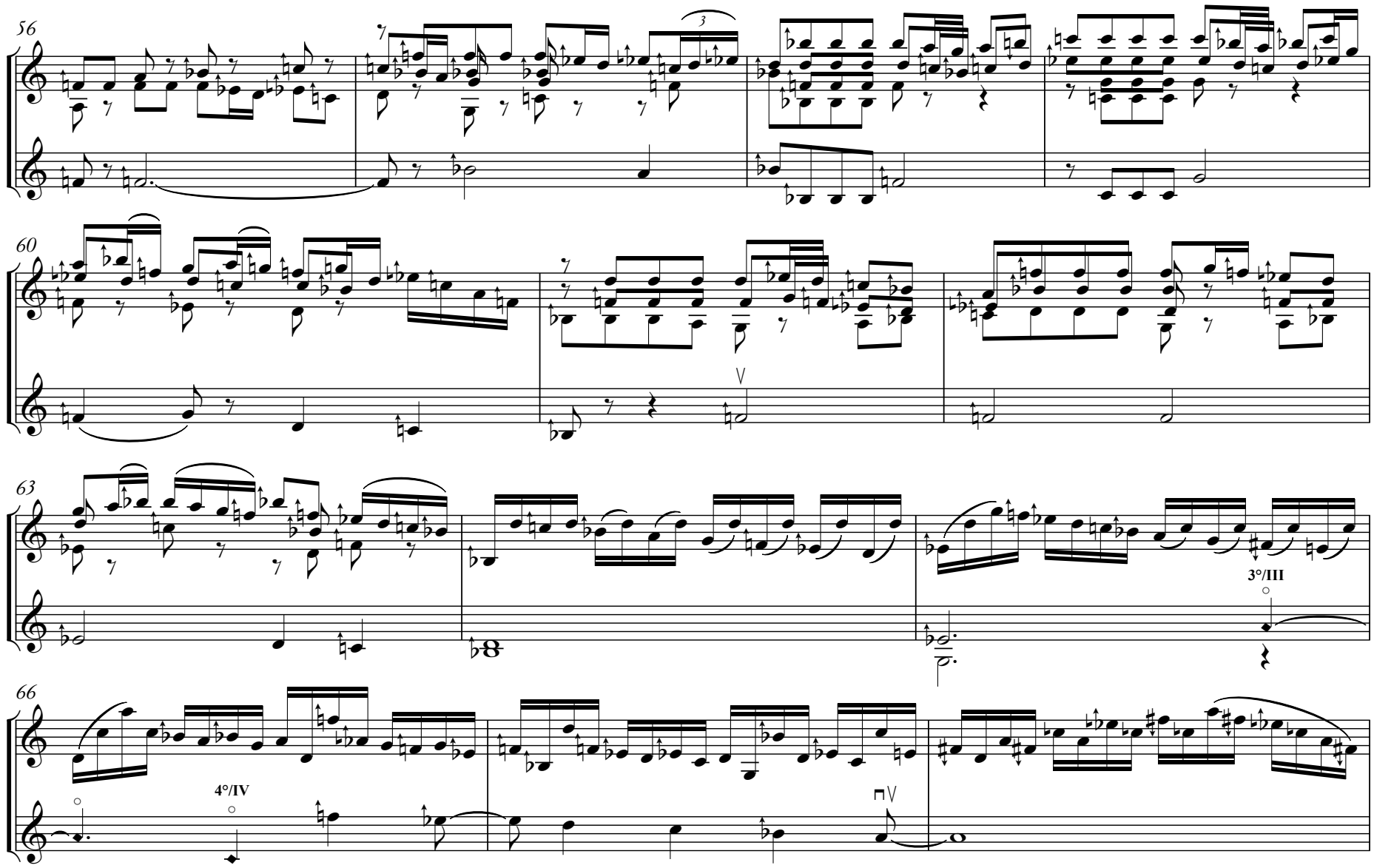
Allegro

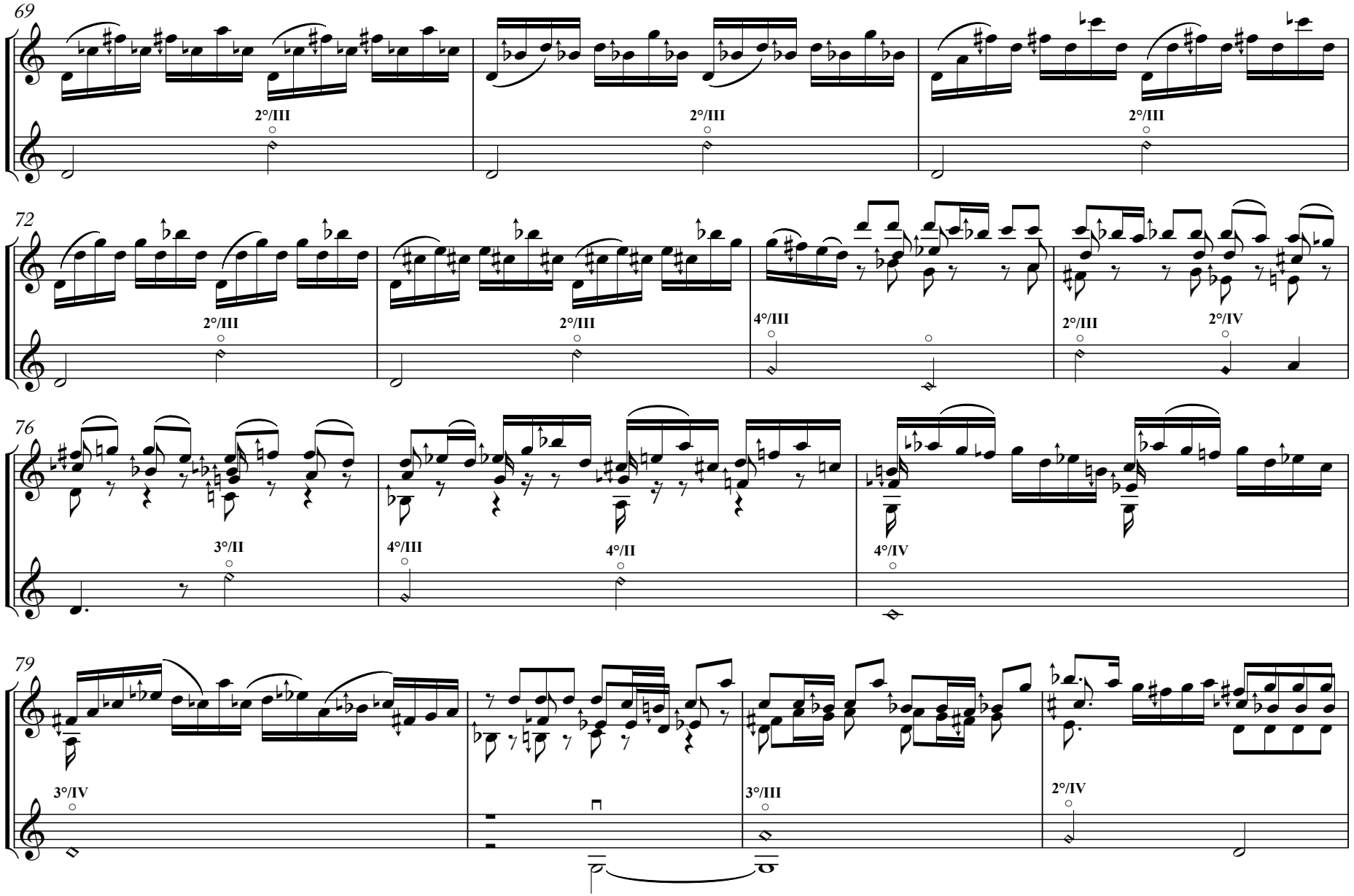
E-natural
(not Eb) in MS

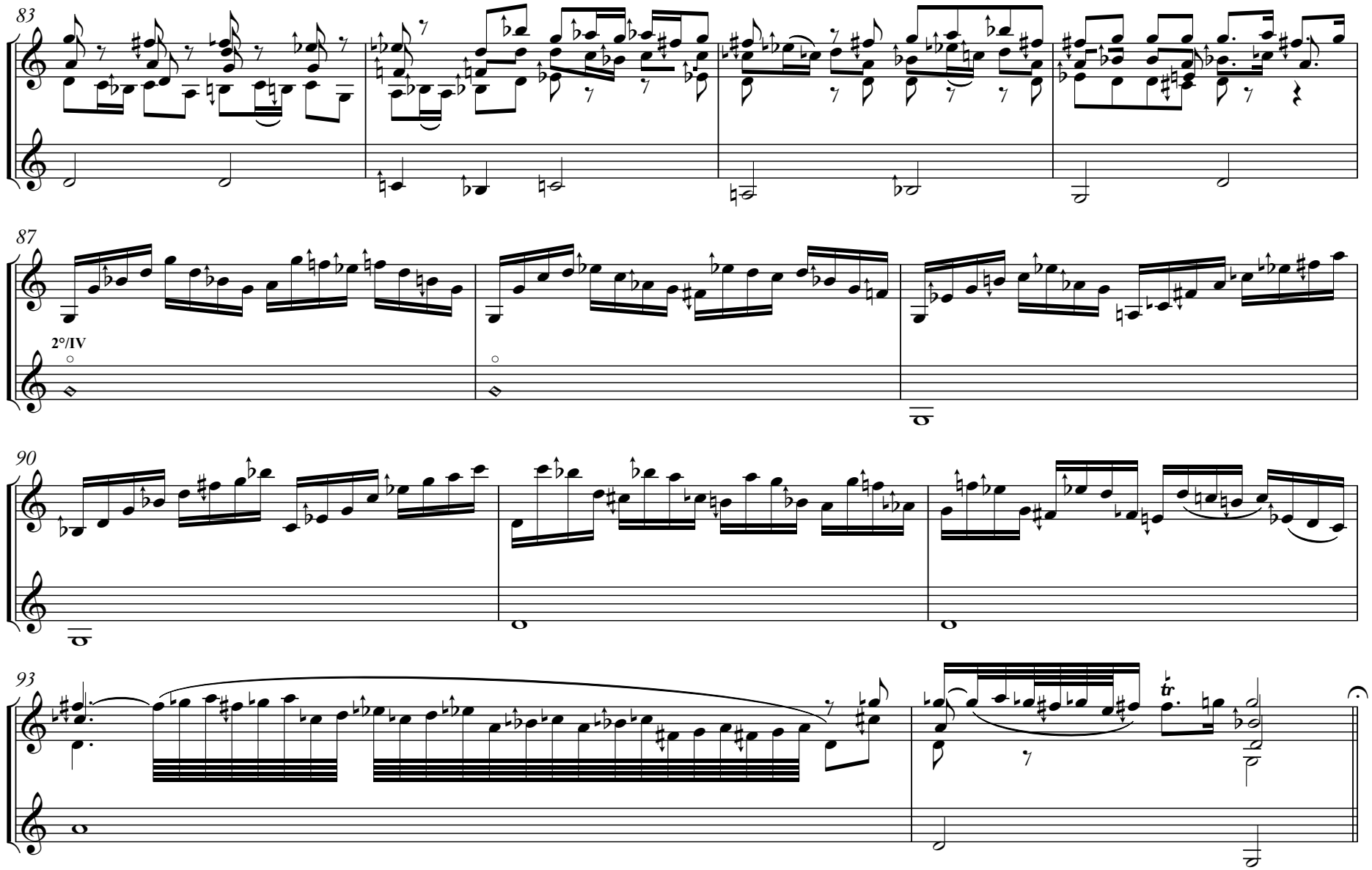

11
3°/IV
4°/IV
2°/III
14
2°/IV
3°/III
4°/IV
4°/III
4°/II
4°/IV
