Andrián Pertout

Āzādeh

for Santūr and Tape

آزاده

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Composed between March and August, 2004 (Revised between January and February, 2005)
Composed for Qmars Piraglu (formerly Siamak Noory)
Premier: 9 February, 2007 (St Andrews on the Terrace, The Asia Pacific Festival/26th ACL Festival & Conference, Wellington, New Zealand, 8-16 February, 2007)
Duration: 13'01"

PROGRAMME NOTES

At the beginning of the twentieth century during the Pahlavi dynasty (1925-1979) we begin to see the resurgence of theoretical research into the Persian theory of intervals and scales. This ideological shift in affect being the impetus for three separate theories on intervals and scales of Persian music proposed in the twentieth century: the twenty-four quarter-tone (equally-tempered) scale proposed by Ali Naqi Vaziri in the 1920s, the alternative twenty-two-note scale proposed by Mehdi Barkešli in the 1940s based on Pythagorean principles, as well as the theory of the five primary intervals of performance practice presented by Hormoz Farhat in his 1990 publication *The Dastgāh Concept in Persian Music*.

'Āzādeh' for Santūr and Tape – composed for Iranian *santūrist* Qmars Piraglu (formerly Siamak Noory) – features the Persian *santūr* (72-string box zither), and serves as a practical study of Persian tuning systems, with its presentation of both 'theoretical' and 'performance practice' tunings. Within the context of an analysis of the tuning methodology of performer Qmars Piraglu, an attempt is made to make comparisons not just with the three propositions outlined previously, but also with other existing alternative tuning systems. This discussion presented in order to generate a greater understanding of the musical processes that govern the theory of Persian intervals, at the same time disclosing some of the strategies employed in the general contemporary 'cross-cultural' compositional process.

The work incorporates six of the most prominent elements of the *radif* of the *dastgāh-e Segāh* belonging to the school of Musa Maaroufi. Pitch material from the main *gušes*, which include *guše-ye Zābol*, *Mūye*, *Moxālef* and *Maqlub*, as well as the *darāmad* and *forūd* have been accessed and catagorized (according to Qmars Piraglu) to then be utilized in adherence to Western contemporary compositional practices, and therefore resulting in a work that has no intention in representing Persian classical music tradition. The juxtaposition of notated improvisation along with corresponding *Taknavāzi-e Santūr* (*Santūr* ad-lib solo) sections for each of the *gušes* a representation of the composer/performer culturally distinct artistic perspective.

A structural scheme based on 'golden mean' or 'golden section' proportions has been incorporated in the linear plan. The aesthetic notion of these proportions being a technique directly borrowed from art and architecture, with its conceptual basis stating that "if the proportion of 'ab' to 'bc' is the same as the proportion of 'bc' to the whole line, then 'ac' is segmented according to the golden mean." The fraction represented by this ideology is .618, and manifests itself in the work at *guše-ye Moxālef* with its introduction of melodic material based on the second tetrachord of *dastgāh-e Segāh*.

The tape element of 'Āzādeh' includes sampled *santūr* (tuned to Barkešli's 'Twenty-Two-Note Division of the Octave') and sampled vocals – combining an F pedal point or drone (with a 500ms and 250ms rhythmic pulse), structural markers, and the recitation of poetry by Qmars Piraglu.

The Artist

Iranian artist Qmars Piraglu (formerly Siamak Noory) was born in Tehran in 1961, and initiated his musical education at the age of five via Orff instruments (children's instruments designed by Carl Orff [1895-1982] such as the xilophon, metalophon and vibraphon). Following a seven-year period, he then adopted the Persian *santūr* (a 72-string [or 18 quadruple-stringed] box zither), initially learning the instrument under the guidance of Ms Farzaneh Noshad (a student at the Persian Traditional Music Conservatory in Tehran). Three years later, he is accepted as a student of "one of Iran's greatest contemporary composers and master *santūrists*," Faramarz Payvar. For the next eight years Qmars develops his knowledge and understanding of the complete Persian classical music repertoire. As well as this, he synchronically studies Western music – the pianoforte with Taher Djalili (a pianist from the Music Conservatory), and for a year, the bassoon with Khosrow Soltani. Qmars ultimately escaped from Iran in 1986 (during the Iran-Iraq war of the eighties), arriving in Turkey as a refugee, to then temporarily settle in Belgium, where he studied the piano at the Music Academy in Antwerp with Hedvig Vanvarenberg, before establishing a permanent base in Sweden in 1989. Here he studied the piano for two years at the Birkagårdens Folkhögskolan in Stockholm with Stella Tchaikowsky, and went on to graduate from the University of Göteborg with a Bachelor of Science in Musicology. Since 2001, Qmars has been living in Melbourne, Australia. In 2003, he completed a Master of Music (MMus) degree at the University of Melbourne, and is currently undertaking a Doctor of Philosophy (PhD) degree at Monash University.

The Instrument

The Persian or Iranian *santūr* is an integral part of the traditional orchestra, sharing the lute repertoire of the *tār* and *setār*. It is also utilized in the *motrebi* 'entertainment music' genre, but folk styles are excluded. An article by Jean During, Scheherazade Q. Hassan and Alastair Dick describes the *santūr's* constructing thus: "The *santūr* consists of a trapeziform case made of walnut wood, approximately 90cm wide at the broad end, 35cm wide at the narrow end and 6cm deep. The sides form an angle of 45 degrees to the wider end. The strings are fixed to hitch-pins along the left-hand side and wound round metal wrest-pins on the right by means of which they are tuned with a tuning-key. Each quadruple set of strings rests on a movable bridge of hardwood (*kharak*). These bridges are aligned almost parallel with the sides of the case. The right-hand rank corresponds to the bass strings and that on the left to the treble strings. In the centre of the *santūr* the low-pitched strings on the right cross the high-pitched strings on the left." Adding to this, the instrument features three courses of strings (the bass strings, made of brass, while the treble ones, steel), with a total of 72 strings, or 18 groups of strings, capable of producing 27 different pitches, and is played "by striking the strings with two hammers (*mezrāb*) held in three fingers of each hand."

The Text

“Kas nadānad darde bi darmāne mā,

Jore Leili dar dele por šūre mā.

Hazar kardim ze harče xalgo donyā

Kajāst Āzādeh in mahpeykare mā?”

Āzādeh, Qmars Piraglu.

“Nobody knows the pain inside me,

The pain that emanates, being away from my beloved Āzādeh.

Because my soul is with her, I am oblivious to everybody and everything

Where is my beloved Āzādeh, who reflects the beauty of moonlight?”

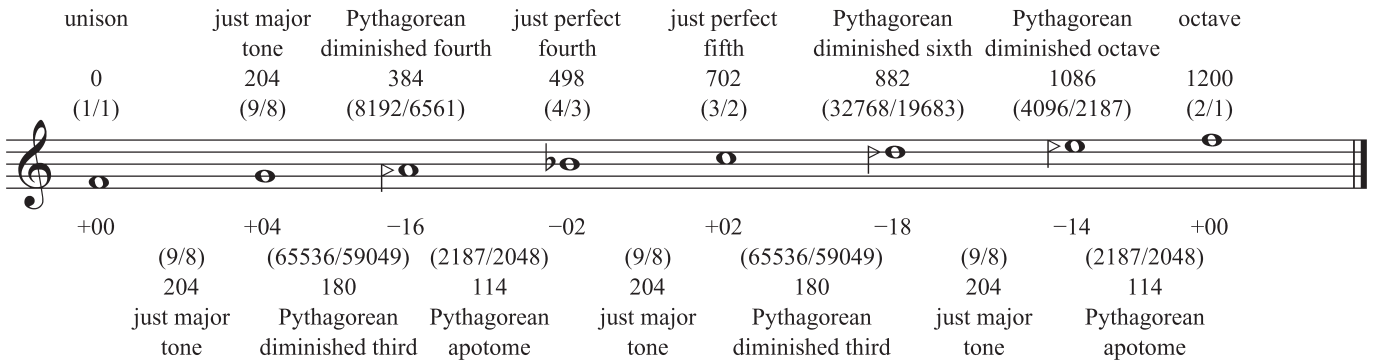
Āzādeh, Qmars Piraglu.

کس نداند درد بی درمان ما جور لیلی در دل پر شور ما

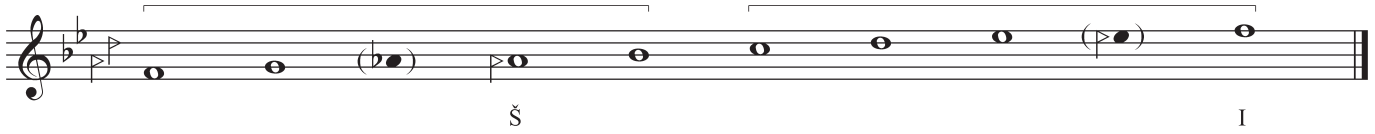
حذر کردم ز هر چه خلق و دنیاست کجاست آزاده این مه پیکر ما

آزاده ، کیومرث پیرگلو

The Harmonic Characteristics of ‘Dastgāh-e Segāh’

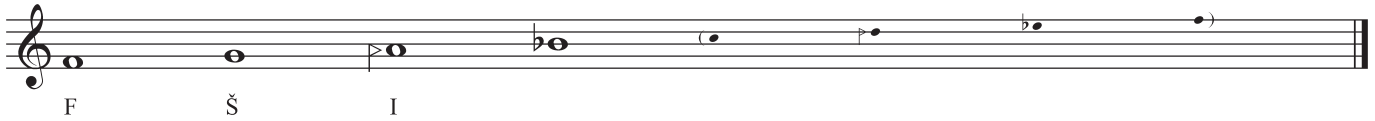


Dastgāh-e Segāh in the Key of F

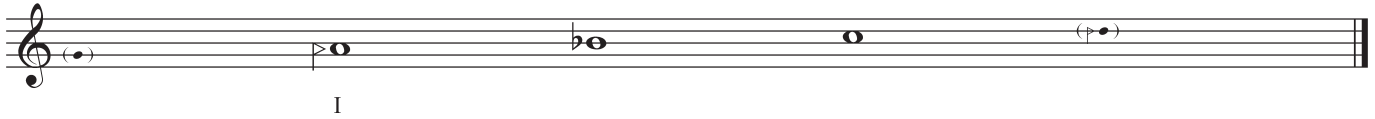


First Tetrachord

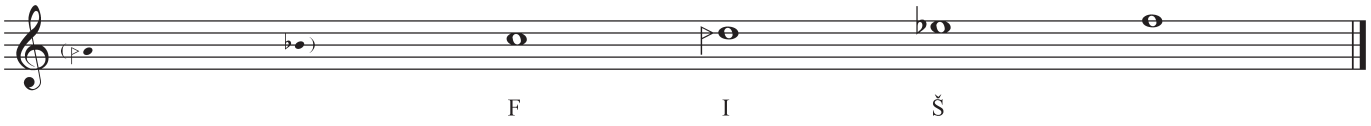
1. darāmad-e Segāh



2. guše-ye Zabōl

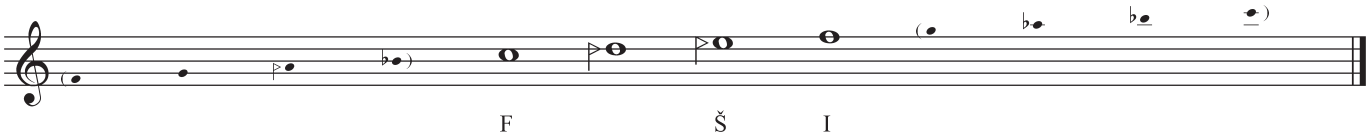


3. guše-ye Mūye

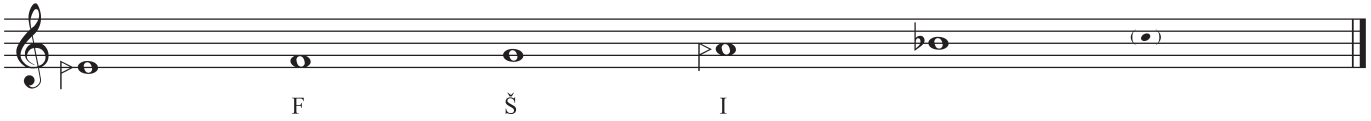


Second Tetrachord

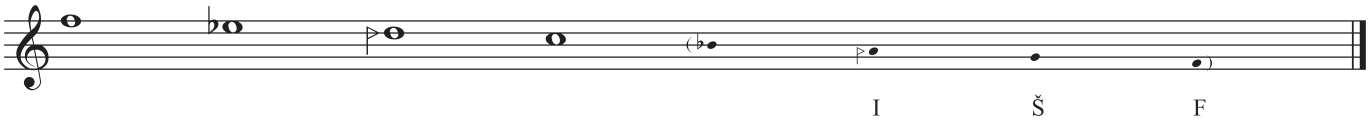
4. guše-ye Moxālef



5. guše-ye Maqlub



6. forūd-e Segāh

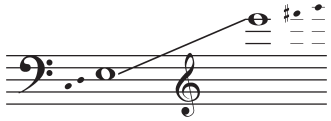


dastgāh = (organization, system); *guše* = (corner, section, piece); *darāmad* = (opening, introduction);
finalis "F" = note of repose and conclusion; *ist* "I" = (stop), ending note for phrases;
šahed "Š" = (witness), prominent note; *forūd* = (descent, cadence)

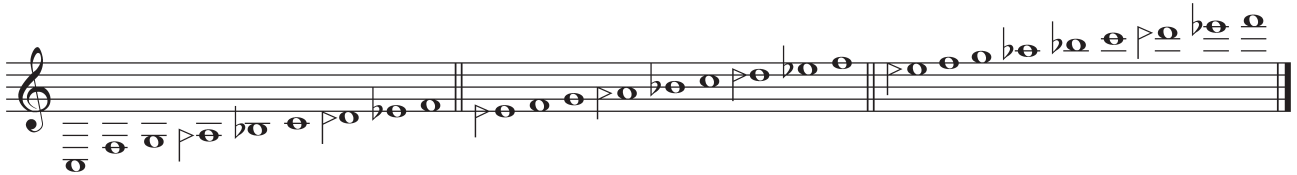
(Hormoz Farhat, *The Dastgāh Concept in Persian Music*, New York: Cambridge U. Press, 1990.)

INSTRUMENTATION

Santūr



Persian 72-string (or 18 quadruple-stringed) box zither



Tuning of the Santūr for Dastgāh-e Segāh (on F)

Tape – Sampled Santūr and Vocals (CD player)

Transposed score

PERFORMANCE NOTES

In this score, accidentals apply throughout the bar (a bar in this particular case representing a unit of time equal to one-sixtieth of a minute, or two beats of a 2/4 bar at ♩=120, marked numerically in the score in five-second increments).

Two tuning systems are proposed: The theoretical 'Twenty-Two Note Division of the Octave' of Persian scholar Mehdi Barkešli based on the cycle of fifths and the 'performance practice' *dastgāh-e Segāh santūr* tuning obtained via the intervallic analysis of Persian performer Qmars Piraglu's instrument.

The Ali Naqi Vaziri Notation System (The Accidentals of Persian Music) is utilized in the score, which is fully disclosed in the section following.

The Ali Naqi Vaziri Notation System (The Accidentals of Persian Music)

 sori – raised by one Pythagorean limma (90.225 cents)

 sharp – raised by one limma and one Pythagorean comma (113.685 cents)

 koron – lowered by one Pythagorean limma (90.225 cents)

 flat – lowered by one limma and one Pythagorean comma (113.685 cents)

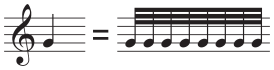
Santūr

 muffle string/s with fingers

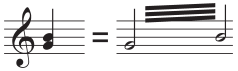
 mano sinistra (left-hand)

 mano destra (right-hand)

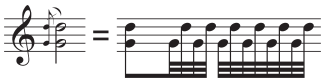
9th bridge



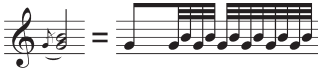
roll note



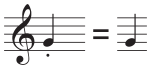
unmeasured tremolo (rapid alternations between the two notes)



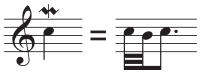
strike both pitches simultaneously, and then execute an unmeasured tremolo



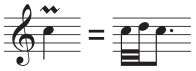
strike the lower pitch, and then execute an unmeasured tremolo



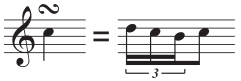
strike pitch (or pitches, if more than one) singularly



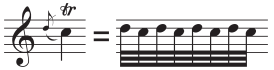
mordent (rapid alternation between the principal note and its lower neighbour)



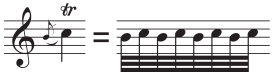
inverted or upper mordent (rapid alternation of the principal note with its upper neighbour)



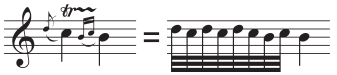
turn (stepwise descent of three notes beginning with the upper neighbour, followed by a return to the principal note)



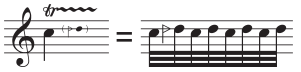
rapid alternations between the principal note and its upper neighbour, beginning with the latter



rapid alternations between the principal note and its lower neighbour, beginning with the latter



rapid alternations between the principal note and its upper neighbour, beginning with the latter and featuring termination (a turned ending)



rapid alternations between the principal note and its upper neighbour chromatically altered

Taknavāzi-e Santūr

Santūr ad-lib solo

Mehdi Barkešli's Twenty-Two-Note Division of the Octave

Relative Pitch: $A_4 = 440\text{Hz}$ / C_4 (middle C) $= 261.6255654\text{Hz}$

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𝄲	superoctave [6] (D) V	256/243	1.053498	275.622	90.225	−10
03	C♯	Pythagorean apotome, or chromatic semitone [7] (A) VII	2187/2048	1.067871	279.382	113.685	+14
04	D𝄬	neutral second [8] (D) X	65536/59049	1.109858	290.367	180.450	−20
05	D	just major tone (A) II (9th harmonic)	9/8	1.125000	294.329	203.910	+04
06	D𝄲	supermajor second [9] (D) III	32/27	1.185185	310.075	294.135	−06
07	D♯	Pythagorean augmented second [10] (A) IX	19683/16384	1.201355	314.305	317.595	+18
08	E𝄬	neutral third [11] (D) VIII	8192/6561	1.248590	326.663	384.360	−16
09	E	Pythagorean major third, or ditone (A) IV (81st harmonic)	81/64	1.265625	331.120	407.820	+08
10	F	just and Pythagorean perfect fourth (D) I	4/3	1.333333	348.834	498.045	−02
11	F𝄲	superfourth [12] (D) VI	1024/729	1.404664	367.496	588.270	−12
12	F♯	Pythagorean tritone, or augmented fourth [13] (A) VI	729/512	1.423828	372.510	611.730	+12
13	G𝄬	subfifth [14] (D) XI	262144/177147	1.479811	387.156	678.495	−22
14	G	just and Pythagorean perfect fifth (A) I (3rd harmonic)	3/2	1.500000	392.438	701.955	+02
15	G𝄲	superfifth [1] (D) IV	128/81	1.580247	413.433	792.180	−08
16	G♯	Pythagorean augmented fifth [2] (A) VIII	6561/4096	1.601807	419.074	815.640	+16
17	A𝄬	neutral sixth [3] (D) IX	32768/19683	1.664787	435.551	882.405	−18
18	A	Pythagorean major sixth (A) III (27th harmonic)	27/16	1.687500	441.493	905.865	+06
19	B♭	Pythagorean minor seventh (D) II	16/9	1.777778	465.112	996.090	−04
20	A♯	Pythagorean augmented sixth [4] (A) X	59049/32768	1.802032	471.458	1019.550	+20
21	B𝄬	neutral seventh [5] (D) VII	4096/2187	1.872885	489.995	1086.315	−14
22	B	Pythagorean major seventh (A) V	243/128	1.898438	496.680	1109.775	+10
01	C	octave	2/1	2.000000	523.251	1200.000	+00

Tuning of the Santūr

The tuning of the *santūr* for *dastgāh-e segāh* (on F) presents the following series of pitches: C_3, F_3, G_3, $A\flat_3$, $B\flat_3$, C_4, $D\flat_4$, $E\flat_4$, F_4 (first position); $E\flat_4$, F_4, G_4, $A\flat_4$, $B\flat_4$, C_5, $D\flat_5$, $E\flat_5$, F_5 (second position); and $E\flat_5$, F_5, G_5, $A\flat_5$, $B\flat_5$, C_6, $D\flat_6$, E_6, F_6 (third position). The 'position' is in reference to each of the instrument's three courses of strings. The instrument's design consisting of eighteen quadruple set of strings, with the division via movable bridges of the second set of nine strings generating the second and third courses (two individual pitches generally tuned octaves apart), to produce twenty-seven pitches in total. The *santūrist* generally commencing with the tuning of the first front string, which then becomes the basis for the generation of unison intervallic relationships (removing beating as much as possible) with the other three strings of each set. An interesting point of note is that although the primary structure of *dastgāh-e segāh* can be essentially stated to be heptatonic, in performance practice the scale is expanded into a three-octave scale with dissimilar tetrachords. Some points of interest include the low brass string tuned to C♮; the A's in the first two octaves tuned to A♭, while in the third, tuned to A♭; E♭ and E♭ alternatives provided in two octaves; and the duplication of F pitches in the second and third octaves. The design of the instrument – providing a total of nine strings per octave, with two strings, E and F, tunable to either E♮, E♭ or E♭; and F♮ or F♯ respectively – allowing for the performance of heptatonic scales (inclusive of their auxiliary pitches) from the complete Persian modal system.

Spectrum Analysis Results

The following three tables (tuning no. 1, 2, and 3 of the *santūr* for *dastgāh-e segāh* [on F]) present the spectrum analysis results collected on three separate occasions (with a periodicity of 3-6 months) for each of the twenty-seven sets of strings, and therefore denotes all data for string set, pitch, order, frequency (Hz), ratio (decimal), and cents. The calculation of frequency represents prime (not normalized) data, and therefore ratio and cents are the only two comparative frames of reference. Ratios have been calculated from the relationship of frequencies to the base pitch of the second position C_5 (526.350Hz, 526.400Hz, and 523.730Hz respectively for each of the three tunings), while cents are a derivative of ratio data. An analysis of simultaneous sonorities based on the tuning process for the three tunings reveal octaves with a mean value of 1201.019 cents, a range between 1181.941 and 1218.810 cents, and a standard deviation of 7.771183; perfect fifths with a mean value of 706.894 cents, a range between 694.718 and 716.381 cents, and a standard deviation of 6.537279; perfect fourths with a mean value of 497.436 cents, a range between 483.049 and 514.208 cents, and a standard deviation of 7.640715; tempered perfect fourths with a mean value of 501.373 cents, a range between 488.349 and 518.700 cents, and a standard deviation of 8.744854; and neutral thirds with a mean value of 350.057 cents, a range between 338.758 and 355.954 cents, and a standard deviation of 6.396299. The fourth table presents an 'analysis of variance' with regards to the three tunings, and therefore provides a platform for the evaluation of the tuning of the seventy-two strings of the *santūr* for *dastgāh-e segāh* (on F) utilizing average and standard deviation criterion. In this case standard deviation has been derived from cents data, and frequencies normalized to A=440Hz, although in direct relation to ratio data, which has been obtained via the mathematical equation of $1200 \div \text{cents} \times \sqrt[24]{2} = \text{ratio}$.

Tuning of the Santūr for Dastgāh-e Segāh (on F) – Tuning no. 1

1st position

STRING SET	NOTE	ORDER	FREQUENCY (HERTZ)	RATIO (DECIMAL)	CENTS
01	C_3	3 (I-iii)	130.830	1.988487	1190.005
02	F_3	6 (II-ii)	174.990	1.329838	493.500
03	G_3	12 (III-ii)	196.480	1.493151	694.032
04	$A\flat_3$	18 (V-ii)	213.800	1.624774	840.287
05	$B\flat_3$	15 (IV-ii)	232.060	1.763541	982.171
06	C_4	2 (I-ii)	261.390	1.986435	1188.218
07	$D\flat_4$	20 (VI-ii)	286.780	1.089693	148.706
08	$E\flat_4$	23 (VII-ii)	310.080	1.178227	283.942
09	F_4	10 (II-vi)	351.200	1.334473	499.524

2nd position

STRING SET	NOTE	ORDER	FREQUENCY (HERTZ)	RATIO (DECIMAL)	CENTS
10	$E\flat_4$	25 (VIII-i)	322.540	1.225572	352.147
11	F_4	5 (II-i)	350.090	1.330256	494.044
12	G_4	11 (III-i)	394.970	1.500788	702.865
13	$A\flat_4$	17 (V-i)	429.610	1.632412	848.406
14	$B\flat_4$	14 (IV-i)	465.950	1.770495	988.983
15	C_5	1 (I-i)	526.350	1.000000	0.000
16	$D\flat_5$	19 (VI-i)	578.200	1.098509	162.655
17	$E\flat_5$	22 (VII-i)	620.720	1.179291	285.504
18	F_5	8 (II-iv)	703.100	1.335803	501.249

3rd position

STRING SET	NOTE	ORDER	FREQUENCY (HERTZ)	RATIO (DECIMAL)	CENTS
19	$E\flat_5$	26 (VIII-ii)	645.220	1.225838	352.522
20	F_5	7 (II-iii)	697.240	1.324670	486.759
21	G_5	13 (III-iii)	788.260	1.497597	699.179
22	$A\flat_5$	27 (IX-i)	827.400	1.571958	783.075
23	$B\flat_5$	16 (IV-iii)	930.310	1.767474	986.027
24	C_6	4 (I-iv)	1049.300	1.993540	1194.399
25	$D\flat_6$	21 (VI-iii)	1144.400	1.087109	144.596
26	$E\flat_6$	24 (VII-iii)	1246.000	1.183623	291.852
27	F_6	9 (II-v)	1406.200	1.335803	501.249

Tuning of the Santūr for Dastgāh-e Segāh (on F) – Tuning no. 2

1st position

STRING SET	NOTE	ORDER	FREQUENCY (HERTZ)	RATIO (DECIMAL)	CENTS
01	C_3	3 (I-iii)	130.790	1.987690	1189.311
02	F_3	6 (II-ii)	174.260	1.324164	486.098
03	G_3	12 (III-ii)	197.400	1.500000	701.955
04	$A\flat_3$	18 (V-ii)	213.740	1.624164	839.637
05	$B\flat_3$	15 (IV-ii)	231.990	1.762842	981.484
06	C_4	2 (I-ii)	260.930	1.982751	1185.004
07	$D\flat_4$	20 (VI-ii)	286.690	1.089248	147.999
08	$E\flat_4$	23 (VII-ii)	310.050	1.178002	283.610
09	F_4	10 (II-vi)	351.170	1.334233	499.212

2nd position

STRING SET	NOTE	ORDER	FREQUENCY (HERTZ)	RATIO (DECIMAL)	CENTS
10	$E\flat_4$	25 (VIII-i)	322.490	1.225266	351.714
11	F_4	5 (II-i)	348.840	1.325380	487.687
12	G_4	11 (III-i)	394.670	1.499506	701.385
13	$A\flat_4$	17 (V-i)	428.470	1.627926	843.642
14	$B\flat_4$	14 (IV-i)	465.940	1.770289	988.782
15	C_5	1 (I-i)	526.400	1.000000	0.000
16	$D\flat_5$	19 (VI-i)	578.150	1.098309	162.341
17	$E\flat_5$	22 (VII-i)	620.620	1.178989	285.061
18	F_5	8 (II-iv)	703.090	1.335657	501.060

3rd position

STRING SET	NOTE	ORDER	FREQUENCY (HERTZ)	RATIO (DECIMAL)	CENTS
19	$E\flat_5$	26 (VIII-ii)	645.160	1.225608	352.197
20	F_5	7 (II-iii)	697.280	1.324620	486.694
21	G_5	13 (III-iii)	788.220	1.497378	698.927
22	$A\flat_5$	27 (IX-i)	829.380	1.575570	787.049
23	$B\flat_5$	16 (IV-iii)	930.230	1.767154	985.714
24	C_6	4 (I-iv)	1048.700	1.992211	1193.245
25	$D\flat_6$	21 (VI-iii)	1144.200	1.086816	144.129
26	$E\flat_6$	24 (VII-iii)	1254.800	1.191869	303.871
27	F_6	9 (II-v)	1406.000	1.335486	500.838

Tuning of the Santūr for Dastgāh-e Segāh (on F) – Tuning no. 3

1st position

STRING SET	NOTE	ORDER	FREQUENCY (HERTZ)	RATIO (DECIMAL)	CENTS
01	C_3	3 (I-iii)	131.160	1.001738	3.005
02	F_3	6 (II-ii)	174.570	1.333282	497.979
03	G_3	12 (III-ii)	197.130	1.505585	708.389
04	$A\flat_3$	18 (V-ii)	212.300	1.621446	836.737
05	$B\flat_3$	15 (IV-ii)	231.460	1.767781	986.328
06	C_4	2 (I-ii)	262.250	1.001470	2.543
07	$D\flat_4$	20 (VI-ii)	285.400	1.089875	148.995
08	$E\flat_4$	23 (VII-ii)	311.140	1.188169	298.489
09	F_4	10 (II-vi)	346.900	1.336185	501.743

2nd position

STRING SET	NOTE	ORDER	FREQUENCY (HERTZ)	RATIO (DECIMAL)	CENTS
10	$E\flat_4$	25 (VIII-i)	320.500	1.223913	349.801
11	F_4	5 (II-i)	348.970	1.332633	497.136
12	G_4	11 (III-i)	394.930	1.508144	711.328
13	$A\flat_4$	17 (V-i)	427.390	1.632101	848.076
14	$B\flat_4$	14 (IV-i)	462.800	1.767323	985.879
15	C_5	1 (I-i)	523.730	1.000000	0.000
16	$D\flat_5$	19 (VI-i)	569.000	1.086438	143.526
17	$E\flat_5$	22 (VII-i)	617.650	1.179329	285.560
18	F_5	8 (II-iv)	698.550	1.333798	498.648

3rd position

STRING SET	NOTE	ORDER	FREQUENCY (HERTZ)	RATIO (DECIMAL)	CENTS
19	$E\flat_5$	26 (VIII-ii)	638.520	1.219178	343.090
20	F_5	7 (II-iii)	695.250	1.327497	490.450
21	G_5	13 (III-iii)	791.640	1.511542	715.226
22	$A\flat_5$	27 (IX-i)	824.560	1.574399	785.761
23	$B\flat_5$	16 (IV-iii)	925.770	1.767647	986.197
24	C_6	4 (I-iv)	1051.000	1.003380	5.84102
25	$D\flat_6$	21 (VI-iii)	1141.700	1.089970	149.146
26	$E\flat_6$	24 (VII-iii)	1242.500	1.186203	295.621
27	F_6	9 (II-v)	1396.800	1.333512	498.276

Tuning of the Santūr for Dastgāh-e Segāh (on F) – Analysis of Variance

1st position

STRING SET	NOTE	FREQUENCY (HERTZ)	RATIO (DECIMAL)	AVERAGE (CENTS)	STANDARD DEVIATION
01	C_3	130.368	1.993204	1194.107	7.713846
02	F_3	173.862	1.329089	492.526	5.999891
03	G_3	196.163	1.499570	701.459	7.191309
04	$A\flat_3$	212.369	1.623461	838.887	1.889998
05	$B\flat_3$	230.848	1.764720	983.327	2.620925
06	C_4	260.408	1.990689	1191.922	9.337949
07	$D\flat_4$	285.069	1.089605	148.566	0.512523
08	$E\flat_4$	309.099	1.181457	288.680	8.496235
09	F_4	349.261	1.334963	500.160	1.380069

2nd position

STRING SET	NOTE	FREQUENCY (HERTZ)	RATIO (DECIMAL)	AVERAGE (CENTS)	STANDARD DEVIATION
10	$E\flat_4$	320.470	1.224917	351.221	1.248094
11	F_4	347.810	1.329419	492.956	4.817387
12	G_4	393.173	1.502808	705.193	5.365009
13	$A\flat_4$	426.662	1.630811	846.708	2.660578
14	$B\flat_4$	462.912	1.769368	987.881	1.737114
15	C_5	523.251	1.000000	0.000	0.000000
16	$D\flat_5$	572.642	1.094404	156.174	10.954514
17	$E\flat_5$	617.019	1.179203	285.375	0.273364
18	F_5	698.585	1.335086	500.319	1.450061

3rd position

STRING SET	NOTE	FREQUENCY (HERTZ)	RATIO (DECIMAL)	AVERAGE (CENTS)	STANDARD DEVIATION
19	$E\flat_5$	640.217	1.223537	349.270	5.354195
20	F_5	693.619	1.325595	487.968	2.149959
21	G_5	786.006	1.502158	704.444	9.338180
22	$A\flat_5$	823.584	1.573975	785.295	2.027411
23	$B\flat_5$	924.807	1.767425	985.979	0.245081
24	C_6	1048.400	1.001813	1197.828	6.963106
25	$D\flat_6$	1138.557	1.087964	145.957	2.771441
26	$E\flat_6$	1242.435	1.187227	297.115	6.147445
27	F_6	1397.011	1.334933	500.121	1.610794

Utilizing the mean ratios from the 'analysis of variance' data, and considering solely the base pitch of second position C_5, as well as all primary derivative pitches (second position F_4, G_4, $B♭_4$, $A♭_4$, $D♭_5$, $E♭_5$, $E♭_4$, and third position $A♭_5$), it is possible to arrive at the 'tuning characteristics' personified by the three tunings, and therefore what may be stated as being a 'performance practice' tuning obtained via the intervallic analysis of Persian performer Qmars Piraglu's instrument, which was tuned to *dastgāh-e segāh* by ear, and therefore not artificially influenced by tuning devices in order to adhere to strict theoretical schemes. Piraglu's tuning methodology involving the obtaining of a fundamental C note calibrated approximately to A=440Hz, which would then serve as the reference for the generation of all required perfect fifths and fourths, as well as tempered fourths, with problem intervals such as A *koron* and A flat left to the discretion of the ear and the perceived musicality of performed extracts from associated *gušes* (individual pieces which make up the repertoire of a particular *dastgāh*).