18
2°/III
2°/II
22
3°/II


26
3°/III
3°/IV
2°/II
4°/IV
2°/II
30
4°/II
34
5°/II
8°/III
4°/I
39
2°/III
II
2°/II

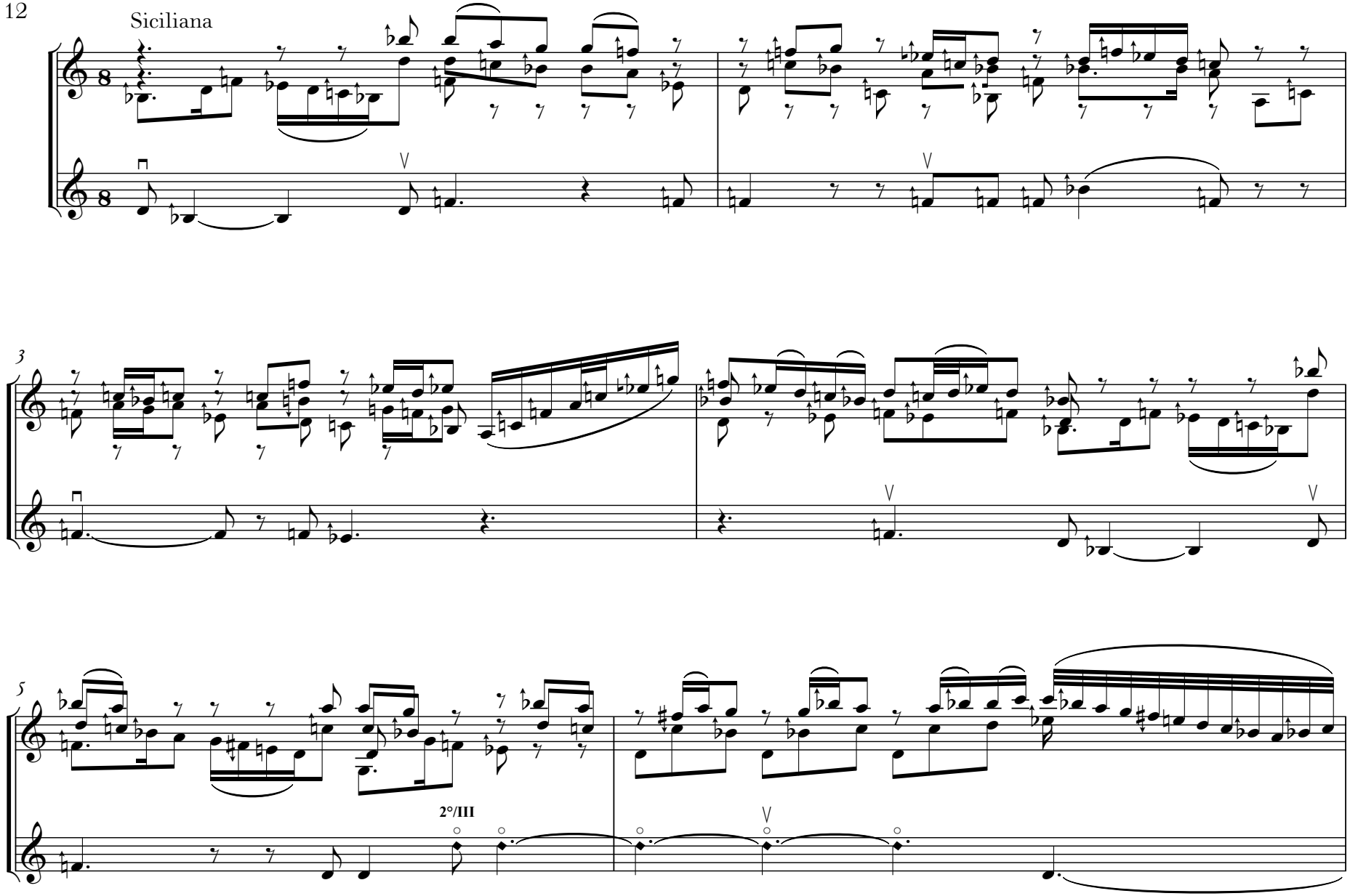

43
2°/IV
III
2°/III
46
2°/IV
2°/IV
49
2°/IV
2°/III
52
V