Dastgāh-e Segāh (on F) – Tuning Characteristics

Relative Pitch: A4 = 440Hz/C4 (Middle C) = 261.6255654Hz

DEGREE NUMBER	NOTE	APPROXIMATE INTERVAL	FREQUENCY (HERTZ)	RATIO (DECIMAL)	AVERAGE (CENTS)
01	C_4	unison	261.626	1.000000	0.000
02	D_4	just major tone (9th harmonic)	295.748	1.130424	212.237
03	$E♭_4$	Pythagorean minor third, or trihemitone	309.753	1.183957	292.339
04	$E♭_4$	neutral third	320.939	1.226709	353.752
05	F_4	just and Pythagorean perfect fourth	348.206	1.330933	494.926
06	G_4	just and Pythagorean perfect fifth (3rd harmonic)	393.594	1.504416	707.044
07	$A♭_4$	grave or small major sixth	430.750	1.646439	863.219
08	$B♭_4$	Pythagorean minor seventh	464.127	1.774012	992.419
09	$B♭_4$	grave or small major seventh	482.120	1.842785	1058.265
01	C_5	octave	523.251	2.000000	1200.000

The abovementioned process consequentially producing intervals approximating the just major tone (9/8), Pythagorean minor third, or trihemitone (32/27), neutral third (11/9), just perfect fourth (4/3), just perfect fifth (3/2), grave or small major sixth (400/243), Pythagorean minor seventh (16/9), and grave or small major seventh (50/27). The findings proclaiming the obvious Pythagorean connection with the resulting 'mean' measurements for the major second (equal to 212.237 cents, with a range between and 208.821 and 214.193 cents, and a standard deviation of 2.968984); minor third (equal to 292.339 cents, with a range between 288.626

and 299.361 cents, and a standard deviation of 6.084603); perfect fourth (equal to 494.926 cents, with a range between 488.743 and 501.094 cents, and a standard deviation of 6.175730); perfect fifth (equal to 707.044 cents, with a range between 702.864 and 712.313 cents, and a standard deviation of 4.817387); and minor seventh (equal to 992.419 cents, with a range between 988.424 and 997.374 cents, and a standard deviation of 4.551339). The research interestingly also suggesting a distinction between the neutral orientation of microtonal inflections such as E𝄲$_4$ (equal to 353.752 cents, with a range between 350.940 and 355.954 cents, and a standard deviation of 2.562172); A𝄲$_5$ (equal to 863.219 cents, with a range between 846.391 and 874.654 cents, and a standard deviation of 14.883326); and B𝄲$_4$ (equal to 1058.265 cents, with a range between 1052.666 and 1064.027 cents, and a standard deviation of 5.682304); which reveal a 'grave or small major' intervallic orientation.

A tuning system comparison table incorporating data from the twenty-four equally-tempered quarter-tone scale of Vaziri, twenty-two-note scale of Barkešli, and the theory of flexible intervals, or of the five primary intervals of performance practice of Farhat, as well as the performance practice tuning of Piraglu reveals a close link between the latter two. Farhat and Piraglu sharing similarities with all intervals (a falsity of +8.237, −1.661, −10.248, −3.074, +5.044, +1.219, −3.581, and −7.735 on each count) but for the neutral third (E𝄲$_4$), which has a closer association with the equally-tempered quarter-tone of Vaziri (a falsity of +3.752, as opposed to −10.248).

Dastgāh-e Segāh (on F) – Tuning System Comparison

DEGREE NUMBER	NOTE	ALI NAQI VAZIRI (CENTS)	MEHDI BARKEŠLI (CENTS)	HORMOZ FARHAT (CENTS)	QMARS PIRAGLU (CENTS)
01	C$_4$	0.000	0.000	0.000	0.000
02	D$_4$	200.000	203.910	204.000	212.237
03	E♭$_4$	300.000	294.135	294.000	292.339
04	E𝄲$_4$	350.000	384.360	364.000	353.752
05	F$_4$	500.000	498.045	498.000	494.926
06	G$_4$	700.000	701.955	702.000	707.044
07	A𝄲$_4$	850.000	882.405	862.000	863.219
08	B♭$_4$	1000.000	996.090	996.000	992.419
09	B𝄲$_4$	1050.000	1086.315	1066.000	1058.265
01	C$_5$	1200.000	1200.000	1200.000	1200.000

Utilizing Farhat's theory of the division of the whole-tone and nomenclature for Persian intervals, it is then possible to conduct an analysis of all minor second (D and E♭), small neutral tone (E𝄭 and F, B𝄭 and C), large neutral tone (D and E𝄭, G and A𝄭), and major second (C and D, E♭ and F, F and G, B♭ and C) intervals encountered within the framework established via the base and primary derivative pitches in the performance practice tuning of Qmars Piraglu, and consequently produce a comparison table outlining range, as well as the average for each interval in the two supportive propositions.

Dastgāh-e Segāh (on F) – Hormoz Farhat's and Qmars Piraglu's Division of the Whole-Tone

DEGREE NUMBER	INTERVAL	HORMOZ FARHAT RANGE (CENTS)	HORMOZ FARHAT AVERAGE (CENTS)	QMARS PIRAGLU RANGE (CENTS)	QMARS PIRAGLU AVERAGE (CENTS)
01	unison	0.000	0.000	0.000	0.000
02	minor second	90.000	90.000	74.433 → 85.664	80.102
03	small neutral tone	125.000 → 145.000	135.000	135.973 → 147.334	141.454
04	large neutral tone	150.000 → 170.000	160.000	136.747 → 162.655	148.845
05	major second	204.000	204.000	200.117 → 214.193	208.631

In conclusion, it must be stated that Farhat's theory of flexible intervals or of the five primary intervals of performance practice certainly holds true in the final analysis, and especially in view of the fact that although general assumptions may be reached with regards to tuning practice, there is no doubt that standard deviation data is so conflicting in some instances (the three tunings producing an overall standard deviation average of 3.258156, with a range between 0.245081 and 10.954514, while octaves between 0.187035 and 13.715187, perfect fifths between 3.980471 and 9.338180, perfect fourths between 1.450061 and 7.960749, tempered fourths between 1.897984 and 12.340378, and neutral thirds between 2.562172 and 7.399249) that the results cannot be stated as being the axiom.

In support of these findings, in *Intervals, Scales and Temperaments: An Introduction to the Study of Musical Intonation* Boyle makes the appropriate observation that "sounds should be pitched according to the dictates of the ear. For this certain notes in the scale must be free to move about a comma (approximately 21.506 cents), which is perfectly possible on all but keyboard instruments." It is further relevant to note that according to foreword contributor Kenneth Van Barthold, in the piano tuning practice of the latter part of the twentieth century, octaves began to be often "stretched for added brilliance," and therefore "theoretically accurate equal temperament" has never existed in piano tuning, with stretched octaves often induced in the highest and lowest octaves. Theoretically accurate octaves or the ratio 2/1 defined in musical acoustics by a "beat-free condition between all the partials of the upper musical tone and the even-numbered partials of the lower tone." Stretched, as well as compressed octaves a common occurrence in Piraglu's tuning of the *santūr*.

Āzādeh

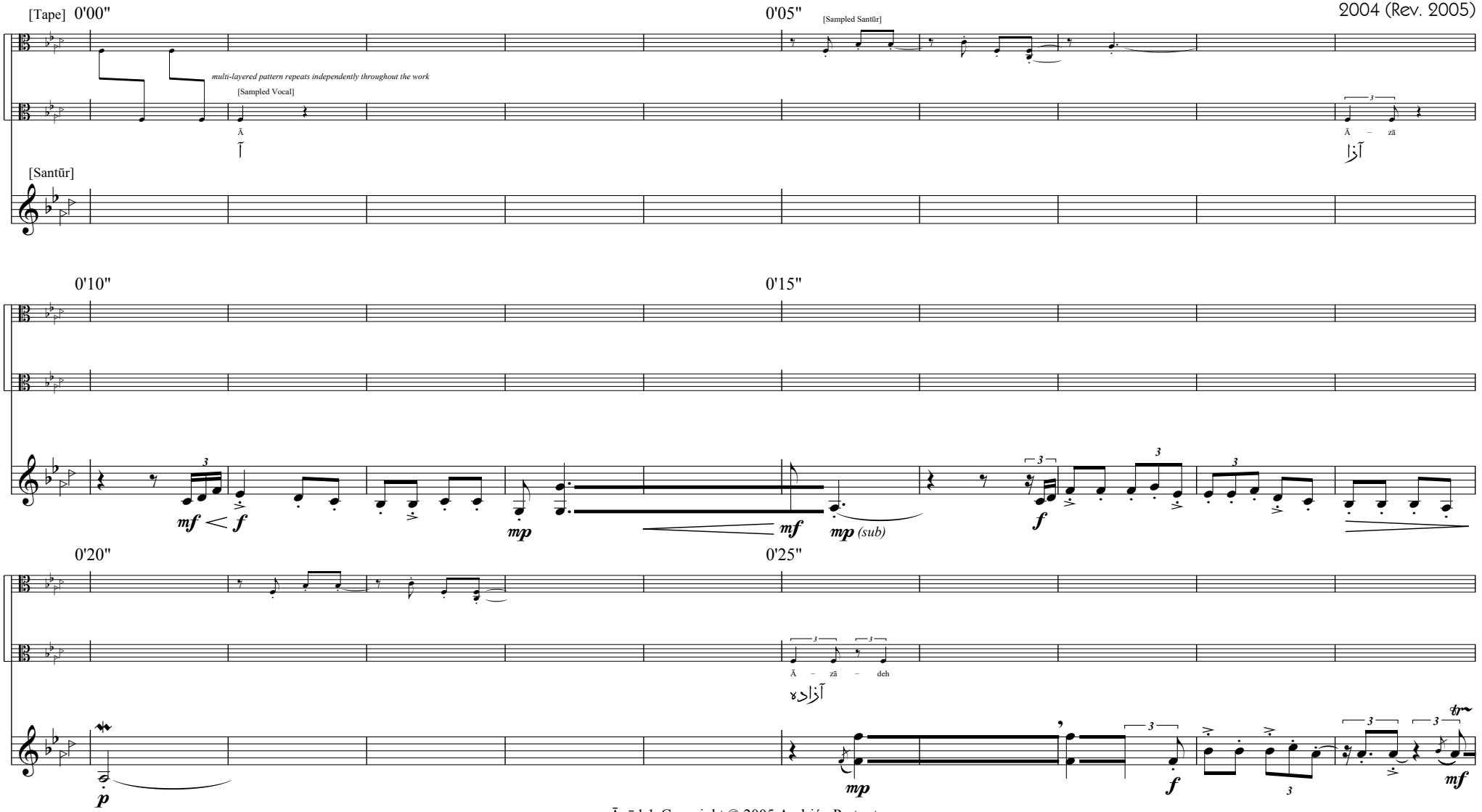
for Santūr and Tape

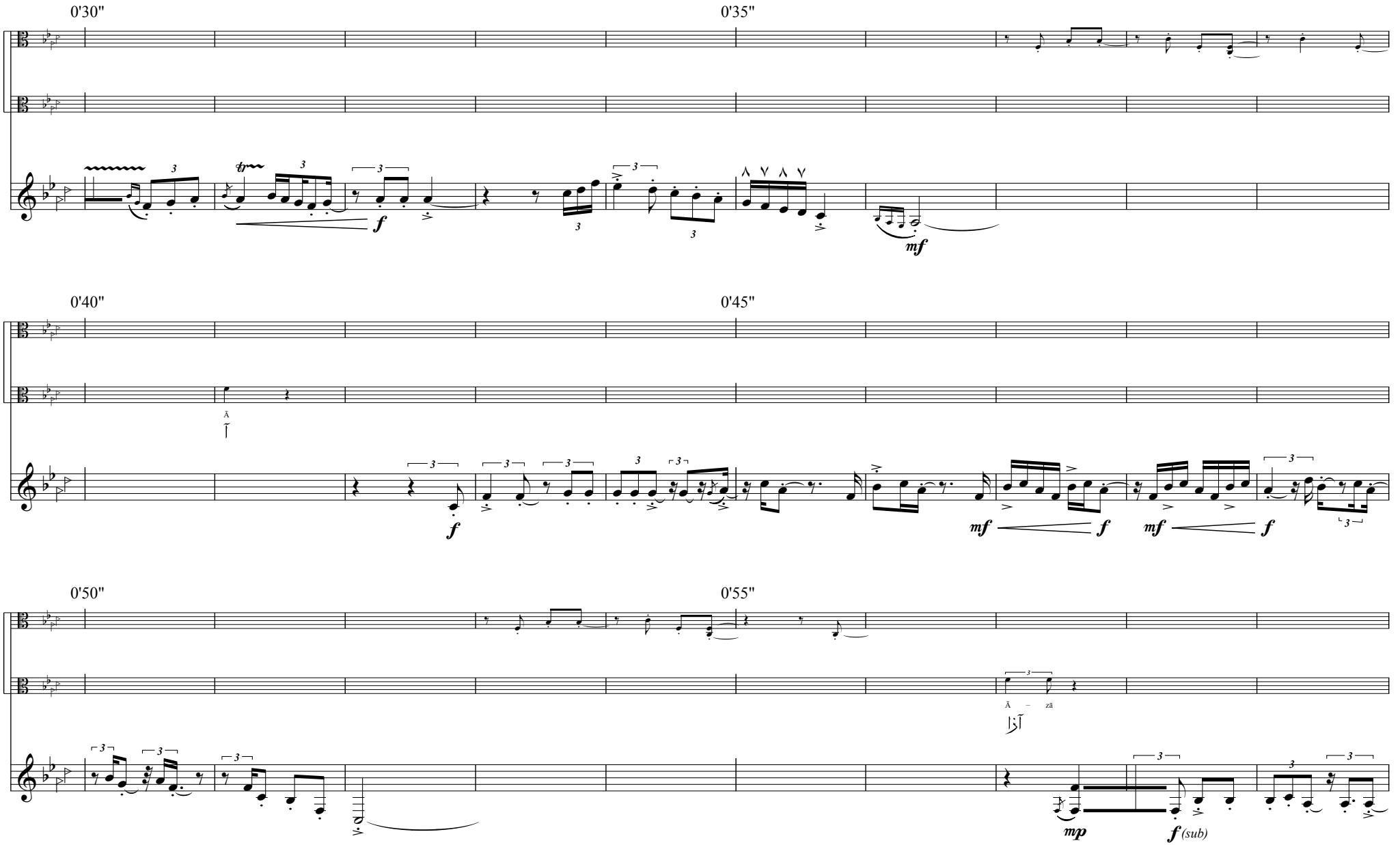
آزاده

Composed for Qmars Piraglu (formerly Siamak Noory)

ساخته شده برای کیومرث پیرگلو (سیامك نوری)

Andrián Pertout, No. 389
2004 (Rev. 2005)