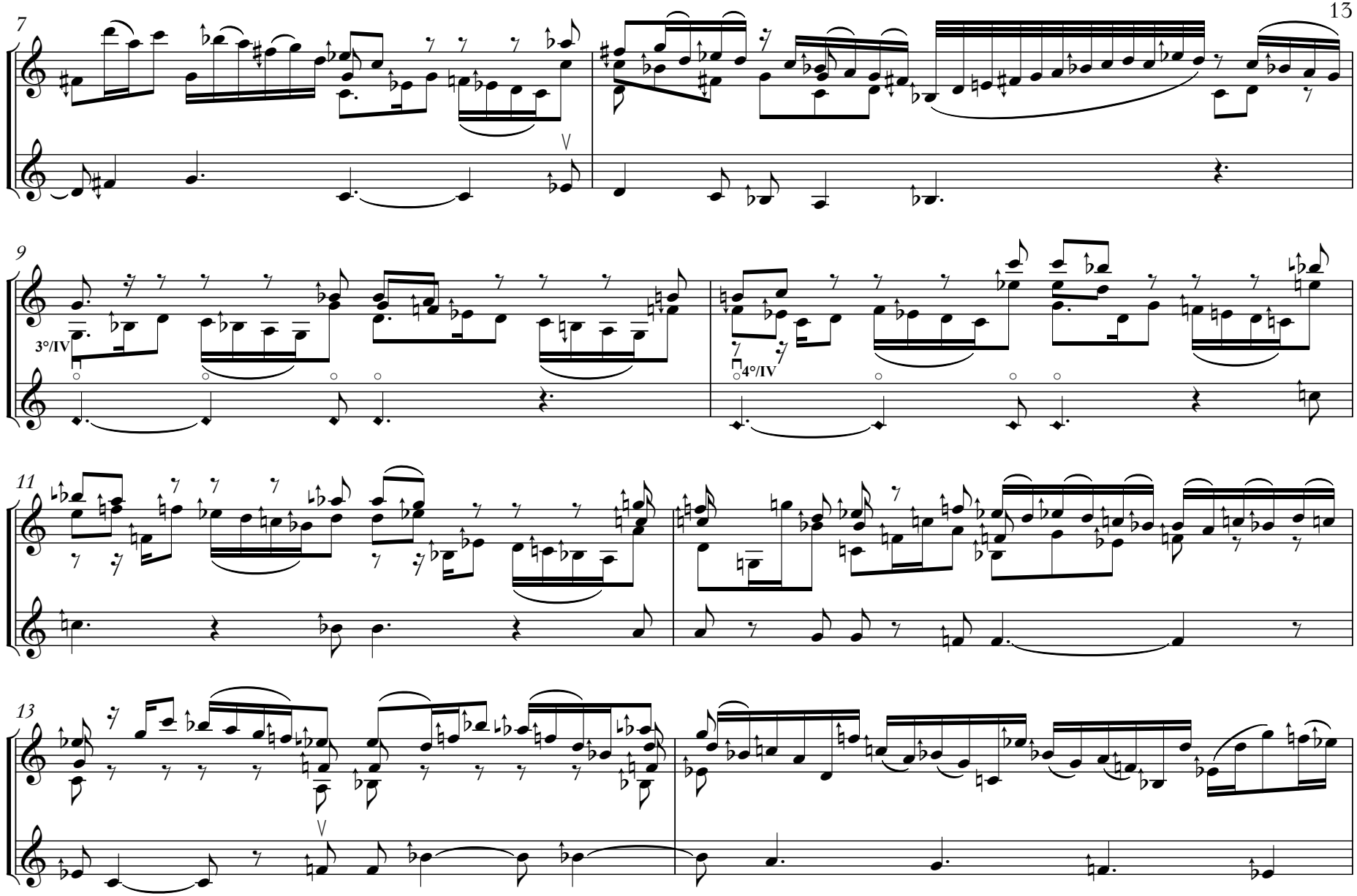

56
60
63
3°/III
66
4°/IV

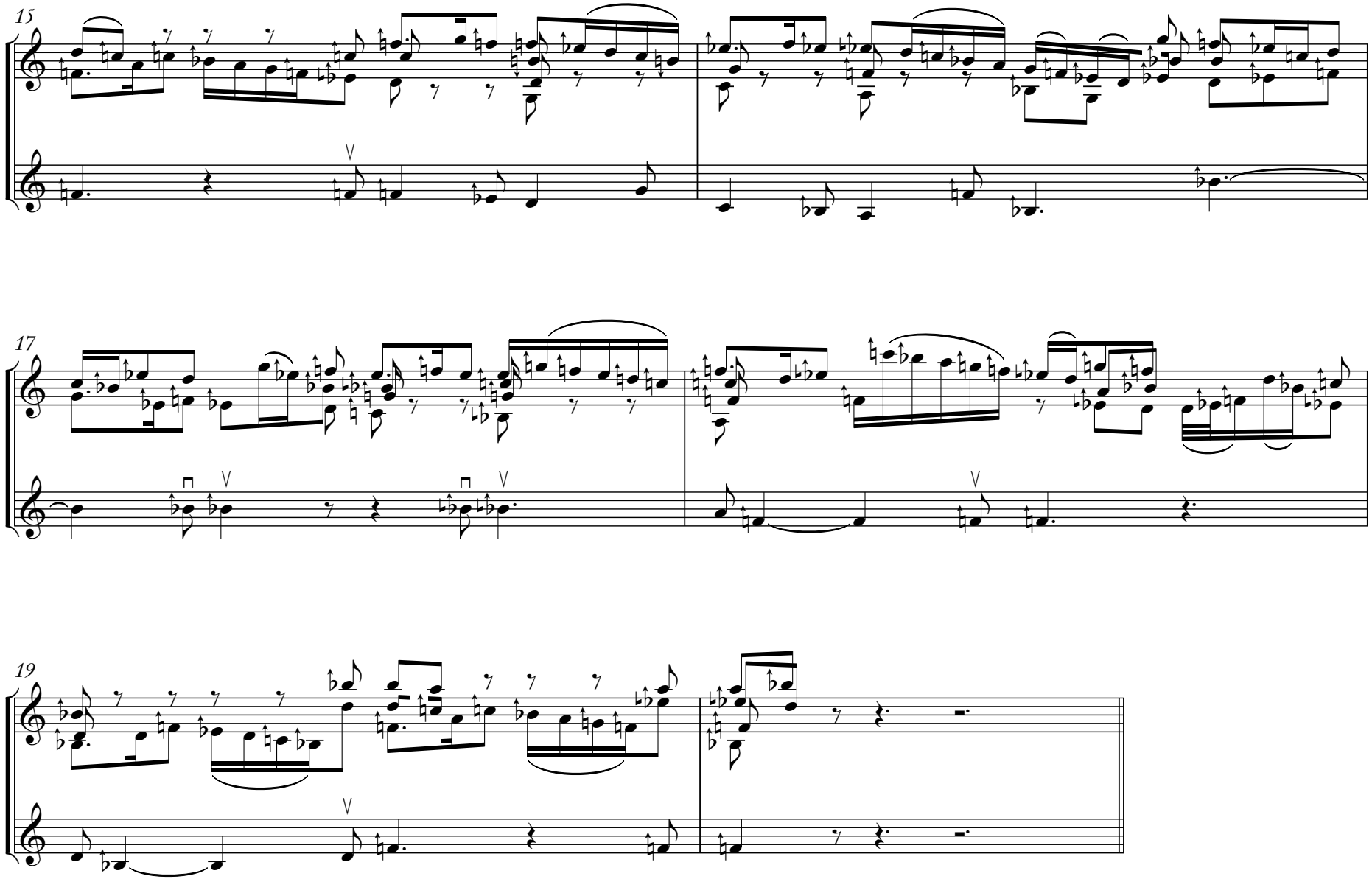

69
2°/III
2°/III
2°/III
72
2°/III
2°/III
4°/III
2°/III
2°/IV
76
3°/II
4°/III
4°/II
4°/IV
79
3°/IV
3°/III
2°/IV


83
87
2°/IV