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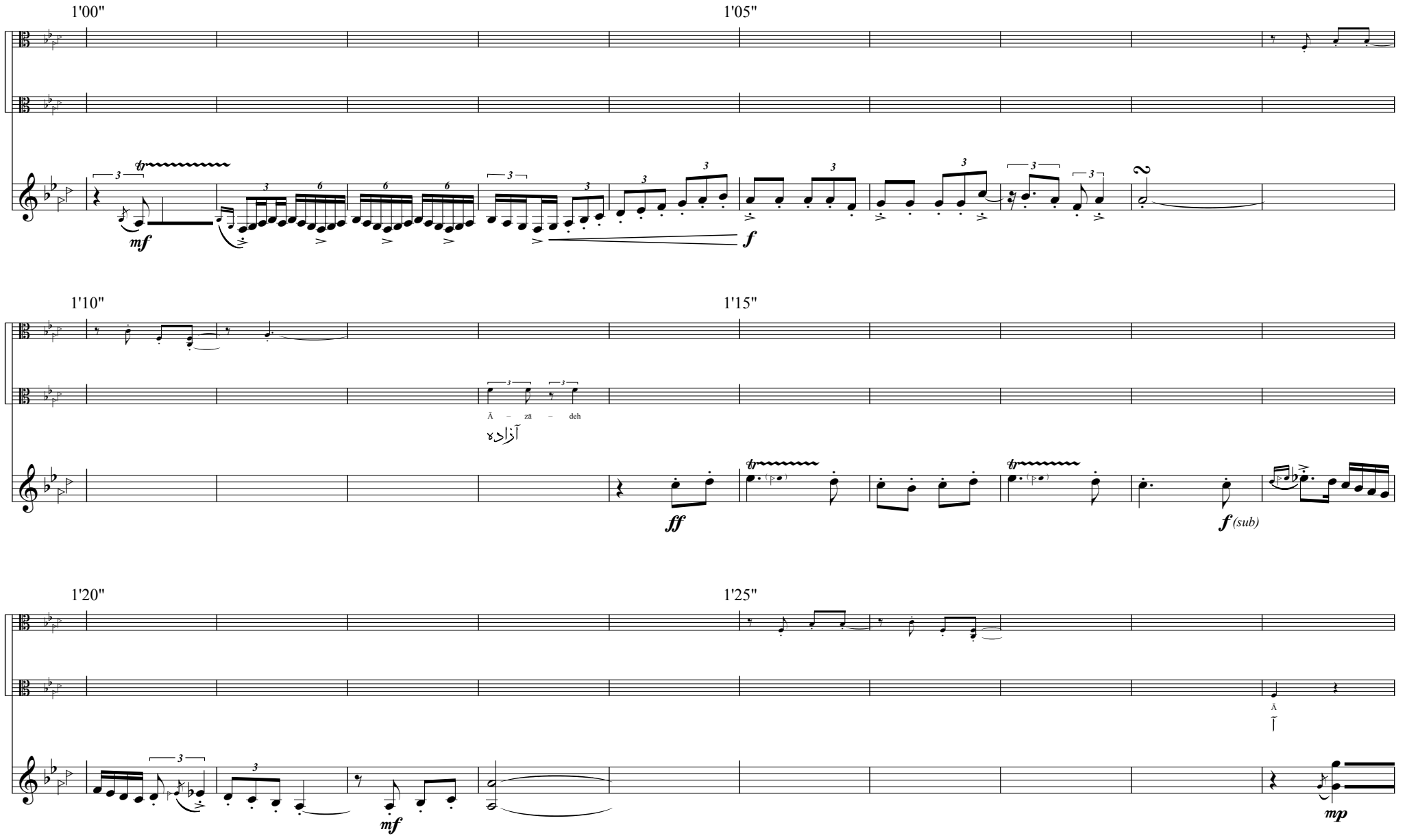
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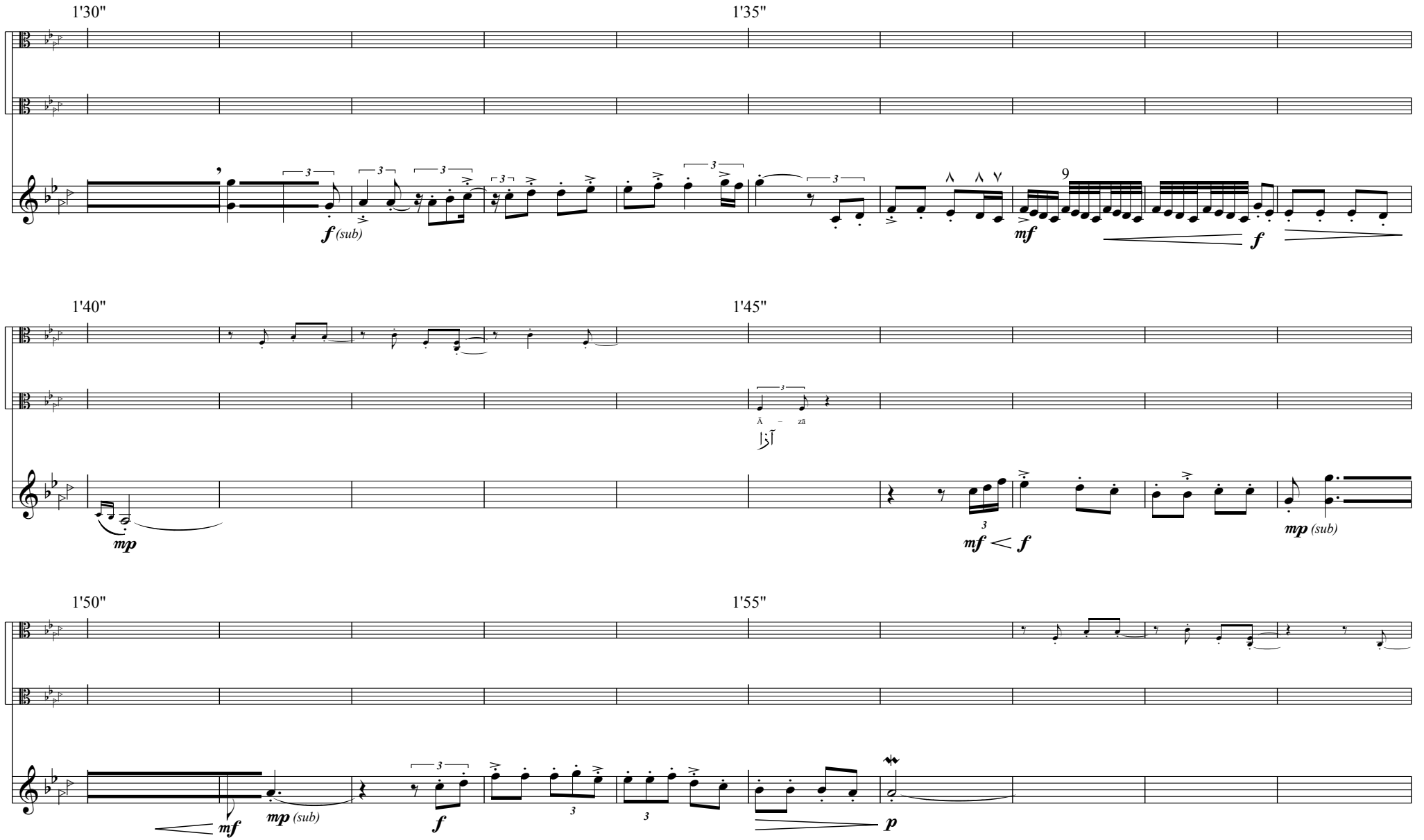
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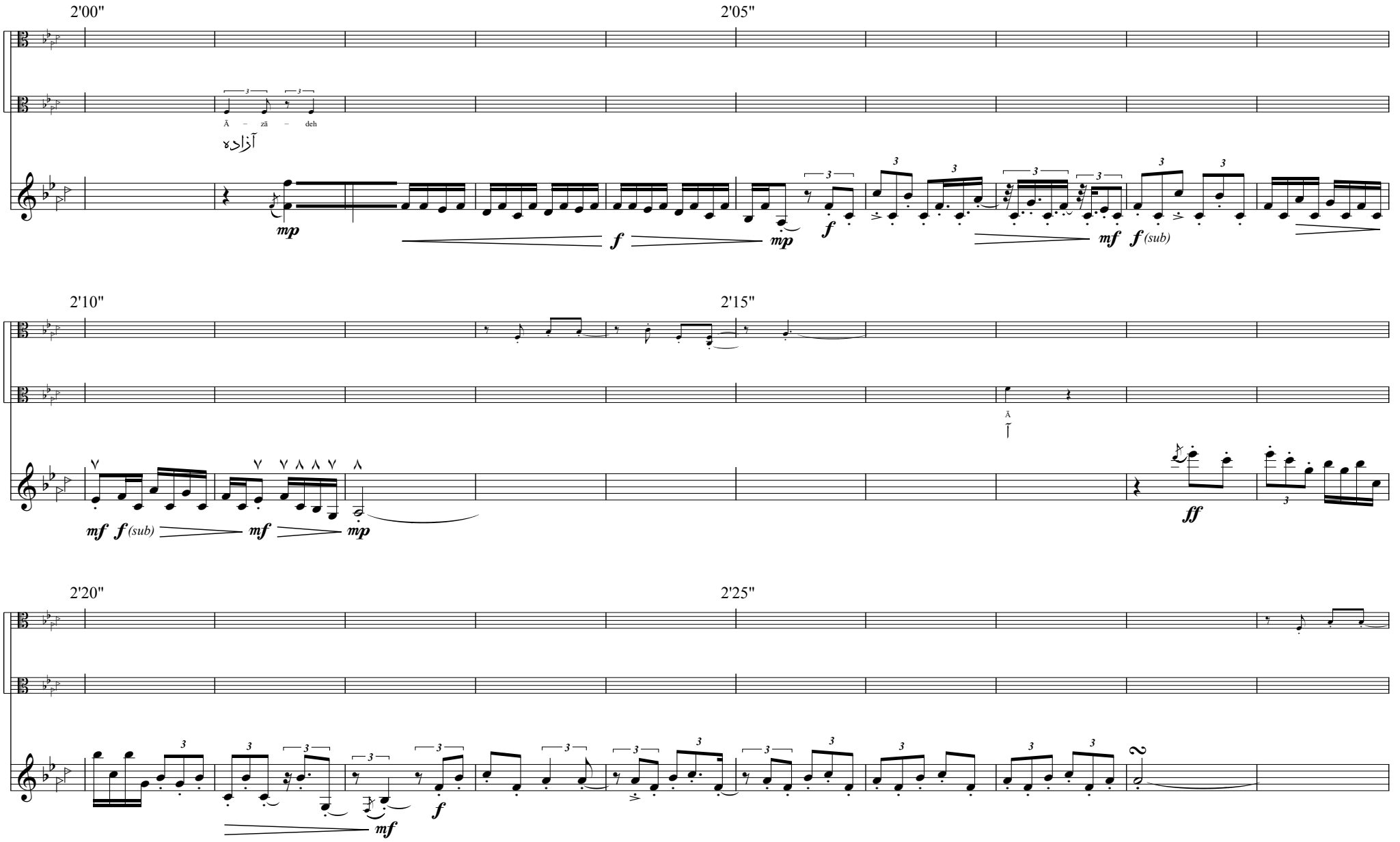
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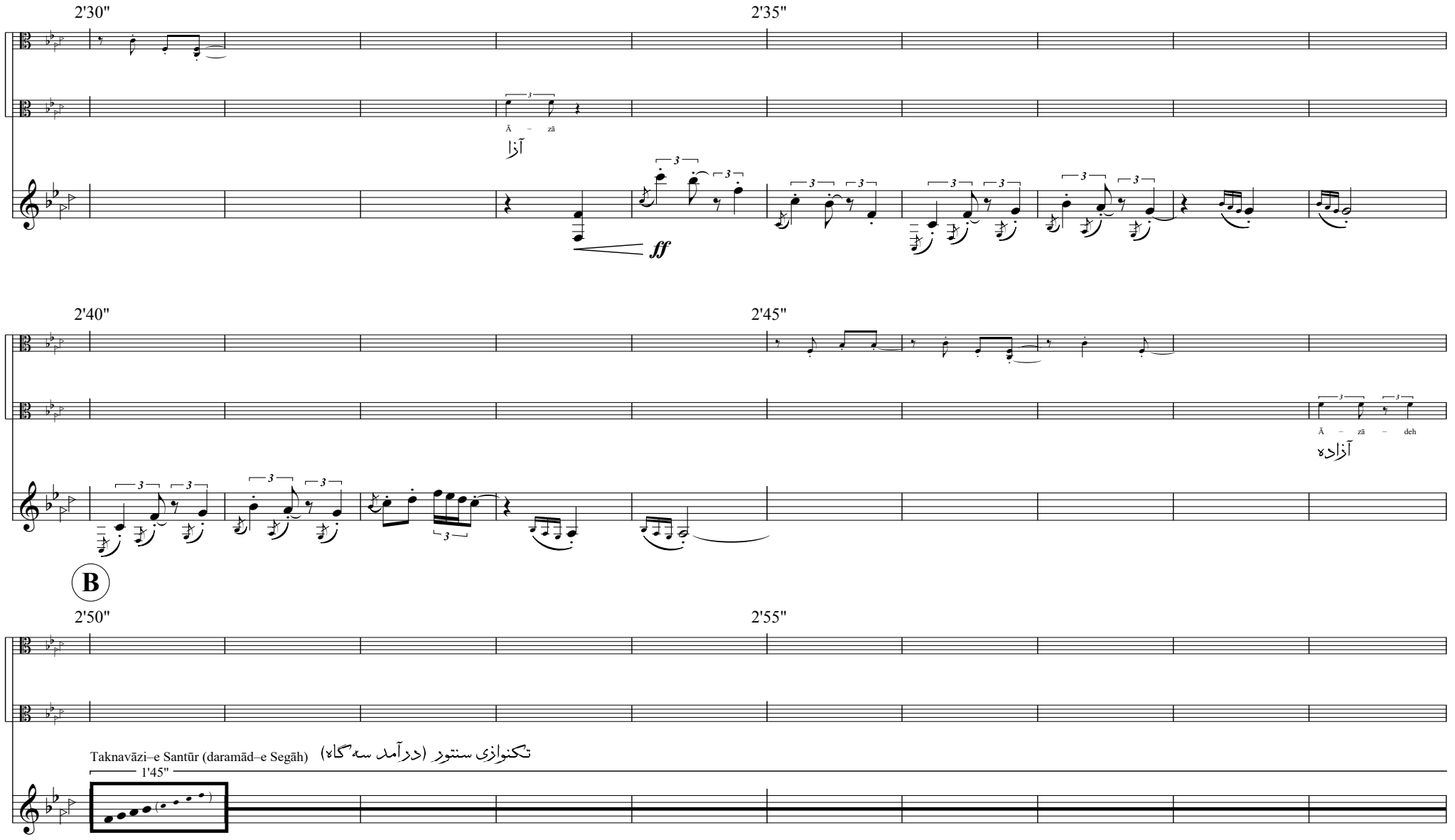
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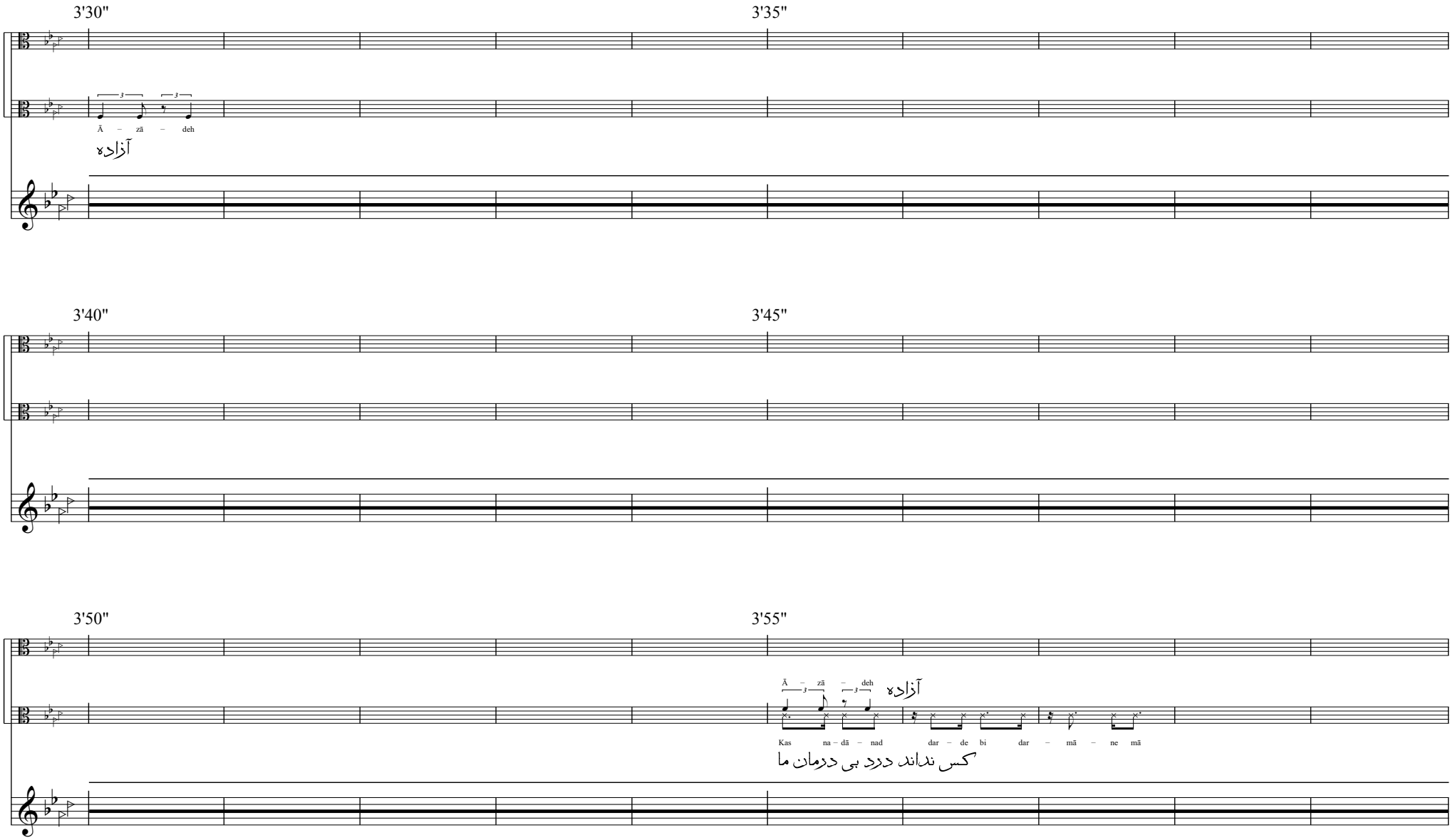