90
93

Siciliana




7
V
9
3°/IV
4°/IV
11
13
V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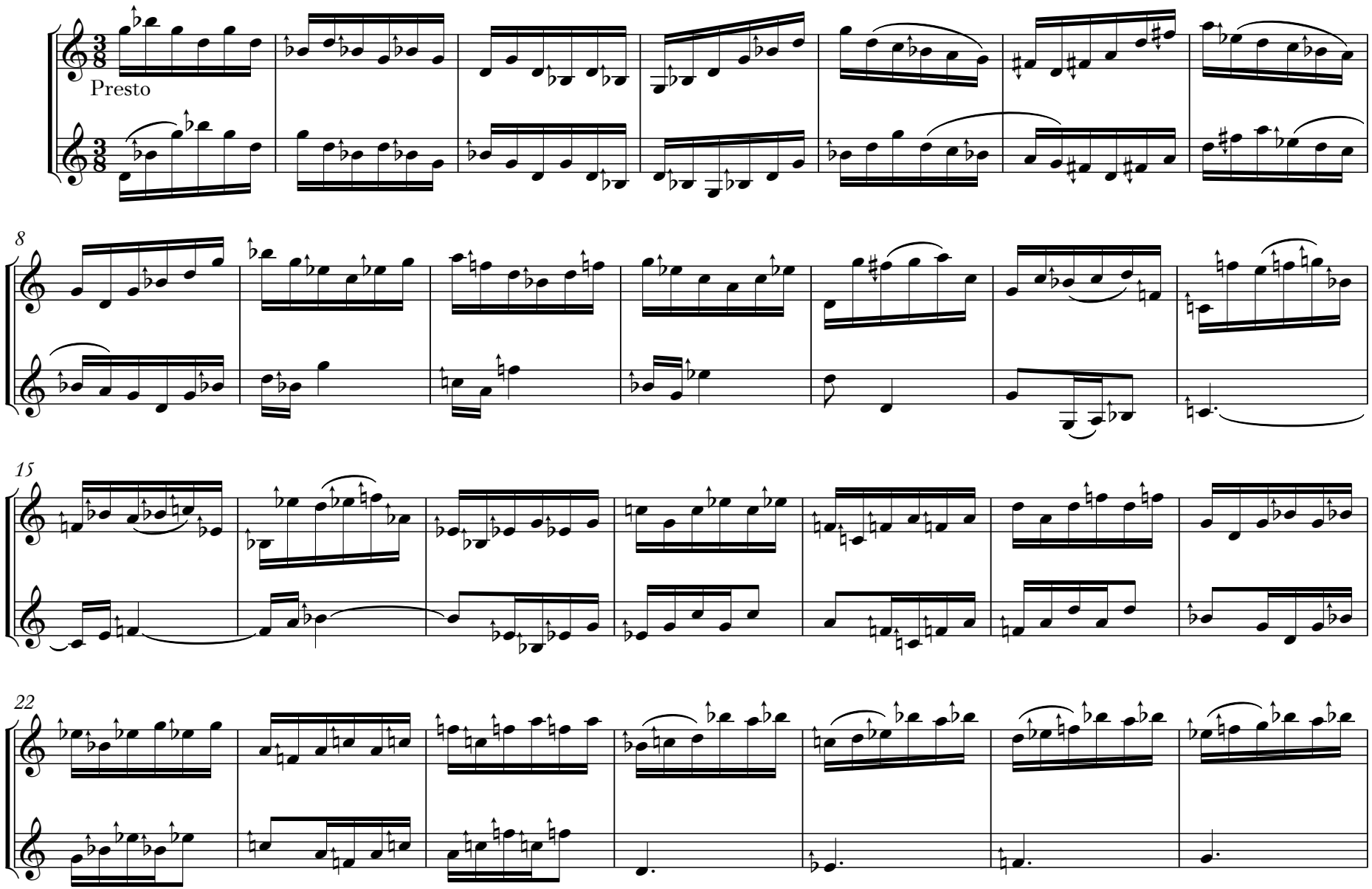
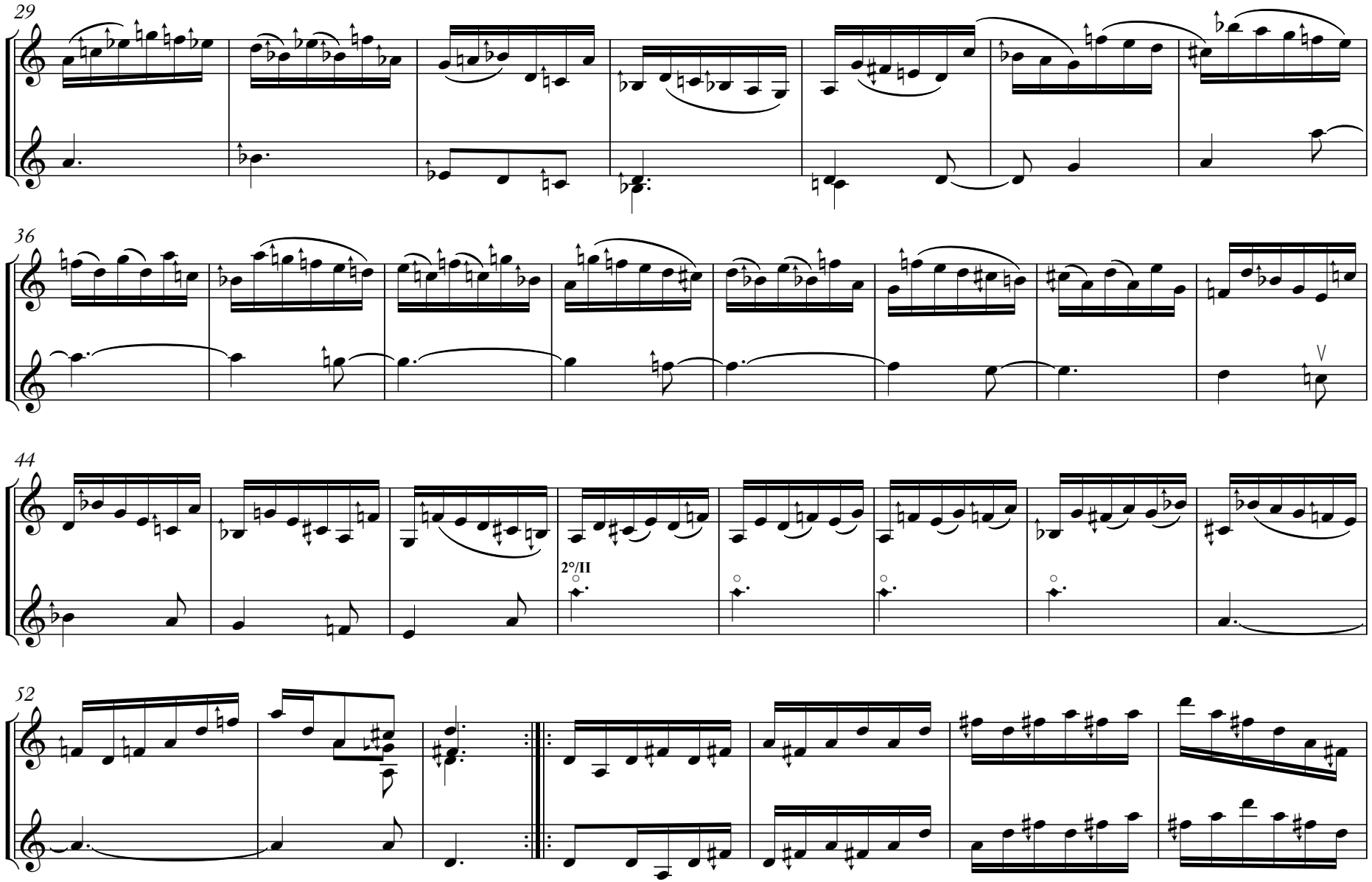
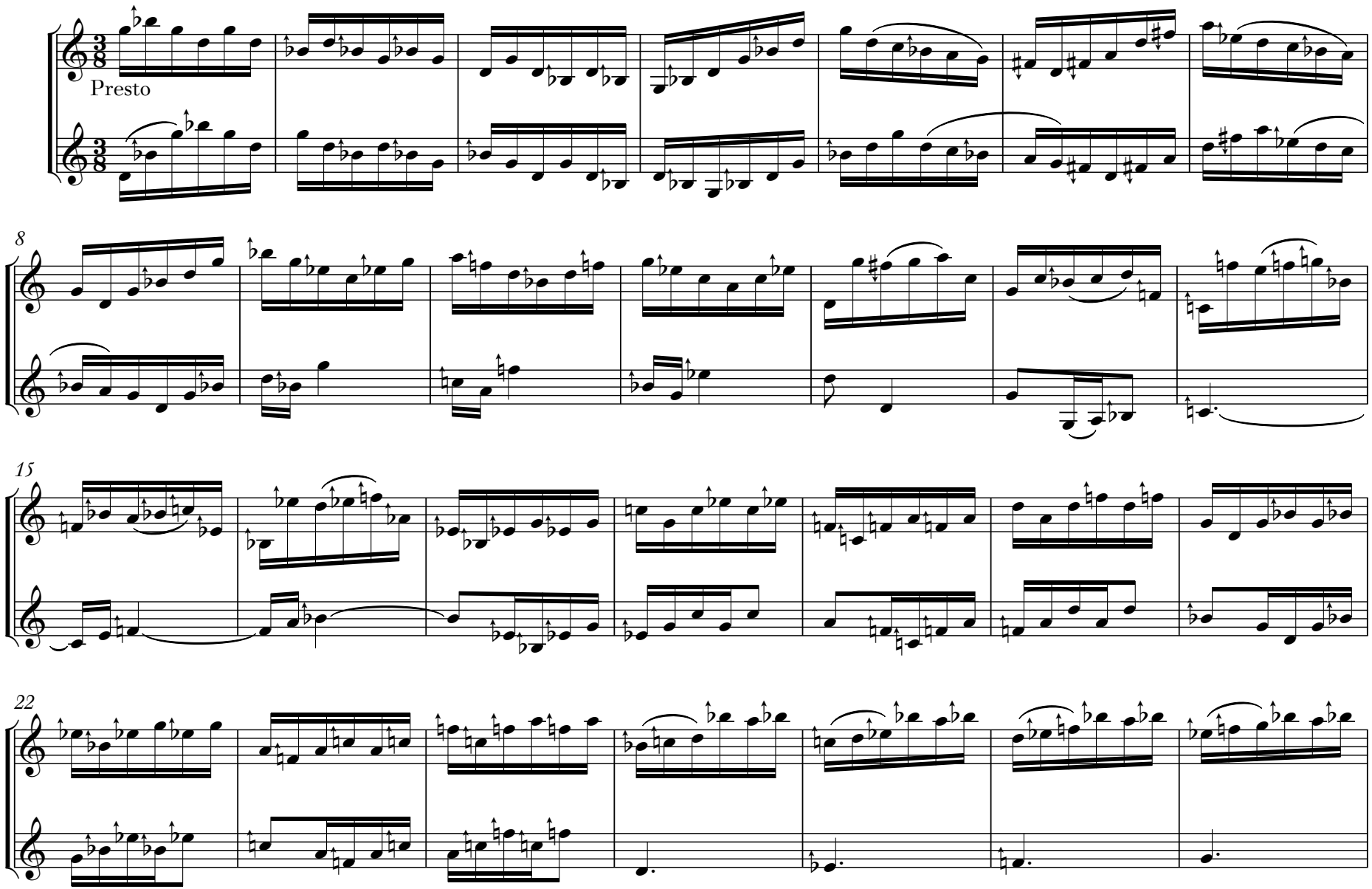

Presto
8
15
22


29
36
44
2°/II
52


Presto
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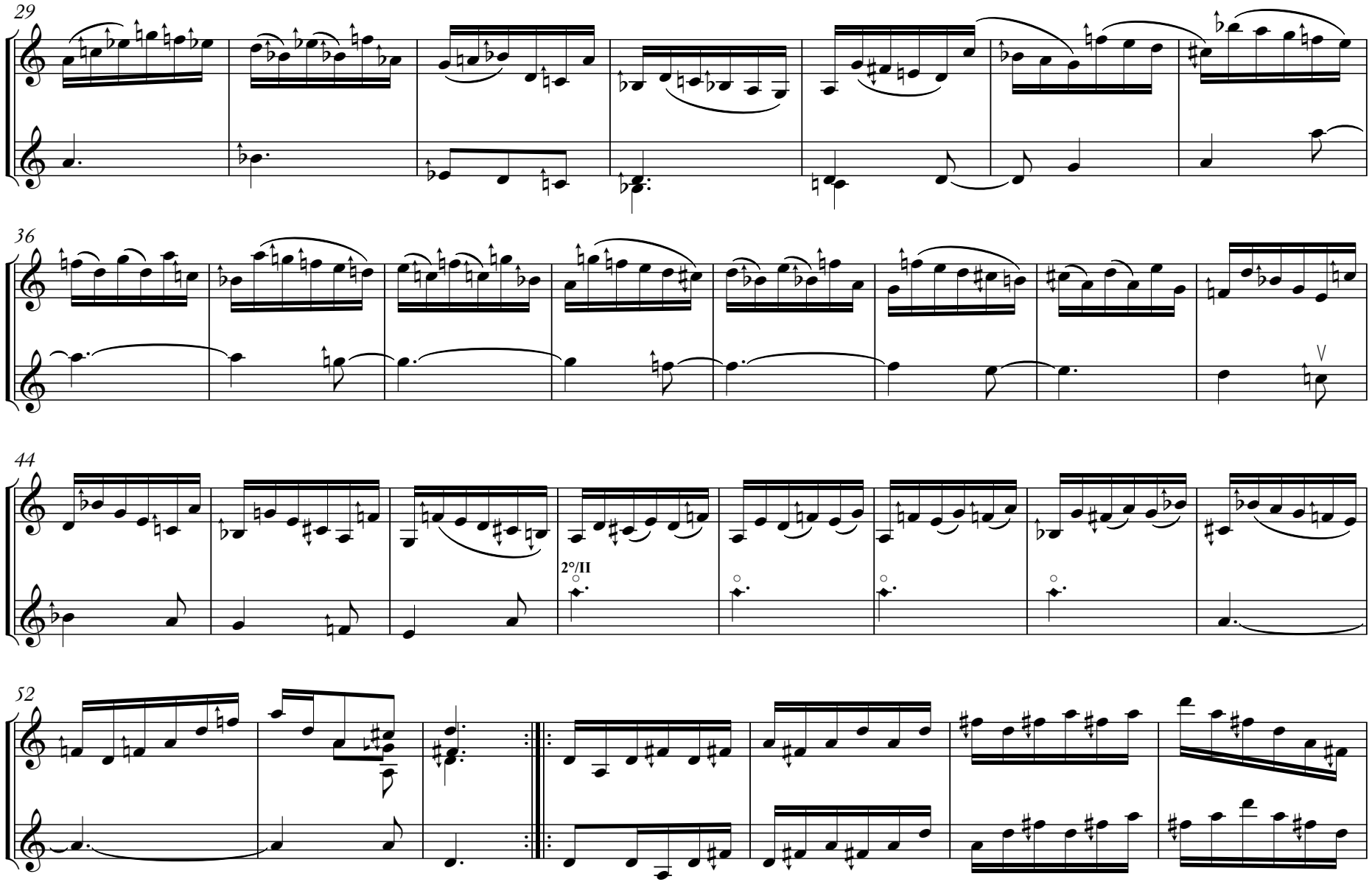
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2°/II
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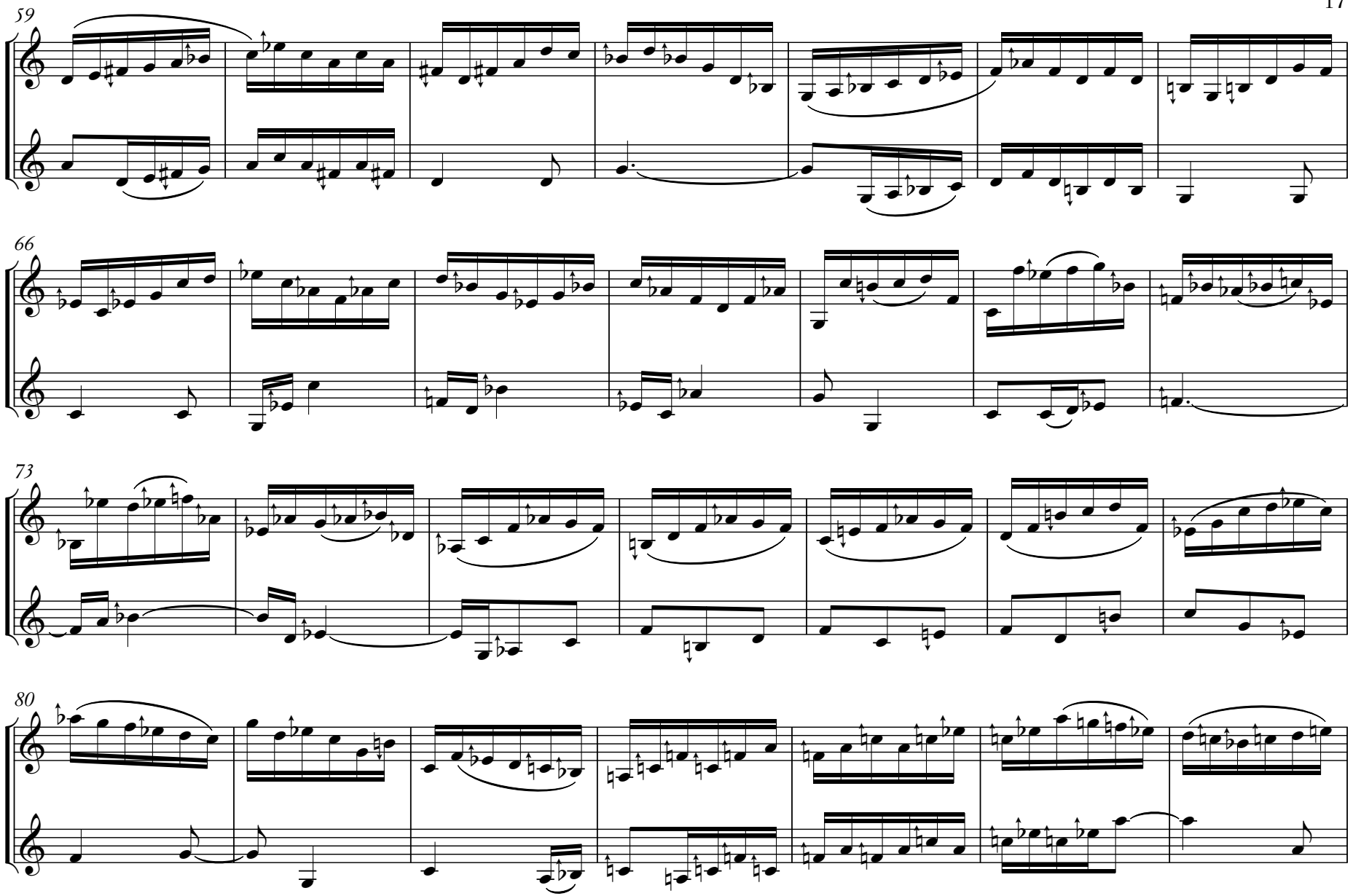
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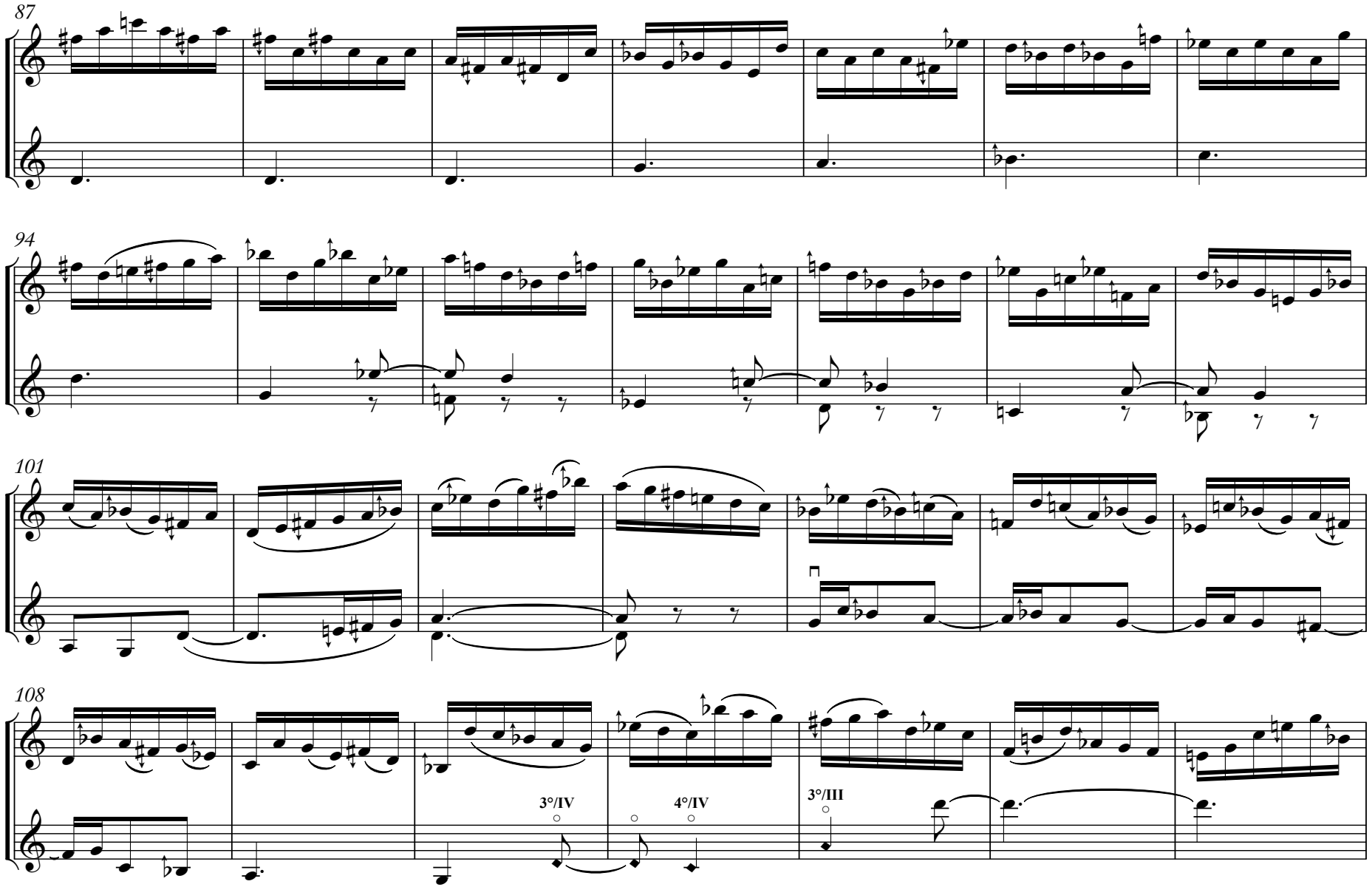
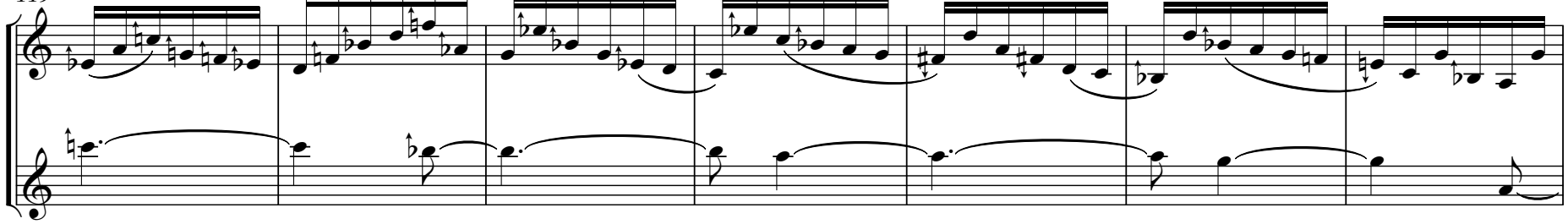

87
94
101
108
3°/IV
4°/IV
3°/III

115



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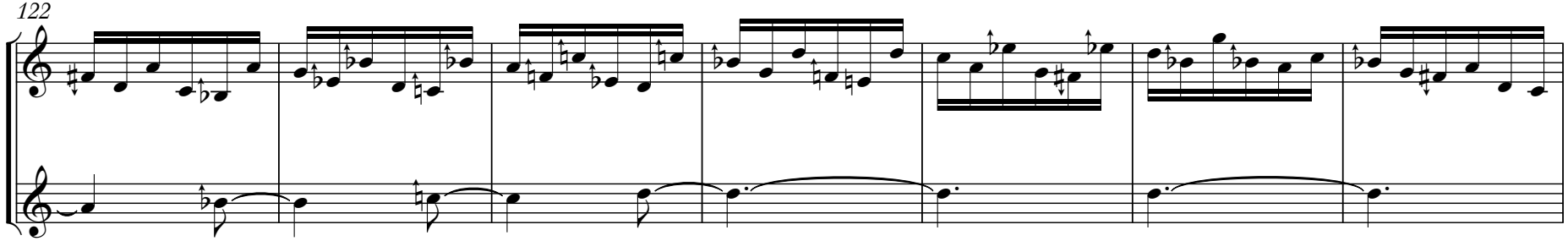