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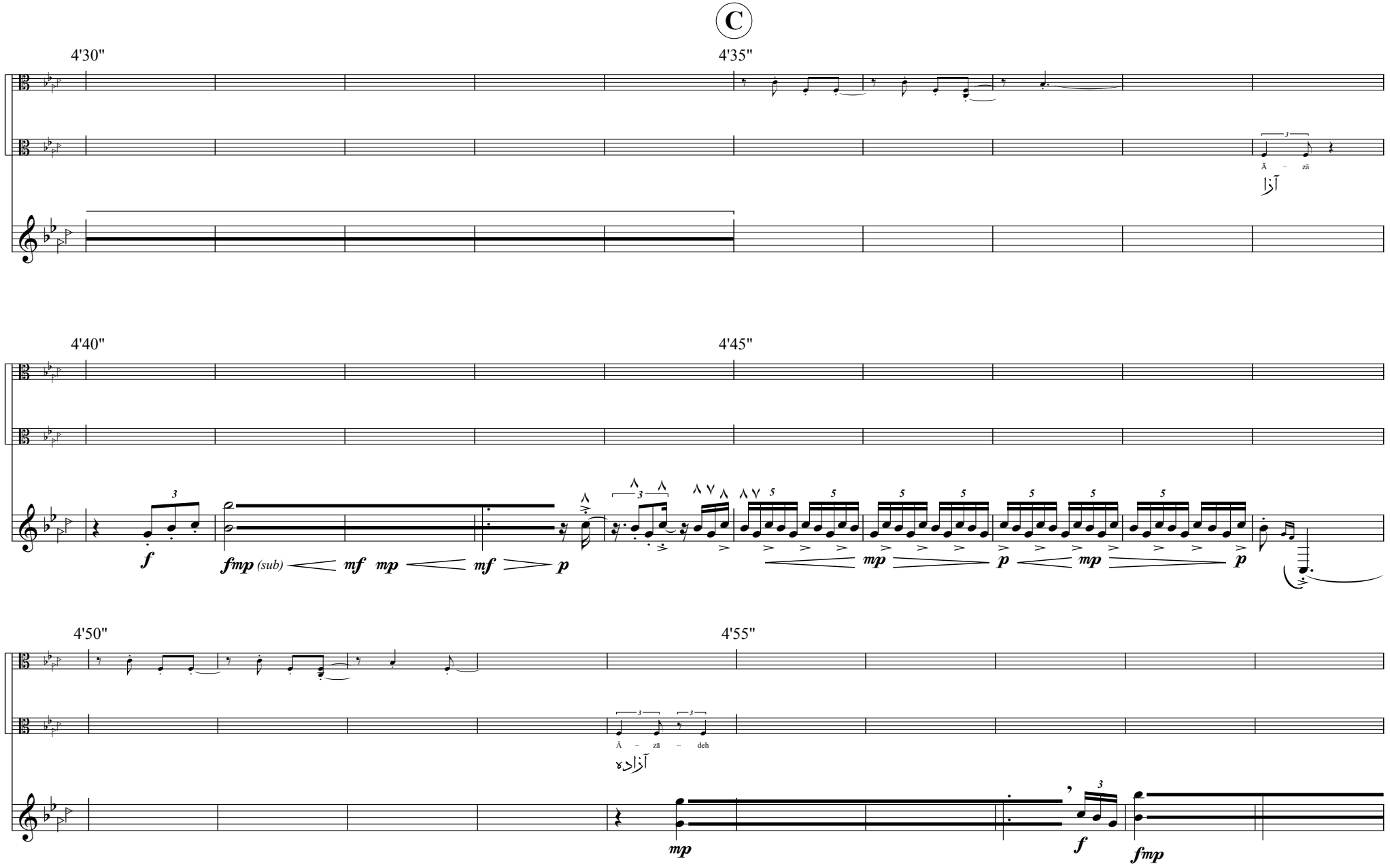
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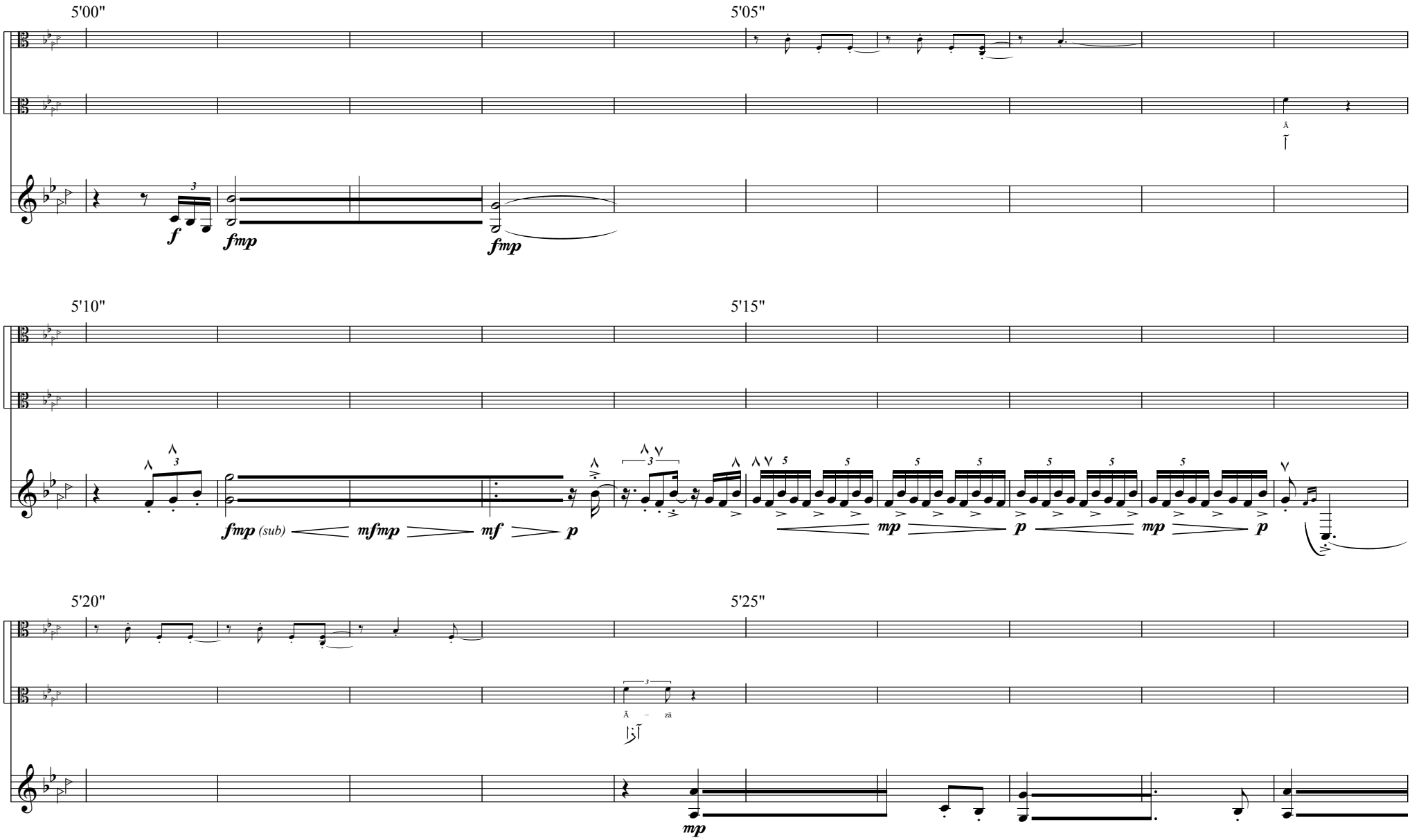
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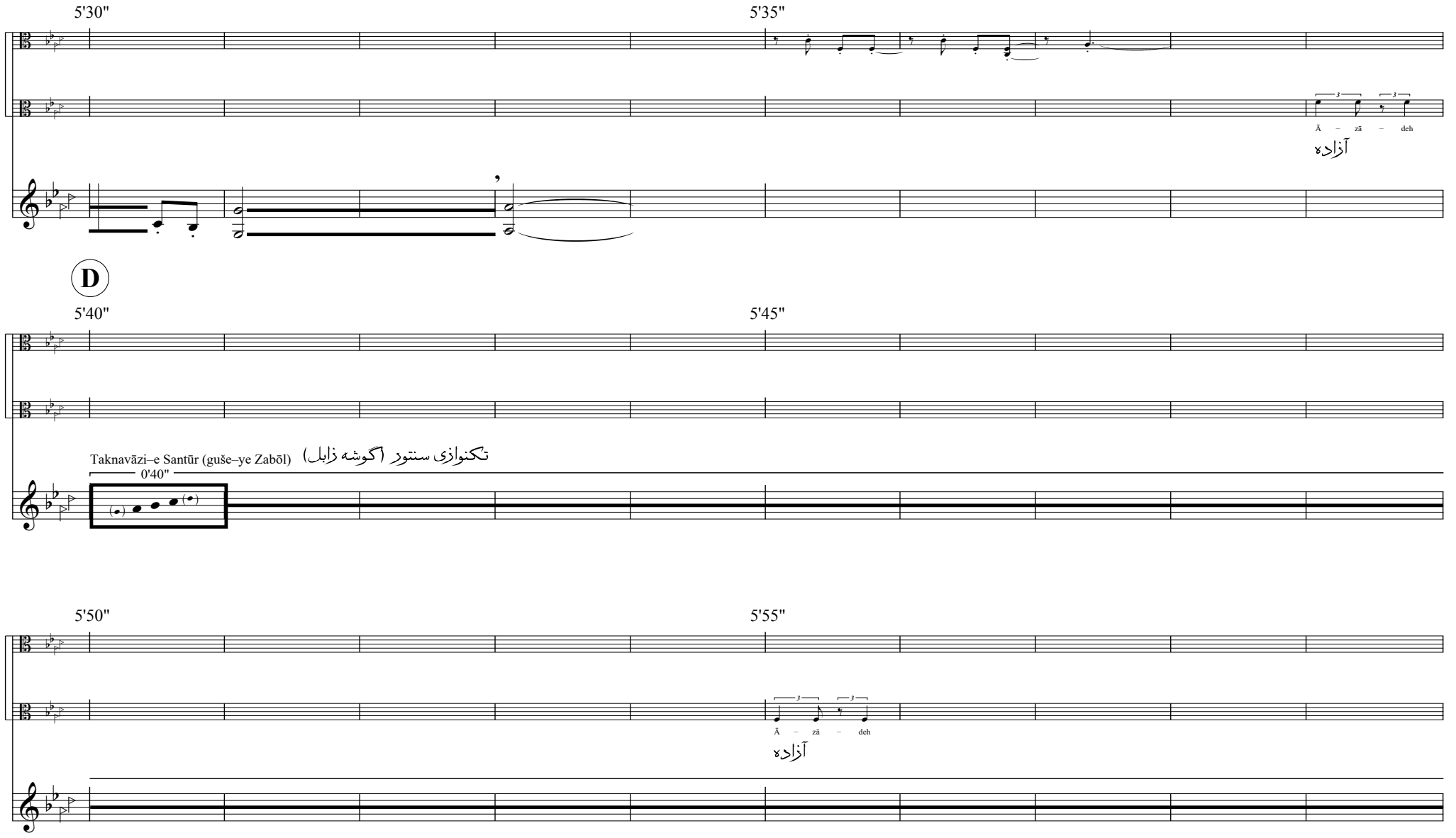
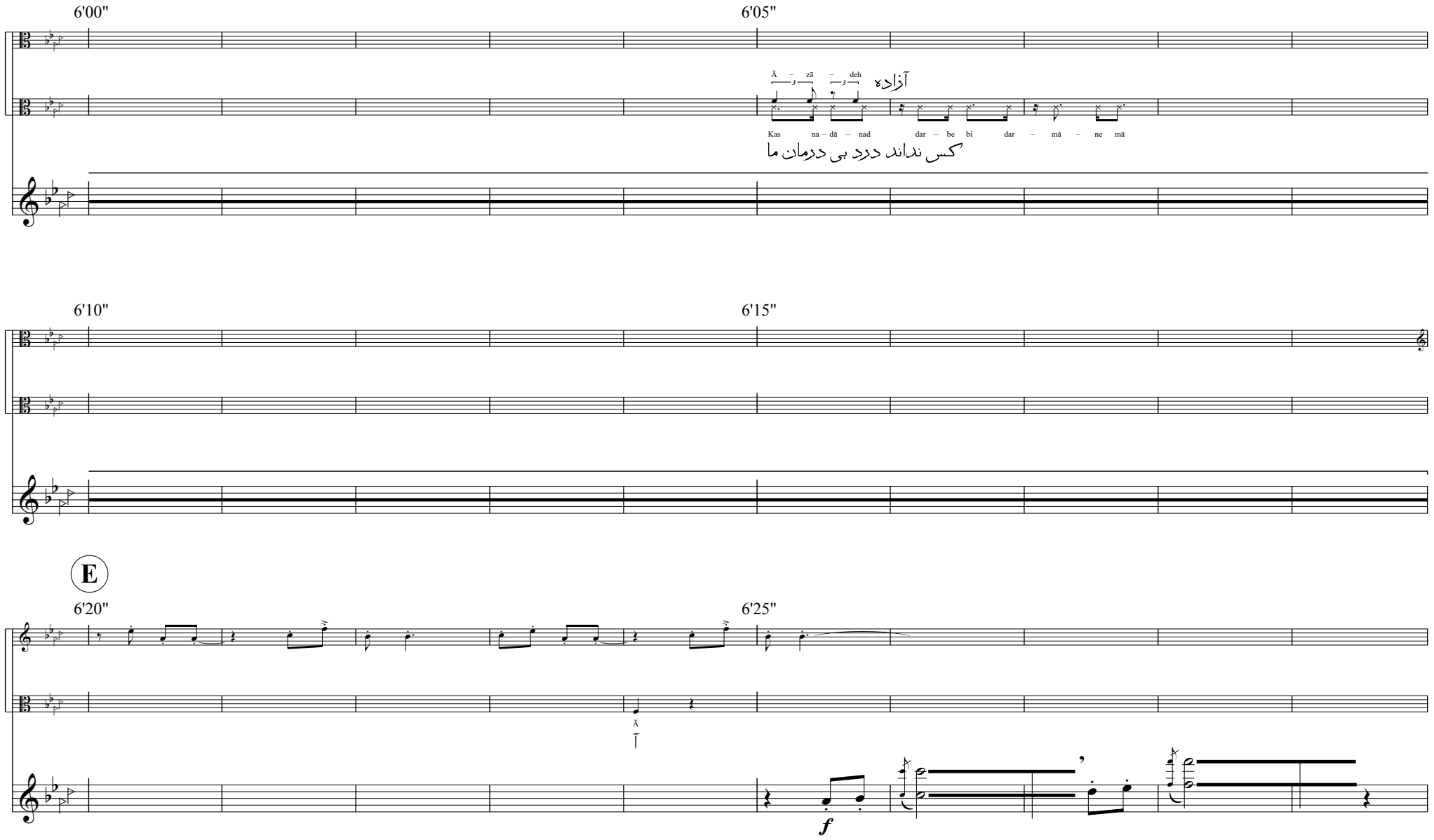
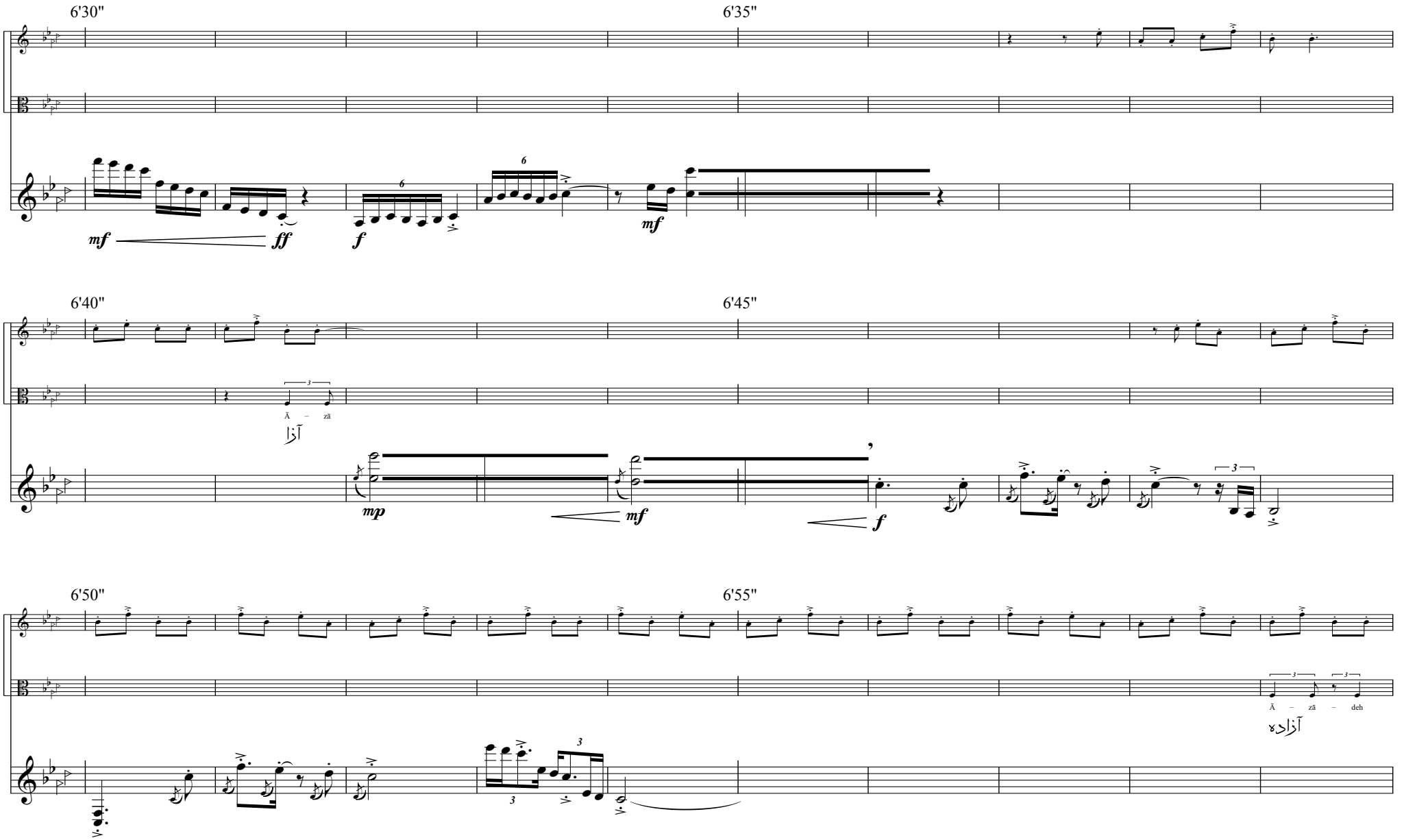
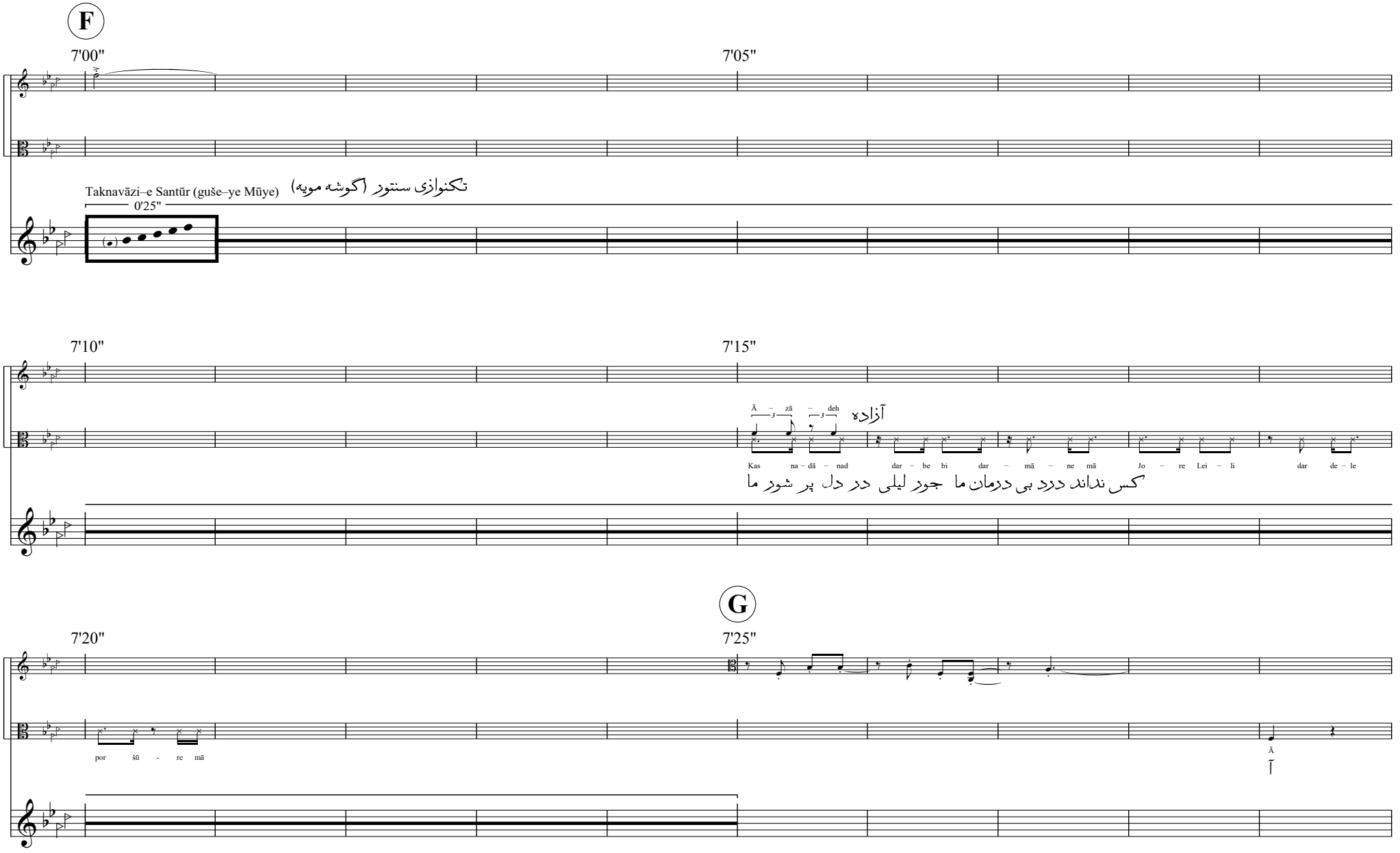
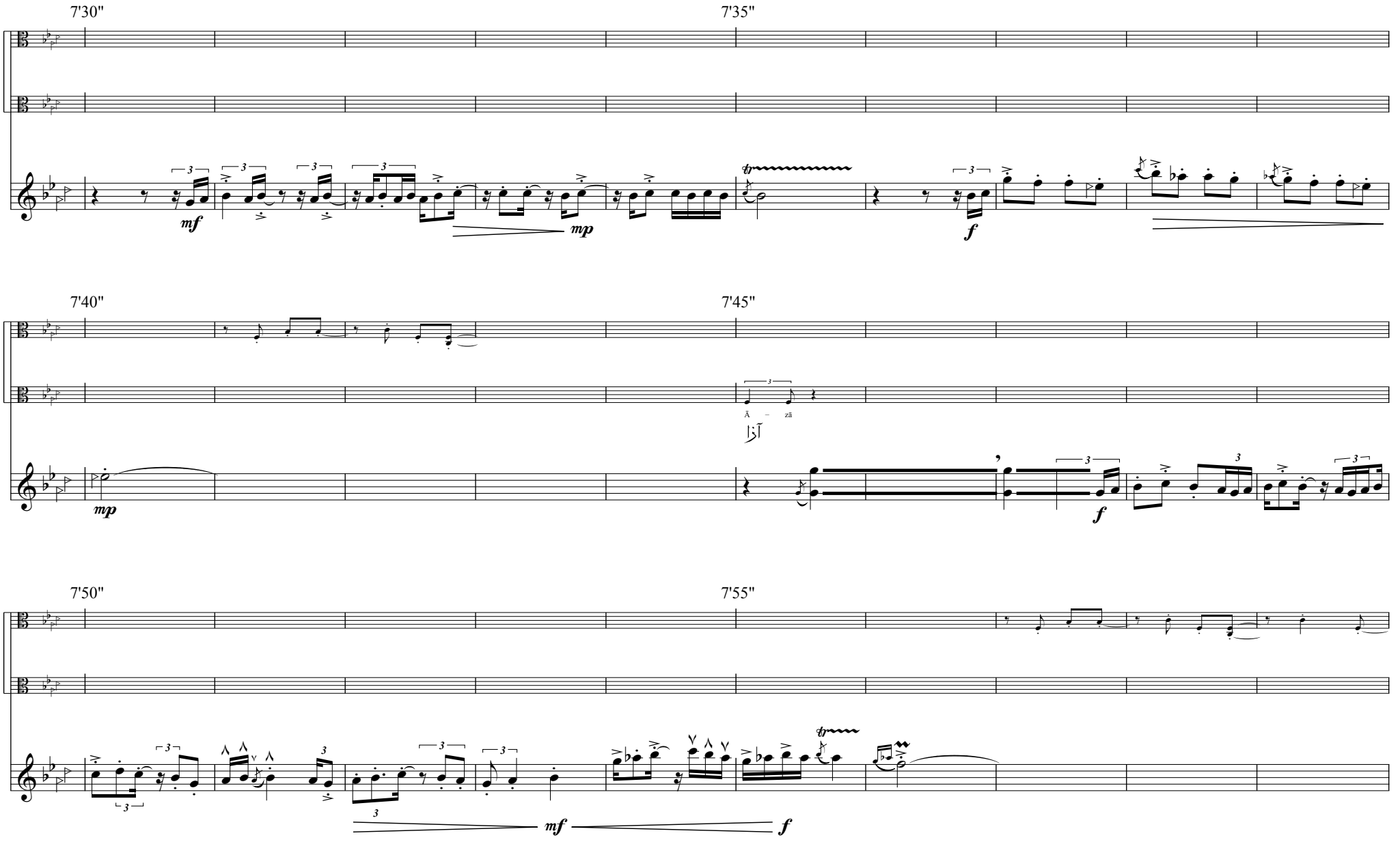
آزا
mp