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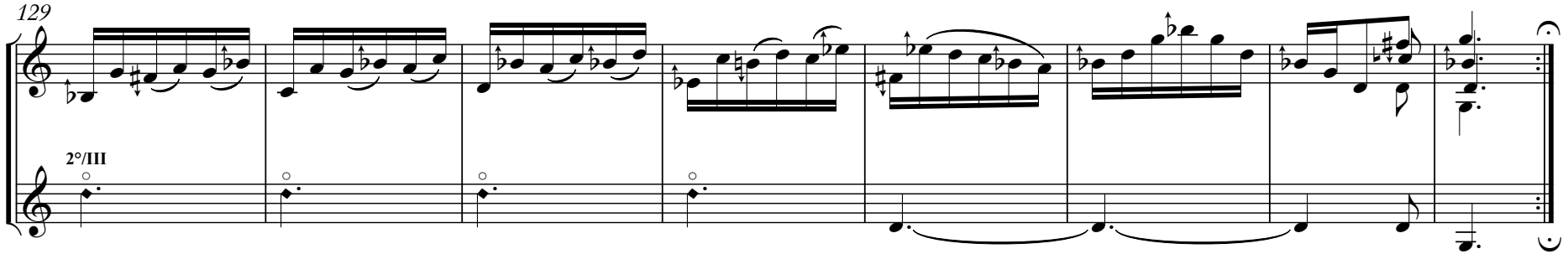

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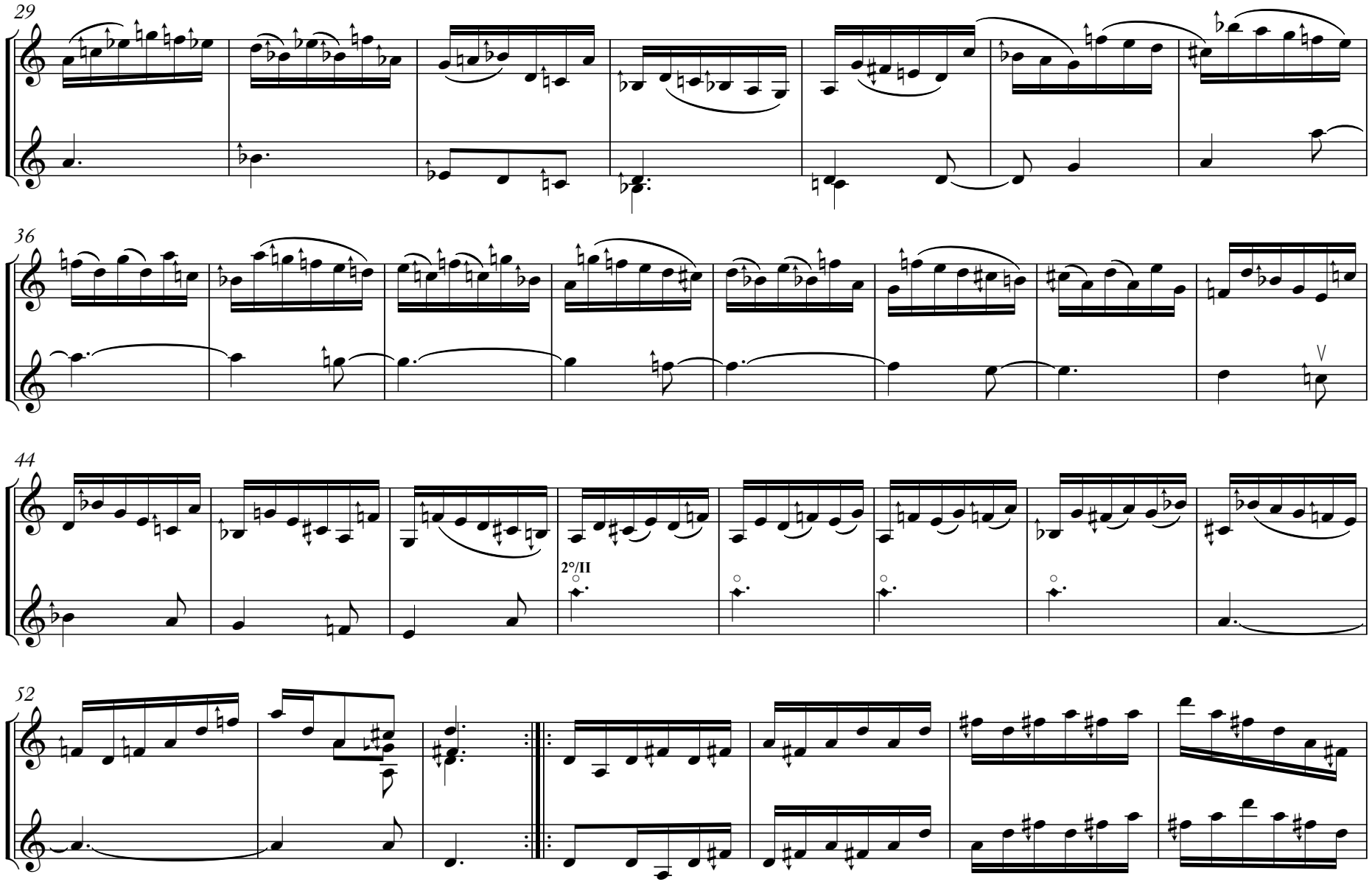
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2°/II
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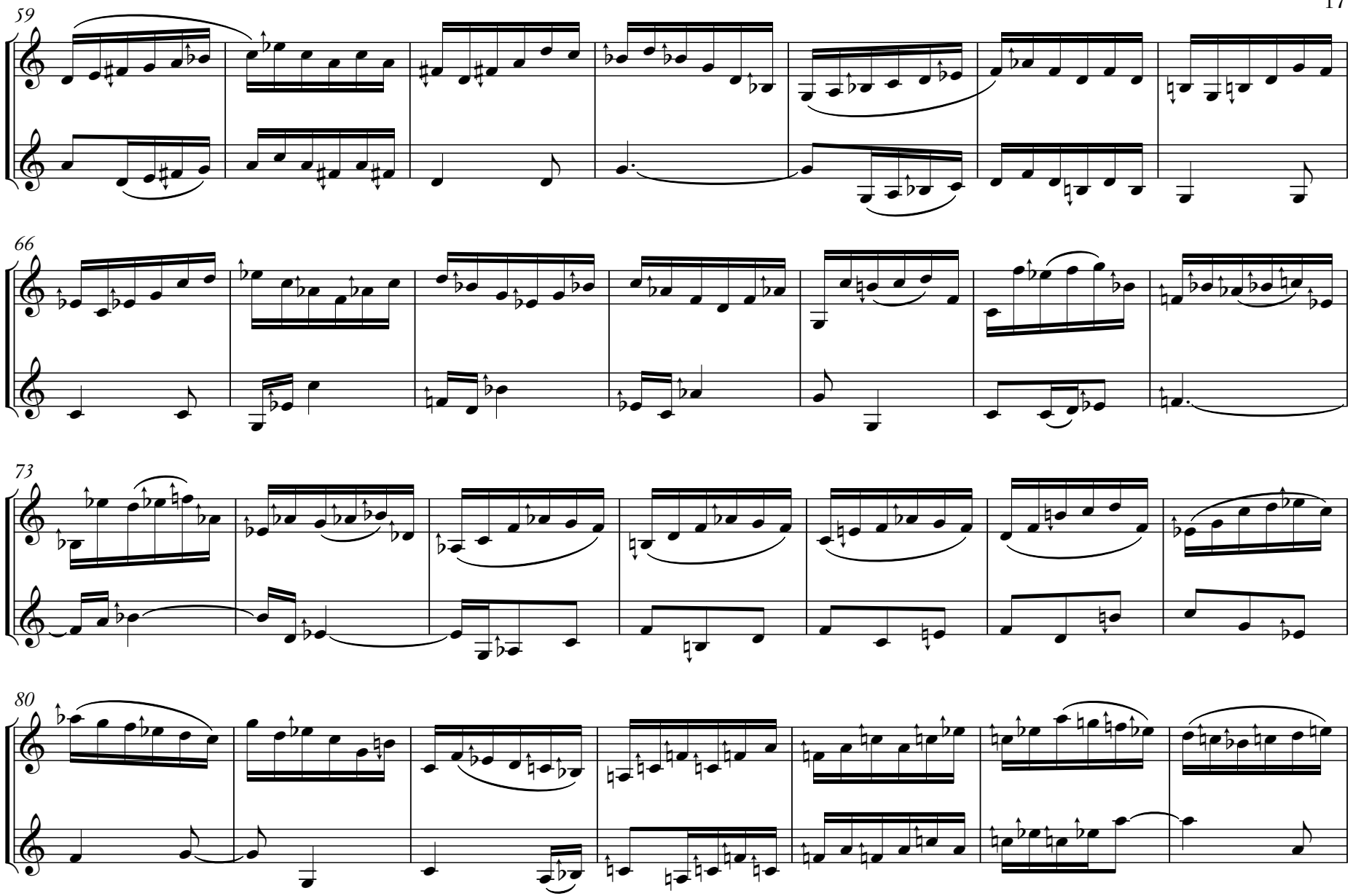
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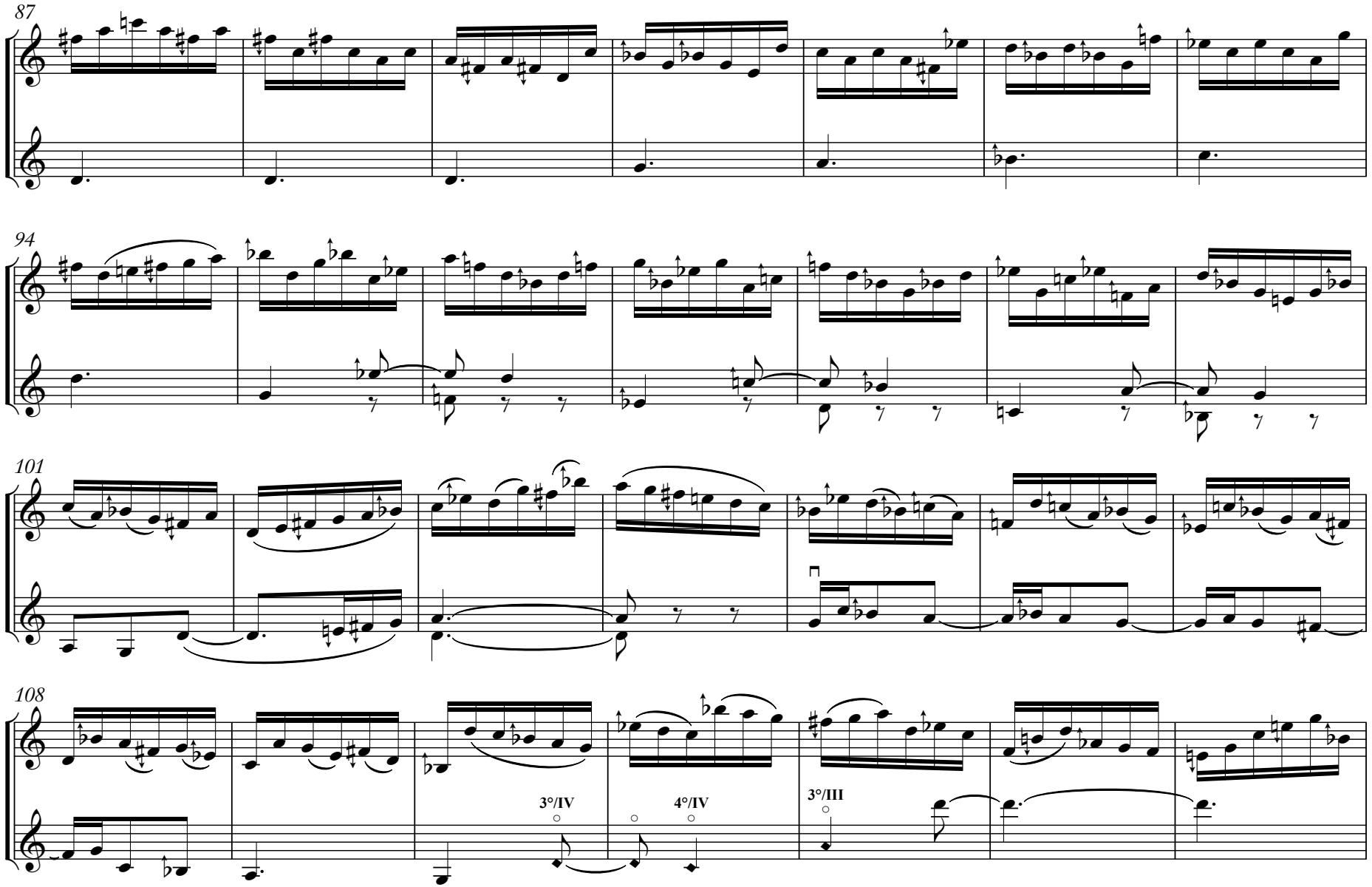
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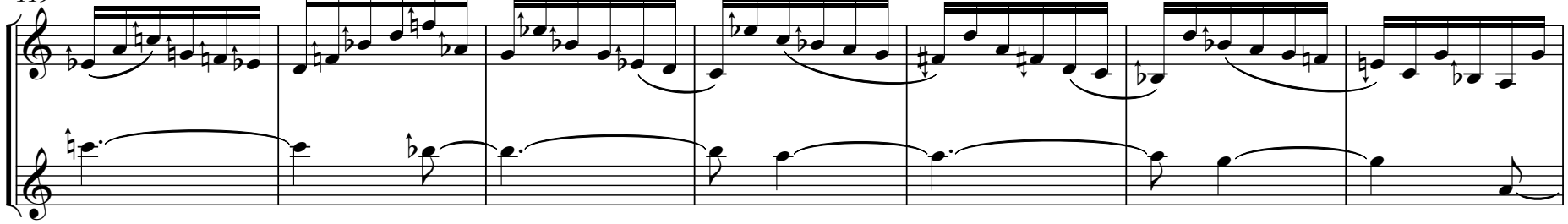
3°/IV
4°/IV
3°/III