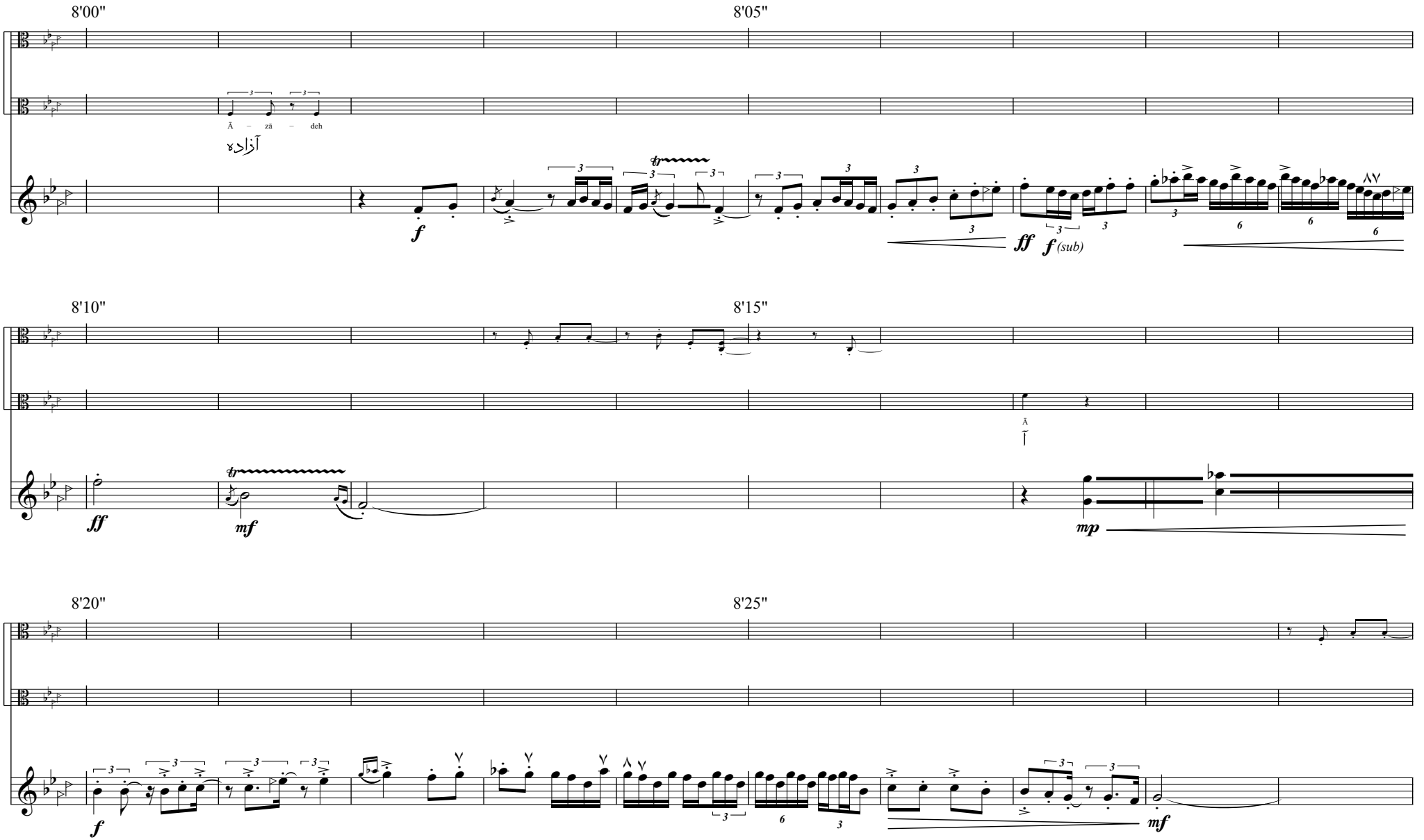

5'30"
5'35"
Ā – zā – deh
آزاده
D
5'40"
5'45"
Taknavāzi–e Santūr (guše–ye Zabōl)
تکنوازی سنتور (گوشه زابل)
0'40"
5'50"
5'55"
Ā – zā – deh
آزاده

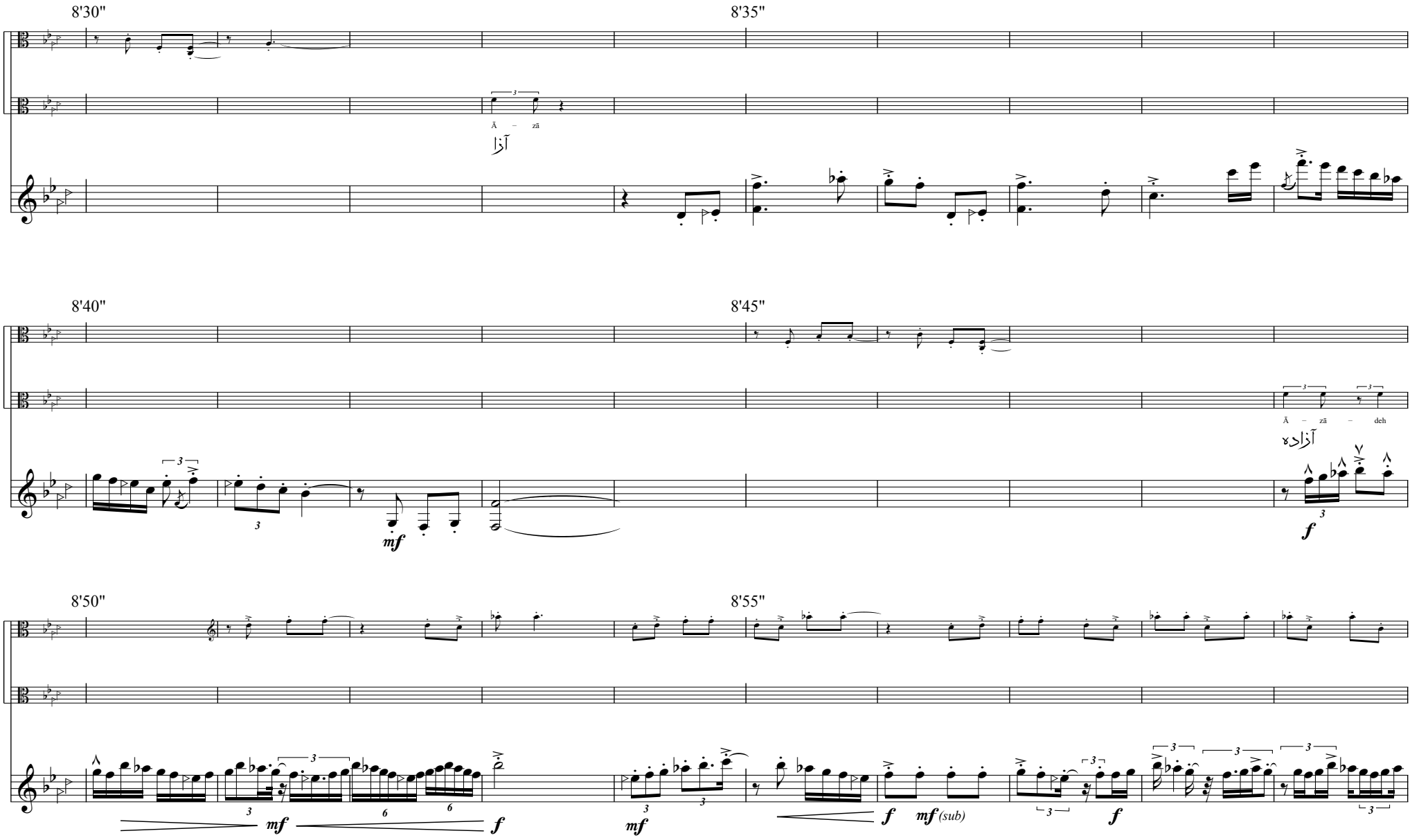

6'00"
6'05"
Ā – zā – deh
آزاده
Kas na – dā – nad dar – be bi dar – mā – ne mā
کس نداند درد بی درمان ما
6'10"
6'15"
E
6'20"
6'25"
Ā
آ
f