115



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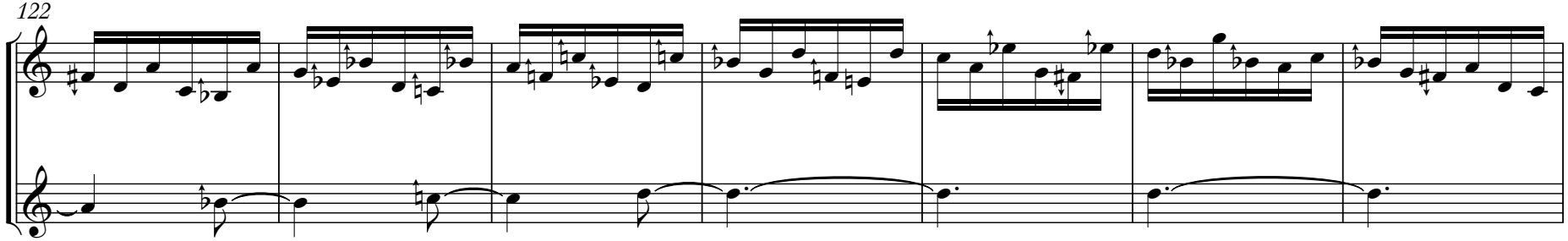

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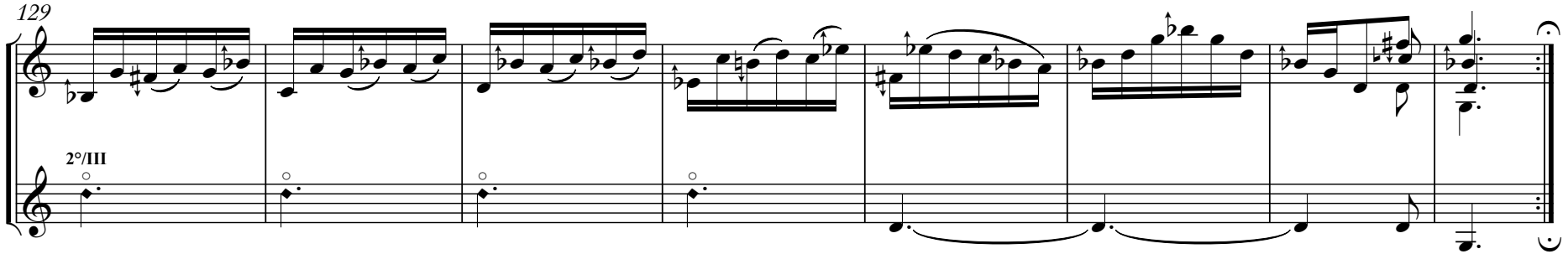

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