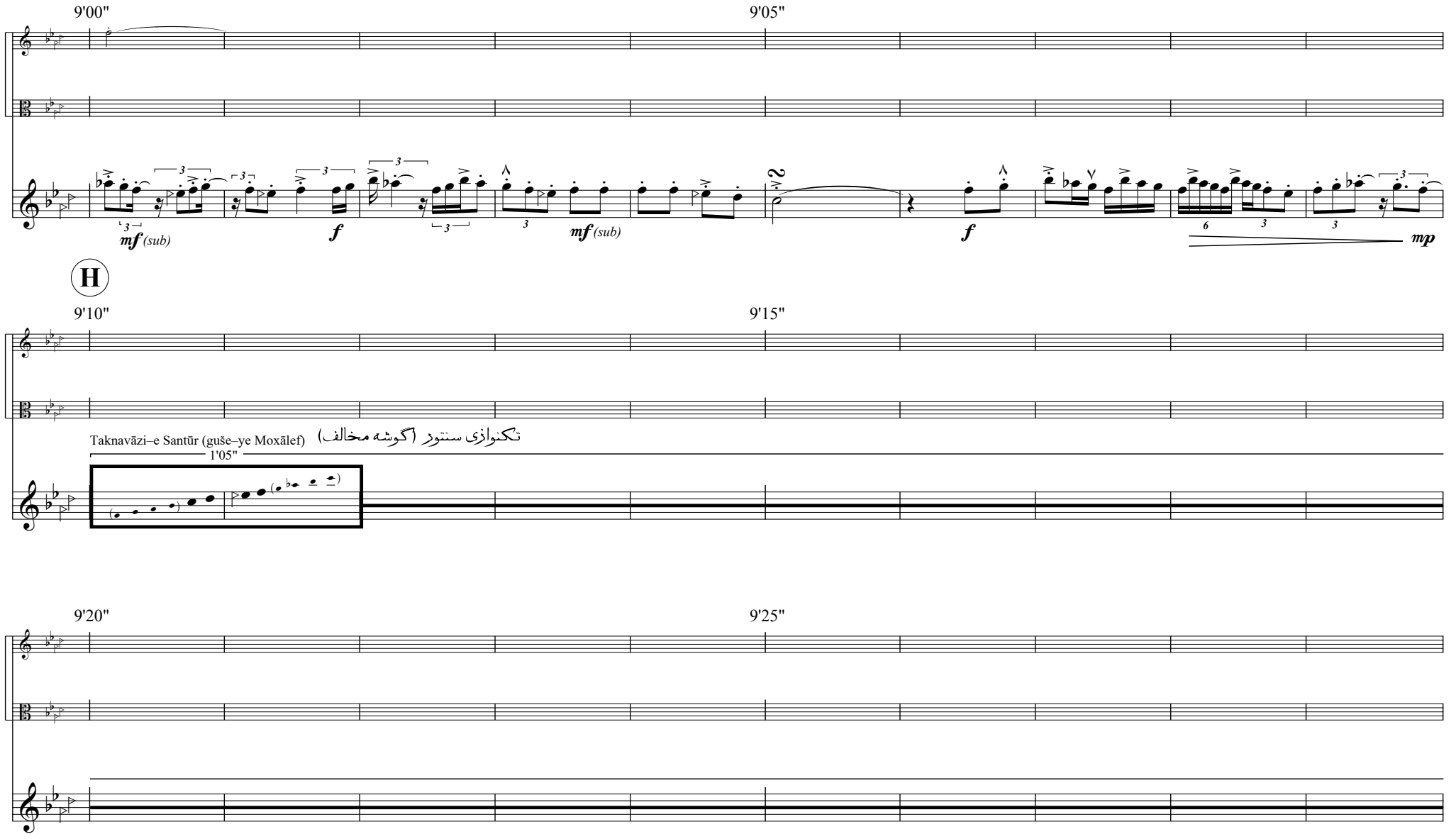

6'30"
6'35"
mf
ff
f
mf
6'40"
6'45"
Ā – zā
آزا
mp
mf
f
6'50"
6'55"
Ā – zā – deh
آزاده

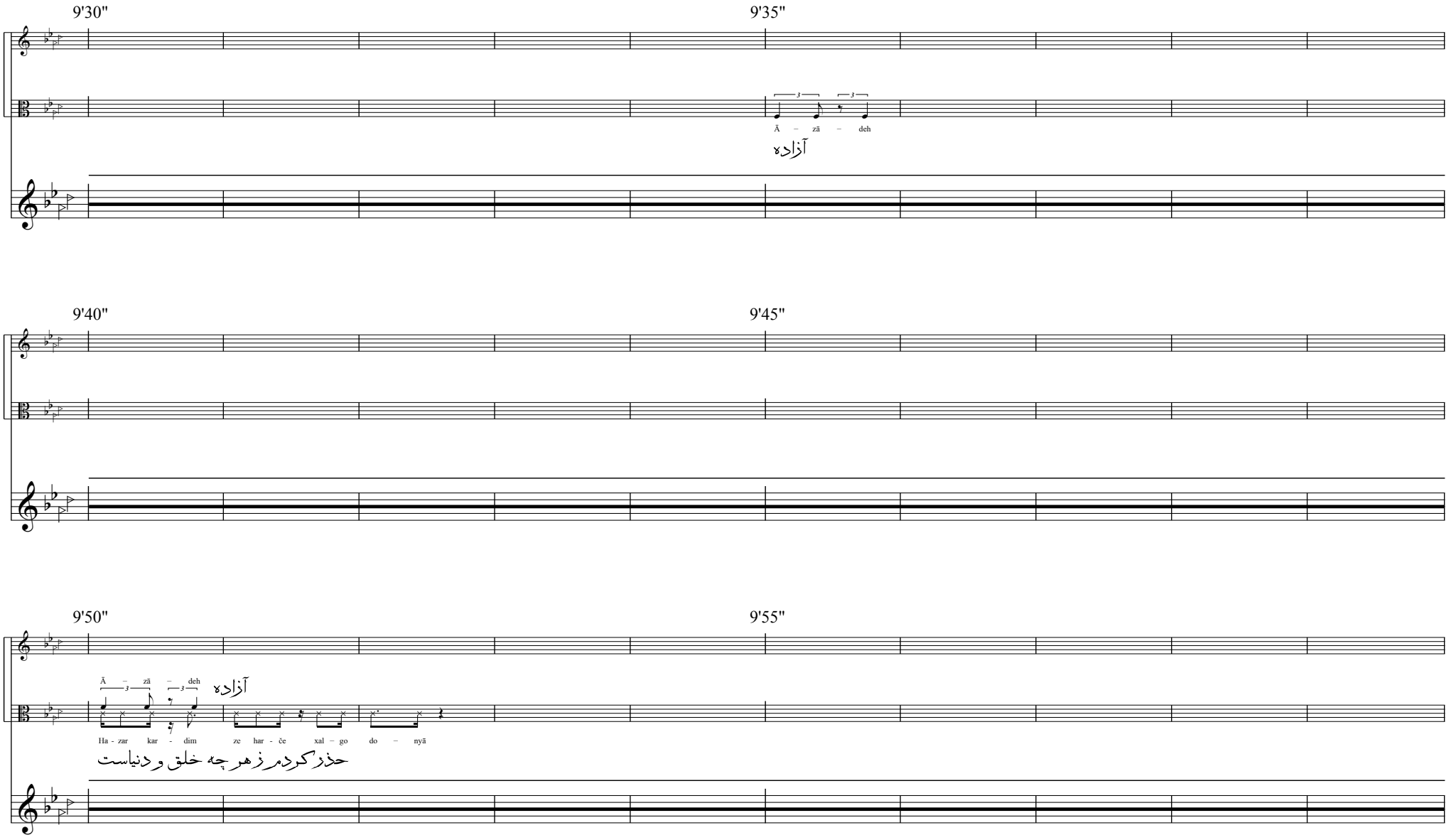

F
7'00"
7'05"
Taknavāzi–e Santūr (guše–ye Mūye) تکنوازی سنتور (گوشه مویه)
0'25"
7'10"
7'15"
Ā – zā – deh آزاده
Kas na – dā – nad dar – be bi dar – mā – ne mā Jo – re Lei – li dar de – le
کس نداند درد بی درمان ما جور لیلی در دل پر شور ما
G
7'20"
7'25"
por šū - re mā
Ā
آ

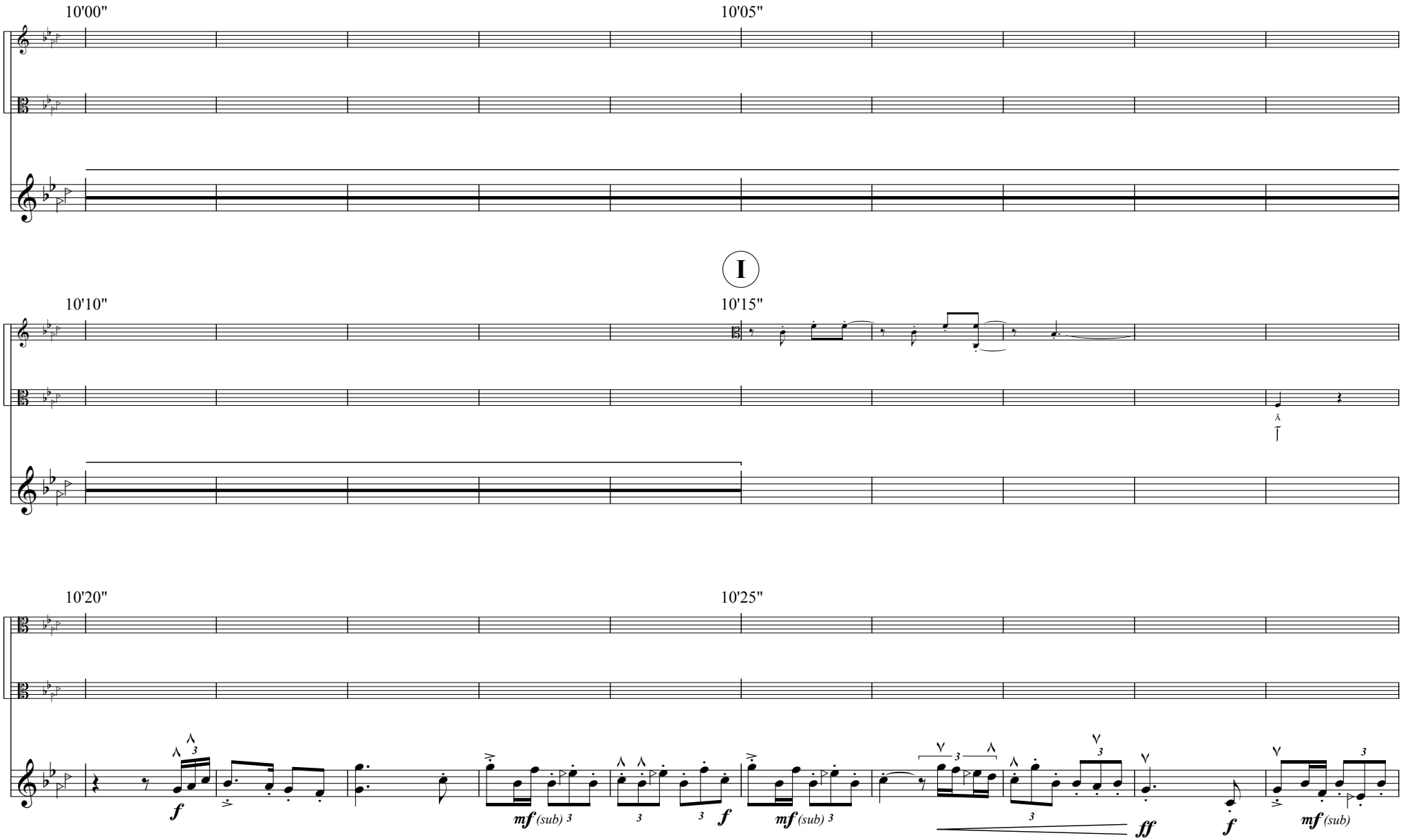

7'30"
7'35"
7'40"
7'45"
7'50"
7'55"
mf
mp
f
Ā – zā
آزا

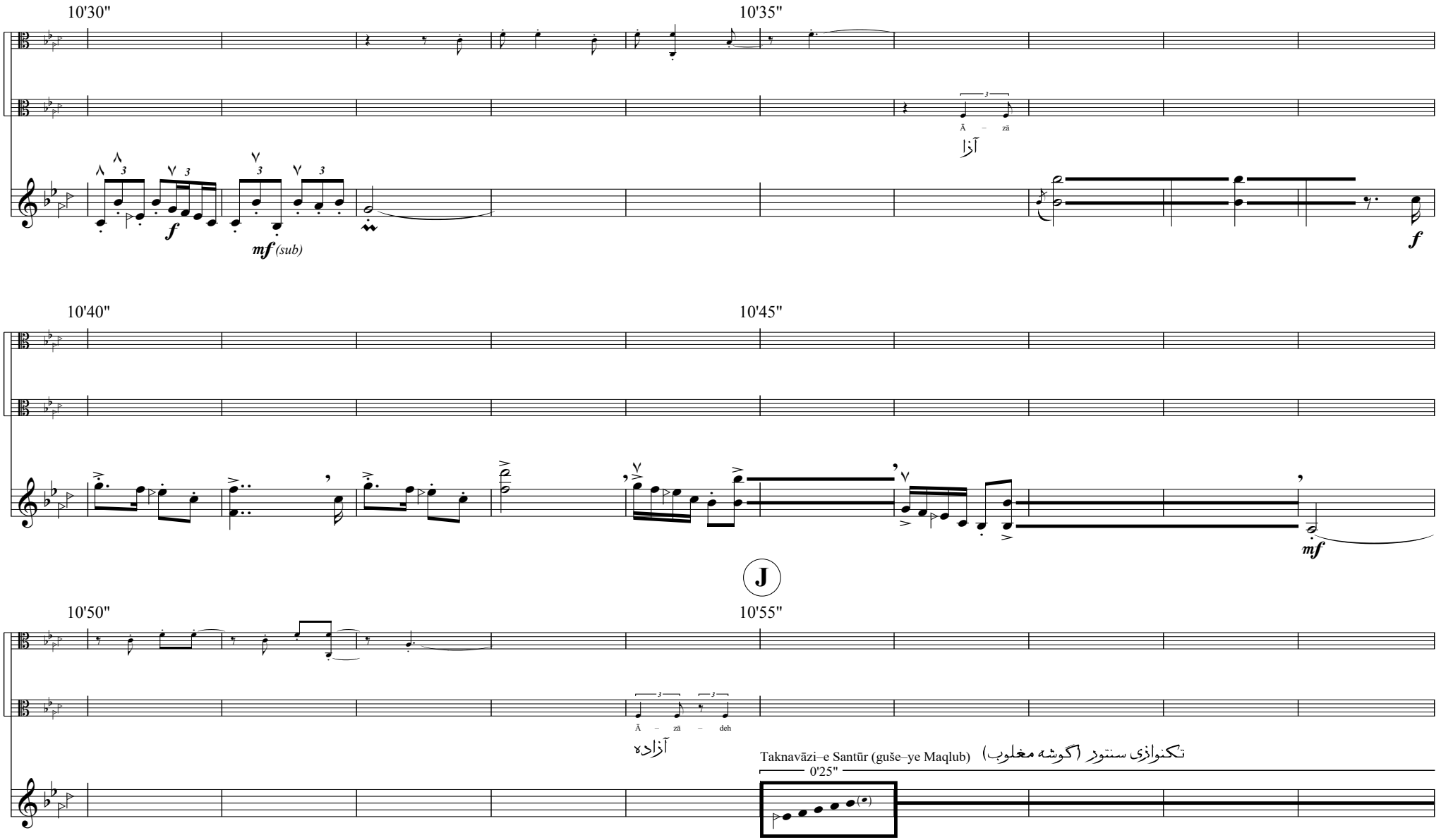

8'00"
8'05"
Ā – zā – deh
آزادہ
f
ff
f (sub)
8'10"
8'15"
Ā
آ
ff
mf
mp
8'20"
8'25"
f
mf

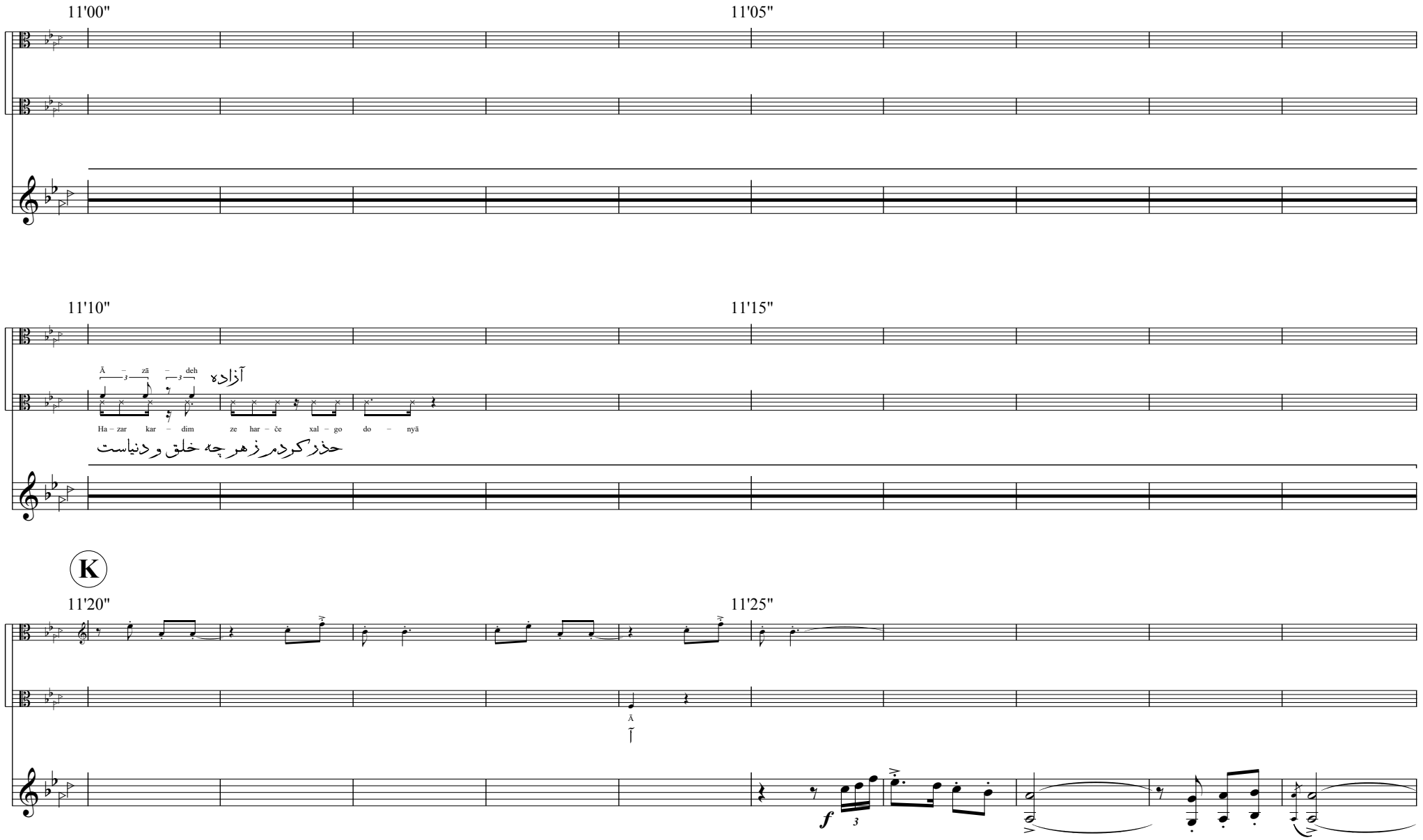

8'30"
8'35"
Ā – zā
آزا
8'40"
8'45"
Ā – zā – deh
آزاده
mf
f
8'50"
8'55"
mf
f
mf
f
mf (sub)
f

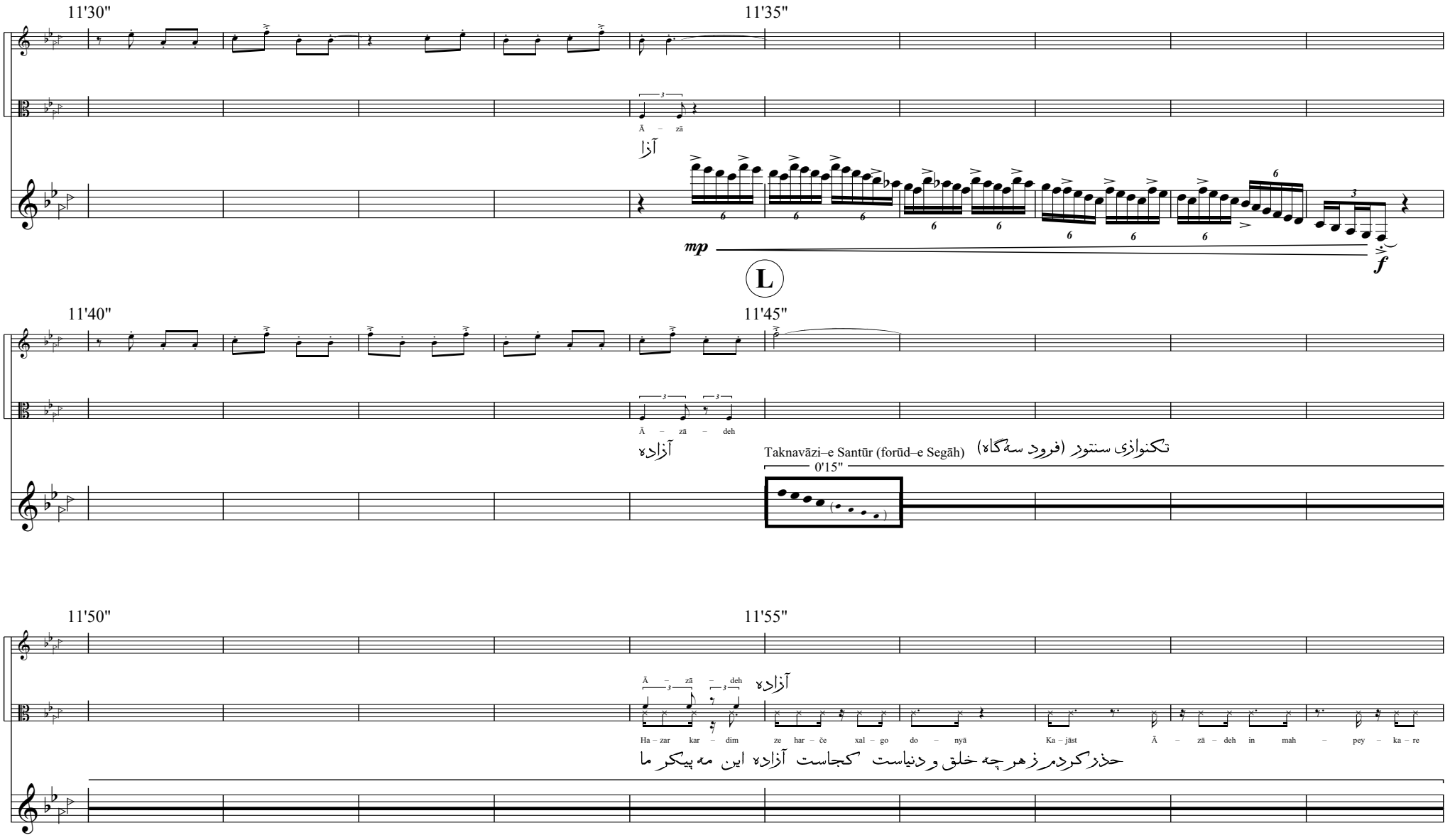

9'00"
9'05"
mf (sub)
f
mf (sub)
f
6
3
3
mp
H
9'10"
9'15"
Taknavāzi–e Santūr (guše–ye Moxālef) تکنوازی سنتور (گوشه مخالف)
1'05"
9'20"
9'25"

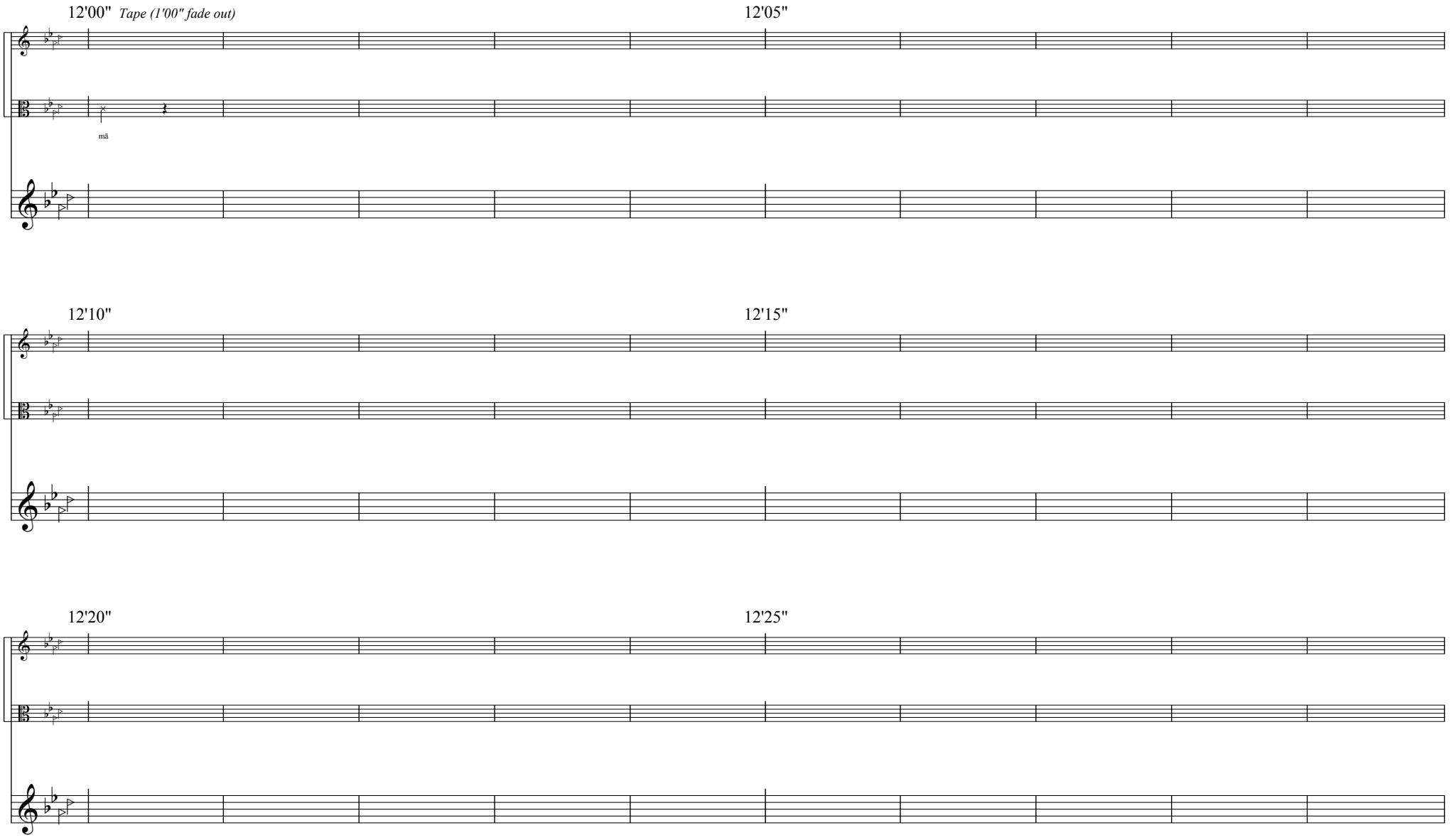

9'30"
9'35"
Ā – zā – deh
آزاده
9'40"
9'45"
9'50"
9'55"
Ā – zā – deh
آزاده
Ha - zar kar - dim ze har - če xal – go do – nyā
حذر کردم ز هر چه خلق و دنیاست

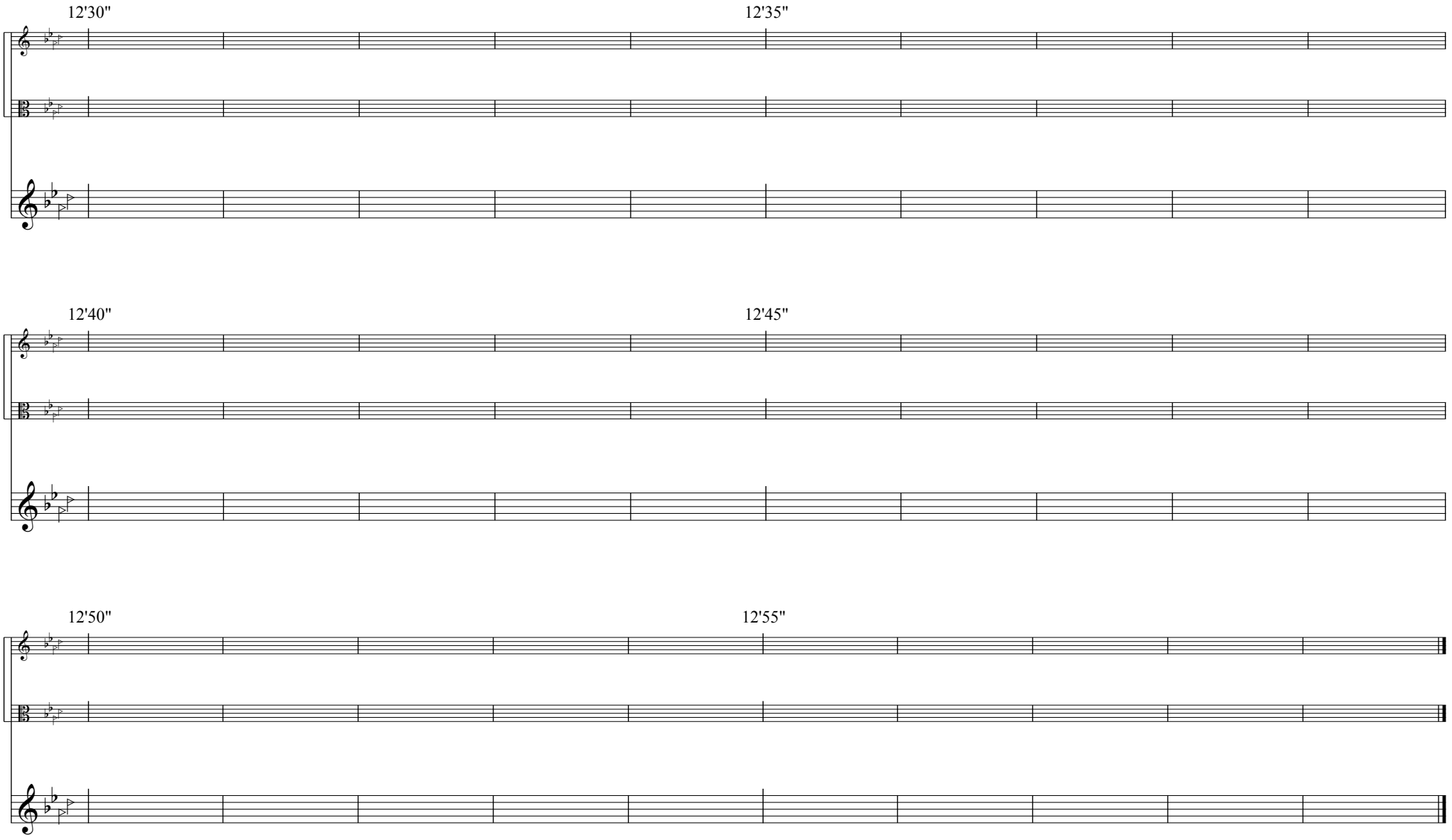

10'00"
10'05"
I
10'10"
10'15"
10'20"
10'25"
f
mf (sub)
ff
mf (sub)


10'30"
10'35"
Ā – zā
آزا
f
mf (sub)
f
10'40"
10'45"
mf
J
10'50"
10'55"
Ā – zā – deh
آزاده
Taknavāzi–e Santūr (guše–ye Maqlub) تکنوازی سنتور (گوشه مغلوب)
0'25"


11'00"
11'05"
11'10"
11'15"
Ā – zā – deh
آزاده
Ha – zar kar – dim ze har – če xal – go do – nyā
حذر کردم ز هر چه خلق و دنیاست
K
11'20"
11'25"
Ā
آ
f
3


11'30"
11'35"
Ā – zā
آزا
mp
f
L
11'40"
11'45"
Ā – zā – deh
آزاده
Taknavāzi–e Santūr (forūd–e Segāh)
تکنوازی سنتور (فرود سه‌گاه)
0'15"
11'50"
11'55"
Ā – zā – deh
آزاده
Ha – zar kar – dim ze har – če xal – go do – nyā Ka – jāst Ā – zā – deh in mah – pey – ka – re
حذر کردم ز هر چه خلق و دنیاست کجاست آزاده این مه پیکر ما


12'00"
Tape (1'00" fade out)
12'05"
mā
12'10"
12'15"
12'20"
12'25"


12'30"
12'35"
12'40"
12'45"
12'50"
12'55"